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Forecasting ECB Policy Rates with Different Monetary Policy Rules

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Abstract

This article compares two types of monetary policy rules – the Taylor-Rule and the Orphanides-Rule – with respect to their forecasting properties for the European Central Bank. In this respect the basic rules, results from estimates models and augmented rules are compared. Using quarterly real-time data from 1999 to the beginning of 2019, we find that an estimated Orphanides-Rule performs best in nowcasts, while it is outperformed by an augmented Taylor-Rule when it comes to forecasts. However, also a no-change rule delivers good results for forecasts, which is hard to beat for most policy rules.

1. Introduction

Understanding the interest rate setting behavior of central banks is important for market participants and the central bank alike. For the prior valuable insights about the future interest rate path could be gained, while for the latter a good communicated strategy could prevent market surprises being a possible source of financial turmoil. One easy and therefore often applied way is to analyze how a central bank sets its interest rate via simple monetary policy rules. The certainly most famous rule in this respect is the so-called Taylor-Rule (Taylor, 1993).

The rumors about central bank interest rate predictability increased as the European Central Bank (ECB) introduced its forward guidance in July 2013 stating that it expects its policy rate to "remain at present or lower levels for an extended period of time" (Draghi, 2013). Later ECB-president Mario Draghi stated: "We want to be clear […] about our assessment of the inflation outlook over the medium term, and about our "reaction function". We want markets to see our reaction function linked in time to the outlook for price stability." (Draghi, 2013a). So several researchers once more tried to deduct some kind of reaction function for the ECB.[1] One of these reaction functions is the Orphanides-Rule (Orphanides, 2003) which tries to explain the change of the policy rate in contrast to the Taylor-Rule which tackles the level of the policy rate. The Orphanides-Rule gained importance as members of the ECB mention it as describing their interest rate setting behavior as remarkable well in one of their publications (Hartmann and Smets, 2018).

Therefore, we will systematically evaluate the now- and forecasting properties of different versions of the Orphanides- and the Taylor-Rule in this article. The

[1] In fact, finding an ECB reaction function is all but new. Several authors have estimated ECB policy reaction functions. See e.g. Gerdesmeier and Roffia (2004), Gerdesmeier and Roffia (2005), Sauer and Sturm (2007), Gorter et al. (2008), Belke and Klose (2011), Klose (2014) or Klose (2016).

properties of those rules will be evaluated against the rule of no change in the policy rate. To the best of our knowledge we are the first to systematically compute the forecasting properties of various monetary policy rules for the ECB. So we will be able to show which rule provides the best forecasts for differing forecasting horizons.
The paper proceeds as follows: Section 2 introduces the two basic rules – the Orphanides- and Taylor-Rule – and its extensions tested in this article. Section 3 describes the data used, while section 4 presents the results. In section 5 the now- and forecasting properties of the various rules will be presented, while section 6 finally concludes.

2. Orphanides- Versus Taylor-Rules

The Orphanides- and the Taylor-Rule are two of the most common monetary policy rules. Their major advantage is that they are quite easy to apply since for both rules only a few variables are needed. In this section we will discuss both rules and possible extensions of them applied in our empirical section.

The Orphanides-Rule dates back to Orphanides (2003) who shows that the rule tracks the interest rate changes of US Federal Reserve rather well since the 1980s. Meanwhile this rule has also been applied to the ECB (Orphanides and Wieland, 2013; Bletzinger and Wieland, 2016; Bletzinger and Wieland, 2017 or Hartmann and Smets, 2018). The Orphanides-Rule can be written as follows:

$$i_t - i_{t-1} = 0.5(\pi_{t+j} - \pi^*) + 0.5(\Delta y_{t+j} - \Delta y^*_{t+j}) \tag{1}$$

The rule tries to predict the changes in the ECB policy rate ($i_t - i_{t-1}$). To do so two deviations are needed: First, the deviation of the inflation rate from its target ($\pi_t - \pi^*$) and second, the deviation of real economic growth from potential growth ($\Delta y_t - \Delta y^*_t$). Moreover, for the inflation rate, real growth and potential growth forecasts are used. The index j indicates the forecast horizon used in Orphanides-Rule. In line with the literature for the ECB mentioned above we will also use one year ahead forecasts in the nowcast rule. Please note that no time index is needed in the case of the inflation target since it is always close to but below two percent in the medium term, in line with the ECB's price stability definition. The reaction coefficients of the inflation and growth deviations are assumed to be 0.5 each.

