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## The effective lower bound: some implications for inflation dynamics beyond the current low interest rate environment

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*The fact that there is an effective lower bound (ELB) on nominal interest rates makes it more difficult for central banks to achieve their inflation objectives with conventional policy tools. This is the case not only in the current environment where policy rates are at, or close to, the ELB, but also when the economy has recovered and policy rates have risen above the ELB.*

It is well understood that if the effective lower bound (ELB) on nominal interest rates is binding so that policy rates cannot be lowered further, it becomes more difficult for central banks to stabilise inflation at its objective using conventional policies. This article argues that even when economic conditions have improved and policy rates have risen above the ELB, the possibility that policy rates may have to return to the ELB in the future – known as ELB risk – is likely to complicate the tasks of central banks in achieving their inflation objectives. This reflects the fact that a forward-looking private sector takes into account such ELB risk when making economic decisions.

The analysis is based on a dynamic stochastic general equilibrium (DSGE) model with rational expectations described in Hills, Nakata and Schmidt (2016). The model is solved using techniques that account appropriately for agents' expectation formation in a non-linear environment. Monetary policy follows an interest rate rule that responds to deviations of inflation from target, the output gap, and the lagged "shadow" policy rate. The shadow policy rate represents the interest rate that would prevail if there were no lower bound on policy rates.<sup>[2]</sup> The baseline calibration assumes an inflation objective of 1.9%, a productivity growth trend of 1.25%, and an ELB at zero.

In the model, the ELB renders asymmetric the central bank's ability to respond to fluctuations in inflation (and the output gap) by means of conventional interest rate policy. The central bank is unconstrained in raising the policy rate to counteract inflationary pressures but may become constrained by the ELB when lowering the policy rate to counteract a decline in inflation. This asymmetry affects private sector expectations and decisions, not only in times when the policy rate is constrained by the ELB, but also in times when the policy rate is above the ELB. This is because even if the policy rate is above the ELB, private agents factor in the possibility that the ELB might constrain interest rate policy in the future.<sup>[3]</sup> The tail risk induced by the ELB constraint tilts private sector inflation expectations to the downside, and these lower expectations also feed into lower actual inflation rates.

