# How Fitting is “one-size-fits-all”? Revisiting the Dynamic Effects of ECB’s Interest Policy on Euro Area Countries

**Maybrit Wächter, Christian R. Proaño, and Juan Carlos Peña**

Working Paper No. 199

November 2024

Bamberg Economic Research Group
Bamberg University
Feldkirchenstraße 21
D-96052 Bamberg
Telefax: (0951) 863 5547
Telephone: (0951) 863 2687
felix.stuebben@uni-bamberg.de
http://www.uni-bamberg.de/vwl/forschung/berg/

ISBN 978-3-949224-20-1

**Redaktion:**
Dr. Felix Stübben[*]

[*] felix.stuebben@uni-bamberg.de

# How Fitting is "one-size-fits-all"? Revisiting the Dynamic Effects of ECB's Interest Policy on Euro Area Countries

Maybrit Wächter*[a], Christian R. Proaño[a,b], and Juan Carlos Peña[a]

[a]Otto-Friedrich-Universität Bamberg

[b]Centre for Applied Macroeconomic Analysis, Australian National University

Nov. 28, 2024

**Abstract**

This paper revisits the "one-size-fits-all" challenge posed by the European Central Bank's (ECB) monetary policy within the heterogeneous economic landscape of the euro area. Using a dataset spanning from 1999Q1 to 2019Q4 for the ECB interest rate and from 2004Q4 onwards for the Wu-Xia shadow rate, we compute country-specific hypothetical Taylor rates across EU-11 countries and examine the dynamic effects of the difference between these rates and the actual ECB policy rate, the so-called Taylor Rate Gaps (*TRGAPs*), on GDP growth and inflation. Employing panel and country-specific local projections, our findings reveal that positive *TRGAPs* negatively impact economic growth, with this effect being more pronounced in periphery countries compared to core countries. The analysis highlights the limitations of a uniform monetary policy in addressing the diverse economic conditions within the euro area, suggesting the need for a more tailored approach to foster balanced and sustainable growth across the region.

**Keywords:** Monetary Policy, Taylor Rule, Euro Area, Economic Growth, Interest Rate Gap

*Corresponding author. E-mail: maybrit.waechter@uni-bamberg.de. We would like to thank Miguel Handt Fueyo for excellent research assistance, as well as Sebastian Gechert, Sven Schreiber, Sebastian Watzka and other participants of the 2024 IMK PhD Workshop in Düsseldorf, Rasmus Hoffmann and other members of the Bamberg Graduate School for Social Sciences (BAGSS). Additionally, we thank Jonas Dix and Anja Kramer for helpful comments and suggestions on a previous draft of this contribution. All errors remain ours.

## 1 Introduction

While the conduct of monetary policy by major central banks via the traditional interest rate channel was significantly constrained by the Effective Lower Bound (*ELB*) on interest rates for most of the 2010s, the recent inflationary developments have substantially changed the landscape. For the euro area, and in particular for the European Central Bank (ECB), this development puts the well-known “one-size-fits-all” problem of a single monetary policy in a heterogenous monetary union again on the spotlight. Indeed, while the sources – disruptions of the global supply chains triggered by the COVID-19 pandemic and high energy prices due to the Russian war on Ukraine, respectively – and extent of the rise of headline inflation are similar across the euro area countries, it is unclear how, in a hypothetical scenario, different independent monetary policies would look like if the euro area, and a common monetary policy dictated by the ECB, did not exist.

How the “one-size-fits-all” problem may affect the macroeconomic development of the euro area was studied intensively during the 2000s, when large, and more importantly, persistent inflation rate differentials among euro area countries raised some concern of researchers and policy-makers. Although most studies focused on the dynamics of inflation in euro area countries from an empirical perspective (Alberola, 2000, ECB, 2003, Altissimo et al., 2006), only a few studies focused on the design of optimal monetary policy in a heterogenous monetary union (see e.g. Benigno, 2004, Lombardo, 2006, Benigno and López-Salido, 2006, Galí and Monacelli, 2008, Proaño, 2012 and Abbritti and Mueller, 2013). The outbreak of the Global Financial Crisis (*GFC*) in 2007, and the subsequent global recession, including the euro area, led this discussion lose momentum, as more pressing topics, like the development of macrofinancial models to understand the *GFC* dynamics, were of a higher priority. Given the current high inflation environment in the euro area, the recent interest rate hikes, and the significant likelihood that member states may still feature by and large the same structural differences regarding their capability to adjust to monetary policy shocks than a decade ago, it is worthwhile to revisit the extent of the “one-size-fits-all” problem from a quantitative perspective.

Starting with the premise that the Taylor rule (Taylor, 1993) provides a good approximation of what would be an adequate or near optimal policy rate given output gap and inflation developments, we estimate the dynamic effect on GDP growth stemming from what we call the Taylor Rate Gaps (*TRGAP*), i.e. the difference between the actual ECB policy rate and the hypothetical Taylor interest rate, which would target country-specific output and inflation developments. For this purpose, we make use of traditional panel regressions and more state-of-the-art local projections (Jordà, 2005). Through this approach, we aim at quantifying to what extent the ECB's "one-size-fits-all" monetary policy has affected (either positively or negatively) the macroeconomic development of the euro area countries contemporaneous and over time. Further, we examine whether this effect varies significantly across subgroups of euro area countries, in particular the so-called core (Belgium, Denmark, France, Germany, Luxembourg and Netherlands) and the so-called periphery (Greece, Ireland, Italy, Portugal and Spain) countries.

The contribution of this paper can be summarized as follows: First, corroborating the findings of Nechio (2011), we find that the ECB's "one-size-fits-all" interest rate policy has often deviated from the rates suggested by the Taylor rule for individual euro area countries, especially in peripheral economies, where the misalignment between actual ECB rate and hypothetical country-specific Taylor rates has tended to be larger. Second, and more importantly, we find that while the monetary policy misalignment represented by the $TRGAP$ has a statistically significant and negative immediate effect on real GDP growth, this effect becomes statistically insignificant when longer horizons are considered. Third, this negative effect seems to be more pronounced in periphery than in core euro area countries, indicating that the former are more sensitive to monetary policy misalignments than the latter. Finally, an increase in the $TRGAP$ has a negative impact on Harmonized Index of Consumer Price (HICP) inflation not only contemporaneously, but over time, being the lagged effect stronger at a horizon of four quarters. This effect is similar in core and periphery countries.

The remainder of this paper is organized as follows: Section 2 reviews the related theoretical and empirical literature. Section 3 outlines the data and the applied econometric methodologies. Section 4 summarizes and discusses the results and Section 5 draws some concluding remarks from this study.

## 2 Literature Review

Ever since the foundation of the euro area the potential "one-size-fits-all" problem of a single monetary policy in a heterogenous currency union has been of considerable concern to policymakers and researchers alike. The core of the debate centers around the effectiveness and appropriateness of a single monetary policy applied across a diverse set of economies, each with distinct economic conditions and needs. The following brief literature review discusses the key contributions to this debate, focusing on the dynamics of inflation, growth, and the application of the Taylor Rule within the euro area.

In the new macroeconomic environment resulting from a monetary unification and the related disappearance of the country-specific nominal exchange rates, other macroeconomic characteristics such as the mobility of the production factors and the degree of wage and price flexibility obtain an even more important role as macroeconomic adjustment mechanisms at the national level to asymmetric shocks. According to the Optimum Currency Area (OCA) theory developed by Mundell (1961), McKinnon (1963) and Kenen (1969), a high mobility of the factors of production, and especially of labor, is a central pre-condition for countries to be adequate candidates for a common currency area. Only in a currency union with high interregional factor mobility, asymmetric shocks do not represent a threat for the internal stability of the former because the regional labor markets are able to absorb these shocks in a quick and efficient manner by reorganizing the distribution of the labor force within the regions. In such a case, the currency union's central monetary authorities are thus able to focus on the currency union's external balance, once the internal balance was assured by the high interregional labor mobility.

A particular development of concern during the early 2000s was the persistent inflation rate differentials existent between many euro area countries that lead to significant shifts in their relative competitiveness (see e.g. ECB, 2003, 2005 and Angeloni and Ehrmann, 2007). As also discussed by Alberola (2000) and De Haan (2010), not the existence itself of inflation rate differentials is problematic, as they are unavoidable in a world with multiple idiosyncratic shocks, but their significant persistence. If inflation differentials among member countries remain relatively small, they may prevent significant shifts in relative competitiveness between them. However, if structural characteristics lead to a significant persistence in such differentials (as found e.g. by Altissimo et al., 2006 and Proaño, 2007), they may lead to a divergent economic performance under a common currency and a common monetary policy, representing a threat for the stability of the monetary union. Gros and Hefeker (2002) identify this heterogeneity across euro area member states to be the main reason why the consequences of a common monetary policy might be weak or inefficient in some states. Finally, according to Lane (2006), the pricing policy at the nation-state level is another cause for inflation persistence and the disparity in macroeconomic outcomes.

Against this background, a first strand of research on optimal monetary policy in a currency union highlighted at the theoretical level concerns over the suitability of a common monetary policy. Especially, in a heterogeneous union marked by a diverse set of economic frameworks implemented into the economic structures of nations-states at different levels of development, these concerns arise. Using a two-country dynamic stochastic general equilibrium (*DSGE*) framework, Benigno (2004) investigates how optimal monetary policy should be conducted in a currency union characterized by countries with different degrees of nominal rigidities. He argues that in such a currency union the central bank should place greater emphasis on stabilizing inflation in the country or countries with the highest nominal rigidity, because inflationary shocks are more disruptive in high-rigidity economies, where slow price and wage adjustments can lead to prolonged economic distortions and welfare losses. The author therefore suggests that a "one-size-fits-all" approach to monetary policy may be suboptimal in diverse unions like the euro area, advocating instead for a policy framework that weighs inflation differently based on each member's structural characteristics. Alternatively, Lombardo (2006) models – also within a standard *DSGE* framework – a currency union with countries differing in their degree of competition, finding that a welfare maximizing central bank should react more aggressively to the inflation pressure generated by the more competitive economy. Benigno and López-Salido (2006) use an optimizing-agent *DSGE* model for the euro area to analyze how the existence of heterogeneity in inflation persistence across regions matters for the design of monetary policy, finding that deviating from the traditional HICP targeting for instance taking into account such inflation inertia may create wrong incentives. Proaño (2012), using a behavioral framework, and Abbritti and Mueller (2013), employing a *DSGE* approach, focus on labor market asymmetries within the euro area.[1] Both studies conclude that focusing on the inflation developments of the country with the more rigid labor market is welfare-enhancing.