Simple rearrangement of equation (1) alters the rule predicting the change in the interest rate to a level rule predicting the level of the key interest rate:

$$i_t = i_{t-1} + 0.5(\pi_{t+j} - \pi^*) + 0.5(\Delta y_{t+j} - \Delta y^*_{t+j}) \tag{1a}$$

Thus, the level Orphanides-Rule takes always the past interest rate as given while any changes to this rate stem from the deviations in inflation or growth. Equation (1a) will thus be our first rule tested in the empirical part.

However, the reaction coefficients in Orphanides-Rule can also be estimated. This will be our second strategy:

$$i_t = i_{t-1} + \alpha_\pi(\pi_{t+j} - \pi^*) + \alpha_y(\Delta y_{t+j} - \Delta y^*_{t+j}) \tag{2}$$

By contrast the Taylor-Rule is a level rule in itself. The level of the Taylor-Rule is determined primarily by the equilibrium real interest rate - Taylor (1993) set this variable equal to two percent - and the current inflation rate. Moreover, the deviation of the current inflation rate from the central bank target and the current output gap determine the policy rate.[2] Each of those two is expected - in line with Taylor (1993) - to have a reaction coefficient of 0.5.

$$i_t = 2 + \pi_t + 0.5(\pi_t - \pi^*) + 0.5(y_t - y_t^*) \tag{3}$$

Simple rearrangement of equation (3) leads to:

$$i_t = 2 - 0.5\,\pi^* + 1.5\,\pi_t + 0.5(y_t - y_t^*) \tag{3a}$$

In this equation the Taylor principle becomes evident; this means that with a rise in inflation the nominal policy rate is increased even further to increase the real rate and vice versa.

However, the basic Taylor-Rule has been extended in several respects. We will therefore implement also versions of augmented Taylor-Rules. First, Taylor-Rules are modified to incorporate an interest rate smoothing term, mimicking the gradual adjustment of policy rates by central banks. Several studies find that this interest rate smoothing term is rather high for the ECB (see e.g. Carstensen and Colaveccio, 2004; Gerdesmeier and Roffia, 2005; Sauer and Sturm, 2007, Gorter et al., 2008 or Belke and Klose, 2011). As an empirical strategy we set the smoothing parameter equal to 0.97, meaning 97 percent of the current policy rate is determined by the past policy rate and only three percent are influenced by the Taylor-Rule.

$$i_t = 0.97\,i_{t-1} + (1 - 0.97)[2 - 0.5\,\pi^* + 1.5\,\pi_t + 0.5(y_t - y_t^*)] \tag{4}$$

The second extension concerns the equilibrium real interest rate. Several studies have shown that this unobservable variable is by no means constant in the Euro area or its member countries.[3] Thus the equilibrium real interest rate (r_t^*) is modelled as a time-varying variable. How this time variation is generated will be explained in the next section.

$$i_t = r_t^* - 0.5\,\pi^* + 1.5\,\pi_t + 0.5(y_t - y_t^*) \tag{5}$$

As an additional extension the modified versions of equations (4) and (5) are evaluated simultaneously in one equation:

[2] Please note that the Taylor-Rule in its basic formulation uses current values of inflation and the output gap instead of forecasts as in the Orphanides-Rule. However, the Taylor-Rule has also been modified in a forward-looking manner, i.e. taking forecast of inflation and output instead of current variables. E.g. Gerdesmeier and Roffia (2004), Sauer and Sturm (2007), Gorter et al. (2008) or Belke and Klose (2011) have done so with respect to the ECB-reaction function. However, we will use the basic Taylor-Rule with current data in our analysis to keep the spirit of the original Taylor-Rule.

[3] See e.g. Mesonnier and Rennes, 2007; Garnier and Wihelmsen, 2009; Holsten et al, 2017; Belke and Klose, 2017 or Belke and Klose, 2019. See also Belke and Klose (2011) or Belke and Klose (2013) for an application of time-varying equilibrium real interest rates in a Taylor-Rule framework.

$$i_t = 0.97\, i_{t-1} + (1 - 0.97)[r_t^* - 0.5\, \pi^* + 1.5\, \pi_t + 0.5(y_t - y_t^*)] \tag{6}$$

Finally, as for the Orphanides-Rule also for the Taylor-Rule we present estimated versions of the equations (3a) to (6).

