BANK OF ENGLAND

Staff Working Paper No. 702

Monetary and macroprudential policies under rules and discretion

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December 2017

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Abstract

We study the policy design problem faced by central banks with both monetary and macroprudential objectives. We find that a time-consistent policy is often superior to a widely studied class of simple monetary and macroprudential rules. Better outcomes result when interest rates adjust to macroprudential policy in an augmented monetary policy rule.

Key words: Monetary policy, macroprudential policy, DSGE models.

JEL classification: E44, E52, G28.

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The views expressed in this paper are those of the authors, and not necessarily those of the Bank of England or its committees. For helpful comments, we are grateful to John Barrdear, Andy Blake, Daisuke Ikeda, Michael McLeay, Stefan Niemann, and Matt Waldron.

The Bank's working paper series can be found at www.bankofengland.co.uk/news/publications

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ISSN 1749-9135 (on-line)

1 Introduction

Central banks are increasingly responsible for meeting both 'traditional' monetary objectives—control of inflation, and stabilization of output—and newer macroprudential objectives, aimed at ensuring financial stability. Along with these new macroprudential responsibilities have come new policy tools. How to set multiple instruments to meet multiple stabilization goals has thus become the principal policy design problem for central banks.

In this note we assess the performance of two possible strategies that a policymaker in control of both monetary and macroprudential tools might follow. The first is to follow the time-consistent policy ('discretion'). Under discretion, policy is reoptimized each period, given current economic conditions (De Paoli and Paustian, 2017). The second strategy is to follow simple feedback rules for monetary and macroprudential instruments. As simple policy rules such as the Taylor rule are found to perform well in the context of monetary policy, it is a natural step to also specify simple rules for macroprudential instruments. Indeed, this practice has been widely followed in the macroprudential policy literature (Angelini et al., 2014; Suh, 2014). Beating discretion should be a low hurdle for well-designed rules to cross (Kydland and Prescott, 1977).

The main message of this note is that in a standard model, and with a standard policy problem, commitment to policy rules often produces worse outcomes than discretion. Only when low importance is attached to the macroprudential objective are rules preferred. Our observation is important because to date the vast majority of studies have used such rules. We identify a source of the poor performance of standard policy rules, and suggest a modification that produces a substantial improvement.

2 A DSGE model with borrowing constraints and banks

In this section we summarize the key features of the New Keynesian model we use in our analyis. Except in certain unimportant details, the model is a special case of that presented in Angelini et al. (2014) in which there are no capital-producing firms, no physical capital accumulation, and no loan rate stickiness. The complete set of model equations may be found in Appendix A. Parameter definitions may be found in Table

1.

Households and housing

There are two household types, savers (s) and borrowers (b). Borrowers choose consumption (C_b), housing (H_b), and hours worked (N_b) so as to maximize:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta_b^t \left[logC_{b,t} + J\ logH_{b,t} - \frac{N_{b,t}^{\eta}}{\eta} \right]$$

Their budget constraint is:

$$C_{b,t} + \frac{R_{b,t-1}}{\Pi_t} B_{t-1} + q_t \left(H_{b,t} - H_{b,t-1} \right) = B_t + w_{b,t} N_{b,t} - \overline{NW} \varepsilon_t^{NW}$$

where R_b is the nominal loan rate, Π the inflation rate, B the quantity of one-period loans, q the real house price, w the real wage, and ε_t^{NW} an i.i.d. shock that redistributes a fraction of borrowers' steady state net worth ($\overline{NW}$) to savers. A binding borrowing constraint is in force. It depends on the expected value of housing collateral and a loan-to-value ratio (m):

$$\mathbb{E}_t \left[\frac{R_{bt}}{\Pi_{t+1}} \right] B_t = m \mathbb{E}_t \left[q_{t+1} H_{b,t} \right] \tag{1}$$

Patient saver households have a lower rate of time preference than impatient borrower households. Savers choose consumption (C_s), housing (H_s), and hours worked (N_s) so as to maximize:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta_s^t \left[logC_{s,t} + J\ logH_{s,t} - \frac{N_{s,t}^{\eta}}{\eta} \right]$$

subject to the budget constraint:

$$C_{s,t} + d_t + q_t \left(H_{s,t} - H_{s,t-1} \right) = R_t \frac{d_{t-1}}{\Pi_t} + w_{s,t} N_{s,t} + T_t + \overline{NW} \varepsilon_t^{NW}$$

where d the quantity of deposits, R the gross nominal deposit interest rate, and T the dividends from firms and financial intermediaries. As housing is in fixed supply, market clearing requires $H_b + H_s = 1$ as in Equation (A.21).

