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The ECB Strategy Review – Implications for the Space of Monetary Policy

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Abstract

This paper investigates two important elements of the ECB's 2021 monetary policy strategy review in an estimated structural open-economy macro model of the euro area: (a) explicit symmetry of the 2% inflation target, which can be expected to lower the risk of hitting the effective lower bound (ELB) on short-term interest rates by raising average inflation towards the target, and (b) commitment to forceful or persistent monetary accommodation in a low interest rate environment, here interpreted as low-for-longer response in the recovery from the ELB. We simulate the model with draws from the estimated distribution of shocks. Both elements increase average inflation and reduce the average output gap. Stabilisation gains are modest in quantitative terms, however, for the given illustrative policy rules, and they are more pronounced when the economy operates at the ELB. Important in the current context, the low-for-longer policy in the model does not jeopardise inflation stabilisation in the event of (inflationary) negative supply shocks at the exit from the ELB. With private sector 'myopia' instead of fully rational expectations, the low-for-longer rule still yields stabilisation gains at the ELB, but they shrink in quantitative terms.

JEL Classification: E30, E52, E58.

Keywords: monetary policy, ELB, policy space, target symmetry, low-for-longer.

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1. INTRODUCTION

In July 2021, the European Central Bank (ECB) published the results of its monetary policy strategy review, launched in January 2020. Based on this review, the ECB Governing Council has modified, or clarified, its monetary policy strategy in two important directions: (1) It has adopted an explicitly symmetric 2% (HICP) inflation target. (2) It has concluded that a forceful and persistent response of monetary policy may be necessary to stabilise the economy in an environment of low interest rates, and this may imply that the ECB could tolerate a temporary overshooting of the inflation target in the recovery from the effective lower bound (ELB). ECB (2021a) provides a detailed account and ECB (2021c) a concise summary of the outcomes of the strategy review.

Stipulating an explicitly symmetric inflation target reacts to concerns that the previous formulation ("below but close to 2%") might have been perceived as asymmetric, leading to lower (below-2%) inflation on average, and narrowing the room for manoeuvre of standard monetary policy to reduce the policy rate in recessions. Explicit symmetry in the inflation target, to the contrary, implies that negative and positive deviations of inflation from its target value are equally undesirable and addressed with equal determination.

The commitment to a forceful and persistent monetary policy response in the neighbourhood of the ELB addresses risks that downward-drifting inflation expectations might become entrenched. It can be seen as a form of (systematic) forward guidance (FG), which keeps the policy rate low for longer.

This paper explores macroeconomic implications and, especially, potential benefits of the elements (1) and (2) through the lens of an open-economy DSGE model of the euro area (EA). In particular, we use an estimated version of the European Commission's Global Multi-country (GM) model (Albonico et al. (2019)) in a two-region (EA-rest of the world (RoW)) configuration (Cardani et al. (2022)).

We simulate the model with estimated shocks from the baseline specification under alternative monetary policy settings and compare the outcomes. In particular, we compare (1) interest rate rules that generate policy space of different size, which we consider as main implication of an explicitly symmetric inflation target in the present exercise, and (2) rules with and without low-for-longer component, which delays the phasing out of monetary accommodation in a recovery from the ELB.

Both elements increase average inflation and reduce the average output gap. Difference are modest in quantitative terms, however, for the given illustrative policy rules, and they are more pronounced when the economy operates at the ELB. Importantly in the current context, low-for-longer policy does not jeopardise macroeconomic stabilisation in the event of (inflationary) negative supply shocks at the exit from the ELB according to the simulations.

Especially low-for-longer policies underline the role of private sector expectations in the transmission of monetary policy and economic shocks. The effectiveness of low-for-longer policies, therefore, depends on forward-looking behaviour and, particularly, the assumption of full-information rational expectations (RE) by households and firms. To explore the importance of assuming RE, we compare results to a model version with 'myopic' agents that discount future events more strongly, following Gabaix (2020). The differences between low-for-longer policies and a standard Taylor rule are qualitatively robust, but quantitatively smaller in a model version with myopic behaviour, making households and firms less responsive to (expected) future shocks and policies.

The simulation results in quantitative terms must be taken with caution, given the stylised nature of our model and, notably, the modelling of monetary policy. The model uses a stylised description of monetary policy (Taylor rule) that may unduly simplify ECB policy in recent years. In particular, the setting does not include non-standard policy measures, such as large-scale asset purchases, that have partly substituted for standard policy at the ELB. The simulations may therefore exaggerate the costs of hitting (and benefits from avoiding the ELB.

In addition, the simulations rely on an estimated benchmark monetary policy rule rather than optimal policy responses. Modifications to private sector behaviour, such as the shift from RE towards myopic agents, would certainly affect the optimal policy prescription in terms of interest rate persistence and the optimal aggressiveness of contemporaneous response parameters.

The ECB, like other central banks, is currently in a process of monetary policy normalisation, following high levels of inflation. An analysis of central elements of the policy strategy, geared towards a low-inflation and low-rate environment, remains relevant nevertheless. Risks of hitting the ELB may resurface when inflation is tamed. Evidence in Jordà et al. (2022 suggests that the economic implications of pandemics tend to lower rather than increase equilibrium ('natural' real interest rates in the longer term. Similarly, pre-COVID structural trends underlying low (real interest rates (including demographic trends and the productivity slowdown, described in Blanchard (2023 and Koester et al. (2021, remain relevant in advanced economies. Future interest rate dynamics will also depend on the persistence of public debt, the financing of climate policies, and the extent of trade and financial fragmentation (IMF (2023.

The strategy review also foresees to explore the inclusion of costs related to owner-occupied housing in consumer prices. Depending on the underlying cost measures, this could also affect the volatility of inflation over the business cycle and the risk of hitting the lower bound (Eiglsperger et al. (2022. Finally, an important message of the simulations in the present paper is that changes to the monetary strategy geared towards a low-rate environment do not impede a forceful and effective response to rising inflation.

2. LITERATURE

The paper builds on, and connects to, different strands of research. In particular, it relates to four areas of the literature. First and foremost, the scenarios in the paper attempt to capture the essence of policy rules providing more policy space on the downside, achieved, e.g., by explicit target symmetry, and a more accommodating stance around the ELB as (the two main elements of the revised ECB strategy review described in ECB (2021a and ECB (2021c. Together with the conclusions of its review, the ECB released a number of detailed background studies. ECB (2021b is central for the review of the quantitative formulation of price stability and the approaches and instruments by which price stability can be achieved, and it lists other papers that explore specific aspects, such as the potential impact of financial stability, supply-side developments, employment, fiscal policy, globalisation and climate change on price stability. Similarly, the Federal Reserve's umbrella communication (Federal Reserve (2020 collects conclusions and background material of its recent policy review.

