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A Note on the Synchronisation of the Natural Rates of Interest in Germany and the Euro Area*

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Abstract

The European Central Bank (ECB) strives to maintain inflation at a 2% target rate, yet the Euro area's diverse economies pose challenges to achieving this goal with a single nominal interest rate. Effective monetary policy transmission hinges on synchronizing the Natural Rate of Interest (NRI) across constituent economies. This note investigates NRI synchronization between Germany, the largest Euro area economy, and the entire Euro area. Utilizing Bayesian estimation of the Holston et al. (2017) model, we find robust synchronization between Germany's NRI and that of the entire Euro area, even amid level differences, supporting effective monetary policy coordination.

Keywords: unobserved component model, natural rate of interest, HLW model, Euro area, Germany

JEL classification: C32, E43, E52

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1 Introduction

The primary goal of the European Central Bank (ECB) is to maintain Euro area inflation at its target rate of 2%. However, since the Euro area consists of 20 individual economies, each with potentially different economic conditions, interest rates consistent with achieving this goal and maintaining country-specific inflation at a 2% target, might differ across the constituent economies. Such differences would hinder the effectiveness of monetary policy transmission. Specifically, for monetary policy to be effective, the Natural Rate of Interest (NRI), which is the real interest rate that corresponds to a closed output gap and thus no inflationary pressure, needs to be synchronized across the Euro area's constituent economies. In this note, we investigate whether this is the case for the largest economy in the Euro area, Germany.

As the Natural Rate of Interest, r^*, is an unobserved quantity, like the output gap or trend inflation, it needs to be estimated. To this end, central banks and policy organizations across the world closely monitor r^* (Cesa-Bianchi et al. 2023, Platzer et al. 2023, Schnabel 2024) and frequently rely on the semi-structural Laubach and Williams (2003) model or its more recent Holston et al. (2017) (HLW) version. Using the Bayesian Berger and Kempa (2019) formulation of the HLW model (see Section 2), we investigate synchronisation of the Natural Rate(s) of Interest for Germany and the entire Euro area (see Section 3). We find both NRIs are well synchronized, even in the presence of small and transitory level differences.

2 A Bayesian Holston-Laubach-Williams Model

Following HLW, we model the NRI r_t^* as a function of potential output growth and a residual component, z_t. For the details of the model structure, we refer to Holston et al. (2017). To enhance the robustness and flexibility of our analysis, our approach deviates from the traditional HLW model in several key aspects. Firstly, we impose a simple autoregressive structure on the cyclical component of the real rate, capturing deviations from the trend rate. Secondly, we incorporate stochastic volatility (SV) into our model, allowing for changes in the size of shocks to output, thus better reflecting periods of economic turmoil. Lastly, we employ a Bayesian framework, as suggested by Berger and Kempa (2019), to estimate the NRI.

To estimate the NRI r_t^*, we specify the following model:

$$y_t = y_t^* + y_t^c, \tag{1}$$

$$\pi_t = \beta_\pi \pi_{t-1} + (1-\beta_\pi)\pi_{t-2,4} + \beta_y y_{t-1}^c + \varepsilon_t^\pi, \qquad \varepsilon_t^\pi \overset{iid}{\sim} \mathcal{N}(0, \sigma_{\varepsilon,\pi}^2), \tag{2}$$

$$r_t = r_t^* + r_t^c, \tag{3}$$

where y_t^* denotes potential output, y_t^c is the output gap, π_t denotes inflation, $\pi_{t-2,4}$ constitutes the average of the second to fourth lags of inflation, r_t is the real short-term interest rate and r_t^c is the interest rate gap. An IS curve relates the output gap to its own lags and two lags of the real interest rate gap, i.e.

$$y_t^c = \phi_1 y_{t-1}^c + \phi_2 y_{t-2}^c + \frac{a_r}{2}\sum_{j=1}^{2} r_{t-j}^c + \exp\{h_t^c\}\eta_t^{y^c}, \qquad \eta_t^{y^c} \overset{iid}{\sim} \mathcal{N}(0,1). \tag{4}$$