The resurgence of inflation and the recent tightening of monetary policy by the ECB have renewed the focus on the "one-size-fits-all" problem. Within this realm, Gern et al. (2022) examine the inflation divergence during the period of post-pandemic recovery, and discuss how structural differences between member countries—such as productivity levels, labor market conditions, and fiscal policies—contribute to these inflation disparities. The authors conclude that the traditional monetary policy approach is ill-suited to counteract inflationary pressures across the euro area. This has led to calls for a more tailored approach to monetary policy that accounts for national differences in economic conditions, echoing the concerns raised in earlier literature. In this line of thought, Palek and Schwanebeck (2019) advocate for a combination of monetary and macro-prudential policies to better respond to asymmetric shocks, arguing that monetary policy alone cannot fully address divergent economic conditions, see also Dräger and Proaño (2020). Proaño and Lojak (2021) propose a state-dependent inflation target, allowing the central bank to adjust its inflation goals based on varying economic conditions, which enhances economic stability and resilience by mitigating the impact of asymmetric shocks across countries.

Another point of extensive debate and scrutiny amongst scholars is the European Union's fiscal stance. A centralized monetary policy implies substantial challenges especially considering the heterogeneity within the union, fiscal policy can be determined by national authorities, in particular as a instrument for shock absorption (see e.g. Galí and Monacelli, 2008). However, the

[1] While Proaño (2012) uses the search-and-matching approach by Mortensen and Pissarides (1994) to model the dynamics of the labor markets, Abbritti and Mueller (2013) model labor market frictions through hiring costs that increase in the degree of labor market tightness.

economic and monetary union (EMU) member states are additionally obliged to and restricted by the Stability and Growth Pact (SGP) and other EU fiscal rules, which impose limits on budget deficits and public debt levels. Whilst these measures ensure fiscal discipline and excessive deficits, aiming at the prevention of financial distress, these constrains limit the individual member state to adequately respond to economic downturns (as illustrated by e.g. Proaño and Lojak, 2017). Masera (2021) finds this results especially significant for EU periphery countries. According to this author, states like Greece, Italy and Spain were unable to enact broad fiscal measures during times of crisis owing to their high public debt and the compliance to EU fiscal rules. Thus, these countries were forced into austerity measures worsening the economic recession (Hauptmeier and Leiner-Killinger, 2020). In this context, Arvai (2024) highlights the importance of political cohesion and shared fiscal policies in ensuring the long-term stability of currency unions, suggesting that deeper political and fiscal cooperation among member states is crucial for sustainable success.

On more practical grounds the Taylor rule has been a well-established approximation of what the "adequate" or near-optimal interest rate should be for given output gap and inflation developments since the seminal work by Taylor (1993). Against this background, Nechio (2011) shows that the ECB's "one-size-fits-all" interest rate policy has often deviated from the rates suggested by the Taylor rule for individual euro area countries, especially in peripheral economies, where the misalignment between actual ECB rate and hypothetical country-specific Taylor rates has tended to be larger. This discrepancy creates challenges for economic recovery, as higher-than-optimal interest rates for peripheral countries exacerbate their economic struggles, such as elevated unemployment and slow growth. To the best of our knowledge, no study so far has investigated the macroeconomic consequences of the "one-size-fits-all" ECB monetary policy on the individual euro area countries using econometric panel regression techniques and the Taylor rule as the policy benchmark. The objective of this paper is thus to fill this gap in the literature.

## 3 Data and Methodology

For the following econometric analysis we use a balanced panel of the EU-11 countries (Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain) on a quarterly basis covering the period from 1999Q1 to 2019Q4 for the ECB main refinancing operations (*MRO*) interest rate and starting from 2004Q4 onwards for the Wu-Xia rate.[2] We use data on annualized quarter-to-quarter real GDP growth and HICP inflation, as

[2] We do not use more recent observations to avoid the inclusion of extraordinary effects on inflation of the COVID-19 pandemic and the Russian aggression war on Ukraine.

well the unemployment rate, the government to GDP ratio and the ECB policy rate stemming from the OECD and the Eurostat databases. Data on the Wu-Xia rate stems from Cythia Wu's website directly. Table 1 summarizes the variables under consideration, their definitions and sources. The summary statistics of these variables, grouped also by core and periphery differentiation, are reported in Table 4 in the Appendix.

Table 1: Variables Definition and Sources

| Variable | Definition | Source |
|---|---|---|
| Real GDP growth | Percentage change from the previous quarter, chain linked volume (2015=100), seasonally adjusted | OECD |
| Inflation | Annual percent change in Harmonized Index of Consumer Prices (HICP) | OECD |
| Unemployment rate | Number of unemployed persons as a percentage of the labor force | Eurostat |
| Gov. Debt as % GDP | Gross debt of the general government as a percentage of GDP. | Eurostat |
| ECB policy rate | Main refinancing operations (MRO) interest rate, measured at the end of each month. | St. Louis Fed |
| Wu-Xia shadow rate | Shadow rate computed using the method of Wu and Xia (2017) and Wu and Xia (2020) | Cythia Wu's website |

Figure 1 depicts the EU aggregate inflation rate around the 2% target over time, showing the fluctuations and variability in inflation across different periods. From 1995 to 2000, the inflation rate fluctuated around the target, with the actual rate mostly staying within a close range. There were significant periods where the inflation rate exceeded it, particularly around 2001 and 2007. A notable peak around 2007 indicates a period of higher inflation, followed by a sharp drop during the Global Financial Crisis around 2008-2009. Post-crisis, the inflation rate remained relatively low, often below its target, indicating periods of low inflation or deflation. Around 2011, there was a brief spike in inflation, but it quickly fell back below the target. There was a significant rise in inflation around 2021-2022, indicating a sharp increase above the target, likely reflecting recent economic disruptions, such as the COVID-19 pandemic and subsequent recovery efforts. Overall, the inflation rate exhibits considerable volatility over the examined period, with periods of both high inflation and deflation. The ECB's efforts to maintain inflation around the 2% target have faced challenges, particularly during major economic events like the financial crisis and the COVID-19 pandemic. The recent sharp increase in inflation highlights potential concerns for economic stability and the effectiveness of a uniform monetary policy in achieving the desired inflation target.

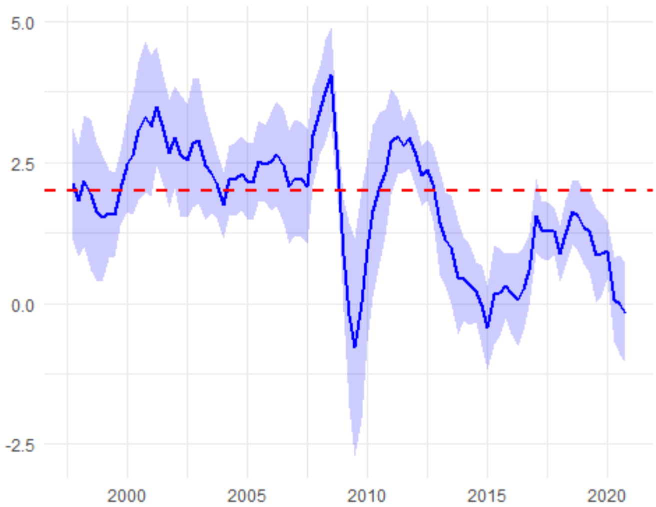



Figure 1: EU aggregate inflation rate around the 2%-target with confidence intervals.

To formalize our analysis of the potential misaligment of the ECB monetary policy with country-specific requirements, we compute hypothetical Taylor rates for the EU-11 countries $i = 1, \ldots, 11$ using the formula

$$i_t^i = \bar{r} + \phi_\pi \left(\pi_t^i - \pi_t^*\right) + \phi_y \, y_t^i \tag{1}$$

where $i_t^i$ is the hypothetical short-term interest rate for country $i$ in time $t$ according to the Taylor rule, $\pi_t^i$ is the corresponding annual inflation rate and $y_t^i$ the corresponding output gap. Nechio (2011) uses the values $\bar{r}$ = 1%, $\pi_t^*$ = 2%, $\phi_\pi$= 1.5 and $\phi_y$ =1 to characterize the ECB policy rate. Accordingly, equation 1 turns to

$$i_t^i \quad = \quad 1 + 1.5 \left(\pi_t^i - 2\right) + y_t^i \tag{2}$$

where we use the Hodrick and Prescott (1997) filter with $\lambda = 1600$ for quarterly data to obtain a measure of each country's output gap $y_t^i$.

Next, we compute the absolute difference between the country-specific hypothetical Taylor rate for a country $i$ at time $t$ and the actual ECB rate rate – what we will call the Taylor Rate Gap – i.e.

$$TRGAP_t^i = i_t^{ECB} - i_t^i. \tag{3}$$

We will interpret these gaps as a proxy for the potential inadequateness of the “one-size-fits-all” monetary policy of the ECB for the individual euro area countries, as done e.g. by Nechio (2011).

Accordingly, a positive $TRGAP_t^i$ at time $t$ implies an excessively restrictive conventional ECB interest rate policy for an individual country $i$ given its country-specific output and inflation developments.

Additionally, in order to take into account the effects of quantitative easing implemented by the ECB since the *GFC*, we compute an alternative $TRGAP$ using the Wu and Xia (2016) shadow rate $i_t^{WX}$, and denote it as

$$WXTRGAP_t^i = i_t^{WX} - i_t^i. \tag{4}$$

Figure 2 displays the hypothetical country-specific Taylor rate (red) against the ECB policy rate (blue) and the Wu and Xia (2016) shadow rate (green) (upper panels) and corresponding $TRGAPs$ (lower panels) for the considered EU-11 countries.