Second, there is a large empirical literature on monetary policy rules and their effectiveness. Taylor (1993 is an early and arguably the most prominent example of a quantitative interest rate rule. Closer to our interest in potential gains from target symmetry in terms of policy space is Paloviita et al. (2017, who estimated specifications of the ECB's short-term interest rate rule on quarterly real time data for 1999q4–2016q4. The results suggest de facto annualised target inflation of 1.6-1.8%, rather than 2%, and substantial endogenous interest rate persistence. Testing specifications of the policy rule with an inflation gap, defined as deviation from target inflation over the previous two years, the authors find evidence for a more aggressive reaction to above-target as opposed to below-target inflation. Paloviita et al. (2020) analyse statements from ECB press conferences and draw similar conclusions, namely actual target inflation of 1.7%, or asymmetry in the response around a 2% target, with a stronger (weaker) reaction to inflation above (below) the target. Symmetric responses around a lower target inflation versus asymmetric responses around a 2% target are difficult to tell apart, i.e. observationally equivalent, in the authors' analysis.[1] Maih et al. (2021), estimating Markov-switching extensions to Smets and Wouters (2007), find support for an asymmetry in the ECB's inflation response (around a 1.9% target) prior to 2014, and a more symmetric policy rule thereafter.[2] Budianto et al. (2023) use a model to show that the ELB on nominal interest rates biases inflation downward even for structurally symmetric policy rules, because the probability of hitting the ELB for large enough shocks leads, in practice, to an asymmetric response to inflation on average.

Third, there is a large body of research on optimal monetary policy in the proximity of the ELB, notably in the context of a decline in the natural interest rate. Regarding the EA, Andrade et al. (2021), building on Andrade et al. (2018), use an estimated New Keynesian DSGE model to characterise the optimal inflation target, dependent on the natural interest rate. Their analysis suggests an increase in the optimal inflation target given an increased probability of hitting the ELB, or strategies with a stronger commitment to make-up for the inflation foregone during ELB episodes. Billi et al. (2022) make the point in a small model, showing that optimal policy aims at a positive average inflation rate in the presence of an ELB and a negative real natural interest rate. Erceg et al. (2021) estimate the model of Smets and Wouters (2007) on EA data and characterise the impact of make-up strategies, such as average inflation targeting (AIT), or price level targeting (PLT), as complements to (or forms of) FG and other unconventional policy tools. Similarly, Coenen et al. (2021) use the ECB's New Area-Wide Model (NAWM) to assess the impact of make-up strategies (AIT, PLT) on top of FG and large-scale asset purchases (QE). They conclude than make-up strategies, if well understood by the private sector, can largely undo the costs of the ELB in terms of negative bias to inflation and output and increased volatility. Maih et al. (2021) compute optimal simple interest rate rules in an ELB environment with low natural rate and find optimal policy to be asymmetric, prescribing a stronger response to inflation and the output gap when inflation is below (as opposed to above) target, which is the opposite of the actual asymmetry suggested by the empirical studies listed above. Nakov (2005) builds a small New Keynesian (NK) model with full-information rational expectations (RE) and illustrates that optimal commitment in the presence of an ELB implies a promise of sustained monetary easing, i.e. forms of FG, at the exit from a liquidity trap. Coibion et al. (2012) derive the optimal inflation rate in a stylised NK model with occasionally binding ELB, taking into account the costs of the ELB constraint as well as the costs of higher inflation.[3] As stressed in the introduction, we deviate from this literature in that we do not investigate optimal policy or a larger set of potentially welfare-improving policy options. Instead, we (try to) operationalise the quantitative implications of two key elements of the ECB's 2021 strategy review, providing a positive analysis of the announced changes, or clarifications, rather than normative prescriptions. Normative contributions on optimal policy, nevertheless, inspire the modelling of different policy strategies and the interpretation of

[1] Especially since the estimation sample mainly contains observations with below-target inflation rates.

[2] Erceg et al. (2021) argue that asymmetry in the policy response could have been the conscious decision of a young central bank to anchor low inflation expectations and institutional credibility.

[3] ECB (2021b) provides a more extensive survey of the literature on optimal inflation targets and optimal monetary policy at the ELB, including also results for the US economy. It emphasises the shock dependence of stabilisation gains. In particular, when supply shocks drive macroeconomic fluctuations, make-up strategies may stabilise inflation, but will increase fluctuations in economic activity.

our results.

Fourth, our analysis connects to the large and growing literature that assesses the robustness of stabilisation gains from monetary and fiscal policy with respect to expectation formation in the private sector. In particular, it appears intuitive that policies, which rely strongly on steering private sector expectations (FG, make-up strategies), require agents to be forward-looking and well-informed. Andrade et al. (2021), e.g., acknowledge that information frictions and cognitive limitations that weaken the expectations channel would reduce the attractiveness of make-up strategies as substitute for higher target inflation. At the same time, a central bank may find it difficult to commit to a higher inflation target when agents' expectations differ on the basis of past experience (ECB (2021b)). From an optimal policy perspective, Budianto et al. (2023) show that price-level targeting (PLT) as an extreme form of make-up strategy, which implies a very persistent policy response, is optimal with RE, but no longer optimal (and potentially very costly in welfare terms) in an environment of bounded rationality. Erceg et al. (2021) address the robustness of make-up strategies to deviations from full-information RE in a closed-economy setting. They implement a (simplified) version of Gabaix (2020) that implies a cognitive discounting of expectations outside the steady state, and they show that this deviation from RE weakens the power of FG and make-up strategy rules. We follow this approach and assess the robustness of our results to deviations from the RE benchmark through a Gabaix (2020) extension of our open-economy model. ECB (2021b) discusses deviations from RE along the more traditional lines of backward-looking ('adaptive') or mixed ('hybrid') expectations and of learning about the inflation target. The learning approach and backward-looking expectations emphasise the transition to a new state, e.g. a new inflation target, and the costs attached to temporary 'confusion' about policy objectives. The analyses building on Gabaix (2020), on the contrary, compare different model structures, in which changes in the policy regime (policy rule) are perceived accurately by the private sector, but implications for future dynamics are discounted to different extents.

3. MODEL

The analysis uses an estimated version of the European Commission's Global Multi-country (GM) model (Albonico et al. (2019)) in a two-region (EA-RoW) configuration (Cardani et al. (2022)). GM is an open-economy dynamic stochastic general-equilibrium (DSGE) model in the New Keynesian tradition.

The EA economy consists of households, a continuum of intermediate goods producers in monopolistic competition (where imperfect substitutability between varieties of goods provides firms with some price setting power), final goods firms in perfect competition, import and export sectors, and a government (fiscal policy) as well as a monetary authority. The EA final goods producers use EA intermediate goods, imported commodities ('industrial supplies') and imported manufactured goods as inputs. Wages are set by trade unions. Both wages and prices are sticky. Commodities also enter directly as component in the consumption basket of households. The RoW block has a simpler structure than the EA economy; it produces manufactured goods and is the supplier of commodities. Contrary to the closed economy in Erceg et al. (2021), the open-economy model with commodities in final demand introduces a distinction between (a) CPI versus GDP price inflation, and (b) headline versus core inflation.

Trade in goods (manufactured goods and commodities) and a financial asset link the EA with the RoW. To provide an empirically plausible account of the macroeconomic environment at quarterly frequency, the model includes nominal and real rigidities. Monetary policy follows a Taylor-type rule for short-term policy rates, with endogenous persistence.[4]

The paper focuses on counterfactual simulations with alternative monetary policy settings (regimes) as introduced by the strategy review. More precisely, we simulate draws from the estimated (demand and supply, domestic and foreign) shocks in the various model environments, i.e. (a) different degrees of policy space that can, e.g., derive from asymmetric versus symmetric inflation targets, and (b) absence or presence of a low-for-longer component during recovery from the ELB. The simulations, hence, include an endogenously binding ELB. Large negative shocks drive the economy (monetary policy) towards the ELB given the respective policy rule.

