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JEL Classification: E42, E43, E52

Keywords: Monetary policy, Interest rates, European central bank, Taylor rule, Orphanides-Wieland rule, New-Keynesian macro-epidemic models

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Policy Rules and the Inflation Surge: The Case of the ECB

Balint Tatar[†] and Volker Wieland[‡]

September 23, 2024

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This paper investigates the implications of monetary policy rules during the surge and subsequent decline of inflation in the euro area and compares them to the interest rate decisions of the European Central Bank (ECB). It focuses on versions of the Taylor (1993) and Orphanides and Wieland (OW) (2013) rules. Rules that respond to recent outcomes of HICP Core or domestic inflation data called for raising interest rates in 2021 and well ahead of the rate increases implemented by the ECB. Thus, such simple outcome-based policy rules deserve more attention in the ECB's monetary policy strategy. Interestingly, the rules support the recent shift of the ECB to policy easing. Yet, they add a note of caution by suggesting that policy rates should not decline as fast as apparently anticipated by traded derivative-based interest rate forecasts.

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1. Introduction

In 2021 and 2022 the euro area experienced an unprecedent surge of inflation. It shared this experience with other currency jurisdictions around the world including the United States. The rise of inflation began at the start of 2021. It followed the partial recovery of economic activity in the second half of 2020 after the first wave of the coronavirus pandemic. Inflation rose further in 2022 following the Russian war of aggression against Ukraine. The war disrupted natural gas supplies and caused energy prices to skyrocket across Europe and elsewhere. Inflation then declined strongly in 2023 and more slowly in the first half of 2024 but still remains somewhat above the 2% inflation target of the ECB.

A recent literature has compared the policy of the U.S. Federal Reserve during this period to the prescriptions of Taylor-style monetary policy rules, including rules regularly published by the Fed itself in its Monetary Policy Report.[1] Many of these rules provided early signals for policy tightening suggesting that the U.S. Fed responded very late to the inflation surge. More recently, interest rate prescriptions from these rules have been coming down substantially suggesting that there may be room for the Fed to ease policy.

This paper investigates the implications of monetary policy rules during the surge and subsequent decline of inflation in the euro area and compares them to the interest rate decisions of the European Central Bank (ECB). It focuses on two rules, a version of the Taylor (1993) rule that figures prominently among those regularly published by the Fed for the U.S. economy and the rule of Orphanides and Wieland (2013) (OW rule) that has a good track record in fitting earlier ECB policy decisions.[2]

For the pandemic period preceding the inflation surge, the paper proposes a simple adjustment of the output gaps used by the rules in order to account for the supply-side effects of the pandemic following Tatar and Wieland (2024). It proceeds to show that Taylor rules, which respond to recent inflation outcomes, provided an early warning for the need of policy tightening well ahead of the ECB's interest rate hikes. By contrast, the OW rule, which employs near-term forecasts from the European Central Bank's survey of professional forecasters (SPF) did not respond as strongly to the rise of inflation. An outcome-based version of the OW rule, however, would have called for raising policy rates much earlier.

Figure 1 shows the development of year-on-year inflation in the euro area from 2018 to 2024 using four different measures: the Harmonised Index of Consumer Prices (HICP), the HICP Core (HICP excluding energy, food, alcohol and tobacco), the deflator of personal consumption

[1] See, in particular, Bullard (2023, 2024), Clarida (2023), Lacker and Plosser (2024), Orphanides (2024), Papell and Prodan (2022, 2024), Taylor (2023), Wieland (2023) and Tatar and Wieland (2024). For an analysis of the rules in the Federal Reserve's Monetary Policy Report prior to the coronavirus period see Cochrane, Tayor and Wieland (2020).

[2] Orphanides and Wieland (2013) showed that a simple rule that relates the change of the interest rate (first-difference) to near-term forecasts of inflation (in deviation of the ECB's target) and output growth (in deviation of the EU-Commission's estimate of potential) matches up quite well with actual ECB decisions. Bletzinger and Wieland (2017) estimate the OW rule with SPF and ECB staff forecasts and obtain numerical estimates for the ECB's target of below but close to 2% inflation (used till 2021). Hartmann and Smets (2018) used the OW rule as a benchmark to discuss ECB policy during the first 20 years of the euro. More recently, Tatar (2023) has presented time-varying estimates of the OW rule.

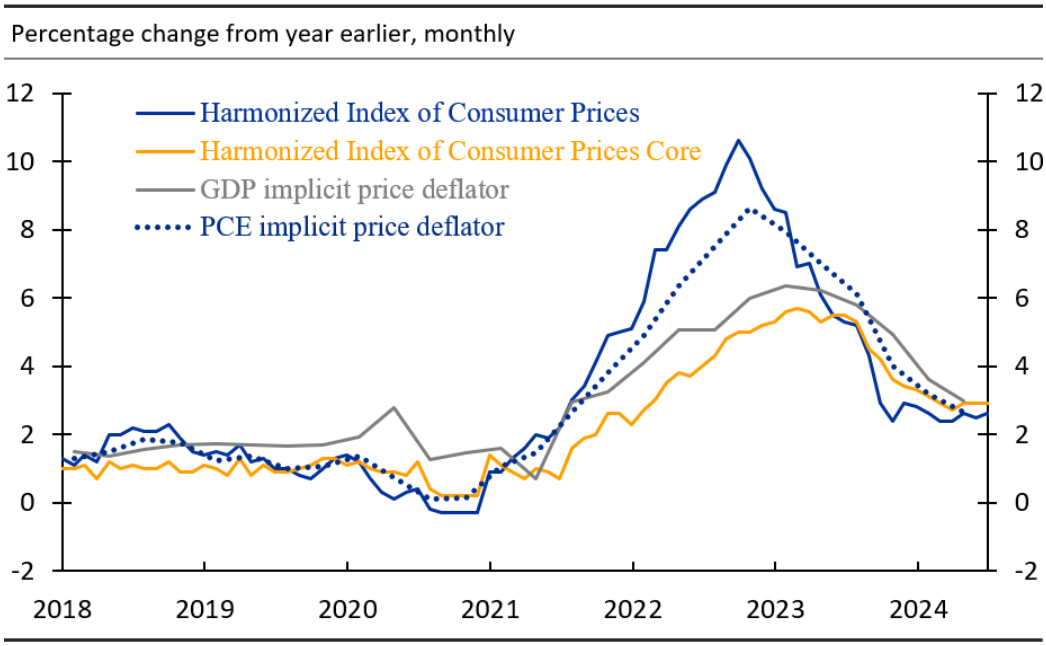
expenditures (PCE deflator) and of gross domestic product (GDP deflator). The HICP and HICP Core measures are more susceptible to substitution bias than the PCE deflator because they do not capture households' automatic shift to cheaper goods as prices increase as quickly. The GDP deflator is the broadest measure of domestic prices including investment goods, construction and government services, but excluding imported goods. Importantly, it captures domestic price rigidities that play a key role in the welfare cost of inflation.

The three consumer price measures all started to rise at the beginning of 2021, the GDP deflator a bit later. By the end of 2021 they had reached 5% (HICP, Dec), 3.3% (PCE, Q4), 2.6% (HICP Core, Dec) and 3.8% (GDP Deflator, Q4), respectively. Thus, inflation had clearly taken off before the Russian attack on Ukraine in February 2022.

Figure 1

The inflation surge in the euro area

Euro area HICP, HICP Core, GDP deflator and PCE deflator 2018-2024



Notes: The chart shows the year-on-year percentage growth rate in the following different price measures: Harmonized Index of Consumer Prices (HICP) inflation (blue line), HICP Core inflation (yellow line), the implicit price deflator for the Gross Domestic Product (GDP) (grey line) and for the Personal Consumption Expenditure (PCE) (dotted blue line). Source: Eurostat

Throughout 2022 energy prices rose very quickly due to the energy crisis and supply shortages caused by the Russian attack. Energy prices figure prominently in the overall measures of consumer price inflation—the HICP and PCE deflator. Not surprisingly, these measures rose very fast in 2022 and peaked at levels of 10.6% (Oct) and 8.6% (Q4), respectively, towards the end of the year. The HICP Core excludes energy and food prices and rose more slowly but steadily. It peaked in March 2023 at a rate of 5.7%. Domestic inflation measured by the GDP deflator rose to a peak of 6.4% in the 1st quarter of 2023.

All four measures of inflation have declined throughout 2023 and 2024. The headline HICP exhibits the strongest decline and came in at 2.2% in August 2024. The HICP Core stands a bit higher at 2.7%. Domestic inflation as measured by the GDP deflator, however, still remains at 3% as of the second quarter of 2024. Overall, inflation is moderating and may be on course to converge to the ECB's inflation objective later in 2025. However, **Figure 1** also shows that the decline has slowed more recently and that domestic inflation remains somewhat higher.