Firms

The production sector follows a standard New Keynesian setup. There is a continuum of monopolistically competitive firms indexed by $j \in [0, 1]$. Each firm j produces a differentiated good according to the production function:

$$Y_t(j) = A_t N_{s,t}(j)^{\alpha} N_{b,t}(j)^{1-\alpha}$$

where A_t is an AR(1) productivity process. In each period, firm j chooses the amount of labour to use in production such as to maximize their profit subject to the constraint that their output equals the demand for their good:

$$Y_t(j) = Y_t^d(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\varepsilon} (C_{s,t} + C_{b,t})$$

Prices are adjusted infrequently according to a Calvo scheme with a probability of prices being reset of $1 - \theta$. At any time t, when a firm j has a chance to reset its price, it chooses its price $P_t(j)$ so as to maximize:

$$\mathbb{E}_t \sum_{k=0}^{\infty} (\theta\beta_s)^k \left(\frac{C_{s,t}}{C_{s,t+k}}\right) \left[\left(\frac{P_t(j)}{P_{t+k}}\right)^{1-\varepsilon} (C_{s,t+k} + C_{b,t+k}) - mc_{t+k|t}(j) \left(\frac{P_t(j)}{P_{t+k}}\right)^{-\varepsilon} (C_{s,t+k} + C_{b,t+k})\right]$$

where $mc_{t+k|t}(j)$ is the real marginal cost in period $t + k$ of a firm j who last reset its price in period t.

Banks

Banks are composed of two units: a competitive wholesale unit that manages the bank's balance sheet, and a monopolistically competitive retail unit that costlessly differentiates wholesale loans into retail products. Wholesale banks raise deposit funding at the policy interest rate R, and incur costs whenever their capital ratio—equity K_b divided by total loans—deviates from its time-varying regulatory target ν:

$$R_{wt} = R_t - \kappa \left(\frac{K_{bt}}{B_t} - \nu_t\right) \left(\frac{K_{bt}}{B_t}\right)^2$$

Retail bank lending takes the form of one-period nominal loans. Retail banks apply a markup to wholesale loan rates (R_w) such that the nominal loan rate faced by borrowers

(R_b) is:

$$R_{bt} = \frac{\zeta}{\zeta - 1} R_{wt}$$

Banks build equity capital through retained earnings. Shareholders have a return-on-assets target, implying that dividends are proportional to assets, ξB. The real resources the bank has at its disposal to meet its capital requirement in period t are the earnings from its lending activities in period $t-1$, net of dividends and of costs associated with being away from the target capital ratio:

$$K_{bt} = \frac{R_{b,t-1} - R_{t-1}}{\Pi_t} B_{t-1} + \frac{R_{t-1}}{\Pi_t} K_{b,t-1} - \xi B_{t-1} - \frac{\kappa}{2} \left(\frac{K_{b,t-1}}{B_{t-1}} - \nu_{t-1} \right)^2 K_{b,t-1}$$

Calibration

Table 1 supplies details of our calibration. We set parameters close to values found elsewhere in the literature, and that produce reasonable financial ratios. The standard deviations of productivity and financial shocks are set to match the volatilities of output growth and bank lending spreads observed between 1995-2014 in euro area data (0.61% and 0.66% respectively), exactly as in De Paoli and Paustian (2017, Section 4.1).

3 Is commitment to simple rules superior to the time-consistent policy?

3.1 Policy strategies

In this section we describe alternative policy strategies for a central bank in control of a short-term nominal interest rate and time-varying bank capital requirements. The latter is akin to the counter-cyclical buffer (or CCyB) introduced under Basel III rules. Our policy problem is identical to that studied in Angelini et al. (2014): The central bank's objective is to stabilize inflation, output growth (Δy), and the loan-to-output ratio (B/Y). The latter term captures concern with 'abnormal' levels of credit relative to economic activity. Formally, policymakers' expected per-period loss is given by:

$$L = \sigma_\pi^2 + k_Y \sigma_{\Delta y}^2 + k_{B/Y} \sigma_{B/Y}^2 + k_R \sigma_{\Delta R}^2 + k_\nu \sigma_{\Delta \nu}^2 \tag{2}$$