The inclusion of the SV term $\exp\{h_t^c\}$ in the innovations to the output gap serves the purpose of accommodating fluctuations in the magnitude of output shocks. For instance, it allows for the possibility of exceptionally large negative output gaps during periods of economic distress, as during the COVID-19 pandemic. The stochastic volatility of the output gap is represented as a random walk, i.e.

$$h_t^c = h_{t-1}^c + \tau_t^c, \qquad \tau_t^c \overset{iid}{\sim} \mathcal{N}(0, \sigma_{\tau^c}^2). \tag{5}$$

The evolution of potential output and the NRI is linked through the time-varying trend growth rate of potential output, g, modeled as a random walk:

$$y_t^* = y_{t-1}^* + g_{t-1} + \eta_t^{y^*}, \qquad \eta_t^{y^*} \overset{iid}{\sim} \mathcal{N}(0, \sigma_{\eta,y^*}^2) \tag{6}$$

$$g_t = g_{t-1} + \eta_t^g, \qquad \eta_t^g \overset{iid}{\sim} \mathcal{N}(0, \sigma_{\eta,g}^2) \tag{7}$$

$$r_t^* = cg_{t-1} + z_t, \quad \text{where} \quad z_t = z_{t-1} + \eta_t^z, \qquad \eta_t^z \overset{iid}{\sim} \mathcal{N}(0, \sigma_{\eta,z}^2) \tag{8}$$

$$r_t^c = \omega r_{t-1}^c + \eta_t^{r^c}, \qquad \eta_t^{r^c} \overset{iid}{\sim} \mathcal{N}(0, \sigma_{\eta,r^c}^2) \tag{9}$$

We use a straightforward Gibbs-Sampling scheme to estimate the model. Table A1 shows the data sources. Table A2 summarizes the prior distributions, which derive from a standard normal-inverse-gamma framework and are identical for both the Euro area and Germany.