$$i_t = c - (\beta_\pi - 1)\, \pi^* + \beta_\pi\, \pi_t + \beta_y(y_t - y_t^*) \tag{7}$$

$$i_t = \gamma\, i_{t-1} + (1 - \gamma)[c - (\beta_\pi - 1)\, \pi^* + \beta_\pi\, \pi_t + \beta_y(y_t - y_t^*)] \tag{8}$$

$$i_t = r_t^* - (\beta_\pi - 1)\, \pi^* + \beta_\pi\, \pi_t + \beta_y(y_t - y_t^*) \tag{9}$$

$$i_t = \gamma\, i_{t-1} + (1 - \gamma)[r_t^* - (\beta_\pi - 1)\, \pi^* + \beta_\pi\, \pi_t + \beta_y(y_t - y_t^*)] \tag{10}$$

Please note that in these estimated Taylor-Rules not only the reaction coefficients towards inflation and the output gap are estimated but also the interest rate smoothing term (γ) and the time invariant equilibrium real interest rate (c) whenever applicable. The latter can be interpreted as the estimated average equilibrium real interest rate in the Euro area. Moreover, we decided to present only the results for the estimated Taylor-Rules when modelled with a time-varying equilibrium real interest rate (equations (9) and (10)) but not those with the values set by Taylor (1993) (equations (5) and (6)). This is simply due to the reason that estimated rules perform generally a bit better in now- and forecasts as we will also see in section 5 and we do not want to compare to many different specifications.

3. Data

In order to model the interest rate setting decision of the ECB correctly we strictly rely on real-time data (Orphanides, 2001), i.e. those data the ECB governing council had at hand in each point in time.

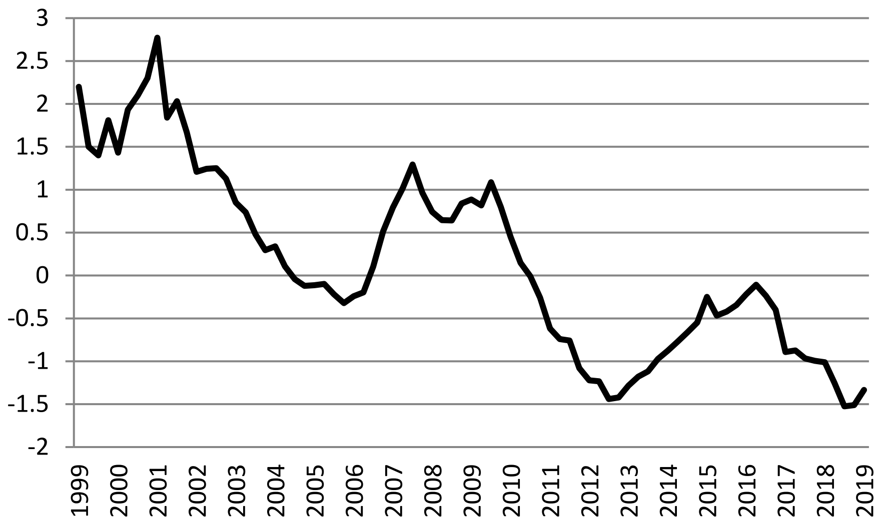
We use quarterly data from 1999Q1 – the first quarter the ECB was responsible for monetary policy in the Euro area – to 2019Q1. The end of the sample is chosen due to data availability. Since it is well-known that especially real-time estimates of potential output and thus the output gap are unreliable, we decided to rely on publicly available data throughout our analysis. This is with respect to the inflation and real economic growth forecasts needed in the Orphanides-Rule the one year ahead forecast of the respective variables given by the ECB Survey of Professional Forecasters (SPF).[4] Please note that this does effectively correspond to a three quarter forecast for the inflation deviation and two quarters for output growth deviations due to the different timing in the releases of both variables (Bletzinger and Wieland, 2017). With respect to potential output growth we take the data from Macro-economic database AMECO from the European Commission. Since those data are only available on a yearly frequency, a linear interpolation has been applied to match the respective quarters. Moreover, the AMECO database is only updated twice a year, so the real-time data of one vintage are always used for two quarters.

[4] Another possible source of forecasts would be the ECB staff forecasts. However, Bletzinger and Wieland (2017) show that these kinds of forecasts do not improve the empirical fit in an Orphanides-Rule but that SPF forecasts tend to perform better, possibly due to constant horizon of the forecasts.

With respect to the Taylor-Rule specifications we use the current inflation rate which is the same ex-post and in real-time since inflation rates get hardly ever revised and are timely available. For the output gap we again rely on the AMECO database and make the very same adjustments as for the potential output.