The ECB has formulated its quantitative inflation objective with regard to the overall HICP and aims to achieve it over the medium term. Till 2003 it aimed for an increase of inflation below 2%, which was understood as a range between 0 and 2%. In its mid-term review in 2003 the ECB clarified the numerical target as below but close to 2%.[3] As a result of its strategy review in 2020/21, the ECB finally announced a symmetric numerical target of 2% in July 2021. Applying the new strategy for the first time, the ECB provided the following forward guidance on monetary policy at the press conference on July 22, 2021:

> *The Governing Council today revised its forward guidance on interest rates. We did so to underline our commitment to maintain a persistently accommodative monetary policy stance to meet our inflation target.*
>
> *In support of our symmetric 2% inflation target and in line with our monetary policy strategy, the Governing Council expects the key ECB interest rates to remain at their present or lower levels until we see inflation reaching two per cent well ahead of the end of our projection horizon and durably for the rest of the projection horizon, and we judge that realised progress in underlying inflation is sufficiently advanced to be consistent with inflation stabilising at two per cent over the medium term. This may also imply a transitory period in which inflation is moderately above target.*

This forward guidance presumably played a key role in shaping the policy response to the rise of inflation. Indeed, it implied that the ECB would accept a moderate, transitory rise of inflation beyond its target.

Figure 2 shows the resulting path of key policy rates for the euro area. The standard rationale behind policy tightening is that it raises real interest rates, which incentivizes saving and dampens both consumption and investment demand. Consequently, aggregate demand aligns more closely with supply, reducing opportunities for firms to raise prices and dampening inflation. Contrary to past ECB practice, policy rates did not rise ahead of inflation or along with it, but followed only much later starting in July 2022. In fact, throughout 2021 ECB representatives insisted that the rise of inflation was transitory and inflation rates would soon decline again.[4]

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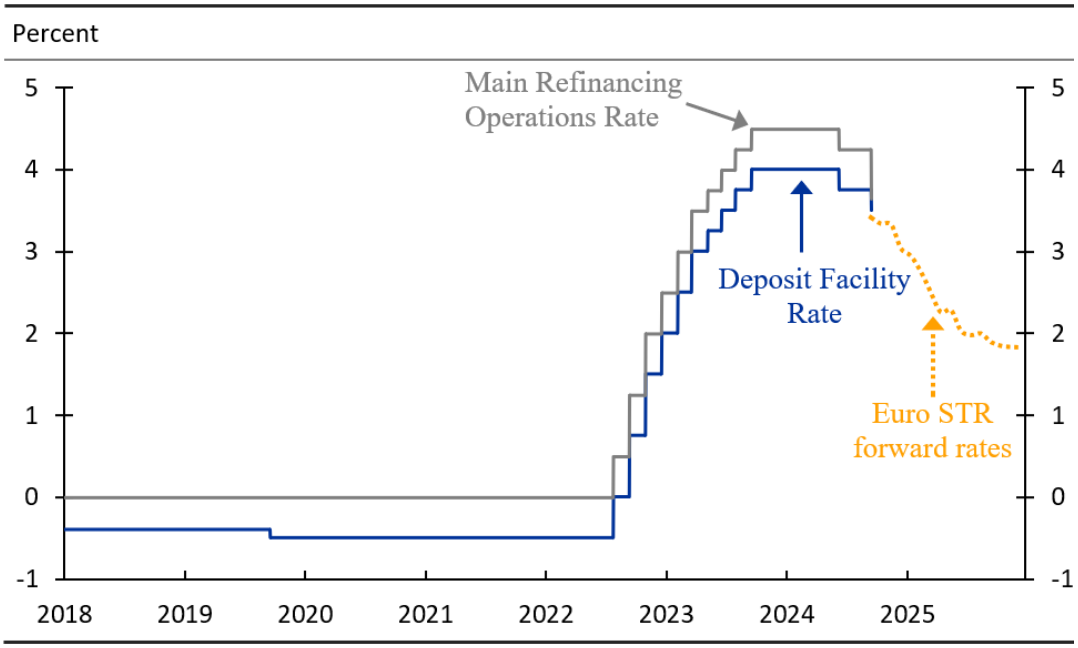
[3] Bletzinger and Wieland (2017) estimate the numerical target at 1.72% based on an empirical interest rate reaction function.

[4] The monetary policy statement of September 9, 2001, said "The current increase in inflation is expected to be largely temporary and underlying price pressures are building up only slowly. The inflation outlook in our new staff projections has been revised slightly upwards, but in the medium term inflation is foreseen to remain well below our two per cent target.' Furthermore, see for example, Reuters September 23, 2021, "Many of the drivers of a recent spike in euro zone inflation are temporary and due to fade in the next year, European Central Bank President Christine Lagarde said", or Reuters, November 8, 2021, "Euro zone inflation will ease next year and remains too weak in the

Figure 2

Policy tightening in the euro area

Deposit facility rate, main refinancing operations rate and Euro short-term futures



Notes: The grey line indicates the ECB's main refinancing operations (MRO) rate, the blue line shows the deposit facility rate. The dotted yellow line indicates the Euro Short Term Rate (STR) forward rates derived from 1-month Euro STR Overnight Index Swap (OIS) Rates on September 13, 2024. Sources: ECB and LSEG/Refinitiv

Arguably, inaction on policy rates was consistent with the strategy and forward guidance announced in July 2021. Not surprisingly, the ECB has been criticized for waiting too long to tighten policy. Subsequently, ECB President Lagarde shared in an interview that she regretted having felt bound by the forward guidance.[5]

From July 2022 till September 2023, the ECB then raised its key policy rates rather quickly by a cumulative 450 basis points. In fact, it proceeded with sharp policy tightening throughout spring of 2023 when banking stress and failing banks in the United States and Switzerland threatened

medium term, European Central Bank chief economist Philip Lane told a Spanish newspaper, repeating the bank's long-standing message that high price growth is temporary.", or Reuters, November 29, 2021, "The ECB believes that inflation peaked in November, meaning it would be premature to raise interest rates as price increases look likely to slow gradually next year, European Central Bank board member Isabel Schnabel said." In fact, the ECB was not alone in this assessment. At the time, other forecasters and central banks such as the U.S. Fed considered the increase in inflation transitory.

[5] See Financial Times, October 27, 2023, Lagarde: "But what I regret personally is to have felt bound by our forward guidance," she adds, referring to the commitment the ECB had given not to start raising interest rates until it had stopped buying billions of euros in mostly government debt, which it did slowly over the first six months of 2022. "I should have been bolder." … "But what we should have learned is that we cannot just rely only on textbook cases and pure models. We have to think with a broader horizon."

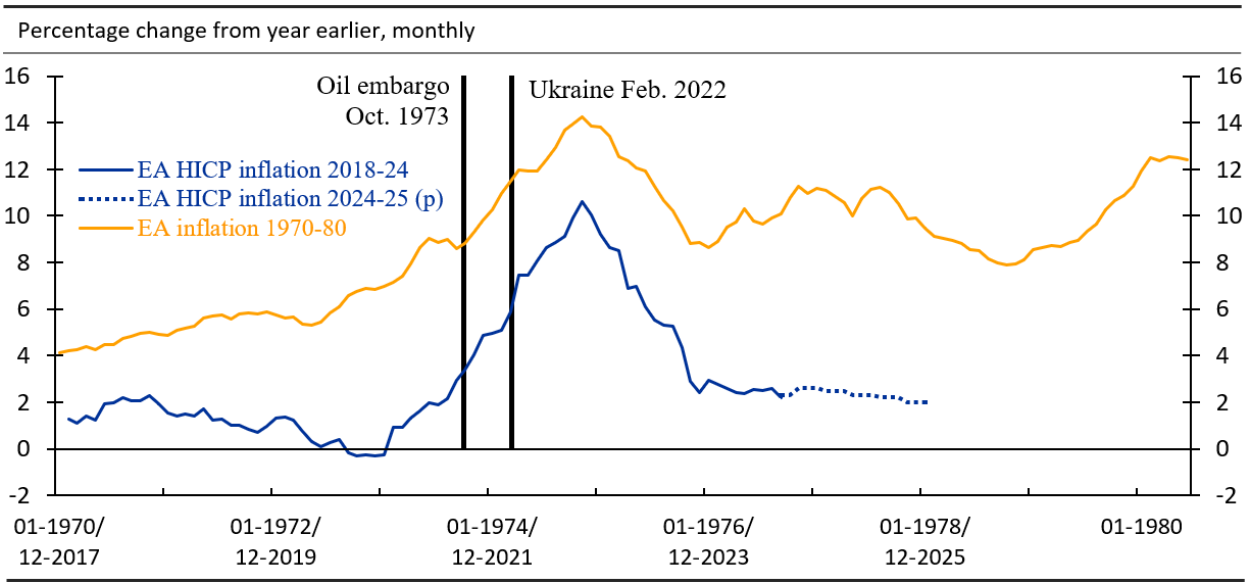
financial stability and continued tightening until September 2023. From September 2023 to June 2024, monetary policy in the euro area remained on hold, with the ECB maintaining the deposit facility rate at 4 percent.