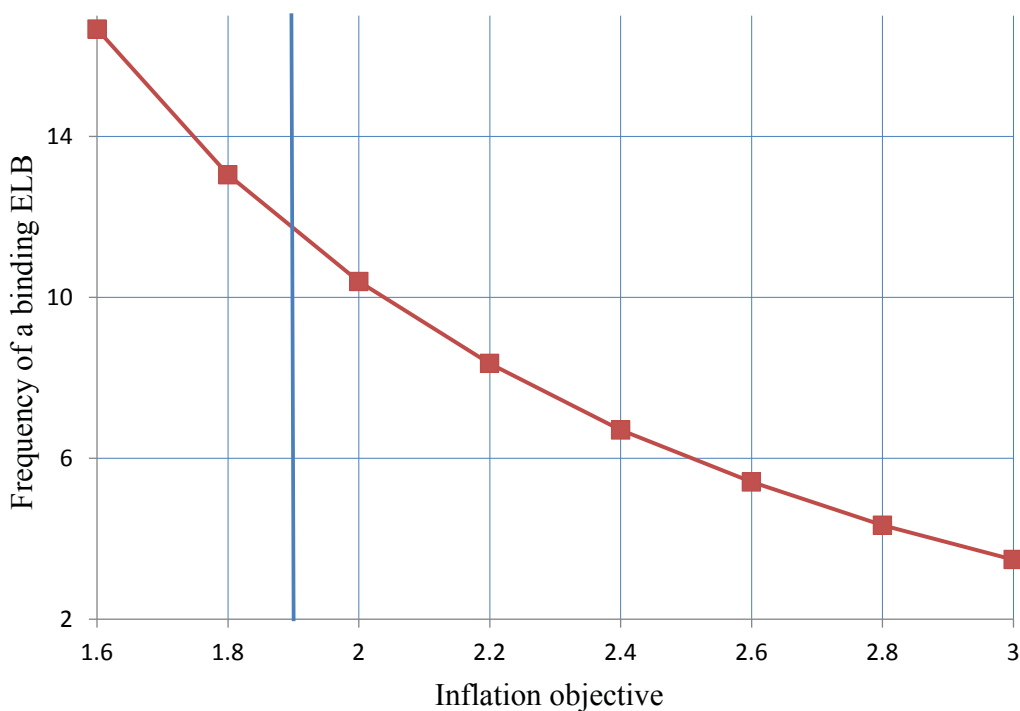
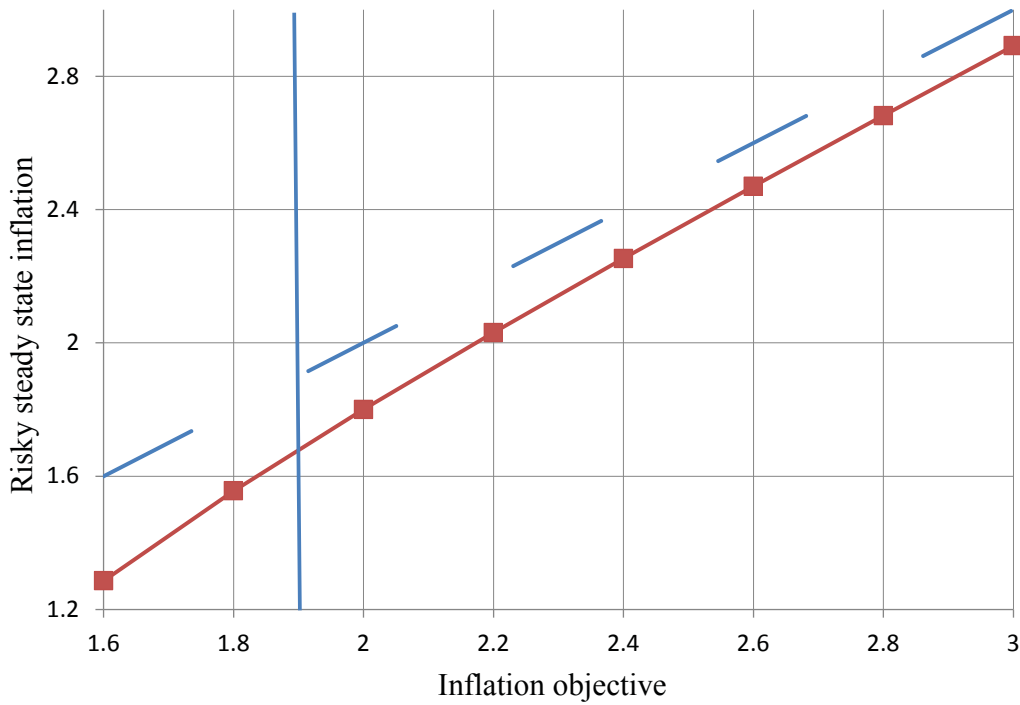
The concept of the "risky steady state" of inflation – the point at which the inflation rate eventually settles as existing economic disturbances dissipate, while taking into account the uncertainty associated with future disturbances – provides a way of quantifying the long-term consequences associated with ELB risk. The risky steady state differs from the more common concept of the deterministic steady state in that it accounts for the risk associated with future economic shocks. If the ELB constraint is removed from the model, the discrepancy between the risky steady state of inflation and its deterministic steady state, which corresponds to the central bank's inflation objective, is negligible.

If, instead, the ELB is taken into account, the model's risky steady state of inflation falls short of the central bank's inflation objective by 0.2 percentage point. According to the model, the presence of ELB risk leads to a systematic undershooting of the inflation objective in the long term – this is referred to as the deflationary bias. The central bank responds to below-target inflation by lowering the policy rate, as prescribed by the policy rule, but the reduction in nominal interest rates is not aggressive enough to fully

offset the deflationary bias. In the risky steady state, the policy rate, as modelled, is 3.3%; this is 0.4 percentage point below its level in the deterministic steady state.

Chart 1 below shows how the risky steady state of inflation and the frequency of a binding ELB constraint depend on the quantitative definition of the inflation objective. Lower inflation objectives are associated with larger deflationary biases. The lower the central bank's inflation objective, the more often the ELB constraint binds in the model simulations. Higher ELB risk increases the asymmetry in the distribution of inflation and translates into a lower inflation rate at the risky steady state. For instance, lowering the inflation objective from 1.9% to 1.6% increases the frequency of a binding ELB constraint by 5 percentage points and raises the discrepancy between the risky steady state of inflation and the inflation objective from 0.2 to 0.3 percentage point.