Table 1: Calibrated parameter values

Parameter	Description	Value
β_s	Discount factor S-type	0.99
β_b	Discount factor B-type	0.96
J	Housing utility parameter	0.1
η	Inverse Frisch elasticity	1
α	Share of S-type labour in production	0.6
ε	Elasticity of substitution, final goods	6
θ	Calvo price parameter	0.75
ζ	Elasticity of substitution, loans	40
κ	Bank capital adjustment cost parameter	50
ν	Steady state capital ratio	15%
m	Steady state LTV ratio	65%
ξ	Implied bank pay-out rate	2.7%
ρ_A	Persistence of productivity shock	0.95
σ_A	Standard dev. productivity shock	0.86
σ_{NW}	Standard dev. net worth shock	2.16

Selected steady states

Variable	Description	Value
R	Deposit rate	1%
$R_b - R$	Spread between loan and deposit rates	2.6%
H_b	Share of B-type housing	.26
C_b/Y	Share of B-type consumption	.56
B/Y	Debt-to-output ratio	.97

where the weights k are set to $(k_Y, k_{B/Y}, k_R, k_\nu) = (0.5, 1, 0.1, 0.1)$, the same as in Angelini et al.; the σ^2 are unconditional variances; and the final two terms penalize volatility in policy rates and capital requirements.

We now describe a commonly adopted class of simple monetary and macroprudential policy rules. Following Angelini et al. (2014), Suh (2014), and others, we choose functional forms that assign the macroeconomic stabilization objectives in (2) to the monetary policy instrument, and assign the financial stabilization objective to the macroprudential instrument. Following this common practice, the linearized forms for our nominal interest rate and CCyB rules are:

$$R_t = \rho_R R_{t-1} + (1-\rho_R)\left[\chi_\pi(\pi_t - \overline{\pi}) + \chi_Y(Y_t - Y_{t-1})\right] \tag{3}$$

$$\nu_t = \rho_\nu \nu_{t-1} + (1-\rho_\nu)\left[\chi_{B/Y}\left(\frac{B_t}{Y_t} - \frac{\overline{B}}{\overline{Y}}\right)\right] \tag{4}$$

An optimal simple rule has coefficients that produce the best outcomes within a parametric class of rules. We therefore choose values for the parameters $(\rho_R, \chi_\pi, \chi_Y, \rho_\nu, \chi_{B/Y})$ that appear in the rules (3) and (4) to minimize the combined losses from macroeconomic and financial volatility captured in (2). This is the case of cooperation described in Angelini et al. (2014, Section 3.2). To compute the equilibrium, we linearize the model around its deterministic steady state and apply the solution methods described in Miao (2014).

3.2 Main results and discussion

The main results of our exercise are shown in Table 2, Panel (a). The main statistic of interest is the central bank's expected loss, reported in the final column. As is readily observed, the central bank would achieve a smaller loss by following a strategy of discretion rather than by committing to an optimized simple rule. Note that the optimized parameter settings for the monetary policy rule are typical of those found in the literature: there is very strong feedback on inflation (the optimized feedback coefficient on inflation χ_π is at its upper bound), with relatively little regard for output growth. The parameters of the macroprudential rule indicate that a higher credit-to-output ratio calls for modest increases in the CCyB, as anticipated, with a substantial degree of smoothing.

At first sight, our result may appear surprising: With standard monetary policy objectives, rules are typically found to perform better than discretion. But the relatively good performance of the time-consistent policy is straightforward to explain. Consider for example a wealth shock (ε^{NW}): Its effect is to tighten borrowers' collateral constraints (1); With less ability to borrow, their demand for consumption and housing falls, putting downward pressure on inflation and house prices.

Under discretion, monetary policy is used to influence real borrowing rates in ways that tend to stabilize debt. Inflation is allowed to rise. As a result, real borrowing costs undergo a substantial decline. That acts to loosen borrowers' collateral constraint, and so to boost output and credit demand. The CCyB is cut in concert with interest rates, which supports credit supply. The overall effect of discretionary policy is therefore to support credit growth. By contrast, under the monetary policy rule (3) inflation is almost completely eliminated. Real borrowing costs are therefore high, and credit demand is relatively low. Although the macroprudential rule (4) calls for a protracted cut in the CCyB, the outward shift in credit supply it induces cannot fully compensate.