In December 2023, future rates already indicated markets trading on the expectation of a change towards policy easing with interest rate cuts starting in the beginning of 2024. Even so, the ECB just like the Fed held rates steady out of concern about persistent inflation and sustained second-round effects. In support of this concern about persistent inflation, it is instructive to compare the recent inflation surge to the rise of inflation in the early 1970s as shown in **Figure 3**.

Figure 3

Comparing the 2021/22 inflation surge with the 1970s

Euro area HICP 2018-2024 vs EA CPI 1970-1980



Notes: The blue line depicts the 12-month growth rate of the weighted consumer price index of Germany, France, Italy and Spain from January 1970 to December 1980. The yellow line shows the 12-month growth rate of the HICP from December 2017 to August 2024. The dotted blue line shows the central projections from the ECB staff macroeconomic projection. Sources: ECB, Eurostat and own calculations.

Inflation, measured by the average 12-month-change in the consumer price index of the four largest euro area economies – Germany, France, Italy and Spain – was already significantly elevated at the start of the 1970s. It rose steadily until the surprise attack on Israel that marked the start of the Yom-Kippur war of October 1973 when Arab states imposed an oil embargo on Western countries including the European economies as well as the United States and caused an energy crisis. With rising energy prices inflation accelerated further.

While, on average, inflation was four to five percentage points higher during the 1973/75 surge than in 2021/23, the speed of the rise and decline of inflation was quite similar. By 1976, the inflation rate decreased to the level which prevailed before the start of the Yom-Kippur war in October 1973, yet the decline came to a halt and was eventually followed by another surge.

This historical experience may have been one of the reasons for the Fed and the ECB to hold off on policy easing during spring and in the case of the Fed also summer of 2024. Eventually, the ECB lowered policy rates first by 25 basis points in June 2024 and then again in September. In the following, we compare the ECB's monetary policy to the prescriptions of some well-known simple interest rate rules. In doing so we explore whether these rules could have been helpful in terms of avoiding keeping rates too low for too long at the start of the inflation surge and whether they suggest that the ECB is at risk of keeping rates too high for too long as inflation has come down.

2. Monetary policy rules for the euro area

The Taylor (1993) rule

We start by applying the well-known Taylor (1993) rule (henceforth Taylor rule) to the euro area. This rule is a reaction function or feedback rule for the level of the central bank interest rate as defined by equation (1):

(1)

$$i_t = r^* + \pi_t + 0.5(\pi_t - \pi^*) + 0.5(q_t - q_t^*)$$

The rule includes the equilibrium real interest rate r^*, the inflation rate π, the deviation of inflation from the target π^*, and the output gap, that is the deviation of the logarithm of GDP, q_t, from the logarithm of potential GDP, q_t^*. The response coefficients on the inflation and output gaps are set to 0.5.

Several variants of this rule have been published regularly by the U.S. Fed in its Monetary Policy Report since 2017 (see Board of Governors (2017) and Cochrane, Taylor and Wieland (2020)). The ECB uses various applications of the Taylor rule and other rules in its internal analysis. Furthermore, the German Council of Economic Experts has regularly published a euro area version in its annual reports since 2013 (see German Council of Economic Experts 2013).

In the following, we use two measures of inflation, the HICP Core and the GDP deflator as inputs to the Taylor rule, together with euro area GDP and the EU Commission's estimate of potential GDP. With regard to r^*, we consider a range of estimates inspired by a recent publication of the ECB (see European Central Bank 2024).

The Orphanides-Wieland (2013) rule

Furthermore, we consider the interest rate rule from Orphanides and Wieland (2013) (henceforth OW rule) which has been found to fit past ECB decisions fairly well (see Bletzinger and Wieland (2017), Hartmann and Smets (2019) and Tatar (2023)). As shown in equation (2), it relates the change of the interest rate (first-difference) to near-term forecasts of inflation (in deviation of the ECB's target) and output growth (in deviation of the EU-Commission's estimate of potential growth):

(2)

$$\Delta i_t = 0.5(\pi_{t+3|t} - \pi^*) + 0.5(q_{t+2|t} - q^*_{t+2|t})$$

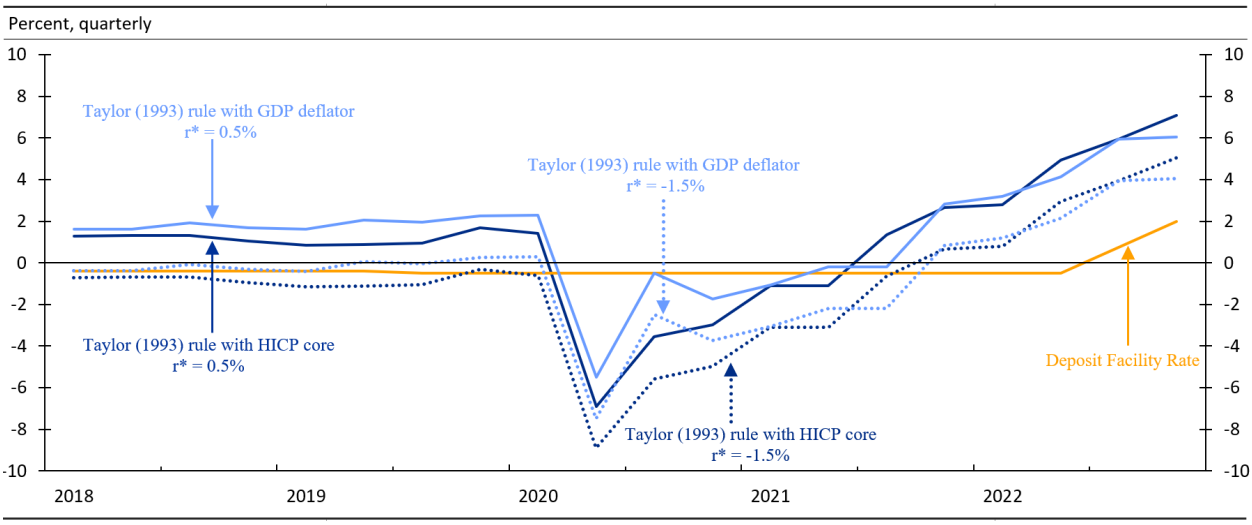
As a first-difference rule, the OW rule does not require an estimate of r^*. The forecasts used by the OW rule are taken from the ECB's Survey of Professional Forecasters. In particular, OW use the forecast 1 year ahead relative to the most recent data point. For HICP inflation, this means effectively three quarters ahead and for GDP growth two quarters ahead relative to the date t when the forecasts are made available to ECB policy makers prior to their decision. Accordingly, the subscripts are $t+3|t$ and $t+2|t$. OW chose reaction coefficients of *0.5* so that a one-percentage-point deviation of the inflation forecast from target or the output growth forecast from potential would result in a 50 basis point adjustment of the policy rate. The estimates obtained by Bletzinger and Wieland (2017) are very close to that.[6]

3. Policy rule prescriptions during the coronavirus crisis

The interest rate prescriptions from the Taylor rule for the period from 2018 to 2022 are shown in **Figure 5.**

Figure 5

Policy rate prescriptions from the Taylor rule: 2018 to 2022



Notes: Taylor (1993) rule prescriptions were calculated with r*=0.5% (solid lines) and with r*=-1.5% (dotted lines) covering a large part of the r*-estimates in ECB (2024). The dark blue lines display the prescriptions using the HICP Core inflation and the light blue lines the prescriptions based on the GDP deflator. For the calculations real time data is used. Since the deflator series are

[6] Ideally, one would want to feed ECB Governing Council members' forecasts of inflation and output growth into this reaction function. For example, Orphanides and Wieland (2008) have used publicly available forecasts of members of the Federal Open Market Committee to estimate a forecast-based rule for the United States. Unfortunately, however, the inflation and output growth forecasts of ECB Governing Council members are not publicly available. Bletzinger and Wieland (2017) also test staff forecasts but obtain a better empirical fit with SPF forecasts.