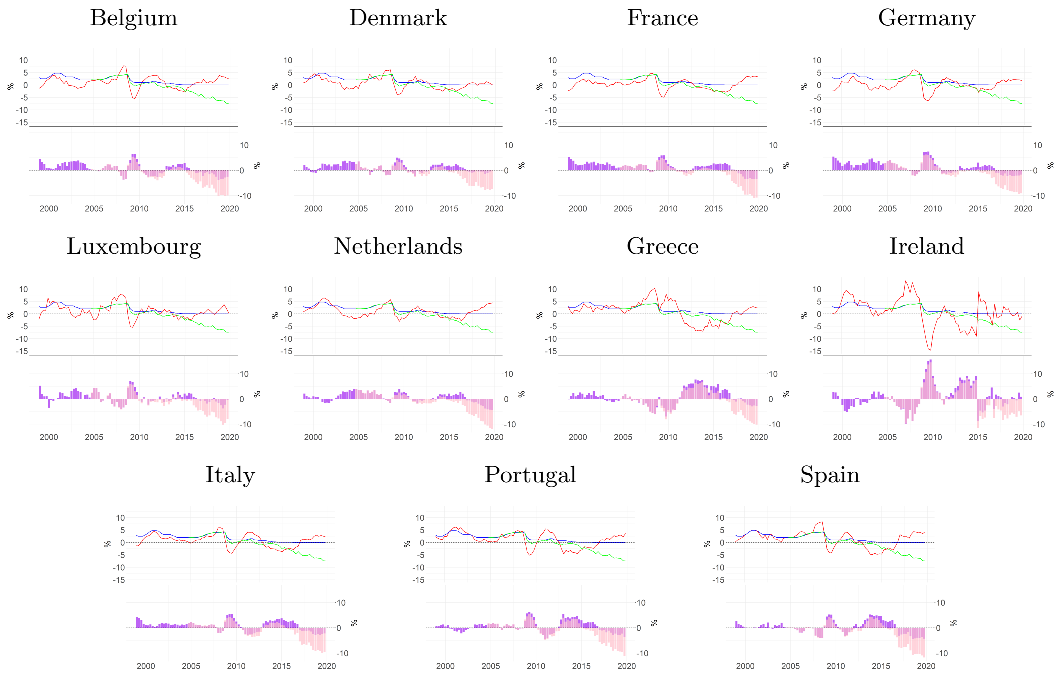



Figure 2: Upper panels (left axis): ECB short-term policy rate (blue), hypothetical country-specific Taylor rate (red) and Wu and Xia (2016) shadow rate (blue); Lower panels (right axis): TRGAP ECB (purple) and TRGAP WX (pink) for individual EU-11 countries. Sources: St. Louis Fed, Wu's website and authors' calculations.

During the *GFC*, the Taylor rates across nations drop sharply below zero, reflecting a recommendation for highly accommodative monetary policy in response to the economic downturn.

The ECB policy rate decreases but remains constrained by the zero lower bound, not following the Taylor rate's steep decline. Similarly, during the European debt crisis (2010-2014), the Taylor rate shows heightened volatility, dropping significantly, while the ECB policy rate remains relatively stable and positive. The Wu-Xia shadow rate, however, tracks the more aggressive accommodative stance suggested by the Taylor rule during these periods, extending below zero to reflect unconventional monetary policy. A general pattern is that in response to economic disruptions, the Taylor rate plummets, suggesting an urgent need for monetary easing, but the ECB rate remains limited by practical constraints. The divergence in rates is more severe in periphery countries compared to core countries, which indicates more sensitive economic conditions and greater vulnerability to restrictive monetary policy in the periphery, empasizing the heterogeneous impact of ECB policies across the euro area. Overall, Figure 2 illustrates both alignment and divergence between ECB policy (and the Wu-Xia shadow rate) and Taylor rule recommendations, reflecting the ECB's need to balance multiple objectives and the limitations of the Taylor rule as a strict guide during economic crises.

When it comes to the divergence in TRGAPs, we observe an opposing pattern compared to those of interest rates across nations. In core countries, both Taylor rate gaps (purple for the ECB policy rate and pink for the Wu-Xia rate) remain relatively close to zero, advocating that core countries' monetary conditions were close to optimal (according to the country-specific Taylor rules) and a strong alignment between the ECB policy rate and the macroeconomic requirements of core countries. Core countries, marked by strong industrial sectors and export-driven growth, seem thus to have benefited more from the ECB's monetary policy environment compared to periphery countries. Further, core countries show economic resilience especially during times of cases while still experiencing challenges during the ultra-low interest rate environment. In peripheral euro area countries, like Portugal, persistent and significant negative TRGAPs in the post-2008 period suggest that those countries face prolonged disinflationary or deflationary pressures, necessitating aggressive monetary easing. The wide negative bars across nations highlight the mismatch between ECB policy and the specific macroeconomic needs of the periphery nations, characterized by significant structural issues (e.g., high debt, weak competitiveness) that were exacerbated by mismatched monetary policy. The inability of individual countries in the monetary union to conduct an independet monetary policy, together with the fiscal constraints determined by the Stability and Growth Pact, see to have contributed to prolonged periods of low economic growth. The post-2015 ultra-low interest rate environment provided some relief but highlighted at the same time the structural inefficiencies of the euro area in addressing long-term growth challenges.

These figures illustrate thus the ECB's challenges in balancing the diverse economic needs of EU-11 countries under a single monetary policy. Both the hypothetical Taylor rate and *TRGAP* reveal instances where country-specific conditions diverged from the ECB's unified stance, highlighting the economic impact of crises. During such periods, the ECB's accommodative path may have supported weaker economies but did not always align with conditions in stronger economies, leading to persistent gaps and demonstrating the limitations of a "one-size-fits-all" approach in the euro area. A greater fiscal coordination is thus critical to address these misalignments, that would undermine the long-term cohesion of the euro area, especially during future crises.

To formally examine how $TRGAP$ may affect economic growth in the euro area, we first regress real GDP growth (and inflation) on the Taylor rule gap $TRGAP$ (and alternatively, the *WX-TRGAP*) and a set of control variables using alternative panel regression specifications for all euro area, core and periphery countires without and with country fixed effects, with country time fixed effects, and with random effects. Then, we apply the local projection method by Jordà (2005) using the following panel regression

$$y_{it} = \alpha_i + \beta_j \Delta TRGAP_{i,t-j} + \sum_{k=1}^{j+K} \Gamma_k \mathbf{X}_{i,t-j-k} + \varepsilon_{i,t} \tag{5}$$

where $y_{it}$ denotes the real GDP growth rate (or the inflation rate), with the subscripts $i = 1, ..., N$ and $t = 1, ..., T$ denoting the respective countries and the time periods, respectively, $\Delta TRGAP_{i,t-j}$ corresponds to the change in the gap between the actual ECB policy rate and the hypothetical country-specific Taylor rates as described by equation (3). Alternatively, the regression considers teh difference between the Wu-Xia shadow rate and the country-specific Taylor rates as described by equation 4). $\mathbf{X}_{i,t-k-j}$ represents the matrix of control variables at lag $t - k - j$ These variables specifically include two lags of the real GDP growth rate, inflation and the government debt as % GDP. Finally, $\varepsilon_{i,t}$ denotes uncorrelated, normally distributed country-specific random shocks.

Local projections (LP), introduced by Jordà (2005), are a flexible econometric technique used to estimate the impulse response functions (IRFs) of economic shocks on key variables over different time horizons. Unlike traditional vector autoregression (VAR) models, local projections directly estimate the effect of a shock at each time horizon through a series of regressions, instead of relying on iterated forecasts based on a single estimated model. Thus, local projections are advantageous over traditional VAR methods in terms of robustness and accuracy. For instance, Ramey and Zubairy (2018) estimate the dynamic responses of output to government spending shocks. Local projections allow them to directly estimate the impact of fiscal policy on output over time, while also accounting for different states of the economy, such as high or low unemployment, or when interest rates are near the zero lower bound. This method is chosen for its flexibility and ability to estimate the effects of shocks over different horizons without relying on a single structural model, making it particularly useful for assessing non-linear relationships, such as the varying effects of fiscal policy in different economic conditions.

Further, Auerbach and Gorodnichenko (2012) uncover the non-linear, state-dependent nature of fiscal multipliers, providing more precise estimates of the varying impacts of fiscal policy across the business cycle. Local projections allow them to capture the changing effects of these shocks over time and provide flexibility in distinguishing between different phases of the business cycle (recession vs. expansion). By estimating the effects separately for periods of economic expansion and contraction, local projections help avoid the restrictive assumptions of linearity in traditional methods, such as VAR models, making it possible to identify non-linearities in fiscal multipliers. Likewise, Teulings and Zubanov (2014) explore the long-term effects of financial crises on economic growth, with a particular focus on whether economies fully recover from such shocks or experience persistent, long-lasting effects on output. The paper aims to answer the critical question of whether economies return to their pre-crisis growth paths after recessions or if there are permanent losses to output. In summary, the use of the local projections methodology seems appropriate for analyzing the effects of Taylor Rate Gaps on output and inflation because of their flexibility, robustness to model misspecification, and ability to capture heterogeneous responses across countries, while mitigating the risks of cumulative estimation errors seen in traditional VAR models (Plagborg-Møller and Wolf, 2021).

The following caveat of our approach should be discussed at this stage, namely the use of $\Delta TRGAP_{i,t-j}$ as the shock variable in the following panel regressions. Indeed, as the variable $TRGAP$ is constructed via equation (3), the country-specific output developments enter by construction (though in a nonlinear, time-varying and weighted manner) in the determination of both the actual ECB policy rate, and the country-specific Taylor rates (a similar argument holds for $WXTRGAP$ constructed via equation (4)). Accordingly, the shocks represented by $\Delta TRGAP_{i,t-j}$ should not be understood as identified structural shocks as e.g. those monetary policy innovations computed by Altavilla et al. (2019), but rather as a first approximation to country-specific monetary misalignment shocks that calls for further research.

# 4 Empirical Results

## 4.1 Panel Regressions

Table 2 presents the results of panel regressions for real GDP growth as the dependent variable, with the primary explanatory variable being the *TRGAP*, across different model specifications. The sample covers ECB policy rate data from 1999Q1 to 2020Q4 and is categorized into "All countries", "Core countries", and "Periphery countries" groups.

Across all groups, the *TRGAP* coefficient is consistently negative and highly significant, at the 1% level, indicating a strong inverse relationship between *TRGAP* and economic growth. The *TRGAP* coefficient ranges from -0.204 to -0.345, suggesting that a higher Taylor Rate Gap is associated with a reduction in real GDP growth for the average EU country. This means that when the actual ECB rate is higher than the country-specific Taylor rate (a positive *TRGAP*), economic growth slows down, possibly due to tighter-than-recommended monetary conditions. The *TRGAP* effect is even more pronounced for periphery countries, with coefficients between -0.259 and -0.393. This larger coefficient indicates that periphery economies are more exposed to deviations of the ECB rate from the country-specific Taylor rate. For core countries, the *TRGAP* coefficients are lower across the different model specifications, suggesting that core countries have other, more dominant economic dynamics or are less directly impacted by or more robust to ECB monetary policy deviations. Model (1) yields a moderate fit across groups, with adjusted $R^2$ values of 0.118, 0.126, and 0.128 for all, core, and periphery countries, respectively. The significant *TRGAP* coefficient implies that even without controlling for individual or time effects, there is a general negative relationship between *TRGAP* and economic growth. By controlling for country-specific factors (Model (2)), the regression's fit improves, particularly for periphery countries (adjusted $R^2 = 0.131$). Therefore, country-level differences explain a substantial part of the variation in growth rates. The higher adjusted $R^2$ in Model (3) implies that both country-specific characteristics and common temporal factors are important for understanding economic growth. The use of random effects provides a reasonably good fit, as suggested by the Hausman test supporting the use of Model (4) over Model (2).[3] The findings underscore the nuanced impact of ECB policy across different economies and the importance of considering both cross-sectional and temporal factors in panel data analyses. The $F-$ and $\chi^2-$statistics reinforce the models' overall significance, supporting the validity of the regressions across different groups and model specifications.[4]

[3]However, we use the fixed effects model for local projections to account for unobserved heterogeneity across countries, ensuring robustness in capturing country-specific dynamics over time.

