

Billi, Roberto

Working Paper

Price level targeting and risk management

Sveriges Riksbank Working Paper Series, No. 302

Provided in Cooperation with:

Central Bank of Sweden, Stockholm

Suggested Citation: Billi, Roberto (2016) : Price level targeting and risk management, Sveriges Riksbank Working Paper Series, No. 302, Sveriges Riksbank, Stockholm

This Version is available at:

<http://hdl.handle.net/10419/189925>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

SVERIGES RIKSBANK
WORKING PAPER SERIES

302



Price Level Targeting and Risk Management*

Roberto Billi

June 2015 (revised December 2016)

WORKING PAPERS ARE OBTAINABLE FROM

Sveriges Riksbank • Information Riksbank • SE-103 37 Stockholm

Fax international: +46 8 787 05 26

Telephone international: +46 8 787 01 00

E-mail: info@riksbank.se

The Working Paper series presents reports on matters in the sphere of activities of the Riksbank that are considered to be of interest to a wider public.

The papers are to be regarded as reports on ongoing studies and the authors will be pleased to receive comments.

The views expressed in Working Papers are solely the responsibility of the authors and should not to be interpreted as reflecting the views of the Executive Board of Sveriges Riksbank.

Price Level Targeting and Risk Management*

Roberto M. Billi

Sveriges Riksbank Working Paper Series No. 302

Revised December 2016

Abstract

Many argue that, because the outlook for the economy is uncertain, monetary policy should apply a risk management approach by raising the policy interest rate gradually from its lower bound. Using a small New Keynesian model, I study the impact of outlook uncertainty on the economic performance of a central bank with a target for the price level or the level of nominal gross domestic product. I show that, in the presence of persistent supply and demand shocks, a price-level target is more effective at mitigating outlook uncertainty because it induces greater policy inertia and improves the tradeoffs faced by the central bank.

Keywords: nominal level targets, optimal policy, inertial Taylor rule

JEL: E31, E52, E58

*I thank for helpful comments Nick Bloom, Chris Carroll, Larry Christiano, Troy Davig, Mike Dotsey, Jeff Fuhrer, Jordi Galí, Marvin Goodfriend, Michael Johnston, Federico Ravenna, Ricardo Reis, Øistein Røisland, Stephanie Schmitt-Grohé, Lars Svensson, Karl Walentin, Ken West, Volker Wieland, Mike Woodford, seminar participants at the Bank of Finland, Federal Reserve Bank of Kansas City, HECER, IIES, Norges Bank, and Sveriges Riksbank, as well as conference participants at the Bank of Canada, Durham University Business School, NASM, and SNDE. The views expressed herein are solely the responsibility of the author and should not be interpreted as reflecting the views of Sveriges Riksbank. Address correspondence to: Roberto M. Billi, Research Division, Sveriges Riksbank, SE-103 37 Stockholm, Sweden; e-mail: Roberto.Billi@riksbank.se.

1 Introduction

Many argue that, because the outlook for the economy is inherently uncertain, central banks should apply a risk management approach to monetary policy, to determine the appropriate timing and pace of the liftoff of the policy interest rate from its zero lower bound (ZLB). For example, during a ZLB episode, if the economic recovery turns out to be stronger than anticipated, the central bank can raise earlier the policy rate or remove accommodation at a faster pace. However, if the central bank overstated the strength of the economic recovery and wants to add policy stimulus, the scope for lowering the policy rate is limited by its ZLB. The central bank, thus, faces an asymmetric risk in setting monetary policy, because of uncertainty about the evolution of the economy and the ZLB constraint.¹

It, thus, would be prudent for a central bank to raise the policy interest rate gradually from the ZLB, to reduce the risk of choking the recovery and thus being forced to revert back to easing policy. One issue, in fact, is that an unexpected policy reversal would tend to erode confidence in the central bank's ability to understand and stabilize the economy. It would also lead to question the usefulness of inflation targeting as a monetary policy framework. Whereas inflation targeting worked well for many central banks before the Great Recession, in light of its recent limitations there are debates over whether it should now be replaced.

This article sheds light on such pressing concerns for central banks. It shows that, when the ZLB threatens, uncertainty in the economic outlook hampers the effectiveness of monetary policy in stabilizing the economy, but the extent to which a central bank mitigates uncertainty depends crucially on its policy framework. In particular, the article compares the effects of an uncertain outlook for the economic performance of two monetary-policy frameworks, which are considered by some as preferable to inflation targeting, a target for the price level or the level of nominal gross domestic product (GDP). Such alternatives are conceptually appealing because the central bank then wants to make up for any past shortfalls from its nominal anchor, which ensures policy stimulus during ZLB episodes.

¹This article adopts the standard practice of referring to a zero lower bound for nominal interest rates, but the recent experience with negative nominal interest rates in Denmark, Japan, Sweden, Switzerland, and the eurozone suggests the effective lower bound is somewhat below zero. See Svensson (2010) for a discussion.