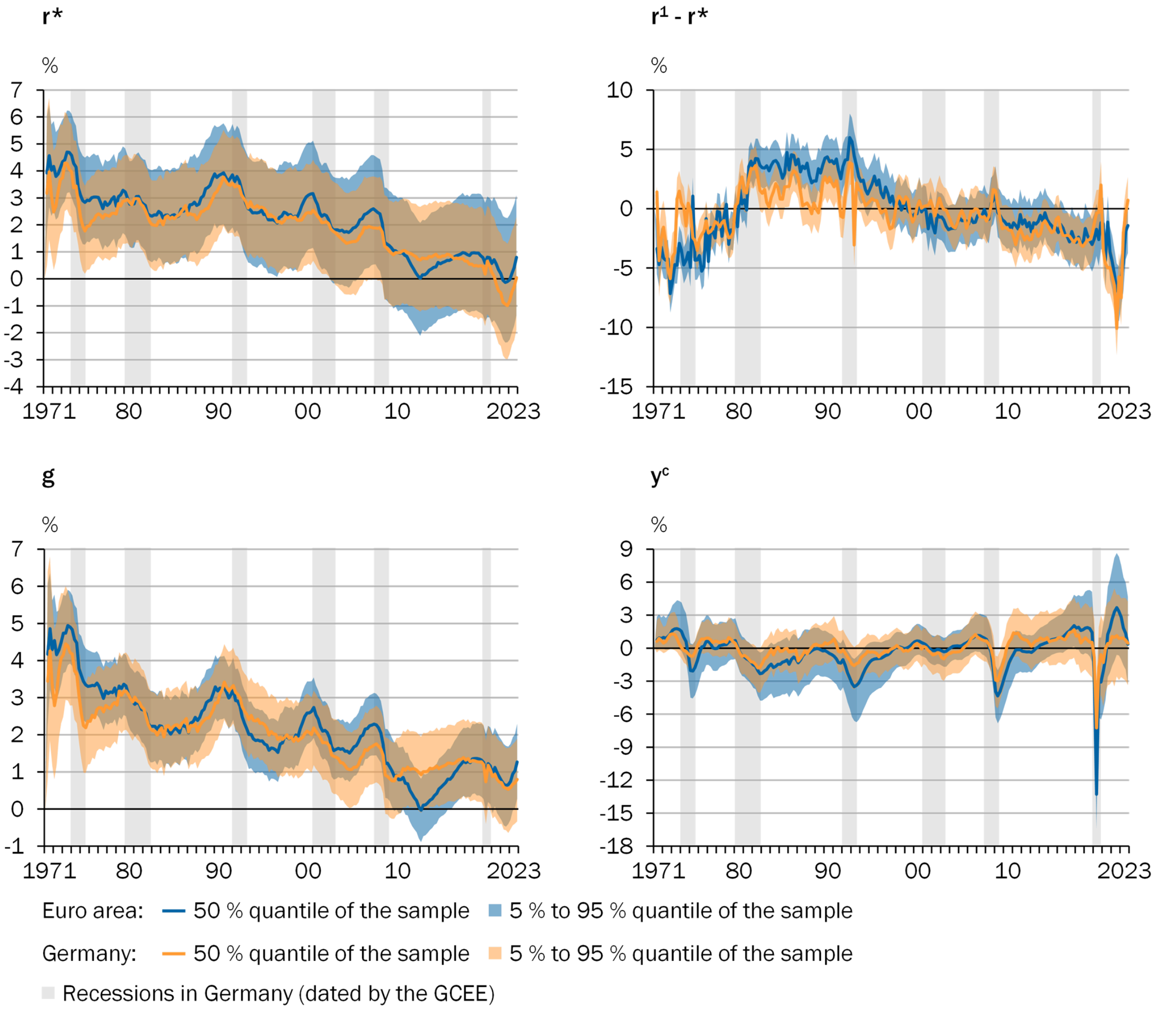
3 Estimation Results

We now turn to discussing our estimation results that are depicted in Figure 1. The NRI for the Euro area and Germany both initiate in 1971 at levels close to 4% (blue and orange lines respectively in the upper left panel of Figure 1). The movement of these rates exhibits a significant degree of synchronization in the sample period, with a correlation coefficient of $\rho = 0.94$ ($\rho = 0.85$ prior to the introduction of the Euro currency in 1999; $\rho = 0.90$ after 1999). Interestingly, this tight correlation is notable even in the decades of the 1970s and 80s, a period before the Euro area had a common monetary policy.

r^* experiences a notable drop to 3% (2%) in the mid-70s in the Euro area (Germany) and remained at this lower level in the 1980s. In this period, the real interest rate gaps – the difference of the real short-term interest rate and r^* –, turn positive, notably within the Euro area at around 4% (upper right panel of Figure 1). As for the case of r^*, there is a high correlation between both interest rate gaps in the sample period ($\rho = 0.76$; $\rho = 0.75$ prior to 1999; $\rho = 0.80$ after 1999). r^* being below the realized real interest rate implies that rates were likely too high for capital markets to clear. This observation aligns well with an estimated negative median Euro area output gap, which dipped to around -3% by

1994, suggesting that the monetary policy stance of what later became the Eurosystem during this time was overly contractionary.

Natural rate of interest, interest rate gap, potential output growth and output gap estimates



1 – r = i - pi.