The equilibrium real interest rate remains, however, an unobservable variable. We model it in the possibly simplest way by building the real rate as the deviation of the actual interest rate and the inflation rate ($r_t = i_t - \pi_t$) and applying the Hodrick-Prescott filter (Hodrick and Prescott, 1997) with a smoothing parameter of 1600 to it.[5] To circumvent the well-known end of sample bias in the Hodrick-Prescott filter the series are extended by a four quarter forecast based on AR(2)-process. The equilibrium real rate is finally constructed using the current rate of the filtered series for each vintage. Figure 1 shows the time-varying equilibrium real rate resulting from this procedure. The result is well in line with other studies in this field, i.e. we also find the declining trend in the equilibrium real rate from about two percent in 1999 to levels below zero as a result of the financial crisis.

Figure 1 Real-Time Equilibrium Real Interest Rate



As the relevant policy rate, we take the main refinancing rate of the ECB. For every quarter we use the rate of the second month to match the releases of the SPF and AMECO best.

Finally, the inflation target is set to 1.75 in line with the ECB price stability definition of inflation rates below but close to two percent in the medium term. However, to be comparable to other studies of the Orphanides-Rule (Orphanides and

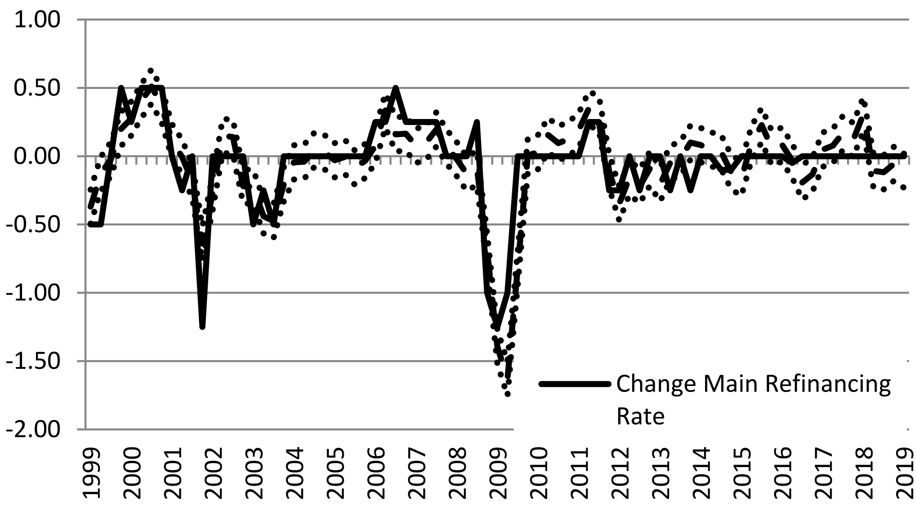
[5] It may be argued that this building of the real rate does not correspond with real-time data since i_t is the policy rate the ECB sets after applying the policy rules. However, since the ECB is free to choose its policy rate it can also estimate rules with varying equilibrium real rates based on different policy rates. What we observe as a public is finally the preferable policy rate from the view of the ECB.

Wieland, 2013; Bletzinger and Wieland, 2016; Bletzinger and Wieland, 2017 or Hartmann and Smets, 2018) we also present results for an upper and lower bound of the inflation target being two and 1.5 percent, respectively. But Bletzinger and Wieland (2017) or Hartmann and Smets (2018) show that an inflation target of 1.75 is actually a good approximation, since they estimate the inflation target to be 1.72-1.79 or 1.76, respectively. Our inflation target is moreover well in line with the empirical findings of Paloviita et al. (2017) who estimate the target to be between 1.6 and 1.8 or Kočenda and Varga (2018), Brož and Kočenda (2018) who use an inflation target of 1.75 in their research.

4. Results

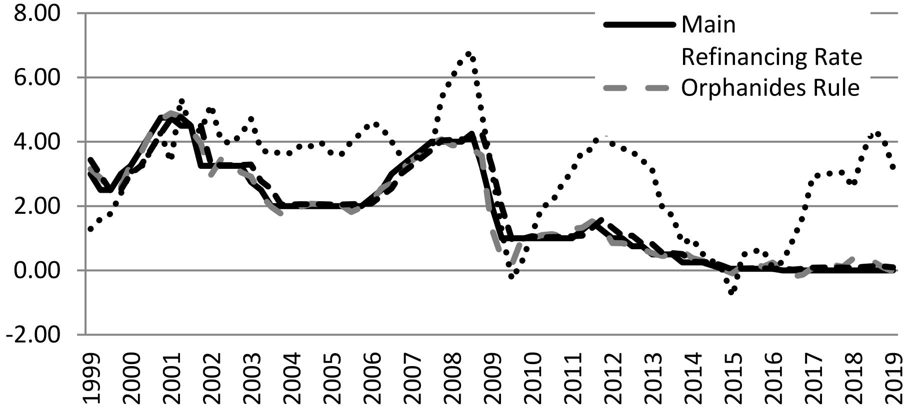
In this section we will present the results for our various Orphanides- and Taylor-Rule specifications. Starting with the basic Orphanides-Rule (equation 1), it is evident that this rule tracks the changes in the ECB policy rate quite well (Figure 2). In almost all cases the actual changes of the main refinancing rate lie within the band of the Orphanides-Rule which is given by the upper- and lower bound of the inflation target with two and 1.5 percent.