[4]Figures 5, 6, 7, 8 in the Appendix report the local projections for all countries in our sample individually.

Table 2: Panel regressions with real GDP growth as dependent variable. Sample: 1999Q1-2019Q4.

| Explanatory variable | Model (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | All countries | | | |
| TRGAP | $-0.204^{***}$ (0.026) | $-0.22^{***}$ (0.026) | $-0.345^{***}$ (0.031) | $-0.215^{***}$ (0.026) |
| Observations | 757 | 757 | 757 | 757 |
| Adjusted $R^2$ | 0.118 | 0.107 | 0.277 | 0.116 |
| F-Statistic | 10.202 | 10.170 | 4.324 | |
| $\chi^2$-Statistic | | | | 109.708 |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 |
| Hausman test | | | | 0.247 |
| | Core countries | | | |
| TRGAP | $-0.145^{***}$ (0.028) | $-0.153^{***}$ (0.027) | $-0.391^{***}$ (0.040) | $-0.150^{***}$ (0.027) |
| Observations | 465 | 465 | 465 | 465 |
| Adjusted $R^2$ | 0.126 | 0.121 | 0.422 | 0.127 |
| F-Statistic | 7.097 | 7.244 | 4.816 | |
| $\chi^2$-Statistic | | | | 78.751 |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 |
| Hausman test | | | | 0.878 |
| | Periphery countries | | | |
| TRGAP | $-0.259^{***}$ (0.0465) | $-0.288^{***}$ (0.046) | $-0.393^{***}$ (0.057) | $-0.28^{***}$ (0.046) |
| Observations | 292 | 292 | 292 | 292 |
| Adjusted $R^2$ | 0.128 | 0.131 | 0.336 | 0.136 |
| F-Statistic | 4.900 | 5.338 | 2.682 | |
| $\chi^2$-Statistic | | | | 56.486 |
| p-value | 0.00 | 0.00 | 0.00 | 0.00 |
| Hausman test | | | | 0.92 |
| Country fixed effects | no | yes | yes | no |
| Time fixed effects | no | no | yes | no |
| Random effects | no | no | no | yes |

*Note:* Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ significance levels. Model (1) summarizes a pooled OLS regression; Model (2) a panel regression with country fixed-effects, Model (3) a panel regression with country and time fixed effects and Model(4) a panel regression with random effects. Hausman tests suggest that the random-effect regressions are the appropriate models. In the regressions with all countries the first and the second lags of the ECB rate, the real GDP growth rate, the HICP inflation rate and the government debt-to-GDP ratio where included. In the core and periphery regressions, only the first lag of these variables was included due to the low cross-sectional dimension of the panel.

The use of the Wu-Xia shadow rate, as a robustness check in place of the ECB-MRO rate, confirms the negative relationship between the Wu-Xia Taylor Rule Gap (*WXTRGAP*) and both real GDP growth and HICP inflation. The panel regression results for real GDP growth (Table 5 in the Appendix) highlight that the *TRGAP* remains a statistically significant predictor of economic growth across all country groups. For all countries, the coefficients range between -0.208 and -0.369, with the strongest effect observed in Model (3), which incorporates both country and time fixed effects. The results for core countries exhibit relatively smaller coefficients (-0.079 to -0.31), indicating a lower impact of *WXTRGAP* shocks compared to periphery countries. For periphery countries, the coefficients are the largest (-0.282 to -0.463), underscoring their higher vulnerability to monetary policy misalignments that is likely to be caused by a more constrained fiscal space. These results underline the role of heterogeneity in the euro area, as core and periphery countries respond differently to monetary policy shocks.

Table 3 summarizes the alternative panel regression specifications with HICP inflation as the dependent variable. Across all groups and models, the *TRGAP* coefficient is consistently negative and highly statistically significant at the 1% level, indicating an inverse relationship between the *TRGAP* and HICP inflation. In other words, a positive Taylor Rule Gap is associated with lower inflation, as expected. Compared to the real GDP growth regressions just discussed, Inflation in core countries is more sensitive to deviations of the ECB rate from the country-specific Taylor rule. This finding possibly reflects a closer alignment with ECB monetary policy as opposed to periphery countries in which other economic or structural factors might smooth the impact of a shock on inflation. Similar to the impact of the *TRGAP* on real GDP growth, Model (3), which includes both country and time fixed effects, yields the highest adjusted $R^2$ values across all groups, suggesting that accounting for both country-specific characteristics and time-specific shocks provides the best fit.

The panel regression results using the Wu-Xia shadow rate can be found in Table 6 in the Appendix. The negative and significant relationship between the *WXTRGAP* and inflation holds across all country groups, with the strongest effect observed in core countries (-0.129 to -0.151). Periphery countries exhibit slightly weaker effects, with coefficients ranging from -0.059 to -0.082, reflecting relatively less sensitivity to *WXTRGAP* shocks. However, the adjusted $R^2$ values remain high, indicating that the models explain a substantial portion of the variation in inflation dynamics. Overall, the findings underline the important role of ECB policy in determining inflation dynamics, particularly through adherence to or deviations from country-specific Taylor rule prescriptions.

Table 3: Summary of panel regressions with HICP inflation as dependent variable. Sample: 1999Q1-2020Q4.

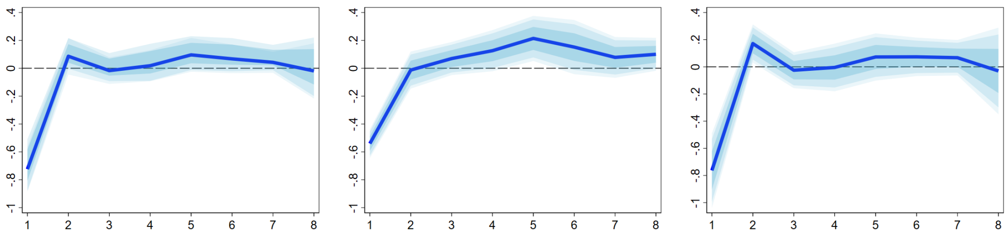
| Explanatory variable | Model (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | All countries | | | |
| *TRGAP* | $-0.104^{***}$ (0.008) | $-0.105^{***}$ (0.009) | $-0.094^{***}$ (0.009) | $-0.104^{***}$ (0.008) |
| Observations | 757 | 757 | 757 | 757 |
| Adjusted $R^2$ | 0.893 | 0.888 | 0.936 | 0.893 |
| F-Statistic | 571.821 | 546.184 | 122.959 | |
| $\chi^2$-Statistic | | | | 6280.28 |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 |
| Hausman test | | | | 0.275 |
| | Core countries | | | |
| *TRGAP* | $-0.145^{***}$ (0.012) | $-0.146^{***}$ (0.012) | $-0.166^{***}$ (0.015) | $-0.146^{***}$ (0.012) |
| Observations | 465 | 465 | 465 | 465 |
| Adjusted $R^2$ | 0.847 | 0.840 | 0.928 | 0.845 |
| F-Statistic | 235.046 | 223.605 | 67.631 | |
| $\chi^2$-Statistic | | | | 2539.21 |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 |
| Hausman test | | | | 0.909 |
| | Periphery countries | | | |
| *TRGAP* | $-0.087^{***}$ (0.013) | $-0.091^{***}$ (0.013) | $-0.086^{***}$ (0.015) | $-0.087^{***}$ (0.013) |
| Observations | 292 | 292 | 292 | 292 |
| Adjusted $R^2$ | 0.914 | 0.912 | 0.945 | 0.914 |
| F-Statistic | 282.632 | 274.814 | 56.74 | |
| $\chi^2$-Statistic | | | | 3108.95 |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 |
| Hausman test | | | | 0.962 |
| Country fixed effects | no | yes | yes | no |
| Time fixed effects | no | no | yes | no |
| Random effects | no | no | no | yes |

*Note:* Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ significance levels. Model (1) summarizes a pooled OLS regression; Model (2) a panel regression with country fixed-effects, Model (3) a panel regression with country and time fixed effects and Model(4) a panel regression with random effects. Hausman tests suggest that the random-effect regressions are the appropriate models. In the regressions with all countries the first and the second lags of the ECB rate, the real GDP growth rate, the HICP inflation rate and the government debt-to-GDP ratio where included. In the core and periphery regressions, only the first lag of these variables was included due to the low cross-sectional dimension of the panel.

## 4.2 Local Projection Results

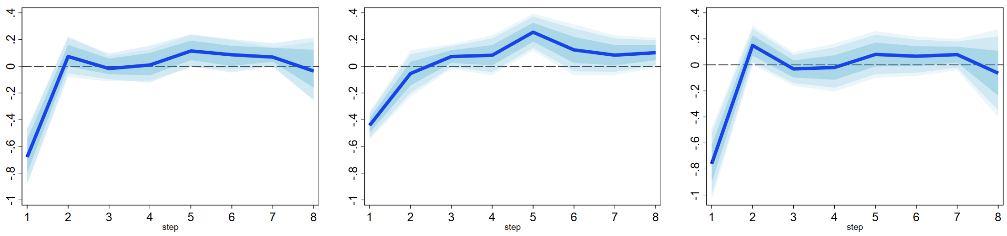
We now turn to the discussion of the effect of *TRGAP* on real GDP growth and inflation over time as represented by the local projections approach.