The following sub-sections describe the implementation in the model of the two elements of the strategy review that are the center of this analysis, and the solution and estimation of the model. A detailed general description of the GM model can be found in Albonico et al. (2019) and Cardani et al. (2022).[5]

3.1. INFLATION TARGET AND POLICY SPACE

The monetary policy (Taylor) rule has the form:

$$i_t^{NOT} - i = \rho^i (i_{t-1} - i) + (1-\rho^i)\left(\eta^{i\pi}\frac{(\pi_t^{c,vat,QA} - \pi^{c,vat,QA})}{4} + \eta^{iy} Y_t^{gap,QA}\right) \tag{1}$$

where i_t^{NOT} is the desired or 'shadow' (quarterly) short-term nominal policy rate, i_t is the actual short-term nominal rate, i is its steady-state level (the rate that would prevail if inflation was at target and the output gap closed), $\pi_t^{c,vt,QA}$ is the quarterly annualised CPI inflation rate (average CPI level over 4 quarters relative to average price level during the preceding 4 quarters), and $Y_t^{gap,QA}$ is the quarterly annualised output gap (log difference between the average level of output over 4 quarters relative to the average level of potential output over the same period, where potential output is output at full employment and full capacity utilisation).

Away from the ELB, the 'shadow' and the actual nominal short-term interest rates coincide, i.e. $i_t^{NOT} = i_t$. When the ELB binds, i.e. the 'shadow' rate is negative (or below the lowest possible actual rate), $i_t^{NOT} < i^{ELB}$, the actual rate is constrained to $i_t = i^{ELB}$, instead.[6]

The 'desired' ('shadow') policy rate in equation (1) reacts to deviations of CPI inflation from target and to the output gap, both at 4-quarter horizon. The interest persistence coefficient is $\rho^i = 0.92$; the coefficients determining the response to inflation and the output gap are set to the estimated values of $\eta^{i\pi} = 2.3$ and $\eta^{iy} = 0.1$.[7] The target inflation rate $\pi^{c,vat,QA}$ is 2% per year. This policy rule specification corresponds to the GM benchmark model (Albonico et al. (2019)) with updated parameter estimates as in Cardani et al. (2022).

[4]The benchmark version of GM does not include non-standard monetary measures, which would instead enter the savings, investment and exchange rate shocks in the estimation. See Hohberger et al. (2019) for an attempt to introduce QE in the GM model.

[5]For details on the GM model calibration strategy, posterior estimates and the list of observables, see also Appendix B in (Cardani et al. (2022)).

[6]While the ELB may not be exactly zero, it tends to be close to zero. For the simulations we, therefore, assume the ELB to be located at zero exactly.

[7]Estimated interest rate rules often include a lagged term to account for the inertia (or gradualism) in interest rate decisions. Interest rate inertia may express the reluctance of central bankers to swiftly change course, but it can also help guiding the expectations of forward-looking agents, as will be discussed in Subsection 3.2 and the related simulations in 4.2. On the benefits of interest rate inertia in RE models see, e.g., Woodford (1999, 2003).

While the evidence for policy asymmetry in the sense of different parameter values for $\eta^{i\pi}$ and/or η^{i}, depending on above- or below-target realisations of inflation and output, is mixed, as discussed in Section 2, a *de facto* asymmetry can emerge for symmetric parameter values when the economy operates close to the ELB.

When demographic and other structural factors (often referred to as "secular stagnation") bring the equilibrium interest rate i close to the ELB, episodes of ELB binding become more frequent in response to dis-inflationary shocks. The average response will therefore look weaker on the downside, i.e. *de facto* asymmetry of the policy response. By implication, the realised average inflation rate will fall below the target rate, narrowing the policy space between the average short-term interest rate and the ELB.[8] A discrepancy between actual and perceived policy rules may also trigger *de facto* asymmetry. E.g., if economic agents perceived an asymmetry in the policy response in the sense of less responsiveness to undershooting the target, inflation would hit the ELB (where the rule becomes unresponsive) more often, thereby confirming expectations on average and leading to lower average inflation rates.

The simulations in Section 4 will keep the policy rule symmetric in the parameters $\eta^{i\pi}$ and η^{i}, as specified in equation (1). At the same time, we approximate a narrowing of the monetary policy space - which can occur through a decline in the equilibrium real interest rate, a lower actual inflation target, or an explicit asymmetry in the policy response - by lifting the ELB to positive territory in the 'less policy space' case, so that the ELB binds more often and inflation is lower on average. We will see that the result of lower average inflation is obtained despite keeping the official inflation target and the interest rate rule unchanged.

3.2. PERSISTENT ACCOMMODATION AT THE ELB

The comparison of policy rules without and with low-for-longer component at the ELB builds on the previous discussion. The setting without low-for-longer element corresponds to equation (1) with $\eta^{i\pi}$=2.3 and η^{i}=0.1. Importantly, it is the actual policy rate that enters with one-quarter lag on the right side of equation (1). The latter implies that future policy will not take into account present binding constraints (directly). In particular, the inability, at present, to implement a negative 'shadow' rate does not directly affect the future policy stance.[9]

The policy with low-for-longer component, instead, takes the form of a more accommodating interest rate rule that delays tightening in a recovery from the ELB. It differs in one respect from equation (1), which is the presence of the lagged value of the 'shadow' rate, i_{t-1}^{NOT}, instead of the actual rate, i_{t-1}, on the right hand side:

$$i_t^{NOT} - i = \rho^i (i_{t-1}^{NOT} - i) + (1-\rho^i)\left(\eta^{i\pi}\frac{(\pi_t^{c,vat,QA} - \pi^{c,vat,QA})}{4} + \eta^{iy} Y_t^{gap,QA}\right) \qquad (2)$$

[8] There would be different ways of introducing explicit asymmetry in a monetary policy rule, other than imposing different coefficients for below- vs above-target realisations of inflation or the output gap. Hodge et al. (2022) introduces an additional penalty at the upper end which amplifies the response to inflation (only) if the latter exceeds the two-percent target by more than 1/2 percentage point. Eggertsson and Kohn (2023) introduce an asymmetry on the employment components in the central banks loss function, which leads to an interest rate bias term in the Taylor rule that depends on the variance of shocks that generate a trade-off between employment and inflation stabilisation.

[9] There would still be an indirect effect insofar as the inability to implement more forceful monetary easing at present affects future output and inflation outcomes to which monetary policy would, in turn, react. Note also that equation (1) implies some persistence also through the response to inflation and output over a 4-quarter horizon instead of an exclusively contemporaneous (current quarter) reaction.

As before, the actual policy rate and the 'shadow' rate coincide ($i_t = i_t^{NOT}$) away from the ELB, whereas $i_t = i^{LB}$ when the ELB binds ($i_t^{NOT} < i^{LB}$).

Contrary to equation (1), rule (2) keeps a memory of past instances of missing the target rate. The desired ('shadow') short-term rate enters current decisions with a lag, i_{t-1}^{NOT}, even when it was not implemented in the previous period due to a binding ELB.[10] Compared to rule (1), a lagged 'shadow' rate in negative territory in equation (2) delays the policy rate reversal (tightening) when the economy recovers from the ELB.