Figure 2 Orphanides-Rule



Thus, when translating the Orphanides-Rule into a level rule (equation (1a)), it does not come as a surprise that this rule remains very good in the sense of mimicking the main refinancing rate quite closely (Figure 3). However, also our smoothed version of the Taylor-Rule with a smoothing coefficient of 0.97 (equation (4)) corresponds closely to the actual main refinancing rate. Only with respect to the basic Taylor-Rule we find larger deviations from the policy rate. In fact those deviations are mainly upward deviations meaning the actual interest rate is lower than the rate proposed by the Taylor-Rule. This holds for the periods 2001-2008, 2011-2013 and from 2017 until the end of the sample period. So if you believe that the Taylor-Rule signals "good" monetary policy, the ECB set its interest rate in these periods systematically too low, thus potentially triggering an overheating of the economy.

Figure 3 Orphanides- and Taylor-Rules



Notes: Reaction coefficients in rules always 0.5 and inflation target 1.75 percent. Interest rate smoothing in Smoothed Taylor-Rule equals 0.97.

The results for the various estimated Orphanides- and Taylor-Rules are presented in Table 1. All rules are estimated using OLS. Except for the basic Taylor-Rule all regressions appear to have a rather good fit. The best fit signaled by the adjusted R^2 is given by the estimated Orphanides-Rule. When it comes to the coefficients in the Orphanides-Rule the responses tend to be a bit lower than the originally proposed 0.5. However, only for the real growth deviation the reaction coefficient is estimated to be significantly below 0.5. Bletzinger and Wieland (2017) find quite similar coefficients in their analysis.

With respect to the Taylor-Rule specifications it is astonishing that the Taylor-principle of a reaction coefficient exceeding unity does not seem to hold.[6] But please note that Gerdesmeier and Roffia (2005), Sauer and Sturm (2007), Belke and Klose (2011) come up with the same result when estimating contemporaneous Taylor-Rules with real-time data. Moreover, the output reaction seems to be lower than the originally proposed 0.5, becoming even insignificant when adding an interest rate smoothing term and a time-varying equilibrium real interest rate.

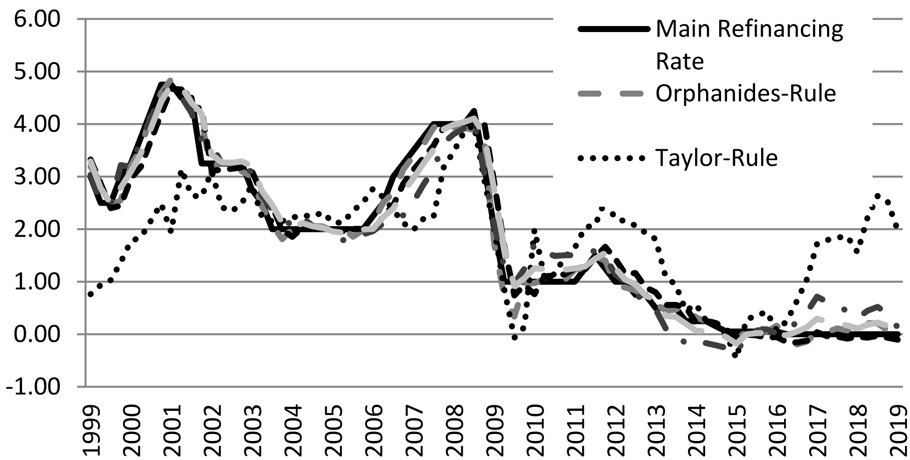
[6] Inference cannot be drawn from the Taylor-Rule incorporating only an interest rate smoothing term because in this case the smoothing parameter is with 0.96 too high to estimate significant coefficients for the inflation and output response. Therefore, our interpretation is based on the three other Taylor-Rule specifications.