**Local Projections with *TRGAP***




(a) All countries (b) Core countries (c) Periphery countries

**Local Projections with *WXTRGAP***

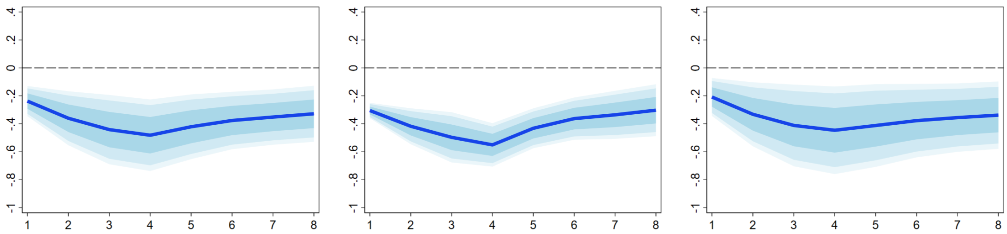



(d) All countries (e) Core countries (f) Periphery countries

Figure 3: Cumulated Response of real GDP growth to a *TRGAP* shock (first row) and to a *WXTRGAP* shock (second row). Notes: the blue line refers to the average development of economic growth and the shaded areas are a 95%, 90% and 68% confidence interval. We control for unemployment rate and government debt as % GDP with two lags respectively.

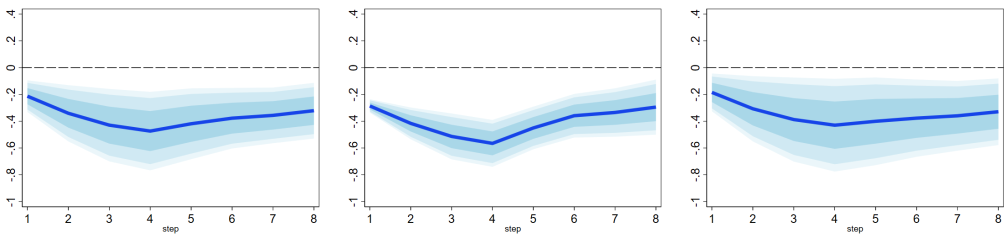
Figure 3 illustrates the local projections for economic growth in response to a *TRGAP* shock (first row) and to a *WXTRGAP* shock (second row) across all European countries in our sample, for a horizon of up to eight quarters. The solid blue line represents the average response of economic growth to the shock, while the shaded areas denote the confidence intervals around this estimate. At large, the impulse responses confirm the results of the panel regressions. A *TRGAP* shock has a strong initial negative impact on growth in the first and second quarter following the shock. This suggests that when the ECB policy rate is set higher than the Taylor rule recommendation (a positive *TRGAP*), growth declines sharply across EU-11 countries. After about two quarters, the negative impact on growth quickly diminishes, fluctuating around zero from the third period onward. This indicates that while there is an immediate, significant impact on growth, the effect becomes more moderate over time and stabilizes closer to zero. Periphery countries show a more pronounced and slightly more resilient recovery following the initial shock, while core countries show a smaller initial impact and a more uncertain longer-term response. Similarly, the cumulative response of real GDP growth to a *WXTRGAP* shock exhibits a sharp initial decline across all country groups, followed by stabilization near zero over time. Core countries display a slower recovery and greater variability, reflecting structural differences, while periphery countries experience a more pronounced initial decline but recover to near-zero growth over longer horizons.

**Local Projections with *TRGAP***



(a) All countries (b) Core countries (c) Periphery countries

**Local Projections with *WXTRGAP***



(d) All countries (e) Core countries (f) Periphery countries

Figure 4: Cumulated response of HICP inflation to a *TRGAP* shock (first row) and to a *WX-TRGAP* shock (second row). Notes: the blue line refers to the average development of economic growth and the shaded areas are a 95%, 90% and 68% confidence interval. We control for unemployment rate and government debt as % GDP with two lags respectively.

Figure 4 illustrates the response of HICP inflation to a *TRGAP* shock (first row) and to a *WXTRGAP* shock (second row). Similarly to the effect on GDP growth, a *TRGAP* shock leads to an immediate and negative impact on inflation, becoming however more pronounced over time, reaching its lowest point by the fourth quarter. This aligns with the theoretical expectation that tighter-than-optimal monetary policy dampens inflation. As before, we observe medium-term moderation and long-term recovery. In comparison, the impact is also more severe in core than in periphery countries. Nonetheless, we observe a faster recovery in core countries. The relatively wide confidence intervals indicate some uncertainty, particularly in the first few periods, but they narrow over time as the impact stabilizes. This suggests a more reliable estimate of the long-term effect. Additionally, the confidence intervals are wider for periphery countries, which may reflect greater economic heterogeneity among periphery countries, leading to less consistent responses to monetary policy shocks. Analogously, a $WXTRGAP$ shock results in an immediate and significant decline in inflation, with the strongest effects observed in core countries. Inflation in periphery countries shows a faster recovery but stabilizes at a negative level, emphasizing persistent downward pressure from monetary policy misalignments.

## 5 Concluding Remarks

How significant is the misalignment of the ECB monetary policy with the individual requirements of the euro area countries? Or put it differently: How fitting is "one-size-fits-all"? Using the Taylor (1993) rule as the underlying theoretical framework for our empirical analysis, we investigated this question by means of standard panel regressions and both, panel and country-specific local projections (Jordà, 2005).

Our estimation results indicate a generally negative statistical relationship between economic growth and inflation, and the difference between the ECB rate and the hypothetical individual Taylor rates of euro area countries ($TRGAP$). However, this effect diminishes and becomes statistically insignificant over longer horizons implying monetary neutrality. The negative impact of the $TRGAP$, espacially on inflation, is more pronounced in periphery euro area countries compared to the core, thus periphery economies are more sensitive to monetary policy misalignments. This sensitivity potentially points to the structural differences between these regions, with core countries being more dependent on the ECB's policy framework.

When considering the effect of potential monetary policy misalignments on HICP inflation, our results show that an increase in the $TRGAP$ has a persistently negative impact on inflation. The effect is strongest at a lag of approximately four quarters, suggesting that the transmission of monetary policy misalignments to inflation is both delayed and prolonged. Notably, the alternative regressions of the Wu-Xia shadow rate further underscores these dynamics. During periods when the nominal ECB policy rate is constrained by the zero lower bound, the Wu-Xia shadow rate better captures the accommodative stance of unconventional monetary policy. Using this measure, the impact of $WXTRGAP$ on both growth and inflation remains negative and statistically significant, with periphery countries displaying a sharper but more uncertain response to $WXTRGAP$ shocks. Overall, the regressions with the Wu-Xia shadow rate provide robust support for the main findings, highlighting the negative effects of ECB monetary policy misalignments, measured by the $TRGAP$ and the $WXTRGAP$ shocks on growth and inflation, with significant heterogeneity across core and periphery euro area countries. This reinforces the heterogeneity within the euro area, emphasizing the need for nuanced and flexible monetary policy approaches that account for the varying sensitivities of member states to policy misalignments.

These findings suggest that the potential "one-size-fits-all" problem of a unique monetary policy in the euro area, while existent and statistically significant, is relevant mostly at short (contemporaneous) horizons, but does not seem to have sizable effect over time neither in core nor in periphery countries as long as real GDP growth is concerned. Regarding inflation, the "one-size-fits-all" problem seems to be more relevant, in particular at longer horizons. Against the background of the theoretical literature regarding the optimal design of monetary policy in the euro area, our findings seem to suggest that the country-specific fiscal and/or macroprudential policies may be indeed more appropriate to deal with country-specific developments (as argued e.g. by Galí and Monacelli, 2008 and more recently by Palek and Schwanebeck, 2019).

Our analysis addresses a key issue that, to the best of our knowledge, has not been addressed before, namely the macroeconomic impact of the potential misalignment of the ECB interest rate policy with country-specific requirements. Investigating this issue requires reforms that go beyond monetary policy, such as enhanced fiscal integration, structural convergence, and new risk-sharing mechanisms to support a more resilient and cohesive euro area. Looking forward, the key challenge will be to reform the EU's fiscal rules to allow for more flexibility while maintaining fiscal discipline. This could involve introducing more nuanced fiscal rules that account for the economic conditions of individual member states or creating mechanisms for greater fiscal transfers within the euro area to help countries weather asymmetric shocks (see e.g. De Grauwe and Foresti, 2016 and Kopits, 2017). Without such reforms, the EU risks perpetuating the economic divergence between core and periphery countries, with potentially destabilizing effects on the entire region.

## References


Abbritti, M. and Mueller, A. (2013), 'Asymmetric labor market institutions in the EMU and the volatility of inflation and unemployment differentials', *Journal of Money, Credit and Banking* **45**(6), 1165–1186.

Alberola, E. (2000), Interpreting inflation differentials in the euro area, *in* 'Economic Bulletin', Banco de España, pp. 61–70.

Altavilla, C., Brugnolini, L., Gürkaynak, R. S., Motto, R. and Ragusa, G. (2019), 'Measuring euro area monetary policy', *Journal of Monetary Economics* **108**, 162–179.

Altissimo, F., Ehrmann, M. and Smets, F. (2006), Inflation persistence and price-setting behavior in the euro area. A summary of the IPN evidence, Ocassional Paper 46, ECB.

Angeloni, I. and Ehrmann, M. (2007), 'Euro area inflation differentials', *The B.E. Journal of Macroconomics* **7**(Iss. 1 (Topics)), Article 24.

Arvai, K. (2024), 'The political economy of currency unions', *Journal of International Economics* **152**, 103991.

Auerbach, A. J. and Gorodnichenko, Y. (2012), 'Measuring the output responses to fiscal policy', *American Economic Journal: Economic Policy* **4**(2), 1–27.

Benigno, P. (2004), 'Optimal monetary policy in a currency area', *Journal of International Economics* **63**, 293–320.

Benigno, P. and López-Salido, J. (2006), 'Inflation persistence and optimal monetary policy in the euro area', *Journal of Money, Credit and Banking* **38**, 587–614.

De Grauwe, P. and Foresti, P. (2016), 'Fiscal rules, financial stability and optimal currency areas', *Economics Letters* **145**, 278–281.

De Haan, J. (2010), 'Inflation differentials in the euro area: a survey', *The European Central Bank at Ten* pp. 11–32.

Dräger, L. and Proaño, C. (2020), 'Cross-border banking and macroprudential policies in asymmetric currency unions', *Macroeconomic Dynamics* **24**(2), 255–290.

ECB (2003), 'Inflation differentials in the euro area: Potential causes and policy implications', Frankfurt a.M.

ECB (2005), Monetary policy and inflation differentials in a heterogeneous currency area, *in* 'ECB Monthly Bulletin', May, pp. 61–78.

Galí, J. and Monacelli, T. (2008), 'Optimal monetary and fiscal policy in a currency union', *Journal of International Economics* **76**, 116–132.