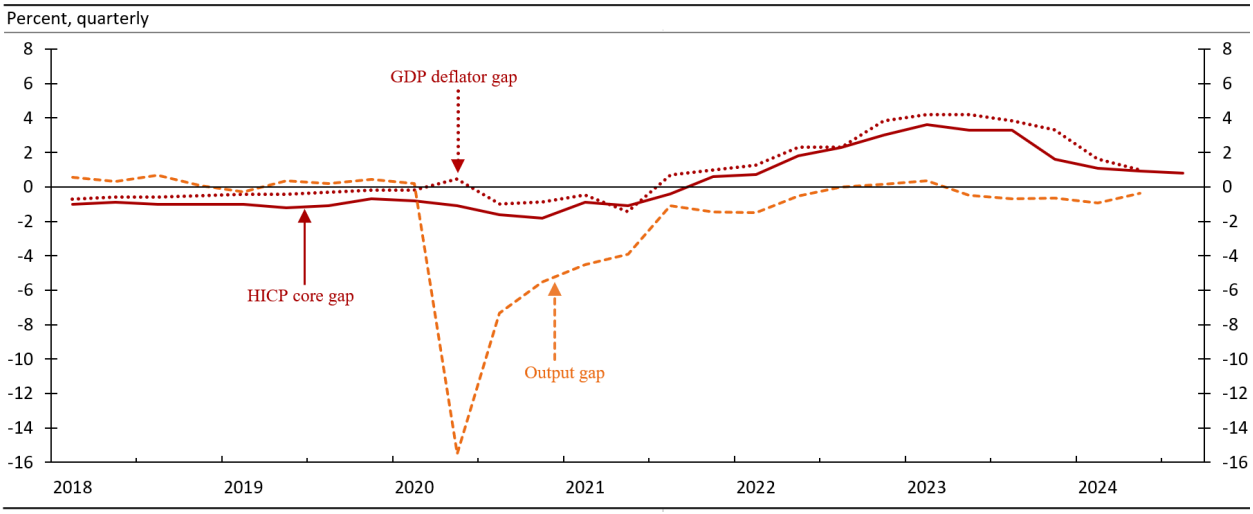
available only with a delay of over two months, for the calculation of the policy rules the GDP deflator series are lagged by one period.Sources: ECB, European Commission, Eurostat and own calculations.

Interestingly, the Taylor rule prescribed deeply negative policy rates during the coronavirus pandemic. As stated by the Federal Reserve (2021), this may have been taken as support for substantial additional quantitative easing and other unconventional policy measures including forward guidance.[7] However, these negative prescriptions disappeared in 2021. The Taylor rule then prescribed an early lift-off of policy rates. Accordingly, it delivered advance warning of needed interest rate hikes well ahead of the interest rate increase implemented by the ECB starting in summer 2022.

These Taylor rule prescriptions are based on the real-time inflation and output gap data reported in **Figure 6**. The inflation gap is calculated for the HICP Core and the GDP deflator with respect to an inflation target of 2%. The output gap is computed with respect to the European Commissions' estimate of potential GDP. The culprit for the deeply negative interest rate prescriptions during the pandemic is the output gap. It is estimated at -15% in the second quarter of 2020, but recovers towards about -5% in the fourth quarter.

Figure 6

The gaps used in the application of the Taylor rule



Notes: The HICP Core gap (solid red line) is defined as the difference between the HICP Core inflation rate and the ECB's 2% inflation target. The GDP deflator gap (dotted red line) is the difference between the percentage change in the GDP deflator and the ECB's 2% inflation target. The changes are calculated with respect to the same quarter in the previous year using real time values, that is, available before the ECB's monetary policy decisions in the third month of the quarter, respectively. For the calculation of the output gap nowcasted GDP values for the actual quarter are used based on the actual ECB staff macroeconomic projections. Since the deflator series are available only with a delay of over two months, for the calculation of the policy rules the GDP deflator series are lagged by one period. Sources: ECB, European Commission, Eurostat and own calculations.

For the real equilibrium real interest rate we consider a wide range from -1.5% to 0.5%, which roughly matches the range of estimates reported by the ECB in 2024 and shown in **Figure 7**.

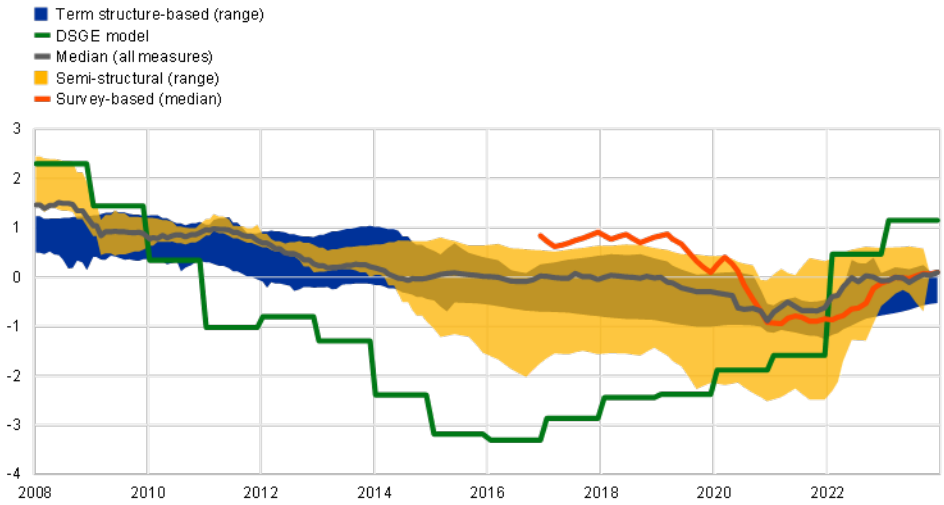
[7] See also the discussion in Tatar and Wieland (2024).

However, these estimates change over time. More recently, the lower end has been around -0.5% and the upper end near 1%.

The uncertainty about the equilibrium real interest rate has a substantial impact on the Taylor rule prescriptions. By contrast, a first-difference rule does not require an estimate of r^* as emphasized by OW. Thus, its prescriptions are not sensitive to the policymakers view on the appropriate equilibrium real interest rate. Nor does it require an estimate of the level of potential GDP, because the growth rate is sufficient.

Figure 7

Time-varying estimates of r^* reported in the ECB Bulletin in 2024



Notes: Source is European Central Bank, (2024), Estimates of the natural interest rate for the euro area: an update, in, *ECB Economic Bulletin*, Issue 1/2024, January.

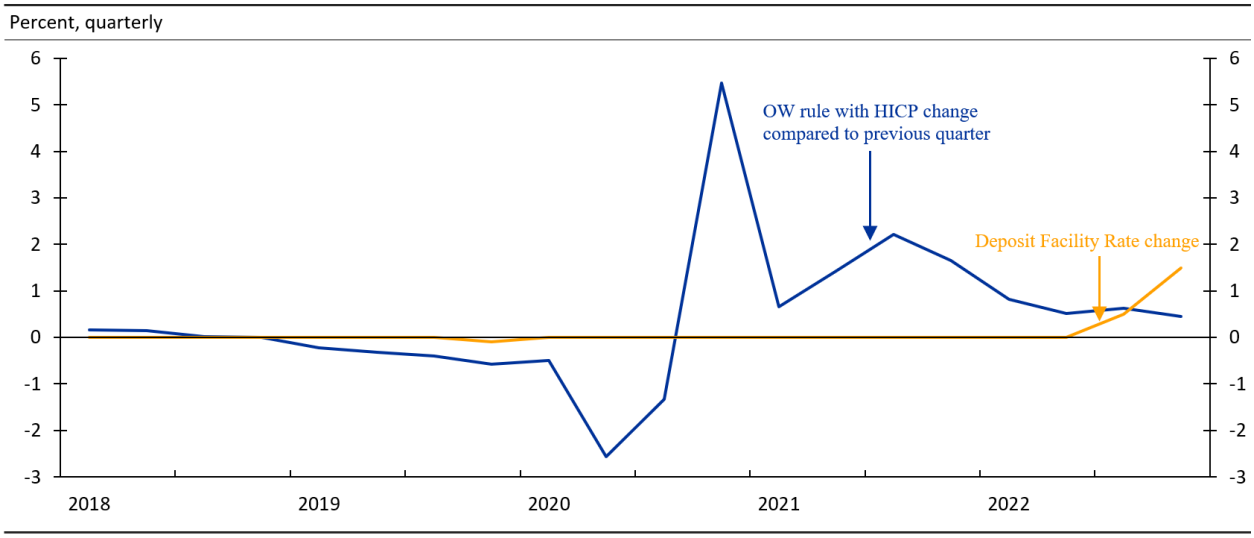
Thus, in principle, it makes a lot of sense to include a first-difference rule such as the OW rule when deliberating the appropriate choice of policy rate. Accordingly, the prescriptions from the OW rule based on SPF forecasts are shown in **Figure 8**. In the second quarter of 2020 the OW rule prescribes a 2.5% interest rate cut. It also recommends a reduction in the policy rate for the third quarter. Yet, in the fourth quarter of 2020 it prescribes a huge tightening on the scale of 6 percentage points. This appears rather erratic.