When do rules do badly?

To investigate how the presence of the loan-to-output ratio in the central bank's objective function contributes to our result, we compute losses under discretion and rules as the weight on the loan-to-output ratio varies. Only when the weight is below a low threshold value $k^*_{B/Y} = 0.18$ are simple rules preferred. Panel (b) of Table 2 displays the results of using this threshold in the loss function. By design, expected losses are equalized. Compared to Panel (a), the loan-to-output ratio is now more volatile, and the feedback coefficient in the macroprudential rule is smaller (.04 versus .19). We conclude that rules (3) and (4) do poorly because they are relatively ineffective in stabilising the credit-to-output ratio, rather than simply because financial frictions are present.

Improving rules

To overcome the drawback of simple rules, we augment the standard rule (3) with feedback on the CCyB, allowing monetary policy scope to reinforce macroprudential policy actions:

$$R_t = \rho_R R_{t-1} + (1 - \rho_R) \left[\chi_\pi (\pi_t - \overline{\pi}) + \chi_Y (Y_t - Y_{t-1}) + \chi_\nu \nu_t \right] \tag{3'}$$

The result of employing the augmented policy rule (3′) leaving the macroprudential rule (4) unchanged appear in Panel (c) of Table 2. The feedback coefficient χ_ν in the optimized monetary policy rule is large, indicating that interest rates and the CCyB should generally be set in close concert. The coefficients on inflation and the output gap are much smaller than under the baseline case shown in Panel (a). Consistent with these less-aggressive responses, macroeconomic variables are more variable than under the baseline case. Meanwhile, macroprudential policy responds much more aggressively to the credit-to-output ratio. The variability of the credit-to-output ratio is therefore materially lower, and as a result, overall losses are much smaller than in Panel (a). Indeed, losses are comparable to the baseline discretionary outcomes.

Summary

This note has considered the policy design problem faced by central banks with powers to set both monetary and macroprudential policies. It has demonstrated the importance of establishing the performance of a benchmark time-consistent policy against which the performance of rules may be judged.

Table 2: Central bank losses under discretion and simple rules

(a) *Baseline objective, standard rules*

Policy	σ_π	$\sigma_{\Delta Y}$	$\sigma_{B/Y}$	$\sigma_{\Delta R}$	$\sigma_{\Delta v}$	Expected loss*
Time consistent	.30	2.0	.75	2.0	2.8	1.84
Simple rules	.06	.53	1.7	2.8	2.6	4.30

Note: Rules given by (3) and (4).

Rule parameters, baseline

ρ_R	χ_π	χ_Y	ρ_v	$\chi_{B/Y}$
0	50	5.9	.83	.19

(b) *Lower weight on B/Y in objective, standard rules*

Policy	σ_π	$\sigma_{\Delta Y}$	$\sigma_{B/Y}$	$\sigma_{\Delta R}$	$\sigma_{\Delta v}$	Expected loss*
Time consistent	.56	1.0	.85	2.4	2.2	1.93
Simple rules	.08	.48	1.8	2.8	2.2	1.93

Note: Lower weight on B/Y in objective $(k_Y, k_{B/Y}, k_R, k_v) = (.5, .18, .1, .1)$. Rules given by (3) and (4).

Rule parameters

ρ_R	χ_π	χ_Y	ρ_v	$\chi_{B/Y}$
0	50	8.7	.84	.04

(c) *Baseline objective, augmented monetary rule*

Policy	σ_π	$\sigma_{\Delta Y}$	$\sigma_{B/Y}$	$\sigma_{\Delta R}$	$\sigma_{\Delta v}$	Expected loss*
Time consistent$^\diamond$	.30	2.0	.75	2.0	2.8	1.84
Simple rules	.13	.94	.35	2.8	2.3	1.86

Note: Rules given by (3′) and (4). $^\diamond$The time consistent policy is identical to that in panel (a).

Rule parameters

ρ_R	χ_π	χ_Y	χ_v	ρ_v	$\chi_{B/Y}$
.11	.78	.42	.82	.12	2.2

* Numbers may not agree precisely due to rounding. Optimized coefficients are constrained to lie in the intervals $[0, .99)$, in the case of (ρ_R, ρ_v), and $[0, 50]$ in all other cases.

A Appendix

This appendix provides a full description of the model equations.