A low-for-longer policy can also be understood as an additional element of making the monetary policy response *ex post* symmetric. As mentioned above, an *ex ante* symmetric policy rule (same parameter values for target under- and overshooting) becomes asymmetric *ex post* when the ELB truncated the policy response at the downside. If shocks are big enough for the ELB to bind, mean inflation and output will be below target over the longer term. The low-for-longer approach can be interpreted as a strategy to extent monetary expansion in time when the policy response is truncated at present. This extension in time makes the overall response to booms and recessions more symmetric *ex post*.

It is important to underline that the chosen specification is just one of different possible ways to model the element of a 'forceful or persistent' response in a low rate environment in the ECB revised strategy. There are alternatives in the literature, including a stronger response to inflation, or variants of average inflation or price-level targeting (Andrade et al. (2021); Coenen et al. (2021); Erceg et al. (2021).

While the ECB has not endorsed any particular rule, we find specification (2) particularly interesting. A defining feature of the new strategy is that a 'forceful or persistent' policy response at the lower bound may also imply a transitory period in which inflation is moderately above target. Both 'transitory' and 'moderate' appear to be satisfied in our simulations.

Second, we do not model FG explicitly as a separate policy. Instead, including i_{t-1}^{NOT} in (2) implies a form of 'credible' (rule-based) FG compared to (1), because the policy rate remains low for longer in the recovery from a recession hitting the ELB, i.e. a recession during which the central bank was unable to implement its target interest rate. Given the memory of negative shadow rates, policy rule (2) is more inclined than (1) to tolerate an overshooting of the inflation target in a recovery from the ELB. We stress the element of credibility as the policy rule remains unchanged compared to policy in 'normal times'; additional FG as exceptional (discretionary) policy would, instead, risk facing more severe time inconsistency problems (e.g., Nakata (2018)).

3.3. SOLUTION TECHNIQUES AND ESTIMATION RESULTS

We compute an approximate model solution by linearising the model around its deterministic steady state. In line with standard practise, we calibrate a subset of parameters to match long-run data properties and estimate the remaining ones with Bayesian methods. The estimation uses 34 time series (27 for EA and 7 for RoW), covering the period 1999q1-2019q4, and it recovers the parameter values as well as the exogenous shocks that drive the dynamics of the endogenous variables.[11]

We limit the estimation sample to pre-Covid data to exclude the exceptional macroeconomic volatility, which the pandemic has created, from the policy comparison. Cardani et al. (2022) test the sensitivity

[10] In equation (1), instead, $i_{t-1} = 0$ when the economy operated at the ELB in period $t-1$.

[11] The path of endogenous variables around their steady-state values is often decomposed into the contribution of various exogenous drivers ('shock decompositions') to uncover the main forces of macroeconomic fluctuations over a particular period. Cardani et al. (2022) is a recent example for shock decompositions of EA GDP growth and inflation with the estimated GM model.

of parameter estimates to the inclusion of quarterly data for 2020-21, finding results to be stable when the model is augmented by transitory shocks (notably, 'forced savings') to capture the extreme volatility of private consumption and hours worked per employee (intensive margin) in the EA during the pandemic.

The estimation of the (linearised) model relies on a monetary policy rule of type (1) with 2% inflation target. The evaluation of the performance of the alternative monetary policy scenarios (less policy space, and low-for-longer component) uses a piecewise-linear approach and a stochastic setting to look at economic fluctuations of plausible size and distribution and allow for an occasionally binding ELB constraint. We compute and report summary statistics based on long-run Monte-Carlo simulations over 20,000 periods. The simulations are run drawing i.i.d. shocks from the estimated shock distributions. Draws are obtained with quasi-Monte Carlo methods, using scrambled Sobol sequences (see Owen (1998) and there references therein).

When performing stochastic simulations of piecewise linear models (as for any non-linear model), issues of non-convergence are likely to occur for specific combinations of states and shocks. In such cases, one could adopt a rejection strategy, by which, in each period of the simulation, one keeps re-drawing i.i.d. shocks until the solver finds a solution for that period and can progress to the next one. This 'brute force' approach raises two issues, however: (i) if the rejection rate is too high, stochastic simulation may be severely affected by selection bias, e.g. too many episodes of binding ELB may be rejected; (ii) when analysing variants of the model (e.g., different monetary policy rules), different rejection rates and selection biases across models may even falsify comparisons and policy conclusions.

To ensure that all variants of the model are exposed to the same sequence of shocks and, hence, properly compared, we run the simulations in blocks of 512 periods and keep blocks for which simulations converge for *all model versions*, until we reach the desired target of 40 blocks in a row (i.e. 20,480 periods). The use of entire blocks of 512 scrambled Sobol draws is key in this procedure, since it ensures that the sample of shocks is always well balanced and keeps the optimal properties of quasi-Monte Carlo sequences (Owen, 1998).

The simulations build on the set of estimated shocks. In particular, they use draws from the estimated distribution of the most common and relevant demand and supply shocks (domestic and foreign) estimated in the model, with the exclusion of permanent shocks.[12] Permanent shocks (e.g., shocks to the growth rate of TFP) are excluded, because long-term implications of permanent shocks may not be compatible with the model solution with myopic agents in Section 5, and because permanent shocks are beyond the scope of monetary and fiscal stabilisation policies, which are, instead, focused on stabilising fluctuations at business-cycle frequencies. We also exclude monetary policy shocks in order to focus on the systematic component of interest rate policy. In addition, monetary policy shocks have played no major role for EA output and inflation in recent years, according to shock decompositions at quarterly frequency.

4. SIMULATION RESULTS

This section presents and discusses the results from model simulations along the two dimensions discussed in detail above, i.e. (a) a change in the available policy space (which could be the result of a shift from an asymmetric to a symmetric policy rule, or a change in the inflation target, but is technically implemented through a shift in the ELB constraint), and (b) a low-for-longer policy rule at the exit from the

[12] See, e.g., Cardani et al. (2022) for a characterisation of estimated shock processes driving output and inflation volatility in the EA.

ELB. For the sake of a concise exposition, we focus on the benchmark model with rational expectations (RE) of intertemporally optimising agents. Section 5 will explore the robustness of the low-for-longer results to a stronger discounting of future policy actions and events. The interpretation of the simulation results focuses on differences with respect to the estimated baseline model.

4.1. INFLATION TARGET AND POLICY SPACE

Reacting less strongly to inflation when the latter is below the 2% target rate, or pursuing *de facto* a lower inflation target increases the likelihood of hitting the ELB as it lowers mean inflation and the mean nominal policy rate. The effect on the monetary policy space is equivalent to the impact of an increase in the ELB threshold, where the ELB is also more likely to bind for smaller negative shocks.