Table 1 Results from Estimated Rules

	OR	*TR*	*TR Smoothed*	*TR VEQR*	*TR VEQR Smoothed*	*OR*
i_{t-1}			0.96*** (0.03)		0.60*** (0.07)	
Constant		0.54** (0.22)	-3.33 (3.28)			
$\pi_{t+3} - \pi^*$	0.46*** (0.07)					0.46*** (0.07)
π_t		0.83*** (0.16)	3.13 (2.02)	0.82*** (0.05)	0.91*** (0.09)	
$\Delta y_{t+2} - \Delta y^*_{t+2}$	0.38*** (0.03)					0.38*** (0.03)
$y_t - y^*_t$		0.35** (0.13)	-1.79 (1.85)	0.07*** (0.03)	0.05 (0.05)	
$adj.R^2$	0.98	0.39	0.96	0.94	0.97	0.98

Notes: OLS estimates; OR=Orphanides-Rule, TR=Taylor-Rule, VEQR=varying equilibrium real interest rate; sample period: 1999Q1-2019Q1, standard errors in parenthesis, ***/**/* signal significance at the 99%/95%/90% level.

Figure 4 Estimated Orphanides- and Taylor-Rules



Notes: Reaction coefficients based on the results of Table 1 and inflation target 1.75 percent.

When it comes to the equilibrium real interest rate, we see in the estimated Taylor-Rule that the proposed level of two percent is systematically too high. The estimated value of the constant, signaling the average level of the equilibrium real interest rate throughout the sample period, is with 0.54 significantly lower. This does not come as a surprise given that we have seen several periods of substantial overshooting in the Taylor interest rate when applying the basic Taylor-Rule. In general, adding our measure of a time-varying equilibrium real interest rate improves the fit of the regression. Moreover, it substantially reduces the interest rate smoothing parameter, thus the Taylor-Rule becomes a higher weight in interest rate settings. Thus, it has to be concluded that this kind of augmented Taylor-Rule performs better than others in the sense of describing the actual interest rate setting of the ECB. This can also be seen in Figure 4 where the estimated Orphanides- and Taylor-Rules are benchmarked against the actual main refinancing rate.

5. Now- and Forecasting

Since we have seen the results for several Orphanides- and Taylor-Rules in the previous section we now want to find out which rule performs best in predicting the current (a so-called nowcast) and future policy rate. We have seen that the fit of an estimated Orphanides-Rule is the highest among the estimated rules. Thus, it can be expected that this rule performs best in the nowcast. However, this does not necessarily imply that this rule is also superior when it comes to forecasts. Therefore, we will test whether is the case or not.

To apply forecasts, we use the data of the SPF because this survey does not only publish one year ahead forecasts of the inflation rate and real growth but also two year ahead forecasts.[7] This enables us to perform forecasts for four quarters, thus one year into the future. Therefore, our Orphanides- and Taylor-Rules presented in section 2 change to:[8]

$$i_{t+k} = i_{t+k-1} + \alpha_\pi(\pi_{t+j+k} - \pi^*) + \alpha_y(\Delta y_{t+j+k} - \Delta y^*_{t+j+k}) \quad (11)$$

$$i_{t+k} = c - (\beta_\pi - 1)\,\pi^* + \beta_\pi\,\pi_{t+k} + \beta_y(y_{t+k} - y^*_{t+k}) \quad (12)$$

$$i_{t+k} = \gamma\, i_{t+k-1} + (1-\gamma)[c - (\beta_\pi - 1)\,\pi^* + \beta_\pi\,\pi_{t+k} + \beta_y(y_{t+k} - y^*_{t+k})] \quad (13)$$

$$i_{t+k} = r^*_{t+k} - (\beta_\pi - 1)\,\pi^* + \beta_\pi\,\pi_{t+k} + \beta_y(y_{t+k} - y^*_{t+k}) \quad (14)$$

$$i_{t+k} = \gamma\, i_{t+k-1} + (1-\gamma)[r^*_{t+k} - (\beta_\pi - 1)\,\pi^* + \beta_\pi\,\pi_{t+k} + \beta_y(y_{t+k} - y^*_{t+k})] \quad (15)$$

In this case k signals the forecast horizon and can take values between 0 and 4. When $k = 0$, i.e. the nowcast estimates, the rules collapse to those in section two. For all other k we use the forecasts of the corresponding vintages of the SPF and AMECO as described in section 2 if necessary, using linear interpolation to match the respective quarters. For the time-varying equilibrium real interest rates we use the Hodrick-Prescott-filtered results of our forecast of the real rate for every vintage.

