1 Appendix C: A detailed overview of monetary policy rules in Modelbase

In the current version of the Modelbase we consider eight common monetary policy rules for comparison exercises. Seven of them are taken from Taylor (1993), Gerdesmeier and Roffia (2004), Levin, Wieland, and Williams (2003), Smets and Wouters (2007), Christiano, Eichenbaum, and Evans (2005), Orphanides and Wieland (2008) and Orphanides and Wieland (2013), respectively. The remaining one is a user-specified rule. The specific formulas of each of the policy rules, in terms of common variables, are shown in the table below.

Table 1: MONETARY POLICY RULES IN MODELBASE

Taylor (1993)	$i_t^z = \sum_{j=0}^{3} 0.38 p_{t-j}^z + 0.50 q_t^z + \eta_t^i$
Gerdesmeier and Roffia (2004)	$i_t^z = 0.66 i_{t-1}^z + \sum_{j=0}^{3} 0.17 p_{t-j}^z + 0.10 q_t^z + \eta_t^i$
Levin et al. (2003)	$i_t^z = 0.76 i_{t-1}^z + \sum_{j=0}^{3} 0.15 p_{t-j}^z + 1.18 q_t^z - 0.97 q_{t-1}^z + \eta_t^i$
Smets and Wouters (2007)	$i_t^z = 0.81 i_{t-1}^z + 0.39 p_t^z + 0.97 q_t^z - 0.90 q_{t-1}^z + \eta_t^i$
Christiano et al. (2005)	$i_t^z = 0.8 i_{t-1}^z + 0.3 E_t p_{t+1}^z + 0.08 q_t^z + \eta_t^i$
Orphanides and Wieland (2008)	$i_t^z = 2.34 E_t \pi_{t+3}^z + 0.765 E_t q_{t+3}^z + \eta_t^i$
Orphanides and Wieland (2013)	$i_t^z = i_{t-1}^z + 0.5 \pi_t^z + 0.5 (q_t^z - q_{t-4}^z) + \eta_t^i$
User-specified rule	$i_t^z = \sum_{j=0}^{j=4} \rho_i i_{t-j}^z + \sum_{j=-4}^{j=4} \rho_{\pi,j} p_{t+j}^z + \sum_{j=-4}^{j=4} \rho_{q,j} q_{t+j}^z + \sum_{j=-4}^{j=4} \rho_{y,j} y_{t+j}^z + \eta_t^i$

In all rules, i_t^z denotes the annualized quarterly money market rate, π_t^z denotes the year-on-year rate of inflation, p_t^z denotes the annualized quarter-to-quarter rate of inflation, y_t^z is the quarterly real GDP, q_t^z is the quarterly output gap which is defined as the deviation of actual output from the level of output that would be realized if prices are flexible.

In the following we provide a brief description of these rules.

- The rule proposed by Taylor (1993) is a well-known monetary policy rule. In the 1990s Taylor's rule received much attention because it described Federal Reserve interest rate decisions since 1987 surprisingly well. Since then, a great number of Taylor-type rules have been used in the literature.
- The rule of Gerdesmeier and Roffia (2004) was estimated on euro area data and was simulated

for model comparison exercises in Kuester and Wieland (2010) in four euro area economy models that are included in the Modelbase. This rule is one of variants of Taylor rule augmented with the interest-rate smoothing term.

- The rule used by Levin et al. (2003) was originally estimated with U.S. data by Orphanides and Wieland (1998). Levin et al. (2003) employs this rule to simulate five models of the U.S. economy for comparison. These models are also included in the Modelbase. This rule allows for interest-rate smoothing and includes the lag of the output gap in addition to the current output gap and current inflation.

- The rule of Smets and Wouters (2007), one of the most known new-Keynesian models, have been estimated together with other structural parameters using Bayesian techniques. This rule contains a response to interest-rate smoothing, current inflation and current and past output gaps.

- Christiano et al. (2005) consider a different policy rule that they ascribe to Clarida, Gali, and Gertler (1999). Their rule includes a response to the one-period ahead forecast of inflation, as opposed to current inflation.