Table 1 compares the performances of a Taylor rule of type (1) with symmetric inflation response around the (annualised) 2% inflation target ('more space'), as set out in the strategy review, to an environment with narrower policy space ('less space'), where the rule achieves 1.75% average annual CPI inflation, which is within the range of 1.6-1.8% estimated by Paloviita et al. (2021), and which corresponds to average annual core inflation in the EA in 1999-2019.[13]

The upper part of Table 1 reports mean values and standard deviations for key macro variables over the entire simulation horizon, whereas the lower part zooms into periods during which the ELB binds. Less policy space (with a mean inflation of 1.75%) increases the probability of hitting the ELB by almost 4 pp. As shown in the first line of Table 1, the probability is 8% for the symmetric rule with 2% target ('more space') and 12% for the scenario with less inflation on average ('less space').[14]

Focusing on ELB episodes in the lower part of Table 1 also indicates lower inflation in the 'less space' scenario as well as a larger negative output gap on average. The expectation of more frequent and longer ELB episodes dampens inflation (expectations) and leads to higher expected real interest rates, which lower demand and further dampen inflation.[15]

Taken together, the 'more space' scenario with policy rule (1) and an ELB at zero increases mean inflation towards the target and reduces the probability of hitting the ELB compared to the 'less space' scenario with less distance from the ELB and average inflation of 1.75%. Even when the economy reaches the ELB, inflation remains higher and the (negative) output gap smaller in the first case, in line with a shorter expected ELB duration and less increase in the real interest rate. The mean level of the real effective exchange rate (REER) remains unaffected, pointing to an offsetting effect from nominal exchange rate appreciation.

[13]Note that stochastic simulations with the symmetric rule (also) generate slightly lower annualised mean inflation (1.97%) than the inflation target (2.00%). The reason is that large negative shocks in the estimated shock distribution drive monetary policy to the ELB, truncating the stabilising potential of short-term policy rate adjustment. By contrast, mean inflation corresponds exactly to the inflation target in a model with never-binding ELB, i.e. where the policy rate can also go into negative territory in the event of large recession shocks.

[14]The average nominal interest rate in Table 1 is the nominal short-term policy rate, where the mean is close to the average 3-month Euribor rate during 1999-2019. In the model, there is a wedge between the short-term policy rate (which determines the policy space and the probability of hitting the ELB for given shocks) and the household borrowing rate (which determines intertemporal consumption-savings decisions). The households' borrowing rate in steady state is linked to the rate of time preference and trend growth, and it is positive in real terms.

[15]Table 1 displays non-zero mean values of the policy rate in ELB episodes. This is because ELB periods refer to a currently binding constraint as well as the ELB binding in expectations. It is possible that policy is constrained in expectation, but not in the current period. This would then entail a positive number for the average policy rate in constrained episodes, where constrained episodes includes instances of the constraint being active in current periods, and such where the constraint is equally or only binding in expectations.

Table 1: '**More space' versus 'less space' scenarios**

		Full sample of simulations		
	stats	*(1) more space*	*(2) less space*	*(2)-(1)*
Annualised nominal interest rate	**p(elb)%**	8.15	11.67	3.53
	mean (pp)	1.57	1.38	-0.19
	std (pp)	1.00	1.00	0.00
Annualised inflation (consumption deflator)	**mean (pp)**	1.97	1.75	-0.22
	std (pp)	1.28	1.30	0.02
Output gap	**mean (pp)**	-0.03	-0.03	0.00
	std (pp)	2.86	2.88	0.02
Real effective exchange rate	**mean (pp)**	1.00	1.00	0.00
	std (pp)	0.16	0.16	0.00

		ELB episodes		
	stats	*(1) more space*	*(2) less space*	*(2)-(1)*
Annualised nominal interest rate	**mean (pp)|elb**	0.15	0.14	-0.01
	std (pp)|elb	0.17	0.14	-0.03
Annualised inflation (consumption deflator)	**mean (pp)|elb**	0.93	0.75	-0.18
	std (pp)|elb	1.17	0.79	-0.39
Output gap	**mean(pp)|elb**	-0.77	-0.84	-0.07
	std (pp)|elb	3.21	1.61	-1.60
Real effective exchange rate	**mean (pp)|elb**	1.02	1.01	-0.01
	std (pp)|elb	0.16	0.08	-0.08

Note: The moments are based on simulations of the non-linear model with occasionally binding ELB with random draws (for 20,000 periods) from the estimated distribution of shocks. The upper part reports results for the entire simulation period; the lower part reports the results conditional on the ELB binding.

4.2. PERSISTENT ACCOMMODATION AT THE ELB

As explained in Subsection 3.2, the interest rate rule (2) keeps policy rates low for longer at the ELB compared to rule (1) without memory of past instances of missing the target. It implies that, when at the ELB with below-target inflation, the central bank is going to tighten interest rates more slowly in the recovery phase than would be the case under normal conditions. Away from a binding ELB, both rules coincide.

The expectation, under the low-for-longer policy rule, of systematically more-gradual monetary tightening in the recovery from the ELB implies lower expected interest rates in the medium term and, in combination with higher expected inflation, lower levels of the expected real interest rate. These elements support interest-sensitive private sector demand at the ELB. The low-for-longer rule, which includes the lagged 'shadow' rate, implies that current policy responds to past inability, associated with the ELB, to reach the inflation (and output gap) target. By consequence, the central bank will tighten later and more gradually at the exit from the ELB, i.e. be more expansionary compared to Taylor rule (1) with otherwise identical arguments and parameter values.

The difference in quantitative terms between the policy rules (1) and (2) is shown in Figure 1. It depicts the inflation and interest rate path in a period of severe contractionary shocks for three different policy settings. First, as a (hypothetical) reference point, the linearised model without ELB constraint, labelled 'linear' (red lines), in which the central bank can always implement the desired policy rate, even if the latter is negative, so that rules (1) and (2) are the same. Second, rule (1) with lagged values of the actual interest rate (truncated at zero), which is labelled 'non-shadow' (blue lines). Third, the low-for-longer rule (2) with the lagged shadow rate, labelled 'shadow' (yellow lines). Given the focus on differences at the ELB, all interest rate rules have the same symmetric inflation target (annually 2%) and are identical with respect to the response coefficients to inflation, the output gap, and the lagged interest rate.

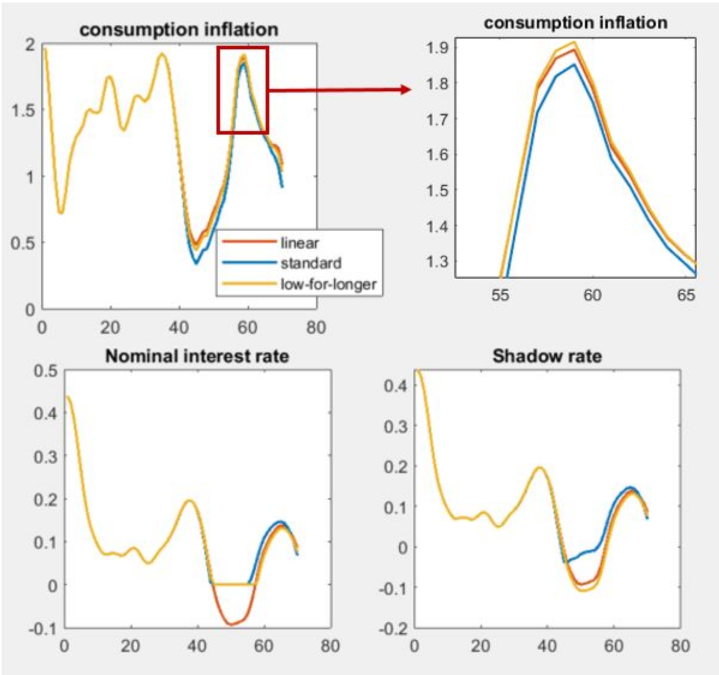
The shadow rate in the piecewise-linear model with low-for-longer rule (yellow line) tracks the unconstrained policy rate in the linear model (red line) closely. It falls somewhat more in the non-linear case, because, for given recessionary shocks, macroeconomic fundamentals are worse when the ELB binds. The shadow rate declines less at the ELB when the rule includes the lagged actual policy (instead of the shadow) rate (blue line). Figure 1 shows that, at the exit from the ELB, rule (2) implies a delayed tightening of the policy rate ('low for longer') compared to the policy rule (1). By implication, the low-for-longer policy rule (yellow line) stabilises inflation at the ELB better than rule (1) (blue line). The low-for-longer rule also implies higher inflation at the peak of the post-ELB recovery, but the difference is small (zoomed in at the top-right panel).