[7] The SPF publishes also five year ahead forecasts of inflation and real growth. This would in principle enable us to lengthen the forecasting period even further. However, the limiting factor here is the availability of potential output growth which is taken from AMECO and does not range five years into the future. Moreover, linear interpolation for a three-year period (between five and two year ahead values) would possibly be a quiet tough assumption to make.

[8] Please note that we only present the equations for the estimated rules here. But the same procedure is also applied for the rules with predefined reaction coefficients.

Table 2 Now- and Forecast Results

	OR			*Est. OR*			*TR*			*Est. TR*			*TR Sm (0.97)*			*Est. TR Sm*			*Est. TR VEQR*			*Est. TR VEQR SM*			*No-change*		
	ME	**MAE**	**MSE**	**ME**	**MAE**	**MSE**	**ME**	**MAE**	**MSE**	**ME**	**MAE**	**MSE**	**ME**	**MAE**	**MSE**	**ME**	**MAE**	**MSE**	**ME**	**MAE**	**MSE**	**ME**	**MAE**	**MSE**	**ME**	**MAE**	**MSE**
t	-0.0002	0.1612	0.0525	0.0003	0.1378	0.0394	1.2446	1.5056	3.3522	0.0164	0.8935	1.3478	0.0800	0.1961	0.1060	-0.0026	0.2069	0.0896	0.0063	0.2788	0.1383	0.0356	0.1978	0.0741	-0.0432	0.1667	0.1044
t+1	0.0945	0.3688	0.2300	0.0843	0.3506	0.2366	1.2491	1.5221	3.2291	0.0190	0.9432	1.4483	0.1518	0.3678	0.3172	0.0323	0.4922	0.4908	-0.0019	0.3810	0.2278	0.0749	0.4010	0.3250	0.0802	0.3148	0.3064
t+2	0.2376	0.6143	0.5991	0.2060	0.5836	0.6007	1.2577	1.5379	3.2808	0.0367	1.0333	1.6643	0.2156	0.5109	0.5798	0.0588	0.7171	0.9524	-0.0138	0.5119	0.4149	0.0882	0.5323	0.5635	0.1111	0.4383	0.5469
t+3	0.4307	0.8706	1.1373	0.3684	0.8255	1.0897	1.2447	1.5172	3.3672	0.0462	1.1036	1.8087	0.2771	0.6499	0.8424	0.0804	0.8830	1.3277	-0.0233	0.6503	0.6737	0.0473	0.6667	0.7944	0.1420	0.5556	0.7880
t+4	0.7303	1.1802	1.9609	0.6096	1.0797	1.7594	1.2664	1.5402	3.5181	0.0785	1.1670	1.9575	0.3433	0.7803	1.1005	0.1029	1.0096	1.5750	-0.0252	0.7905	0.9487	0.0679	0.7640	0.9652	0.1790	0.6667	1.0251

Notes: OR=Orphanides-Rule, TR=Taylor-Rule, Est.=estimated coefficients, Sm=smoothed rule, VEQR=varying equilibrium real interest rate, ME=mean error, MAE=mean absolute error, MSE=mean square error.

We will test our policy rules against the benchmark of a no-change rule, thus assuming that the best forecast for the current or future interest rate is the interest rate last observed:

$$i_{t+k} = i_{t+k-1} \qquad (16)$$

When comparing the goodness of fit of the various rules, we make use of three concepts: First, the mean error (ME) showing the average forecast error of each rule. With this indicator it can be shown whether there is a systematically positive or negative bias in the now- or forecasts. Second, the mean absolute error (MAE), thus the average of the errors in absolute terms. Third, the mean squared error (MSE), which does in contrast to the MAE put a larger weight on larger deviations. The results for the various policy rules and forecast horizons can be found in Table 2:

Several important results can be drawn from Table 2: First, not surprisingly errors in the nowcast tend to be lowest among the different rules. The errors are increasing with the forecast horizon thus being highest for the four quarter ahead forecasts. The only exception is to some extent the basic Taylor-Rule but here the errors are generally found to be highest for all forecast horizons. This is exactly what we would have expected given the substantial upward bias in this rule as presented in Figure 2, due to the high value of the equilibrium real interest rate.

Second, in the Orphanides-Rule there tends to be an upward bias as well as to some extent in the Taylor-Rule with 0.97 interest rate smoothing and the no-change rule. In these cases, the ME increases with the forecast horizon, meaning that the rules predict too high rates in the future. This upward bias is most pronounced in the basic Orphanides-Rule where the ME four quarters ahead is about 0.73 thus the rule predicts the policy rate to be on average 73 basis points above the actual value realized four quarters thereafter.