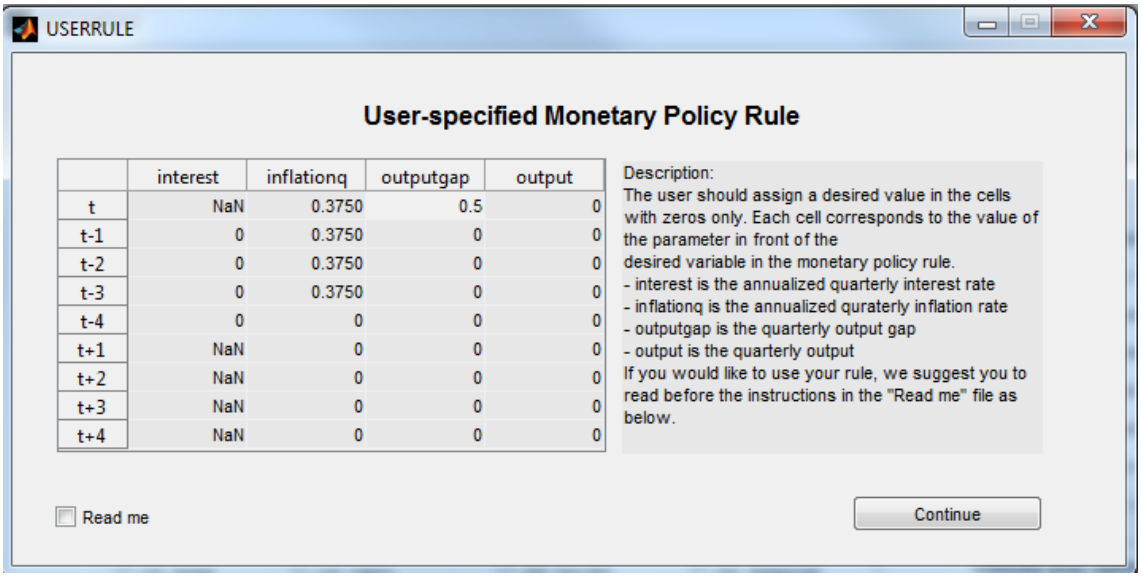
- Orphanides and Wieland (2008) have estimated the monetary policy rules with the publicly-available FOMC's projections for inflation and unemployment rate, while deliberately considering the timing of releasing the semiannual monetary policy report to the Congress. The rule is forward-looking in the sense that it contains three quarters-ahead forecasts for inflation and the unemployment rate. We have implemented the rule without the interest-rate smoothing (the fourth column in Table 3 in Orphanides and Wieland (2008)). Furthermore, the unemployment rate in the original rule is replaced with the output gap using Okun's law, $-2(u-\bar{u}) \approx (y-\bar{y})$.

- Orphanides and Wieland (2013) propose an outcome-based simple policy rule with the change in the policy rate responding equally to the current inflation and output gap growth over the last four quarters. They find that this simple rule is quite robust over the eleven euro area macroeconomic models considered.

- The last option provide users with the possibility to conduct comparison analysis with a "User-specified monetary policy rule". To this aim, a general form of a monetary policy rule is offered in terms of common variables in the MMB. Users can specify the desired values for the coefficients in front of the variables in the rule. For example, suppose that you implement the Taylor (1993) rule using the option for user-specified monetary policy rule. The coefficients should be set as follows: $\rho_{\pi,0} = \rho_{\pi,-1} = \rho_{\pi,-2} = \rho_{\pi,-3} = 0.375$, $\rho_{q,0} = 0.5$, with the rest of coefficients being set to zero. The figure below illustrates how to use the option for a user-specified

rule with the example of Taylor (1993) rule. Note that with some rule parametrization, certain models might not be solved due to several reasons. The system of equations may violate the Blanchard-Kahn condition so that they do not yield a unique stationary rational expectations equilibrium. There is no clear guideline for conditions for determinacy, but Levin et al. (2003) suggest several crucial characteristics of rules that deliver a unique equilibrium: a relatively short inflation forecast horizon, a moderate degree of responsiveness to the inflation forecast, an explicit response to the current output gap, and a substantial degree of policy inertia.

Figure 1: TAYLOR (1993) RULE USING THE OPTION OF USER-SPECIFIC RULE



In addition to the rules above, whenever possible, we also have included original model-specific monetary policy rules expressed in terms of common variables. This option is available for the exercise with *One model, many policy rules*. With the original rules of each model, we expect users not only to understand well the mechanism of a particular model but also to replicate the impulse responses of the paper considered. Currently, the original model-specific rule is available for forty two models in the Modelbase. The models with their policy rule implemented are: NK_LWW03, NK_CGG99, NK_CGG02, NK_MCN99cr, NK_IR04, NK_BGG99, NK_GK11, NK_CK08, NK_CKL09, NK_MM10, NK_KRS12, US_OW98, US_SW07, US_ACELm, US_ACELt, US_ACELswm, US_ACELswt, US_OR03, US_PM08, US_PM08fl, US_DG08, US_IAC05, US_RA07, US_CCTW10, US_IR11, US_IN10, US_VMDno, US_VMDop, EA_CW05ta, EA_CW05fm, EA_SW03, EA_QUEST3, EA_CKL09, EA_GE10, EA_GNSS10, G7_TAY93, G3_CW03, G2_SIGMA08, EAUS_NAWM08, EAUS_NAWMctww, EAES_RA09, BRA_SAMBA08. One can access the formulas for the model-specific rules in the file "MSR_COEFFS.m".

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