Table 2 summarises the simulation results for the policy rate, inflation, the output gap, and the REER. The upper part of the Table reports numbers for the entire simulation horizon. The lower part zooms into outcomes during ELB episodes. The first column of numbers ('standard') displays simulation results for Taylor rule (1). The second column ('low-for-longer') displays the results for the more persistent accommodation under the low-for-longer rule (2). The third column shows the difference between columns 2 and 1. All simulations use the non-linear model with occasionally binding ELB.

The upper part of Table 2 provides very similar results for both interest rate rules. This is not surprising and due to the fact that, in practical terms, the two rules only differ at the ELB, and the frequency of ELB periods is limited. In particular, the probability of hitting the ELB is 8% in column 1.[16] Note-

[16]The probability of operating at the ELB is higher (10%) in column 2, because rule (2) with response to the shadow rate has

Figure 1: **Inflation, actual and target policy rates under different policy rules**



Note: Inflation is the quarterly annualised change in the consumer price index as defined in equation 1; the nominal interest rate is the quarterly rate. On the y-axes, 1 corresponds to 1%. The x-axis shows the time dimension, i.e. the number of periods for which simulations are reported (realisations in a given period are a mix of delayed effects of past shocks and the response to new shocks). The panels zoom into a 70-period window (out of 20,000 periods in total) dominated by contractionary shocks, except the top right panel, which represents the zoomed rectangular area of the top left panel. Average inflation over this 70-period window is, by consequence, lower than the sample mean displayed in Table 2.

Table 2: **Low-for-longer policy rule with symmetric inflation target**

		Full sample of simulations		
	stats	***(1) standard***	***(2) low-for-longer***	***(2)-(1)***
Annualised nominal interest rate	**p(elb)%**	8.15	9.58	1.43
	mean (pp)	1.57	1.56	-0.01
	std (pp)	1.00	1.00	0.00
Annualised inflation (consumption deflator)	**mean (pp)**	1.97	1.99	0.02
	std (pp)	1.28	1.29	0.00
Output gap	**mean (pp)**	-0.03	-0.01	0.02
	std (pp)	2.86	2.87	0.01
Real effective exchange rate	**mean (pp)**	1.00	1.00	0.00
	std (pp)	0.16	0.17	0.00

		ELB episodes		
	stats	***(1) standard***	***(2) low-for-longer***	***(2)-(1)***
Annualised nominal interest rate	**mean (pp)|elb**	0.15	0.13	-0.02
	std (pp)|elb	0.17	0.16	-0.01
Annualised inflation (consumption deflator)	**mean (pp)|elb**	0.93	1.11	0.18
	std (pp)|elb	1.17	1.06	-0.11
Output gap	**mean(pp)|elb**	-0.77	-0.58	0.20
	std (pp)|elb	3.21	3.11	-0.10
Real effective exchange rate	**mean (pp)|elb**	1.02	1.03	0.01
	std (pp)|elb	0.16	0.16	0.00

Note: The moments are based on simulations of the non-linear model with occasionally binding ELB with random draws (for 20,000 periods) from the estimated distribution of shocks. The upper part reports results for the entire simulation period; the lower part reports the results conditional on the ELB binding.

worthy, and in line with the theoretical priors, is the higher average inflation under the low-for-longer policy rule, due to the forward guidance element illustrated in Figure 1.

Focusing on the lower part of Table 2 (ELB episodes), i.e. the situation where the low-for-longer rule differs from the policy rule (1) in terms of (quantitative) policy prescriptions, we find substantially higher mean inflation (1.1% instead of 0.9%) with the shadow-rate rule (2) and a smaller negative output gap (-0.6% instead of -0.8%). Mean differences between both policy rules are minor for the REER, suggesting a compensating adjustment of domestic prices and the nominal exchange rate. In sum, the low-for-longer policy rule implies gains in terms of inflation and output stabilisation around the ELB. In quantitative terms, the gains are rather contained for our parametrisation of the monetary policy rule (notably, 0.2 pp. for inflation), however.

Similarly, existing papers looking at alternative monetary policy rules that would implement persistent accommodation in response to shocks that lower inflation and output below target, such as average inflation targeting (AIT), or price level targeting (PLT), find only moderate differences, compared to a standard Taylor rule, with respect to long-term averages of inflation and the output gap, in line with Table 2, but (partly) larger differences concerning the volatility of inflation and output (e.g., Arias et al. (2020); Coenen et al. (2021); Erceg et al. (2021)). The comparison has to keep in mind that the implied deviations from a standard Taylor rule in these papers tend to be larger than the modification in equation (2), which replaces only the lagged interest rate on the right side of the equation, but keeps all parameter values as in (1).

A possible objection against low-for-longer policies is that they may react too slowly at the exit from the ELB (which would also imply a problem of time consistency and ex ante credibility of the policy). An interesting case is the post-Covid recovery, combined with a large energy price shock, which has caused a strong increase in inflation. Would a low-for-longer rule imply a substantially steeper rise in the inflation rate? Would it make a notable difference with respect to output stabilisation?