Gern, J., Sonnenberg, N. and Stolzenburg, U. (2022), Inflation divergence in the euro area: Nature and implications, Monetary dialogue papers, European Parliament.

Gros, D. and Hefeker, C. (2002), 'One size must fit all: National divergences in a monetary union', *German Economic Review* **3**(3), 247–262.

Hauptmeier, S. and Leiner-Killinger, N. (2020), 'Reflections on the stability and growth pact's preventive arm in light of the covid-19 crisis', *Intereconomics* **55**(5), 296–300.

Hodrick, R. J. and Prescott, E. C. (1997), 'Postwar U.S. business cycles: An empirical investigation', *Journal of Money, Credit, and Banking* **29**, 1–16.

Jordà, Ò. (2005), 'Estimation and inference of impulse responses by local projections', *American Economic Review* **95**(1), 161–182.

Kenen, P. B. (1969), The theory of optimum currency areas: An eclectic view, *in* R. M. Mundell and A. K. Swoboda, eds, 'Monetary Problems of the International Economy', University of Chicago Press, Chicago, pp. 41–60. as reprinted in De Grauwe (2001), *The Political Economy of Monetary Union*, Cheltenham, UK: Edward Publishing Limited.

Kopits, G. (2017), 'The imf and the euro area crisis: The fiscal dimension', *The IMF and the crises in Greece, Ireland and Portugal* pp. 209–253.

Lane, P. R. (2006), 'The real effects of european monetary union', *Journal of Economic Perspectives* **20**(4), 47–66.

Lombardo, G. (2006), 'Inflation targeting rules and welfare in an asymmetric currency area', *Journal of International Economics* **68**(2), 424–442.

Masera, R. (2021), 'The case for a different stability and growth pact: Towards a fiscal and political union in the euro area', *Available at SSRN 4019095* .

McKinnon, R. (1963), 'Optimum currency areas', *The American Economic Review* **53**, 717–725.

Mortensen, D. and Pissarides, C. (1994), 'Job creation and job destruction in the theory of unemployment', *Review of Economic Studies* **61**, 397–415.

Mundell, R. A. (1961), 'A theory of optimum currency areas', *The American Economic Review* **51**, 657–664.

Nechio, F. (2011), 'Monetary policy when one size does not fit all', *FRBSF Economic Letter* **18**, 13.

Palek, J. and Schwanebeck, B. (2019), 'Optimal monetary and macroprudential policy in a currency union', *Journal of International Money and Finance* **93**, 167–186.

Plagborg-Møller, M. and Wolf, C. K. (2021), 'Local projections and VARs estimate the same impulse responses', *Econometrica* **89**(2), 955–980.

Proaño, C. and Lojak, B. (2017), Macroeconomic risk, fiscal policy rules and aggregate volatility in asymmetric currency unions: A behavioral perspective, *in* A. Bökemeier, B. & Greiner, ed., 'Inequality and Finance in Macrodynamics', Vol. 23 of *Dynamic Modeling and Econometrics in Economics and Finance Series*, Springer, New York, pp. 221–242.

Proaño, C. R. (2007), Inflation differentials and business cycle fluctuations in the European Monetary Union, Working Paper 05/2007, Macroeconomic Policy Institute (IMK), Düsseldorf, Germany.

Proaño, C. R. (2012), 'Should monetary policy take account of national labor market asymmetries in a currency union?', *Economics Bulletin* **32**(3), 1878–89.

Proaño, C. R. and Lojak, B. (2021), 'Monetary policy with a state-dependent inflation target in a behavioral two-country monetary union model', *Journal of Economic Dynamics and Control* **133**, 104236.

Ramey, V. A. and Zubairy, S. (2018), 'Government spending multipliers in good times and in bad: Evidence from US historical data', *Journal of Political Economy* **126**(2), 850–901.

Taylor, J. B. (1993), 'Discretion versus policy rules in practice', *Carnegie-Rochester Conference Series on Public Policy* **39**, 195–214.

Teulings, C. N. and Zubanov, N. (2014), 'Is economic recovery a myth? Robust estimation of impulse responses', *Journal of Applied Econometrics* **29**(3), 497–514.

Wu, J. C. and Xia, D. (2016), 'Measuring the macroeconomic impact of monetary policy at the zero lower bound', *Journal of Money, Credit and Banking* **48**(2-3).

Wu, J. C. and Xia, F. D. (2017), 'Time-varying lower bound of interest rates in europe', *Chicago Booth Research Paper* (17-06).

Wu, J. C. and Xia, F. D. (2020), ‘Negative interest rate policy and the yield curve’, *Journal of Applied Econometrics* **35**(6), 653–672.

# A Summary statistics

Table 4: Summary statistics: EU-11 and core and periphery subgroups. Authors' calculations.

| Variable | Mean | Std. Dev. | Min. | Max. | N |
|---|---|---|---|---|---|
| **All countries** | | | | | |
| GDP Growth Rate | 0.448 | 1.415 | -5.563 | 23.375 | 924 |
| Inflation | 1.8 | 1.384 | -6.128 | 6.568 | 924 |
| Unemployment rate | 8.938 | 4.872 | 2.1632 | 27.784 | 807 |
| Gov. Debt % GDP | 77.687 | 39.725 | 6.8 | 187.5 | 823 |
| Hypothetical Taylor rate | 0.913 | 3.119 | -14.664 | 13.333 | 924 |
| ECB policy rate | 1.732 | 1.500 | 0 | 4.75 | 924 |
| Wu-Xia rate | -0.735 | 3.312 | -7.42 | 4.258 | 671 |
| *TRGAP* | 0.819 | 2.706 | -9.833 | 15.664 | 924 |
| **Core countries** | | | | | |
| GDP Growth Rate | 0.455 | 0.907 | -4.682 | 5.183 | 504 |
| Inflation | 1.711 | 0.954 | -1.219 | 5.589 | 504 |
| Unemployment rate | 6.902 | 2.347 | 2.163 | 16.133 | 496 |
| Gov. Debt % GDP | 68.854 | 26.885 | 18.5 | 126.6 | 484 |
| Hypothetical Taylor rate | 0.759 | 2.37 | -6.419 | 8.032 | 504 |
| ECB policy rate | 1.732 | 1.500 | 0 | 4.75 | 504 |
| Wu-Xia rate | -0.735 | 3.314 | -7.42 | 4.258 | 366 |
| *TRGAP* | 0.972 | 2.157 | -4.474 | 7.419 | 504 |
| **Periphery countries** | | | | | |
| GDP Growth Rate | 0.439 | 1.849 | -5.563 | 23.375 | 420 |
| Inflation | 1.906 | 1.763 | -6.128 | 6.568 | 420 |
| Unemployment rate | 12.186 | 5.975 | 3.811 | 27.784 | 311 |
| Gov. Debt % GDP | 90.297 | 50.337 | 6.8 | 187.5 | 339 |
| Hypothetical Taylor rate | 1.097 | 3.824 | -14.664 | 13.333 | 420 |
| ECB policy rate | 1.732 | 1.500 | 0 | 4.75 | 420 |
| Wu-Xia rate | -0.735 | 3.315 | -7.42 | 4.258 | 305 |
| *TRGAP* | 0.634 | 3.238 | -9.833 | 15.664 | 420 |

## B Panel regression results for the Wu-Xia rate

Table 5: Panel regressions with real GDP growth as dependent variable. Sample: 2004Q4-2019Q4.

| | Model | | | |
|---|---|---|---|---|
| Explanatory variable | (1) | (2) | (3) | (4) |
| | All countries | | | |
| *WXTRGAP* | $-0.208^{***}$ | $-0.221^{***}$ | $-0.369^{***}$ | $-0.218^{***}$ |
| | (0.031) | (0.031) | (0.038) | (0.031) |
| Observations | 515 | 515 | 515 | 515 |
| Adjusted $R^2$ | 0.138 | 0.127 | 0.282 | 0.135 |
| F-Statistic | 8.477 | 8.598 | 4.152 | |
| $\chi^2$-Statistic | | | | 91.588 |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 |
| Hausman test | | | | 0.174 |
| | Core countries | | | |
| *WXTRGAP* | $-0.079^{***}$ | $-0.083^{***}$ | $-0.31^{***}$ | $-0.084^{***}$ |
| | (0.029) | ($-0.029$) | (0.048) | (0.029) |
| Observations | 329 | 329 | 329 | 329 |
| Adjusted $R^2$ | 0.117 | 0.117 | 0.436 | 0.119 |
| F-Statistic | 4.933 | 5.397 | 4.855 | |
| $\chi^2$-Statistic | | | | 55.467 |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 |
| Hausman test | | | | 0.845 |
| | Periphery countries | | | |
| *WXTRGAP* | $-0.282^{***}$ | $-0.314^{***}$ | $-0.463^{***}$ | $-0.308^{***}$ |
| | (0.057) | (0.057) | (0.074) | (0.056) |
| Observations | 186 | 186 | 186 | 186 |
| Adjusted $R^2$ | 0.167 | 0.174 | 0.356 | 0.184 |
| F-Statistic | 4.366 | 4.827 | 2.572 | |
| $\chi^2$-Statistic | | | | 52.660 |
| p-value | 0.00 | 0.00 | 0.00 | 0.00 |
| Hausman test | | | | 0.999 |
| Country fixed effects | no | yes | yes | no |
| Time fixed effects | no | no | yes | no |
| Random effects | no | no | no | yes |

*Note:* Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ significance levels. Model (1) summarizes a pooled OLS regression; Model (2) a panel regression with country fixed-effects, Model (3) a panel regression with country and time fixed effects and Model(4) a panel regression with random effects. Hausman tests suggest that the random-effect regressions are the appropriate models. In the regressions with all countries the first and the second lags of the ECB rate, the real GDP growth rate, the HICP inflation rate and the government debt-to-GDP ratio where included. In the core and periphery regressions, only the first lag of these variables was included due to the low cross-sectional dimension of the panel.