The source of this result becomes clear when considering the inputs in the rule that are shown in **Figure 9**. It is the predicted GDP growth gap. In the second quarter of 2020, it had become clear that the pandemic would have a major impact on economic activity, yet the economy had already contracted. Hence, the forecast for GDP growth between the fourth quarter of 2019 and the fourth quarter of 2020 was negative, but did not capture the full scale of the decline from the first to the second quarter. In the fourth quarter of 2020, a steep recovery from the depth of the coronavirus recession was anticipated. Hence the predicted GDP growth rate from the second quarter of 2020 to the second quarter of 2021 was far above the potential growth rate estimate by the European Commission. As a consequence, the OW rule prescribes a sharp increase in the policy rate.

However, the European Commission's estimate of the level and growth of potential GDP essentially refers to a long-run trend. The resulting gaps do not provide a plausible indicator of the actual divergence of aggregate demand and aggregate supply during the coronavirus pandemic.

Figure 8

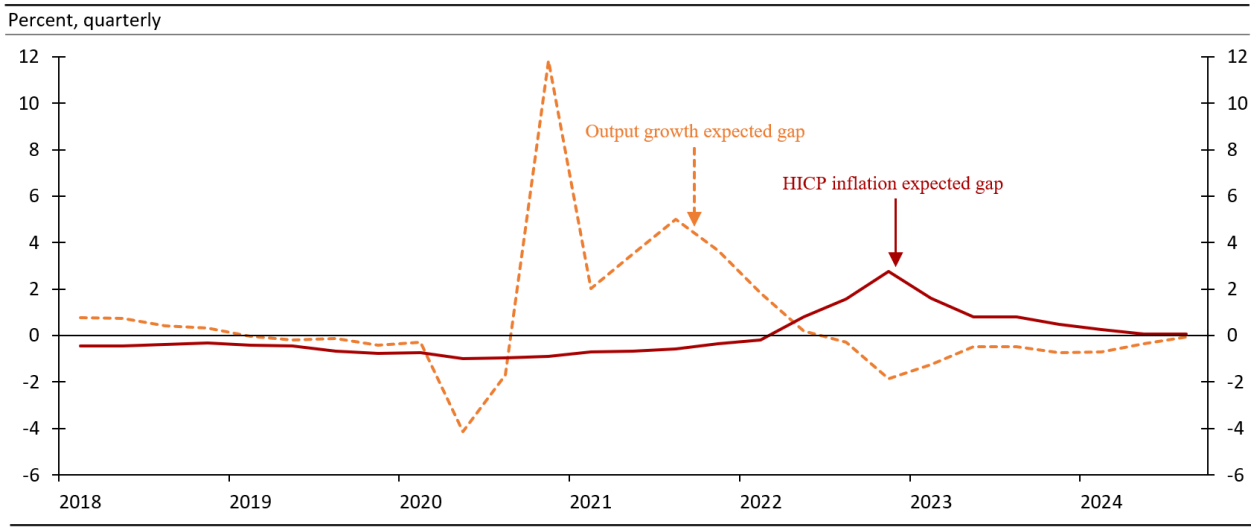
Prescriptions for the change of the policy rate from the Orphanides-Wieland rule with SPF Forecasts: 2018 - 2022



Notes: The chart shows the changes in the ECB's Deposit Facility Rate (DFR) compared to the previous period prescribed by the OW rule (blue line) and the changes in the ECB's DFR itself compared to the previous quarter. The DFRs used for the calculations refer to the second month in the quarter, respectively. Sources: ECB, European Commission and own calculations.

Figure 9

The SPF forecast gaps used in the OW-Rule



Notes: The chart shows the expected HICP inflation gap (difference between the expected yearly inflation rate and the ECB's inflation target of 2%) based on the ECB SPF as well as the expected output growth gap (orange line), that is, the difference between

the forecasted GDP growth rates from the ECB SPF and the interpolated potential growth forecasts of the European Commission. Sources: ECB, European Commission and own calculations.

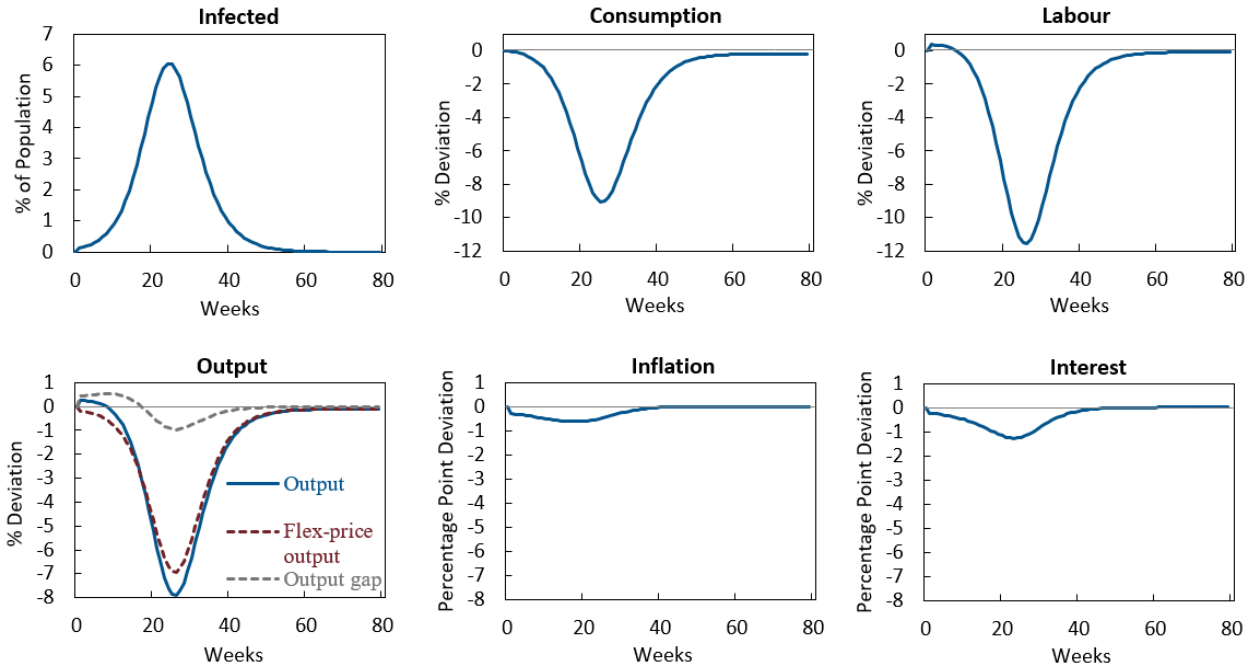
4. Correcting for the supply-side effects of the pandemic

In fact, the pandemic had a fairly parallel impact on aggregate demand and aggregate supply. Consumers and workers who were concerned about contracting the virus reduced contact-intensive consumption and work hours. Employers shut down contact-intensive production, in some cases dismissed workers, or let them work from home. Governments implemented lockdowns to further reduce the risk of infections. Consequently, demand and supply of contact-intensive goods and services largely moved in lock-step, first sharply down and then back up. Hence the relevant gap indicating disinflationary pressures from the pandemic was much smaller than the deviation from long-run potential.

In Tatar and Wieland (2024), we have proposed to use a model-based concept of the output gap that appropriately captures the supply-side effects of the pandemic in order to correct the GDP level and growth gaps used in policy rules. Specifically, we used the New-Keynesian macro-epi model of Eichenbaum, Rebelo and Trabandt (2022) to simulate the consequences of an epidemic for the output gap, inflation and interest rates under the Taylor rule. As shown in **Figure 10** (taken from Tatar and Wieland 2024) consumers and workers reduce contact-intensive consumption and work hours in order to avoid infection.