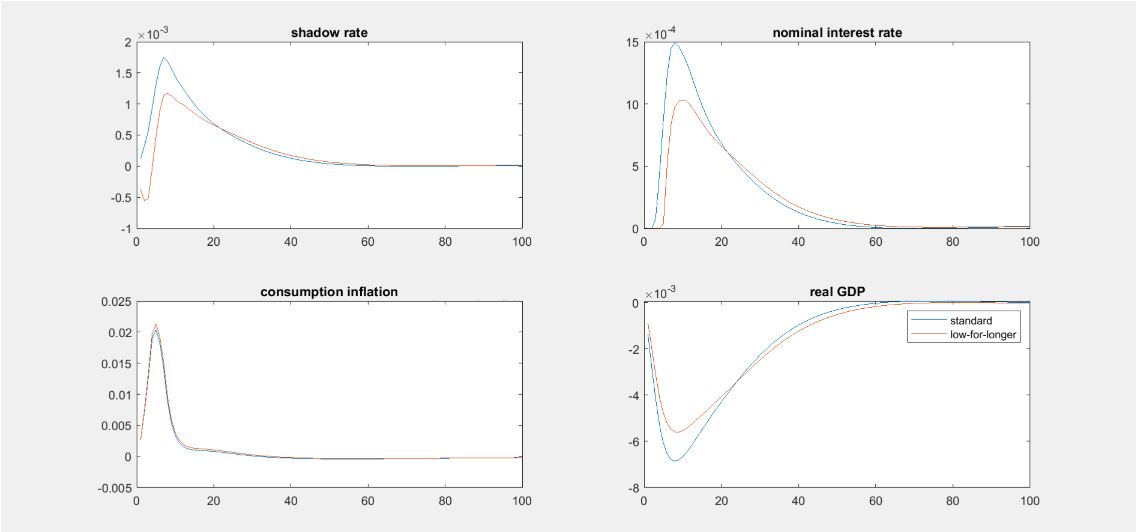
Figure 2 addresses this question. It shows impulse responses for an energy price shock that lifts CPI inflation by (at peak) 2 pp. While the size of the shock is illustrative, it corresponds approximately to the contribution of commodity prices to EA CPI inflation in 2022 in Cardani et al. (2023).[17] Figure 2 shows the response to the energy price shock under the standard Taylor rule (1) and the low-for-longer specification (2). At the starting point the economy operates at the ELB. Initially, the low-for-longer rule even point to a further decline of the shadow rate, in light of past undershooting of inflation and output targets, despite the occurrence of the large negative supply shock. Monetary policy then tightens interest rates, more strongly under the standard rule without memory of the past low-inflation environment (annualised 60 basis-point policy rate at peak).

Given the implied steeper tightening, the standard rule (1) generates a stronger output contraction (circa 0.2 pp. more output contraction), in light of the inflation-output trade-off in the monetary stabilisation of supply shocks. Interestingly, however, the inflation response is practically the same in both cases, i.e. an increase in the inflation rate by 2 pp. at peak, which is only marginally larger under the low-for-longer strategy. While differences might be small in light of the moderate difference between

longer periods in which the central bank would want to keep the policy rate below the ELB, and keeps it at the ELB as a result.

[17]The impulse responses in Figure 2 are generalised impulse response functions(GIRF), which take account of the occasionally binding ELB. With an occasionally binding constraint, the impact of a particular shock depends on the shock size and also on all other shocks, because the latter matter for whether the economy operates at the constraint, or not, which in turn affects the transmission of the shock, notably the (available) policy response. In practise, the model is simulated (1) with the full set of shock from a given starting point, and (2) with all shocks except the shock of interest. The response to the shock of interest is then the difference between (1) and (2) with respect to the trajectories of the dependent variables.

Figure 2: **Low-for-longer and inflationary shocks**



Note: The x-axis indicates the number of time periods (quarters) after the shock. On the y-axis, inflation is the quarterly annualised change in the consumer price index (0.01 = 1*pp.*) as defined in equation 1; the nominal interest rates (shadow rate, actual rate) are quarterly rates (0.01 = 1*pp.*); real GDP is shown in log levels.

the two policy rules, they also point towards effectiveness of elements of forward guidance away from the ELB. In particular, the anticipation of a more persistent tightening under the low-for-longer rule with endogenous interest rate persistence, as shown in Figure 2, dampens inflation expectations, which feeds back into lower current inflation in the New Keynesian Phillips curve.[18]

5. ROBUSTNESS WITH RESPECT TO MYOPIC BEHAVIOUR

The effectiveness of low-for-longer policies rests on the ability of policy makers to anchor the expectations of the private sector. Households and firms respond by revising their expectations about future interest rates downwards and inflation expectations upwards. Both imply lower real interest rates in the medium term, which implies less saving and stronger current demand by intertemporally optimising households and firms.

Deviations from full-information rational expectations (RE) reduce the power of the expectations channel of monetary policy. When discussing benefits of revisions to monetary policy, it is therefore important to understand the quantitative relevance of deviations from RE for the policy transmission. Robustness of the benefits of a particular policy to (plausible) modifications of the underlying model, reflecting uncertainty about the functioning of the economy, increases the policy's appeal.

The DSGE literature has explored various ways of departing from the RE assumption. One way is the introduction of financially constrained households. The latter may have accurate expectations about the future, but cannot (fully) act on them. The benchmark GM model includes this departure from fully

[18]The importance of the expectations channel for the effectiveness of low-for-longer in stabilising the economy at the exit from the ELB is corroborated by the observation that the Gabaix (2020) extension of Section 5 widens the gap between the standard and the low-for-longer policy rule in the stabilisation of the inflationary energy price shock, with the low-for-longer performance deteriorating compared to the faster response under the standard Taylor rule.

forward-looking behaviour by including liquidity-constrained households, accounting for a part of the population (ca. 1/3 of households for the EA). Other departures from RE in dynamic adjustment include myopic behaviour, backward-looking ('adaptive') expectations, or learning about shocks and structure.

This section augments the GM model with myopic households as introduced by Gabaix (2020). Myopic households discount the future more strongly than RE agents, who act in line with their subjective rate of time preference. Stronger discounting of future events and actions should dampen the power of low-for-longer policies that target private sector expectations with the objective of affecting private sector behaviour at present. We do not re-estimate the model, but plug the estimated shocks from the RE set-up into the model version with myopia (i.e., where households discount expected future fluctuations in economic activity and inflation more strongly than the households' rate of time preference would suggest). The results show how myopic agents would react to the same shocks and policies as in the RE model. In particular, we are interested in whether the low-for-longer policy rule implies similar stabilisation gains as in the RE benchmark.[19]

In technical terms, the Gabaix (2020) approach linearises the model around the RE steady state and then adds additional discounting to where the discount factor appears in the equations governing the dynamic adjustment to shocks. Hence, agents have RE concerning the long-run equilibrium, but discount expectations about the adjustment process more strongly.

The Gabaix (2020) approach has become fairly popular in monetary policy models (e.g. Budianto et al. (2023), Erceg et al. (2021)) as a way of alleviating the FG puzzle. The FG puzzle consist in the observation that, in standard New Keynesian RE models, the power of an interest rate change increases the further it occurs in the future. Myopic behaviour as in Gabaix (2020) counteracts the increasing power with increasing distance in time. It does not cancel the impact of FG policies over the shorter horizon, however. Backward-looking (adaptive) expectations, to the contrary, would weaken the impact of FG at any time horizon, not only concerning the distant future.[20]

Table 3 displays simulation results for the interest rate rule (1) with lagged actual interest rate ('standard'), where the latter is truncated at the ELB, and rule (2) with lagged response to the shadow rate ('low-for-longer'), which implies a low-for-longer stance in the recovery from the ELB.

Columns 1 and 5 ('RE') in Table 3 correspond to columns 1 and 2 in Table 2. The other columns report the results for increasing degrees of myopia, i.e. increasingly strong discounting of future policies and events.[21]

Myopia reduces the probability of hitting the ELB, compared to RE, for both policy rules and given shocks. The reason is that myopia also discounts future exogenous factors, embodied in the autoregressive shock processes. ELB episodes in the RE model are mainly driven by persistent negative shocks. Myopic behaviour dampens the response to shock persistence and, hence, the contraction of private sector demand. In line with less relevance of shock persistence and less frequent ELB episodes, myopic behaviour, for the same shocks, implies that mean inflation is closer to target, the output gap is smaller,

[19]We do not re-run the more 'versus less policy space comparison with myopic agents, because the difference there relates to the contemporaneous policy response, and myopic behaviour is less relevant for comparing alternative contemporaneous policy responses.