Sources: Deutsche Bundesbank, ECB, Federal Statistical Office, Holston et al. (2017), own calculations

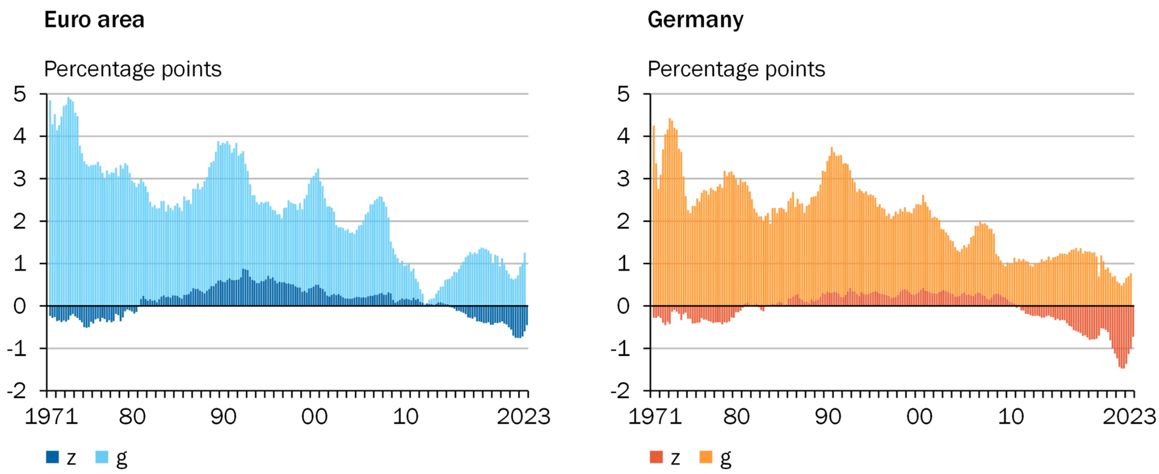
Figure 1

Around 1991, a notable tandem decrease in the NRIs of both the Euro area and Germany commences, which, despite minor upward adjustments in the mid-1990s and early 2000s, represents a sustained downward trend. This decline in NRIs correlates with substantial reductions in the potential output growth rates (lower left panel of Figure 1). Following the 2008 financial crisis, there is again a marked decline in the NRIs for both regions, reflecting the new economic landscape of persistently low real equilibrium interest rates. This period of low NRIs coincides with sharp declines in potential output growth rates during the 2009 crisis.

While there is a subsequent period of economic recovery, real interest rates remained below the peaks of the late 1990s. We note that the Great Recession and the subsequent

European banking and sovereign debt crisis have left scars, in particular in the Euro area with potential output growth approach zero during the 2010s. During the COVID-19 pandemic, the NRIs for both the Euro area and Germany show little movement, an anomaly given the economic turmoil of the period. However, in early 2022, we observe a significant decline in the NRIs. While the model does ultimately not permit for causal conclusions, the hypothesis that the decline in r^* can be partly attributed to the energy crisis in Europe (with a more pronounced effect on German r^*), possibly amplified by the geopolitical tensions and economic repercussions of the Russian attack on Ukraine, is close at hand: Times of economic turmoil may decrease potential output growth and investment demand, such that r^* may decrease in turn.

Decompositions of natural rates of interest in the euro area and Germany



Sources: Deutsche Bundesbank, ECB, Federal Statistical Office, Holston et al. (2017), own calculations
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Figure 2

To understand the drivers of NRIs, we examine the decompositions of r^* into the potential output growth rate and the residual (Figure 2). Two results emerge. First of all, for most of the sample period potential output growth (light blue and light orange bars in the left and right panel of Figure 2, respectively) determines the larger share of variation in r^*, for both the Euro area as well as Germany. Overall, this may imply that most of the reduction in r^* is related to a reduction in potential output growth. Second, in recent years, the graph shows that the potential output growth rate makes smaller relative contributions to the natural rate than in the prior decades, while the residual contribution continues to have a variable but larger relative size. This change indicates that relatively recently, determinants other than potential output growth have increasingly co-determined the natural rate of interest in both the Euro area and Germany. The NRI literature explores various factors influencing the NRI beyond the traditional focus on potential output growth. Notably, 'flight-to-heaven'dynamics, where investors gravitate towards safe assets during periods of heightened uncertainty, are considered significant drivers of the NRI (Del Negro et al. 2019), as well as the relative price of capital, debt levels and demography beyond its impact on potential output (Cesa-Bianchi et al. 2023).