Figure 10

Simulation of an epidemic in a New-Keynesian macro-epi model

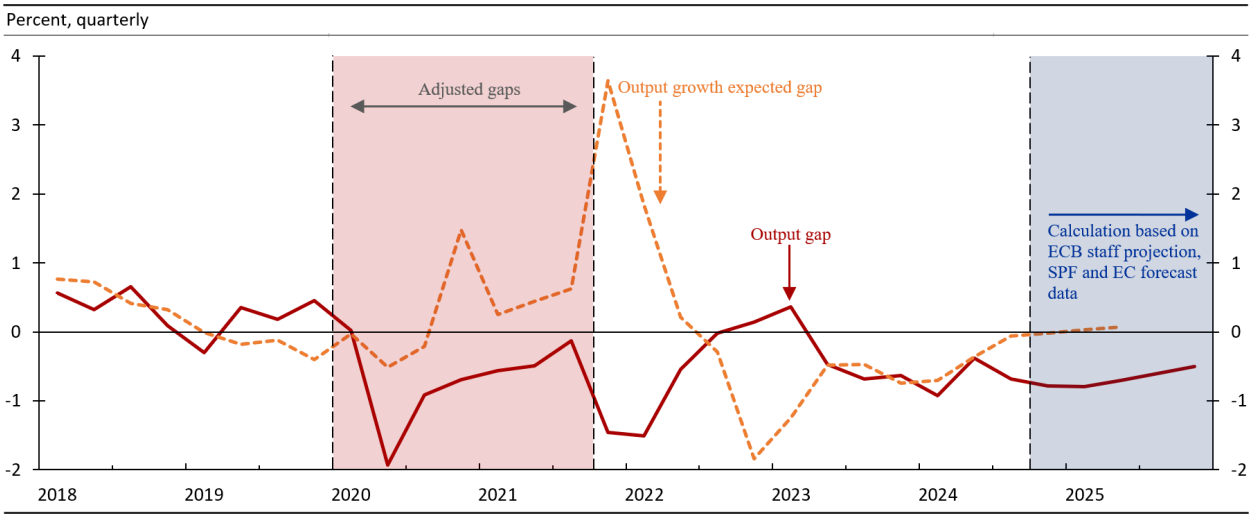


In this model, real GDP declines substantially, but once infections come down again, consumption and hours worked rise again quickly. Inflation only falls by about half a percentage point. The relevant output gap is defined in the model as the difference between the level of actual real GDP and real GDP that would prevail if the price level was completely flexible. This model-based gap is attributed to price rigidities arising from staggered wage and price contracts. The bottom-left panel shows GDP (blue line), flex-price GDP (red dashed line) and the implied output gap. This gap is roughly 1/8 of the deviation of GDP from its long-run steady state. In the model, monetary policy is assumed to follow the Taylor rule using the model-based output gap. As a result, the rule prescribes an interest rate cut of one and a quarter percentage points.

Building on our earlier analysis for the case of the U.S. economy, we proceed to use a factor of 1/8 to adjust the output level and growth gaps for supply-side effects of the pandemic.[8] **Figure 11** shows the effect of the adjustments.

Figure 11

Output level and growth gaps adjusted for supply-side effects of the pandemic



Notes: The adjusted gaps equal to one eighth of the original gaps. The calculation of the forecasted values is based on the ECB SPF as well as staff macroeconomic projections and the European Commission's forecasts. The recent revision of the GDP data was also considered for the calculation of the potential GDP. Sources: ECB, European Commission, Eurostat and own calculations.

5. The inflation surge and the Taylor principle

With the new gap series in hand, we proceed to recalculate the policy rule prescriptions up to the current data cutoff and project them forward using ECB staff projections, SPF forecasts and European Commission forecasts. The policy prescriptions from the Taylor rules are shown in **Figure 12**. The Taylor rules called for abolishing the negative policy rate and lifting interest rates towards positive levels already in the summer of 2021 under the assumption of a small positive or

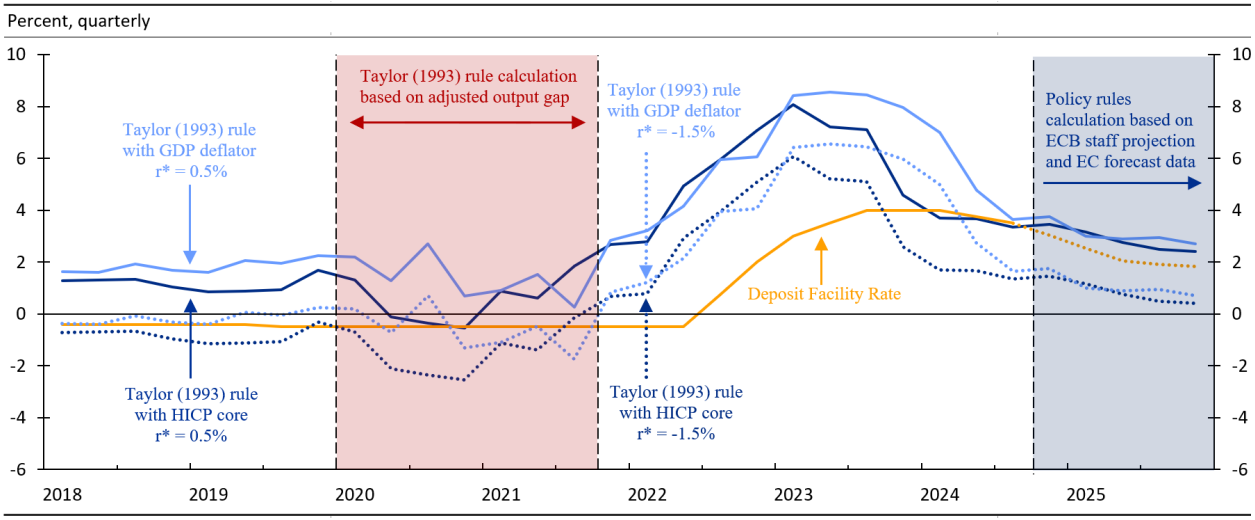
[8] Such an adjustment is also consistent with early research on efficient simple interest rate rules under uncertainty about the output gap. As shown in Smets (2002) output gap uncertainty reduces the efficient response to the estimated output gap relative to inflation in restricted instrument rules such as the Taylor rule.

near zero *r**, which seems most reasonable. Even with the very low *r** of -1.5 and the time lag resulting from the relatively late availability of the GDP deflator data, the Taylor rules recommended policy tightening well ahead of the first ECB policy rate increase from -0.5% to 0% in July 2022. By the fourth quarter of 2021, the Taylor rule prescriptions based on an *r** of 0.5% stood already at 2.7% and 2.8%, using the HICP Core and GDP deflator respectively. Even in the admittedly rather unrealistic case of an equilibrium rate of -1.5%, the rate prescriptions reached 0.7% and 0.8% at that time.

The reason is that the rules incorporate the Taylor principle. According to this principle, the central bank needs to tighten interest rates more than one-for-one with inflation (or inflation expectations) in order to bring inflation back under control. This principle is a key feature of monetary policy in Keynesian and New-Keynesian models, where it is necessary for inflation to settle on the central bank's target.

Figure 12

Policy rate prescriptions from the Taylor rule including projections for 2025



Notes: The adjusted output gaps equal to one eighth of the original gaps. The calculation of the forecasted values is based on the ECB staff macroeconomic projections and the European Commission's forecasts. Since the deflator series are available only with a delay of over two months, for the calculation of the policy rules the GDP deflator series are lagged by one period. The forecasted values for the ECB's Deposit Facility Rate refer to the 1-month Euro Short Term Rate (STR) forward rates which were derived from the Euro STR OIS Rates on September 13, 2024 and refer to the third month in the quarter, respectively. Sources: ECB, European Commission, LSEG/Refinitiv and own calculations.

The tightening implied by the Taylor rules is not driven by energy or food prices. We use the HICP Core inflation, which excludes energy and food, and the GDP deflator, which excludes import prices that also have a substantial energy and food component. Headline HICP inflation stood already at 3% in August of 2021.

If the ECB had responded to the rise of inflation earlier than it did, it could have moved more slowly by spreading the tightening over a longer period. This would have made it easier for the financial sector to adjust to higher interest rates, for example, by allowing banks more time to strengthen their capital and liquidity positions and to account for potential losses due to asset price

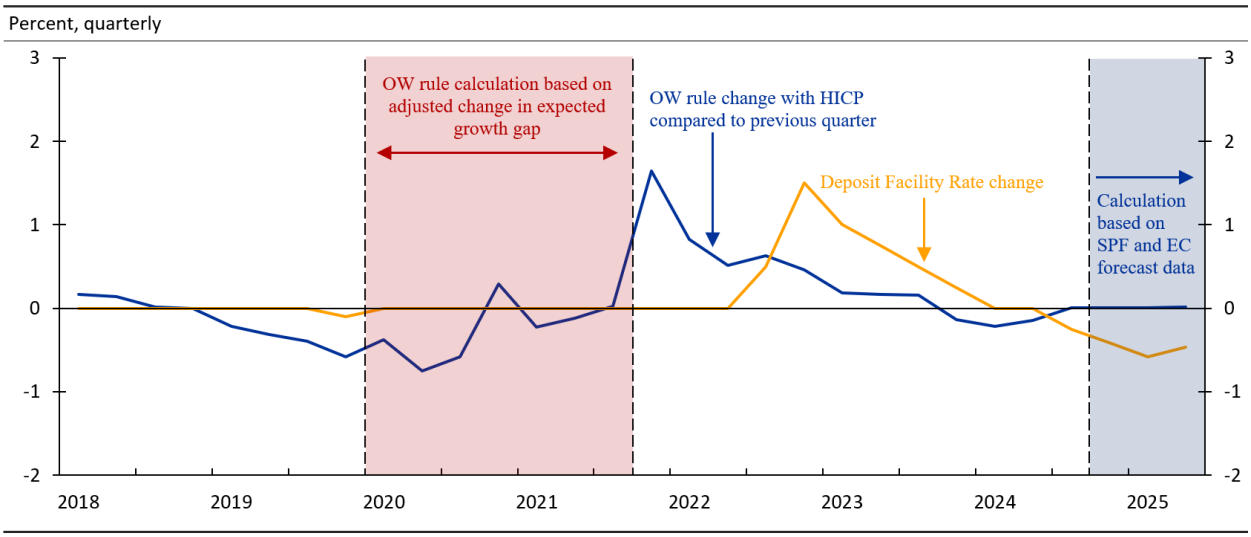
reversals. Furthermore, the ECB would have maintained better control over near-term inflation expectations that moved up during 2021 and 2022.