Table 6: Summary of panel regressions with HICP inflation as dependent variable. Sample: 2004Q4-2019Q4.

| | Model | | | |
|---|---|---|---|---|
| Explanatory variable | (1) | (2) | (3) | (4) |
| | All countries | | | |
| *WXTRGAP* | $-0.092^{***}$ (0.009) | $-0.097^{***}$ (0.009) | $-0.075^{***}$ (0.009) | $-0.093^{***}$ (0.009) |
| Observations | 515 | 515 | 515 | 515 |
| Adjusted $R^2$ | 0.894 | 0.892 | 0.942 | 0.894 |
| F-Statistic | 394.781 | 389.372 | 124.763 | |
| $\chi^2$-Statistic | | | | 4322.54 |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 |
| Hausman test | | | | 0.292 |
| | Core countries | | | |
| *WXTRGAP* | $-0.129^{***}$ (0.013) | $-0.134^{***}$ (0.013) | $-0.151^{***}$ (0.018) | $-0.130^{***}$ (0.013) |
| Observations | 329 | 329 | 329 | 329 |
| Adjusted $R^2$ | 0.852 | 0.849 | 0.936 | 0.850 |
| F-Statistic | 172.887 | 168.924 | 72.977 | |
| $\chi^2$-Statistic | | | | 1879.68 |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 |
| Hausman test | | | | 0.456 |
| | Periphery countries | | | |
| *WXTRGAP* | $-0.075^{***}$ (0.013) | $-0.082^{***}$ (0.014) | $-0.059^{***}$ (0.016) | $-0.075^{***}$ (0.013) |
| Observations | 186 | 186 | 186 | 186 |
| Adjusted $R^2$ | 0.918 | 0.915 | 0.95 | 0.918 |
| F-Statistic | 188.603 | 183.155 | 53.503 | |
| $\chi^2$-Statistic | | | | 2074.63 |
| p-value | 0.000 | 0.000 | 0.000 | 0.000 |
| Hausman test | | | | 0.989 |
| Country fixed effects | no | yes | yes | no |
| Time fixed effects | no | no | yes | no |
| Random effects | no | no | no | yes |

*Note:* Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ significance levels. Model (1) summarizes a pooled OLS regression; Model (2) a panel regression with country fixed-effects, Model (3) a panel regression with country and time fixed effects and Model(4) a panel regression with random effects. Hausman tests suggest that the fixed-effect regressions are the appropriate models. In the regressions with all countries the first and the second lags of the ECB rate, the real GDP growth rate, the HICP inflation rate and the government debt-to-GDP ratio where included. In the core and periphery regressions, only the first lag of these variables was included due to the low cross-sectional dimension of the panel.

# C Country-specific local projections using the ECB-MRO rate

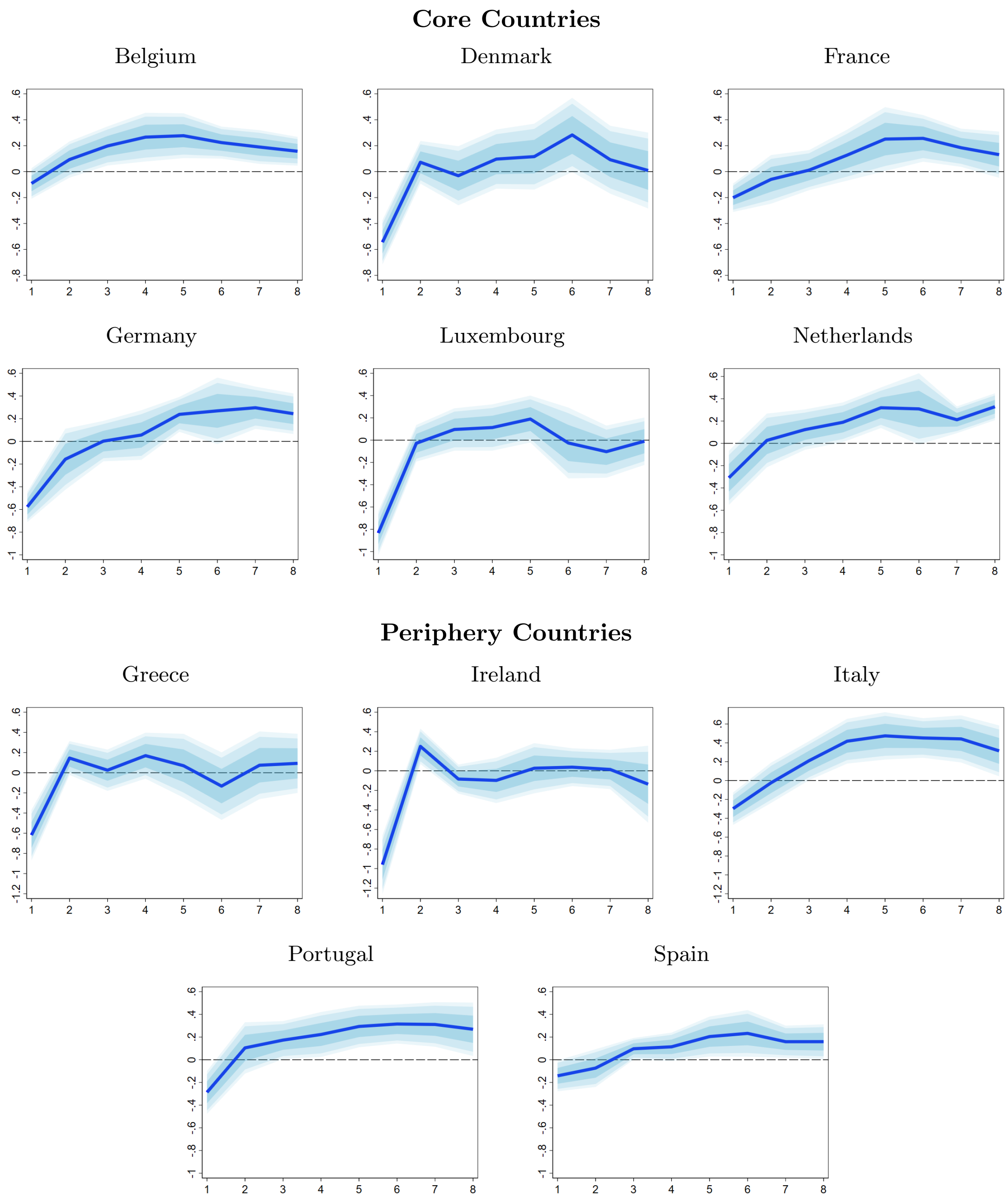



Figure 5: Local projections for real GDP growth for all, core and periphery countries. Notes: the blue line refers to the average development of economic growth and the shaded areas are a 95%, 90% and 68% confidence interval. We control for unemployment rate and government debt as % GDP with two lags respectively.

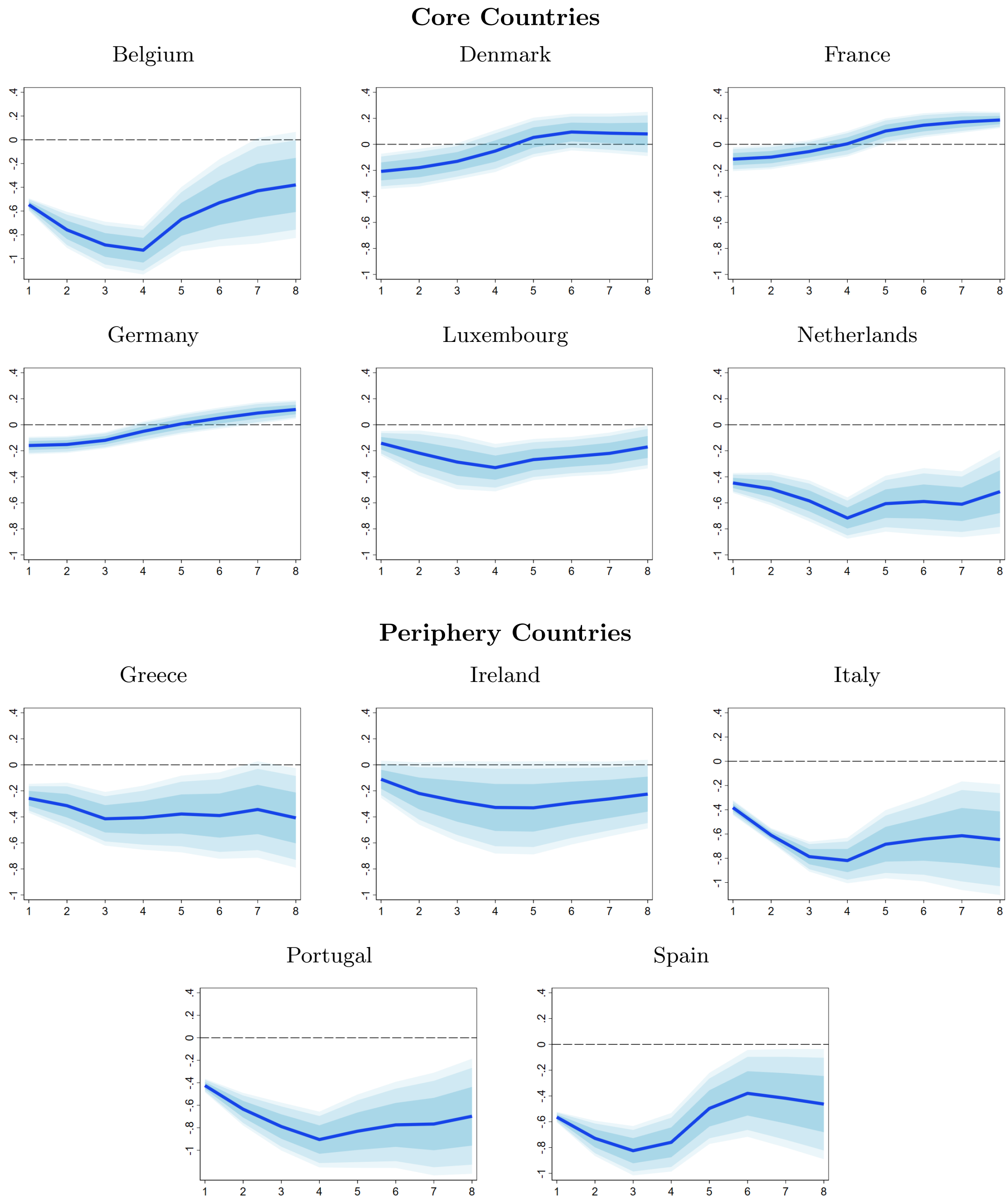



Figure 6: Local projections for HICP inflation for all, core and periphery countries. Notes: the blue line refers to the average development of economic growth and the shaded areas are a 95%, 90% and 68% confidence interval. We control for unemployment rate and government debt as % GDP with two lags respectively.