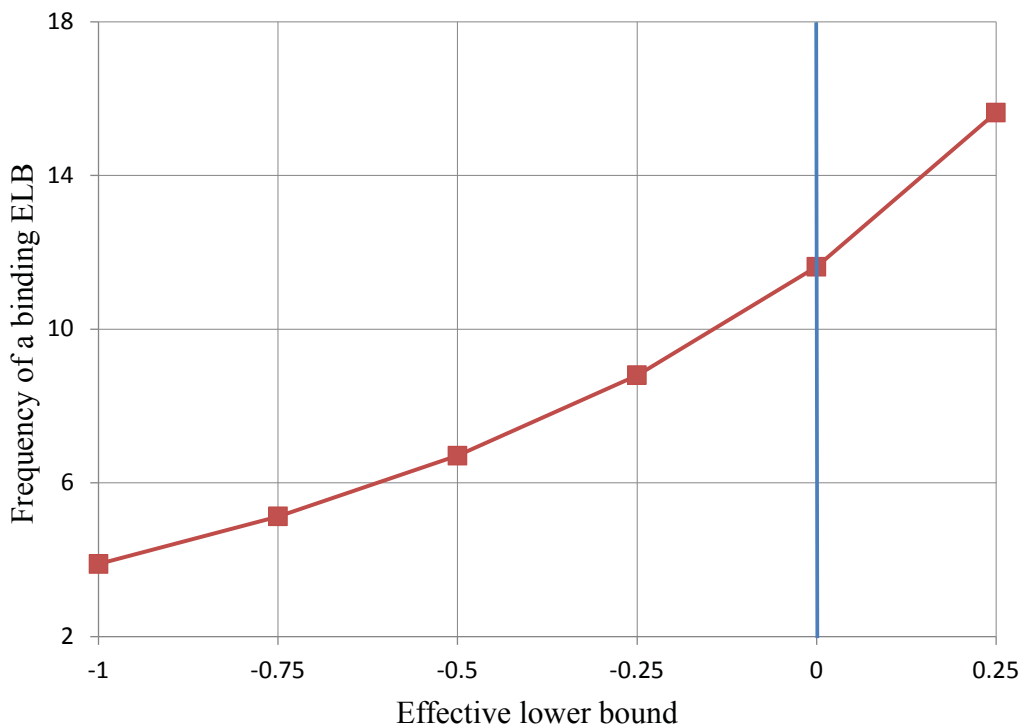
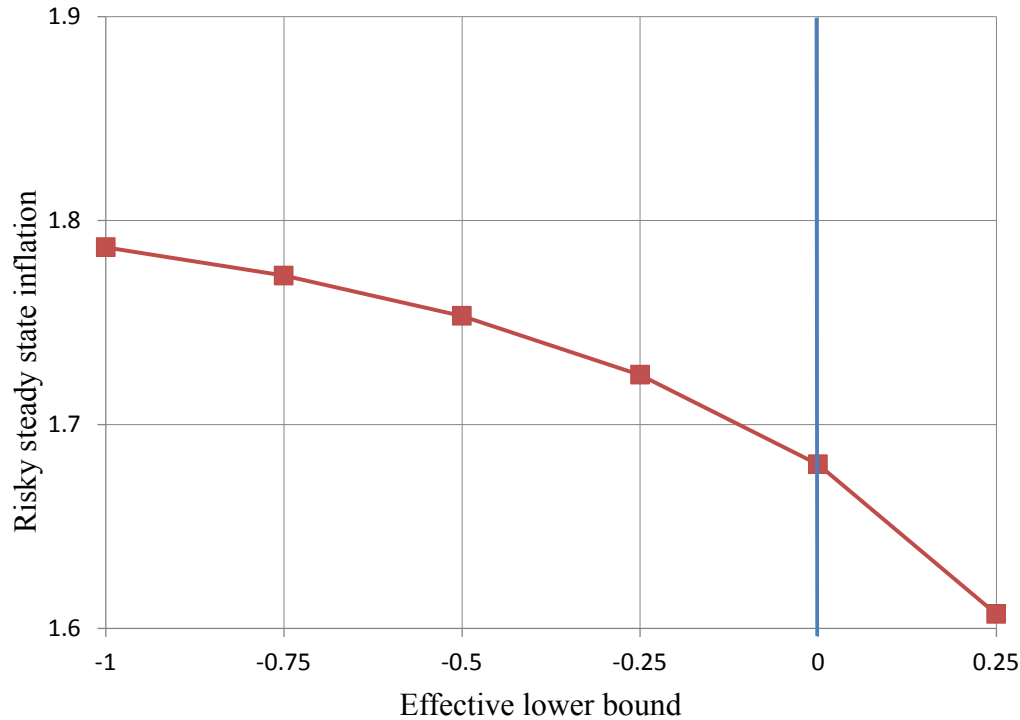
**Chart 1: The role of the inflation objective**