Throughout 2023 the policy prescriptions have declined substantially along with the decline in inflation. In 2024, they approach the level of the ECB's deposit facility rate from above, first the rule with the HICP Core inflation and then the one based on the GDP deflator, both with an r^* of 0.5%.

Furthermore, the uncertainty about r^* provides a motivation for considering the prescriptions also from the OW rule. These are shown in **Figure 13** together with projections for 2025 that are based on SPF forecasts.

Figure 13

Prescriptions for the change of the policy rate from the OW rule and projections for 2025 based on SPF forecasts



Notes: The adjusted output gaps equal to one eighth of the original gaps. The calculation of the forecasted values is based on the ECB SPF and the European Commission's forecasts. The forecasted values for the change in the ECB's Deposit Facility Rate refer to the change in the 1-month Euro Short Term Rate (STR) forward rates which were derived from the Euro STR OIS Rates on September 13, 2024 and refer to the second month in the quarter, respectively. Sources: ECB, European Commission, LSEG/Refinitiv and own calculations.

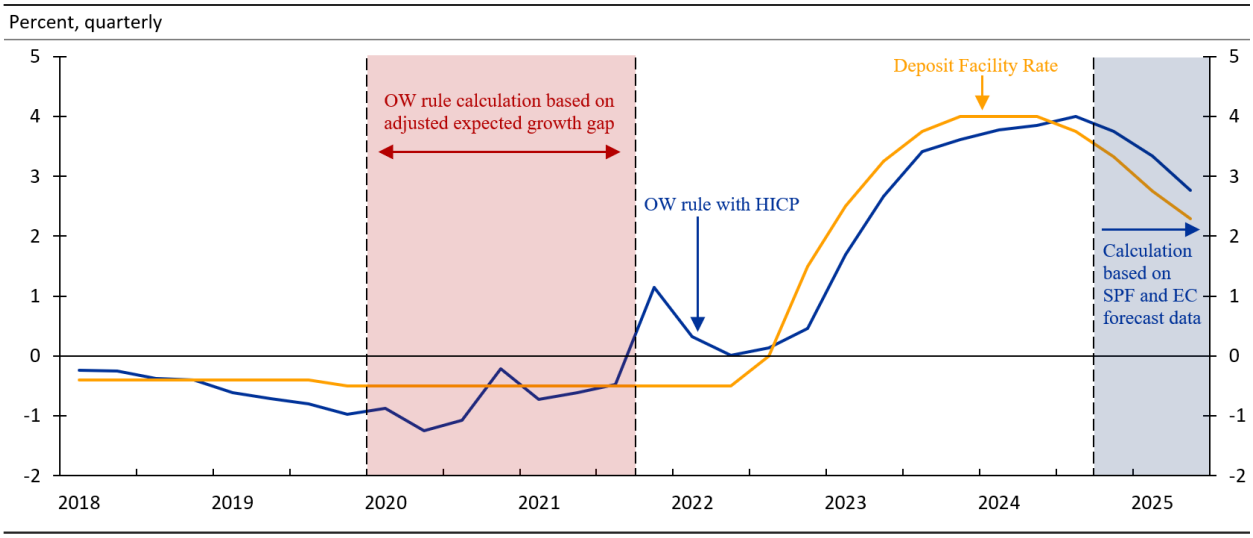
Interestingly, the OW rule also called for a substantial interest rate hike in the fourth quarter of 2021. Yet, this was not a response to higher inflation forecasts, but rather to the expected growth rate which exceeded the forecast of potential growth substantially during the recovery from the pandemic (see **Figure 11**). The SPF inflation forecast 1-year ahead from the most recent data point remained below the target of 2% in 2021 and only started to exceed it in 2022. The predicted inflation gap relative to the target reached a peak of 2.76% in the fourth quarter of 2022 (recall **Figure 9**). As a consequence, the rule prescribes only modest interest rate increases in 2022 and 2023 as shown in **Figure 13**.

The OW rule implements the Taylor principle in expectation. Hence the timeliness of the policy reaction depends on the quality of the forecast. Yet, mean SPF forecasts largely failed to predict the inflation surge of 2021/22 at least at the 1-year horizon. Hence, mean forecasts provided some support for the ECB's long-held conviction that the rise of inflation in 2021 was purely transitory. However, nowcasts and very near-term expectations tended to rise along with data on recent inflation outcomes during that period.

In the end, the ECB executed the interest rate hikes that started in July 2022 more quickly and forcefully than the SPF forecast-based OW rule would have suggested. This finding is also directly apparent from the projections of the level of the policy rate that are shown in **Figure 14**.

Figure 14

Prescriptions for the level of the policy rate from the OW rule and projections for 2025 based on SPF forecasts



Notes: The adjusted output gaps equal to one eighth of the original gaps. The calculation of the forecasted values is based on the ECB SPF and the European Commission's forecasts. The forecasted values for the ECB's Deposit Facility Rate refer to the 1-month Euro Short Term Rate (STR) forward rates which were derived from the Euro STR OIS Rates on September 13, 2024 and refer to the second month in the quarter, respectively. Sources: ECB, European Commission, LSEG/Refinitiv and own calculations.

Forecast-based versus outcome-based policy rules

Clearly, this comparison indicates a potential drawback of policy rules that respond to forecasts like the OW rule versus rules that respond to data on recent macroeconomic outcomes such as the Taylor rules presented below. At the same time, it is a potential advantage of the OW rule that it does not require an estimate of the equilibrium real interest rate due to its form as a first-difference or change rule.

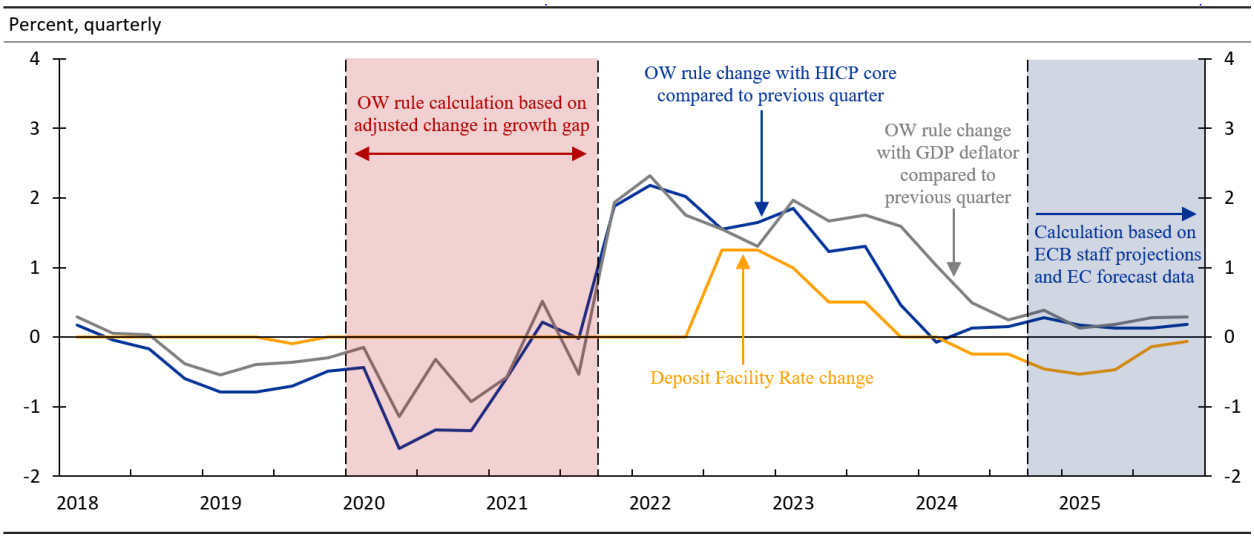
To maintain this advantage but to avoid the application of forecasts at the same time, we compute a version of the OW rule that responds to recent outcomes of inflation deviations from target and GDP growth deviations from potential growth. In fact, the extensive model-based performance and robustness evaluations conducted by Orphanides and Wieland (2013) came to the following conclusion:

> "*Interestingly, a simple difference rule with coefficients of 1/2 on inflation and output growth deviations, just like the rule shown to be useful for interpreting ECB interest rate policy, is quite robust as long as it responds to current outcomes rather than forecasts.*"

In other words, the OW rule with SPF forecasts matched up quite well with actual ECB decisions. However, it did not perform robustly across a range of macroeconomic models because different models imply different forecasts. By contrast, the outcome-based first-difference rule that responds to the most recent observations of inflation and GDP growth performed better in the sense that it delivered better outcomes in terms of output and inflation stabilization, on average, across a range of quite different yet empirically estimated models of the euro area economy. The interest-rate prescriptions from such an outcome-based OW/first-difference rule during the pandemic and the subsequent surge of inflation are shown in **Figure 15** in change form and in **Figure 16** in levels form.