4 Conclusion

Our investigation into the synchronization of the Natural Rates of Interest (NRIs) for Germany and the entire Euro area sheds light on the effectiveness of monetary policy coordination within the Euro area. Despite the Euro area's diverse economic landscapes, our findings suggest that NRIs are well synchronized, even when considering level differences. This synchronization indicates a fundamental alignment in the economic conditions and outlooks of Germany and the broader Euro area, in line with the ECB's efforts to maintain inflation at its target rate of 2%. Moving forward, continued monitoring and analysis of NRI synchronization will be crucial for ensuring the effectiveness and stability of monetary policy across the Euro area's constituent economies.

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A Tables

Series	Source and Code	Transformation
Germany, real GDP y_t	Federal Statistical Office ($81000 - 0020 - VGRPVK - X13JDKSB$)	SA, log
Germany, CPI π_t	Deutsche Bundesbank ($BBDP1.M.DE.Y.VPI.C.A00000.I20.A$)	SA, QQ, log $\times$ 400
Germany, Interbank Rate i_t	Federal Reserve Economic Data ($RSTCI01DEM156N$)	annualized
Euro area, real GDP y_t	ECB Data Portal ($Q.Y.I8.W2.S1.S1.B.B1GQ.\_Z.\_Z.\_Z.EUR.LR.N$)	SA, log
Euro area, CPI π_t	ECB Data Portal ($M.U2.N.XE0000.4.INX$)	SA, QQ, log $\times$ 400
Euro area, Interbank Rate i_t	ECB Data Portal ($Q.U2.EUR.RT.MM.EURIBOR3MD\_HSTA$)	annualized

Table A1 Data: SA = seasonally adjusted, QQ = quarter-on-quarter changes, log = natural logarithm, annualized = $100\left((1 + i_t/36000)^{365} - 1\right)$.

Innovation variances				
			a	b
Philip's curve innovation variance	$\sigma^2_{\eta,\pi}$	$\mathcal{IG}\,(aT, abT)$	0.005	1
IS curve SV innovation variance	$\sigma^2_{\eta,z}$	$\mathcal{IG}\,(aT, abT)$	0.005	1
g innovation variance	$\sigma^2_{\eta,g}$	$\mathcal{IG}\,(aT, abT)$	0.1	0.0001
y^* innovation variance	σ^2_{η,y^*}	$\mathcal{IG}\,(aT, abT)$	0.1	0.01
Regression parameters				
			μ	ϵ^2
IS AR(1) parameter	ϕ_1	$\mathcal{N}\,(\mu, \epsilon^2)$	1.55	0.15^2
IS AR(2) parameter	ϕ_2	$\mathcal{N}\,(\mu, \epsilon^2)$	0.95	0.15^2
Coefficient on r^c in IS	a_r	$\mathcal{N}\,(\mu, \epsilon^2)$	-0.15	0.15^2
Philip's curve parameter 1	β_π	$\mathcal{N}\,(\mu, \epsilon^2)$	0.8	0.15^2
Philip's curve parameter 2	β_y	$\mathcal{N}\,(\mu, \epsilon^2)$	0.2	0.15^2
Coefficient on g in r^c	c	$\mathcal{N}\,(\mu, \epsilon^2)$	1	0.15^2
AR(1) of r^c	ω	$\mathcal{N}\,(\mu, \epsilon^2)$	0.95	0.15^2

Table A2 Prior distributions. $\mathcal{N}$ designates a normal distribution and $\mathcal{IG}$ an inverse-gamma distribution, T denotes the size of the time dimension.