Saver households:

$$\frac{1}{C_{s,t}} = \beta_s \mathbb{E}_t \left[\frac{R_t}{\Pi_{t+1} C_{s,t+1}} \right] \tag{A.1}$$

$$w_{s,t} = N_{s,t}^{\eta-1} C_{s,t} \tag{A.2}$$

$$\frac{J}{H_{s,t}} = \frac{1}{C_{s,t}} q_t - \beta_s \mathbb{E}_t \left[\frac{1}{C_{s,t+1}} q_{t+1} \right] \tag{A.3}$$

Borrower households:

$$\frac{1}{C_{b,t}} = \beta_b \mathbb{E}_t \left[\frac{R_{bt}}{\Pi_{t+1} C_{b,t+1}} \right] + \lambda_t R_{bt} \tag{A.4}$$

$$w_{b_t} = N_{b,t}^{\eta-1} C_{b,t} \tag{A.5}$$

$$\frac{J}{H_{b,t}} = \frac{1}{C_{b,t}} q_t - \beta_b \mathbb{E}_t \left[\frac{1}{C_{b,t+1}} q_{t+1} \right] - \lambda_t m \mathbb{E}_t \left[q_{t+1} \Pi_{t+1} \right] \tag{A.6}$$

$$\mathbb{E}_t \left[\frac{R_{bt}}{\Pi_{t+1}} \right] B_t = m \mathbb{E}_t \left[q_{t+1} H_{b,t} \right] \tag{A.7}$$

$$C_{b,t} + \frac{R_{b,t-1}}{\Pi_t} B_{t-1} + q_t \left(H_{b,t} - H_{b,t-1} \right) = B_t + w_{b,t} N_{b,t} - \overline{NW} \varepsilon_t^{NW} \tag{A.8}$$

Firms:

$$Y_t = A_t N_{s,t}^{\alpha} N_{b,t}^{1-\alpha} \tag{A.9}$$

$$w_{s,t} = \mathrm{mc}_t \alpha \frac{Y_t}{N_{s,t}} \tag{A.10}$$

$$w_{b,t} = \mathrm{mc}_t (1-\alpha) \frac{Y_t}{N_{b,t}} \tag{A.11}$$

$$\Pi_t^* = \frac{\varepsilon}{\varepsilon - 1} \frac{\Omega_{1,t}}{\Omega_{2,t}} \tag{A.12}$$

$$\Omega_{1,t} = \mathrm{mc}_t (C_{s,t} + C_{b,t}) (1-\tau) + \theta \left(\beta_s \frac{C_{s,t}}{C_{s,t+1}} \right) \Pi_{t+1}^{\varepsilon} \Omega_{1,t+1} \tag{A.13}$$

$$\Omega_{2,t} = (C_{s,t} + C_{b,t}) + \theta \left(\beta_s \frac{C_{s,t}}{C_{s,t+1}} \right) \Pi_{t+1}^{\varepsilon-1} \Omega_{2,t+1} \tag{A.14}$$

$$1 = \theta \Pi_t^{\varepsilon-1} + (1-\theta) \Pi_t^{*1-\varepsilon} \tag{A.15}$$

$$\Delta_t = (1-\theta) (\Pi_t^*)^{-\varepsilon} + \theta (\Pi_t)^{\varepsilon} \Delta_{t-1}, \qquad \text{where } \Delta_t := \int \left(\frac{P_t(j)}{P_t} \right)^{-\varepsilon} \mathrm{d}j \tag{A.16}$$

Banks:

$$R_{wt} = R_t - \kappa \left(\frac{K_{bt}}{B_t} - \nu_t \right) \left(\frac{K_{bt}}{B_t} \right)^2 \tag{A.17}$$

$$R_{bt} = \frac{\zeta}{\zeta - 1} R_{wt} \tag{A.18}$$

$$K_{bt} = \frac{R_{b,t-1} - R_{t-1}}{\Pi_t} B_{t-1} + \frac{R_{t-1}}{\Pi_t} K_{b,t-1} - \xi B_{t-1} - \frac{\kappa}{2} \left(\frac{K_{b,t-1}}{B_{t-1}} - \nu_{t-1} \right)^2 K_{b,t-1} \tag{A.19}$$

Market clearing conditions:

$$(C_{b,t} + C_{s,t}) \Delta_t = Y_t \tag{A.20}$$

$$H_{b,t} + H_{s,t} = 1 \tag{A.21}$$

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