Third, the Orphanides-Rule performs best in the nowcast. For neither the basic rule nor for the estimated rule there is a substantial bias as signaled by the ME. Moreover, both rules are found to have the lowest MAE and MSE with the estimated Orphanides-Rule performing a bit better in both categories.[9]

Fourth, while the Orphanides-Rule performs good in nowcasts, its accuracy diminishes substantially in forecasts, thus all other rules except the basic and estimated Taylor-Rule deliver better forecasts as the Orphanides-Rule at least for longer forecasts horizons. So it is found that the MAE and MSE for the Taylor-Rule with a smoothing parameter of 0.97, both Taylor-Rules with a time-varying equilibrium real interest rate and the no-change rule are lower for two quarter forecasts and above, while this holds for the estimated Taylor-Rule with interest rate smoothing only for the four quarter ahead forecast. The reason for this result is quite simple: While the Orphanides-Rule rests more than the other rules on the observed interest rate in the previous period, it performs worse if the forecasts have to be built for these periods, since there is an upward bias. So what is the advantage of the Orphanides-Rule when it comes to

[9] It is quite generally found that estimated policy rules perform better than those with reaction coefficients set. The only exception is the Taylor-Rule with only an interest rate smoothing term. This is, however, due to the rather imprecise reaction coefficients to inflation and output in the estimated rule.

nowcasts is the disadvantage when forecasts are applied, since the level of the rule gets pushed upwards with the forecast horizon.

Fifth, for the one quarter ahead forecast several rules perform almost equally well. Those are the two Orphanides-Rules the Taylor-Rule with a time-varying equilibrium real interest rate and the no-change rule. For two quarter ahead forecasts and above there are, however, two rules which are superior to the others depending on whether one looks at the MAE or MSE. The MAE is always lowest for the no-change rule thus neither the Orphanides- nor the Taylor-Rules deliver better results than simply assuming the policy rate to remain unchanged. But when one looks at the MSE the Taylor-Rule with a time-varying equilibrium real interest rate performs best, thus if larger deviations should be avoided one should follow this rule. Quite astonishing in this case is that adding an interest rate smoothing coefficient to this rule does not improve the fit but that the opposite is true. This holds irrespectively of using the MAE or MSE.

6. Conclusions

In this article we have evaluated different versions of the Orphanides- and the Taylor-Rule. While the prior is a rule explaining the change in the interest rate the latter is a level rule by construction. Evaluating the rules using real-time data, we show that both rules have their advantages but also disadvantages.

The Orphanides-Rule (i.e. its estimated version) performs best when it comes to nowcasts, meaning if you want to forecast the current interest rate of the ECB, e.g. directly before an interest rate decision of the ECB governing council, you should rely on this rule. However, the Orphanides-Rule performs worse when it comes to forecasts.

Here the Taylor-Rule comes into play. Various versions of this rule deliver indeed more accurate forecasts than the Orphanides-Rule. But it is crucial in this respect to modify the basic Taylor-Rule since especially the assumption of a constant equilibrium real interest rate of two percent is hard to justify for the Euro area. Thus, we find that a Taylor-Rule with a time-varying equilibrium real interest rate performs best when it comes to forecasts of the interest rate path. So we recommend using this rule when one wants to forecast the interest rate path of the ECB in the next year, especially if one wants to avoid large forecast errors.

If one does not care about large errors the no-change rule delivers also very good results. But this result may be due to the low interest rate period since the beginning of the financial crisis culminating in zero interest rates since 2016Q2. Thus, we have not seen substantial interest rate swings in the recent years, leading to low errors of a no-change rule. But this critique holds to a lesser extent for all rules relying at least partially on prior policy rates. This being said the optimal policy rates may change over time and a frequent analysis needs to be made to find always the best rule.

Moreover, the Orphanides- and Taylor-Rule were built to explain the policy rate of a central bank which is the main refinancing rate in the case of the ECB. This was the focus of the present article. However, since the start of the financial crisis and the subsequent European debt crisis we have seen the ECB – like other central banks – to engage extensively in unconventional monetary policies. Thus, the monetary stance of the ECB is even looser than the main refinancing rate suggests. One way to incorporate these unconventional monetary policy measures is using the shadow rate (Wu and Xia, 2016). This rate can be used instead of the main refinancing rate in estimated Orphanides- or Taylor-Rules. But this goes clearly beyond the scope of the present article. We thus leave it for further research.

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