# D Country-specific local projections using the Wu-Xia rate

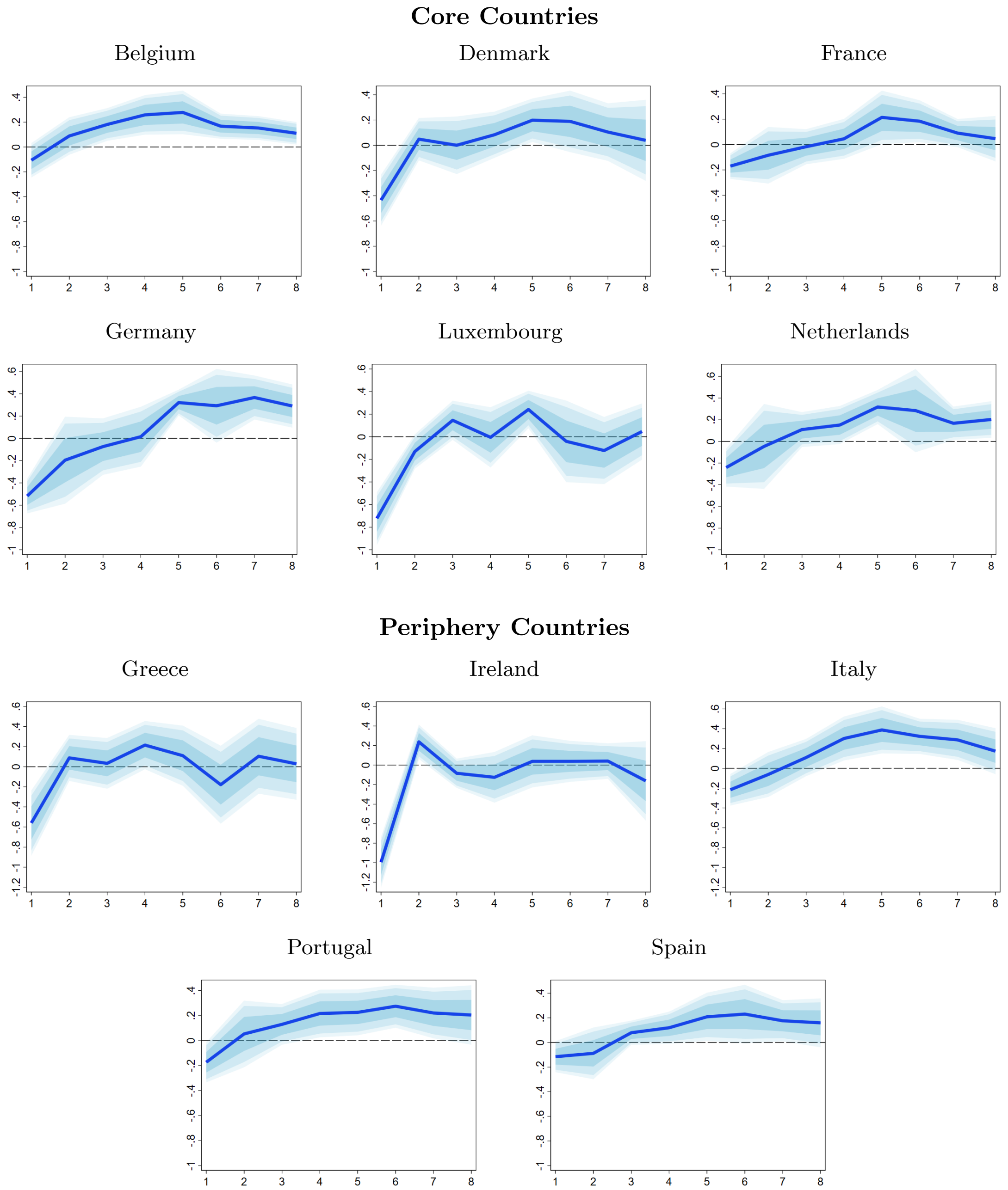



Figure 7: Local projections for real GDP growth for all, core and periphery countries. Notes: the blue line refers to the average development of economic growth and the shaded areas are a 95%, 90% and 68% confidence interval. We control for unemployment rate and government debt as % GDP with two lags respectively.

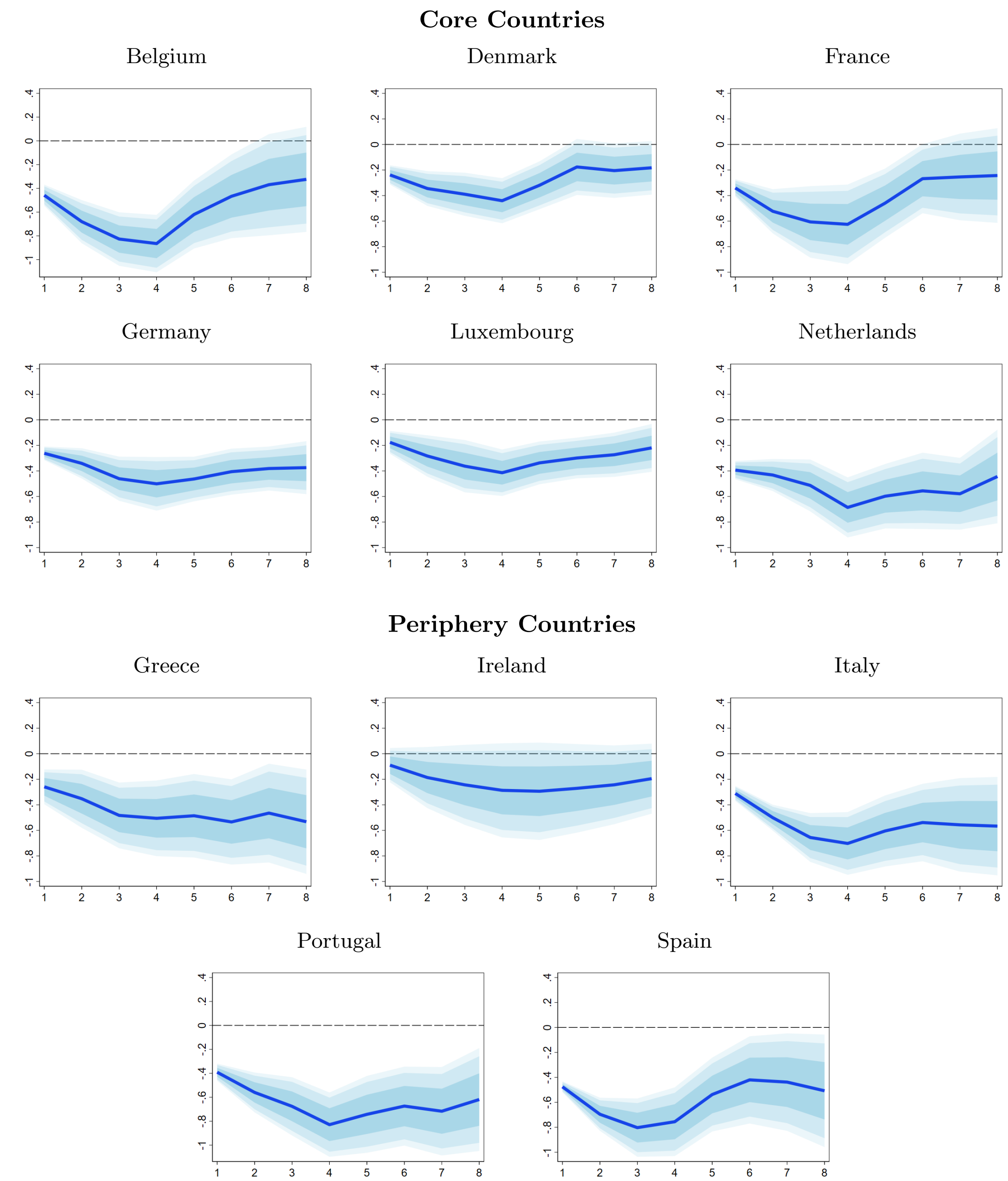



Figure 8: Local projections for HICP inflation for all, core and periphery countries. Notes: the blue line refers to the average development of economic growth and the shaded areas are a 95%, 90% and 68% confidence interval. We control for unemployment rate and government debt as % GDP with two lags respectively.

## **BERG** Working Paper Series (most recent publications)

183 Stefan **Dürmeier**, *A Model of Quantitative Easing at the Zero Lower Bound*

184 Stefanie Y. **Schmitt**, *Competition with limited attention to quality differences*

185 Fabio E.G. **Röhrer**, Christian **Proaño** and Lebogang **Mateane**, *The Impact of Macroeconomic Activity and Yield Valuation on Mergers and Acquisitions in Europe*

186 Daniel M. **Mayerhoffer** and Jan **Schulz**, *Social Segregation, Misperceptions, and Emergent Cyclical Choice Patterns*

187 Sarah **Mignot**, Fabio **Tramontana** and Frank **Westerhoff**, *Complex dynamics in a nonlinear duopoly model with heuristic expectation formation and learning behavior*

188 Leonhard **Ipsen**, Armin **Aminian** and Jan **Schulz**, *Stress-testing Inflation Exposure: Systemically Significant Prices and Asymmetric Shock Propagation in the EU28*

189 Sarah **Mignot** and Frank **Westerhoff**, *Explaining the stylized facts of foreign exchange markets with a simple agent-based version of Paul de Grauwe's chaotic exchange rate model*

190 Roberto **Rozzi** and Stefanie Y. **Schmitt**, *Vertical product differentiation, prominence, and costly search*

191 Florian **Herold** and Christoph **Kuzmics**, *Farkas' Lemma and Complete Indifference*

192 Sarah **Mignot**, Paolo **Pellizzari**, and Frank **Westerhoff**, *Fake News and Asset Price Dynamics*

193 Fabian **Dietz** and Marco **Sahm**, *Fairness in Round-Robin Tournaments with Four Players and Endogenous Sequences*

194 Jan **Schulz**, Caleb **Agoha**, Anna **Gebhard**, Bettina **Gregg** and Daniel M. **Mayerhoffer**, *Excessive White Male Privilege Biases the Measurement of Intersectional Wage Discrimination*

195 Leonhard **Ipsen** and Jan **Schulz**, *The (Dis-)Equalizing Effects of Production Networks*

196 Ivan **Savin**, Philipp **Mundt** and Margherita **Bellanca**, *The paradox of climate policy diffusion*

197 Dominik **Bruckner** and Marco **Sahm**, *Party Politics: A Contest Perspective*

198 Lasare **Samartzidis**, Philipp **Mundt** and Jan **Schulz**, *Input specificity and labor's bargaining power: A production tree approach to functional income distribution*

199 Maybrit **Wächter**, Christian R. **Proaño**, and Juan Carlos **Peña**, *How Fitting is "one-size-fits-all"? Revisiting the Dynamic Effects of ECB's Interest Policy on Euro Area Countries*

**Free access to all publications at:** www.uni-bamberg.de/en/economics/research/wp/