Notes: Inflation is expressed as a percentage in annualised terms, and the frequency of a binding ELB constraint is expressed as a percentage. Vertical solid blue lines indicate the baseline calibration. The dashed line in the upper panel delineates the 45-degree line.

Chart 2 below shows how the risky steady state of inflation and the frequency of a binding ELB constraint depend on the level of the ELB. If the ELB is negative rather than zero, then the ELB constraint binds less often and the difference between the risky steady state and the central bank's inflation objective becomes smaller.

**Chart 2: The role of the effective lower bound (ELB)**



Notes: Inflation is expressed as a percentage in annualised terms, and the frequency of a binding ELB constraint is expressed as a percentage. Vertical solid blue lines indicate the baseline calibration.

While a higher inflation objective – if credible – and negative interest rate policies can, according to the analysis, mitigate the deflationary bias, these are not the only tools available to central banks. To the extent that balance-sheet policies of the type employed by various central banks improve stabilisation outcomes at the ELB, they also help to re-align the risky steady state of inflation with the central bank's objective by mitigating the asymmetry in the ability of monetary policy to respond to inflationary and disinflationary economic disturbances. See, for instance, Coenen and Schmidt (2016) and Reifschneider (2016). Furthermore, Nakata and Schmidt (2016) show that the standard interest rate rule can be adjusted so that the risky steady state inflation rate equals the central bank's inflation objective.

Finally, it is important to keep in mind that the theoretical analysis presented does not include any measurement of the welfare costs and benefits associated with achieving a certain rate of inflation, but merely explores how the task of central banks in meeting their inflation objectives is likely to become more complicated in an environment where the private sector considers it likely that monetary policy might be constrained by the ELB in the future.

## References

Coenen, G., and Schmidt, S. (2016), "The role of the ECB's asset purchases in preventing a potential de-anchoring of longer-term inflation expectations", *Research Bulletin*, ECB, Frankfurt am Main, 25 July.

Hills, T., Nakata, T. and Schmidt, S. (2016), "The risky steady state and the interest rate lower bound", *Working Paper Series*, No 1913, ECB, Frankfurt am Main, June.

Nakata, T. and Schmidt, S. (2016), "The risk-adjusted monetary policy rule", *Finance and Economics Discussion Series*, 2016-061, Board of Governors of the Federal Reserve System, Washington.

Reifschneider, D. (2016), "Gauging the ability of the FOMC to respond to future recessions", *Finance and Economics Discussion Series*, 2016-068. Board of Governors of the Federal Reserve System, Washington.

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<sup>[1]</sup>Disclaimer: This article was written by Sebastian Schmidt (Economist, Directorate General Research, Monetary Policy Research Division). The views expressed here are those of the author and do not necessarily represent the views of the European Central Bank and the Eurosystem. The author would like to thank Paul Dudenhefer and Geoff Kenny for their helpful comments.

<sup>[2]</sup>The larger the economic downturn in a liquidity trap, the more negative is the shadow rate and the longer the actual policy rate remains low.

<sup>[3]</sup>For instance, in the United States, market participants attach a 30% probability (median) to moving to the zero lower bound at some point in 2016-2019. For more details, see Federal Reserve Bank of New York (2016), *Survey of Market Participants*, New York, September.

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