[20]Examples of monetary policy models with hybrid expectations include Fuhrer and Moore (1995), and Rudebusch (2002). Gust et al. (2022) develop a 'mixed' model, where households build forward-looking expectations over the shorter horizon (up to around two years), but are backward-looking in the longer term. Hebden et al. (2020) analyse the robustness of make-up strategies in the context of the Fed's strategy review in a model with learning.

[21]The parameter values (0.8-0.95) for the Gabaix (2020) extension have qualitatively and quantitatively the same interpretation as the discount factor in standard models of forward-looking behaviour. Erceg et al. (2021) provide an estimate of 0.95 for the cognitive discounting parameter; in light of this, a value of 0.8 is rather extreme.

Table 3: **Gains from low-for-longer policy with RE and myopic behaviour**

Full sample of simulations									
		(1) standard				(2) low-for-longer			
	stats	**RE**	**Gbx 0.95**	**Gbx 0.9**	**Gbx 0.8**	**RE**	**Gbx 0.95**	**Gbx 0.9**	**Gbx 0.8**
Annualised nominal interest rate	**p(elb)%**	8.15	4.48	3.34	2.40	9.58	5.50	4.20	3.14
	mean (pp)	1.57	1.55	1.55	1.55	1.56	1.55	1.55	1.54
	std (pp)	1.00	0.85	0.77	0.74	1.00	0.85	0.77	0.74
Annualised inflation (consumption deflator)	**mean (pp)**	1.97	1.99	2.00	2.00	1.99	2.00	2.00	2.00
	std (pp)	1.28	1.14	1.08	1.00	1.29	1.14	1.08	1.00
Output gap	**mean (pp)**	-0.03	-0.01	-0.01	-0.01	-0.01	0.00	0.00	-0.01
	std (pp)	2.86	2.54	2.40	2.35	2.87	2.54	2.40	2.35
Real effective exchange rate	**mean (pp)**	1.00	1.00	1.00	1.01	1.00	1.00	1.00	1.01
	std (pp)	0.16	0.18	0.20	0.25	0.17	0.18	0.20	0.25

ELB episodes									
		(1) standard				(2) low-for-longer			
	stats	**RE**	**Gbx 0.95**	**Gbx 0.9**	**Gbx 0.8**	**RE**	**Gbx 0.95**	**Gbx 0.9**	**Gbx 0.8**
Annualised nominal interest rate	**mean (pp)|elb**	0.15	0.15	0.15	0.13	0.13	0.13	0.12	0.10
	std (pp)|elb	0.17	0.17	0.18	0.15	0.16	0.16	0.17	0.12
Annualised inflation (consumption deflator)	**mean (pp)|elb**	0.93	1.13	1.18	1.23	1.11	1.18	1.22	1.26
	std (pp)|elb	1.17	0.94	0.96	0.94	1.06	0.92	0.95	0.94
Output gap	**mean(pp)|elb**	-0.77	-0.71	-0.91	-1.10	-0.58	-0.64	-0.86	-1.08
	std (pp)|elb	3.21	2.65	2.37	2.25	3.11	2.66	2.37	2.22
Real effective exchange rate	**mean (pp)|elb**	1.02	0.98	0.93	0.87	1.03	0.98	0.94	0.88
	std (pp)|elb	0.16	0.16	0.18	0.23	0.16	0.16	0.18	0.23

Note: The moments are based on simulations of the non-linear model with occasionally binding ELB with random draws (for 20,000 periods) from the estimated distribution of shocks. The upper part reports results for the entire simulation period; the lower part reports the results conditional on the ELB binding. Gbx stands for the Gabaix (2020) extension with different degrees of myopia.

and inflation and output are less volatile.

Overall, the standard Taylor-type rule (1) and the low-for-longer rule (2) perform similarly with myopic behaviour, given that both rules differ only during ELB episodes, which become less frequent with the Gabaix (2020) extension for an unchanged set of shocks. The low-for-longer rule (columns 5-8) still performs better than the standard rule, but the difference is less pronounced under myopic private sector behaviour compared to the benchmark RE model. Mean inflation under the low-for-longer rule increases from 1.1% (RE) to 1.2-1.3% for different degrees of myopia, and from 0.9% to 1.1-1.2% under the standard Taylor-type rule. Similarly, differences in the average output gap, which is less negative for the low-for-longer rule (2) compared to (1) in the RE setting, become smaller with myopic behaviour. Hence, myopic behaviour lowers the stabilisation gain from low-for-longer without (for the degrees of myopia considered here) completely offsetting it. The promise of more persistent accommodation has less traction with myopic agents compared to RE.

Our results are not directly comparable to Erceg et al. (2021), given the differences in the underlying models and the scenario design. The orders of magnitude of the effects (different policies, and comparison of RE with myopic behaviour) appear to be similar, however, including the limited average stabilisation gain.

6. CONCLUSION

This paper has explored the macroeconomic impact of modifications to monetary policy rules that (a) provide different degrees of policy space (linked, e.g., to asymmetric versus symmetric reactions to deviations from target, or a shift in the inflation target), or (b) include a commitment to provide persistent accommodation in the recovery from the ELB (low-for-longer). The aim of the exercise has been to characterise, at least qualitatively, the possible implications of core elements of the ECB Strategy Review of 2021 (notably the commitment to a symmetric HICP inflation target of 2%, and the commitment to take into account asymmetries induced by the ELB in the conduct of post-ELB policy, including a 'forceful or persistent' response that would also tolerate a temporary and moderate overshooting of the inflation target).

Our analysis uses a two-region (EA, RoW) configuration of the European Commission's estimated DSGE model (GM). The quantitative results are illustrative, given that the Strategy Review did not specify a particular policy rule. We simulate the model with occasionally binding ELB constraint with draws from the estimated distribution of shocks, including demand and supply as well as domestic and foreign disturbances. The simulations suggest that both components (increasing the average distance from ELB, and more persistent accommodation in the neighbourhood of the ELB) improve the ability of monetary policy to achieve its inflation target and to stabilise output around potential.

In particular, a symmetric 2% inflation target, which lifts inflation by 0.2 pp. from the 1999-2019 average of core inflation (1.75%) to 2%, reduces the probability of hitting the ELB in our simulations by 4 pp., from 12% to 8%. The lower frequency of ELB episodes increases, on average, the central bank's room for manoeuvre to stabilise the economy in the event of severe negative shocks.

In addition, a low-for-longer policy at the exit from the ELB can help stabilising the economy at the ELB as long as the commitment is credible. Average inflation during ELB episodes would be lifted by 0.2 pp., from 0.9% to 1.1%, and the output gap by the same amount, from -0.8% to -0.6%, for our parametrisation of the standard and the low-for-longer interest rate rules. Qualitative results are robust to behavioural deviations from full-information rational expectations in the form of myopia (Gabaix (2020)), but the power of the low-for-longer component declines in quantitative terms when households and firms become less forward-looking.

Importantly in the current context, low-for-longer policy geared towards a low-rate and low-inflation environment does not jeopardise macroeconomic stabilisation in the event of (inflationary) negative supply shocks at the exit from the ELB according to the simulations as long as private agents are sufficiently forward-looking.

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