Figure 15

Prescriptions for the change of the policy rate from an outcome-based OW rule

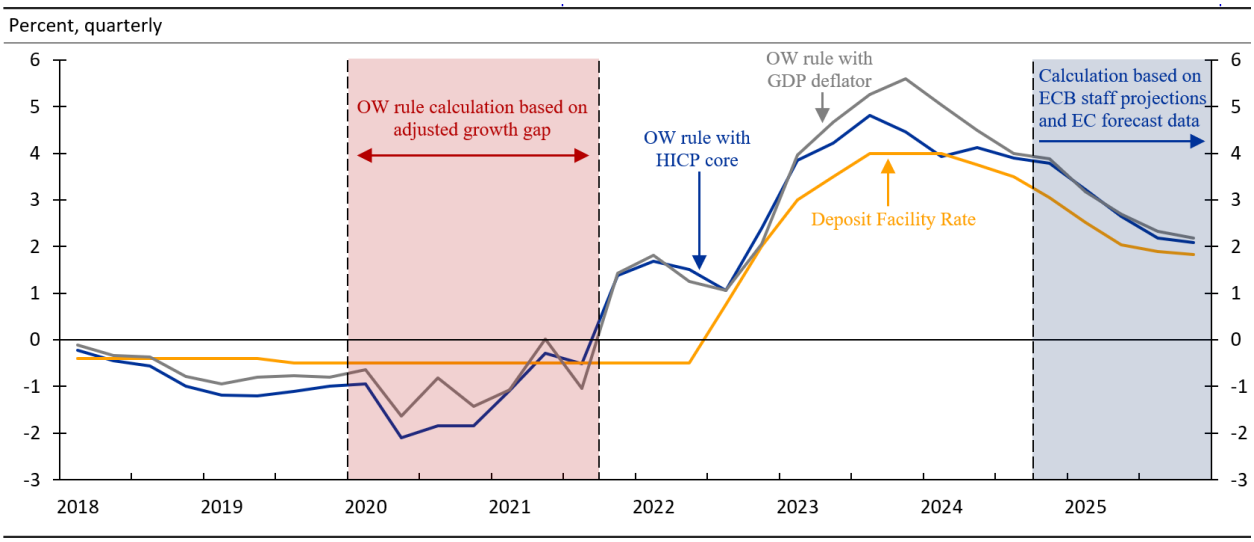


Notes: The adjusted output gaps equal to one eighth of the original gaps. The calculation of the forecasted values is based on the ECB staff macroeconomic projections and the European Commission's forecasts. Since the deflator series are available only with a delay of over two months, for the calculation of the policy rules the GDP deflator series are lagged by one period. The forecasted values for the ECB's Deposit Facility Rate refer to the 1-month Euro Short Term Rate (STR) forward rates which were derived from the Euro STR OIS Rates on September 13, 2024 and refer to the third month in the quarter, respectively. Sources: ECB, European Commission, Eurostat, LSEG/Refinitiv and own calculations.

We calculate two versions of the outcome-based first difference rule using the HICP Core and the GDP deflator measures for inflation just like in the euro area applications of the Taylor (1993) rule. The two versions deliver fairly similar implications. The outcome-based rules call for tightening policy well ahead of the policy tightening executed by the ECB starting in the second half of 2022. Interestingly the outcome-based policy rules keep a somewhat hawkish tilt throughout 2023 and 2024.

Figure 16

Prescriptions for the level of the policy rate from the outcome-based OW rule



Notes: The adjusted output gaps equal to one eighth of the original gaps. The calculation of the forecasted values is based on the ECB macroeconomic projections and the European Commission's forecasts. Since the deflator series are available only with a delay of over two months, for the calculation of the policy rules the GDP deflator series are lagged by one period. The forecasted values for the ECB's Deposit Facility Rate refer to the 1-month Euro Short Term Rate (STR) forward rates which were derived from the Euro STR OIS Rates on September 13, 2024 and refer to the third month in the quarter, respectively. Sources: ECB, European Commission, Eurostat, LSEG/Refinitiv and own calculations.

How to proceed with interest rate cuts?

Table 1 reports the numbers for the interest rate prescriptions and projections from 2024 to 2025. From the perspective of the Taylor rules, a case can be made in support of the two policy rate cuts in June and September 2024. However, projecting the rules forward using ECB staff projections, the policy prescriptions decline quite a bit more slowly than market expectations.

Even so, the prescriptions depend importantly on the estimated r^*. Current estimates reported by the ECB have risen above our upper bound of 0.5%. Thus, there is good reason to move more slowly in terms of removing policy restrictiveness, so as to avoid reaching a neutral or expansionary policy stance too soon.

The OW rules, which do not rely on r^* estimates, do not support the ECB rate cuts of June and September. This is primarily because recent HICP Core and GDP deflator outcomes as well as

SPF inflation forecasts are not yet below the 2% target. Projections of the OW rule prescriptions for 2025 also decline more slowly than forecasts based on traded financial derivates.

Table 1

Projections of policy rule prescriptions for 2024 and 2025

	Policy Rule	2024		2025			
		Q3	Q4	Q1	Q2	Q3	Q4
r^{LR} = 0.5%	Taylor (1993) rule with HICP Core inflation	3.4	3.5	3.2	2.8	2.5	2.4
	Taylor (1993) rule with GDP deflator	3.6	3.8	3.0	2.9	2.9	2.7
	Orphanides-Wieland (OW) rule with SPF forecasts	4.0	3.8	3.3	2.8		
	Outcome-based OW rule with HICP Core inflation	3.9	3.8	3.2	2.6	2.2	2.1
	Outcome-based OW rule with GDP deflator	4.0	3.9	3.2	2.7	2.3	2.2
	1m Euro STR forward rates	**3.5**	**3.0**	**2.5**	**2.0**	**1.9**	**1.8**

Notes: The table summarizes the forecasted values from the different policy rule calculations. The projections for the Taylor rules and the outcome-based OW rules are calculated on the basis of ECB staff projections for HICP Core and GDP deflator inflation as well as real GDP growth. The 1-month Euro Short Term Rate (STR) forward rates were derived from the Euro STR OIS Rates on September 13, 2024 and refer to the third month in the quarter, respectively. Sources: LSEG/Refinitiv and own calculations.

6. Conclusions

Our comparison of policy rules and ECB interest rate decisions before and during the recent rise of inflation shows that standard simple policy rules provided advance warning of the need for policy tightening well ahead of the increase in policy rates implemented by the ECB. This finding holds for policy rules that respond to recent outcomes for inflation and GDP data. It results from the so-called Taylor principle that calls for changing policy rates more than one for one in responses to changes in inflation rates.

The results do not depend on policy rules responding directly and immediately to energy price hikes that are embodied in headline consumer price data. Rather, we focus on HICP Core inflation and the GDP deflator as the broadest measure of domestic inflation. In that case, the rules respond to rising prices of imported energy only when demand conditions allow domestic producers of goods and services to succeed in passing on cost increases to their customers.

The Taylor rules depend importantly on estimates of the unobserved longer-run equilibrium real interest rate r^* that is highly uncertain. For this reason, we consider a range of r^* estimates and

we compare prescriptions from the Taylor rule to those of a first-difference rule that does not require an estimate of r^*, that is, the so-called the Orphanides-Wieland rule.

Interestingly, the OW rule that relies on one-year ahead forecasts of inflation and output growth from the ECB's Survey of Professional Forecasters did not provide advance warning of the rise of inflation because the mean forecasts consistently underestimated the rise and persistence of inflation. Yet, outcome based versions of the OW rule that use the HICP Core and the GDP deflator, did call for tighter policy well ahead of the ECB's policy tightening. Such outcome-based rules performed more robustly in the model-based policy evaluation of Orphanides and Wieland (2013) but did not match up as well with past ECB decisions. From these findings, we conclude that such simple outcome-based policy rules deserve more attention in the ECB's monetary policy strategy.

As inflation has come down substantially in 2023 and 2024, the prescriptions from the Taylor and OW rules have also declined. As of the third quarter of 2023 the Taylor rule prescriptions have declined below the level of the ECB's deposit facility rate of 4% that prevailed till June 2024. Thus, they provide some support for the ECB policy rate cuts administered in June and September. Looking forward, however, the prescriptions from the policy rules decline more slowly than the market-based interest rate forecasts, thereby adding a note of caution to the debate on the further path of monetary policy.

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