As studied recently by Billi (2016), the setting here is a small New Keynesian model with the central bank operating under optimal discretion and facing a ZLB on nominal interest rates. In the model, three types of shock buffet the economy. On the supply side of the economy, technology shocks push output gaps and prices in the same direction, whereas cost-push shocks instead cause an inflation-output tradeoff. On the demand side, adverse demand shocks and the ZLB constraint create a tradeoff between stabilizing current and future output, because it is desirable for the central bank in a ZLB episode to promise to induce an economic expansion after the ZLB episode. The stylized model offers a clear illustration of such tradeoffs in the evaluation of the policy frameworks. Before the evaluation, the model is calibrated to recent U.S. data, with the conduct of monetary policy described by a simple policy rule, namely a version of the Taylor rule with interest-rate smoothing, which features prominently in Federal reserve discussions. In the analysis the shocks are persistent, to generate propagation in the model as in the data. The policy frameworks are then ranked in terms of economic performance, based on the model's social welfare function.

Billi (2016) highlighted the following. First, if the economy is only subject to technology shocks, nominal-GDP-level targeting is clearly inferior because it fails to insulate the economy from technology shocks. In contrast, strict-price-level targeting and the simple policy rule fully insulate the economy from technology shocks. Second, if the economy is only subject to cost-push shocks, the outcome depends on the persistence of the shocks. With persistent cost-push shocks, strict-price-level targeting is superior.² Third, if the economy is only hit by demand shocks, nominal-GDP-level targeting is an inferior targeting framework, because it involves less policy inertia and, ironically, leads to larger falls in nominal GDP during ZLB episodes. The simple policy rule is even less effective and causes large fluctuations in output and prices. Fourth, accounting for all three types of shock, strict-price-level targeting is superior, because

²More specifically, faced with only purely-temporary shocks to inflation (namely cost-push shocks, which are assumed to follow a white-noise stochastic process), nominal-GDP-level targeting and the simple policy rule may be preferable because they require the burden of shocks to be shared by prices and output. Strict-price-level targeting instead causes costly fluctuations in output. However, if shocks to inflation are persistent (cost-push shocks follow an autoregressive stochastic process), nominal-GDP-level targeting results in costly price fluctuations, and the two targeting frameworks are similarly effective in terms of social welfare, whereas the simple policy rule is less effective and causes even larger changes in prices.

it involves greater policy inertia and thus improves the tradeoffs faced by the central bank. Finally, such results are robust to a wide range of alternate calibrations.

This article introduces, into such a setting, a risk management approach to monetary policy. In the analysis, in addition to the aforementioned policy frameworks, also considered is the optimal commitment policy to be used as a benchmark for the evaluation.³ The analysis considers two distinct economic environments, as regards the outlook for the economy. In one environment, agents rationally account for the existence of uncertainty about the future state of the economy (rational expectations). In the other environment, even though future shocks buffet the economy, the future state of the economy is assumed to be known in advance with absolute certainty (naive expectations). Thus, the distinctive feature of the two environments is, precisely, whether the central bank in setting monetary policy rationally accounts for uncertainty in the economic outlook. Outlook uncertainty is important for the economic performance of the policy frameworks because of the asymmetric risk imposed by the presence of the ZLB constraint.⁴

Comparing the model outcomes from such two distinct environments, the analysis produces two main results, related to the types of shock buffeting the economy. First, if the economy is only subject to supply shocks, that is technology and cost-push shocks only, economic performance is then the same in the two economic environments. The reason is that supply shocks do not lead to ZLB episodes in this analysis.⁵ Still, strict-price-level targeting is a superior targeting framework, because it fully insulates the economy from technology shocks and transfers the burden of cost-push shocks onto output. In contrast, under nominal-GDP-level targeting, persistent cost-push shocks give rise to costly inflation fluctuations. However, inflation volatility is even larger under the simple policy rule.

As a second result, if the economy is also hit by demand shocks, uncertainty in the economic outlook then hampers the effectiveness of the central bank in stabilizing the economy

³Billi (2016) did not consider the optimal commitment policy.

⁴Under rational expectations, the mere possibility of hitting the ZLB, even when not yet binding, shapes expectations in the economy. However, in the naive-expectations economy, the ZLB affects expectations only when actually binding.

⁵In the absence of the ZLB constraint, the model displays certainty equivalence and the outcome is independent of whether the future is uncertain.

during ZLB episodes. The deterioration in economic performance from outlook uncertainty is generally worst under nominal-GDP-level targeting, followed by the simple policy rule and then by strict-price-level targeting. The reason for such outcomes is that strict-price-level targeting induces greater policy inertia and, therefore, improves the tradeoffs faced by the central bank. At the same time, there is generally less scope for the simple policy rule to mitigate outlook uncertainty, because the simple policy rule leads to substantially less frequent encounters with the ZLB.⁶

In the New Keynesian literature, adverse demand shocks and the ZLB create a tradeoff between stabilizing current and future output, because it is desirable in a ZLB episode to promise to induce an economic expansion after the ZLB episode. As this article shows, uncertainty in the economic outlook worsens such a tradeoff, facing the central bank in the setting of monetary policy. As a consequence, monetary policy is not nearly as effective in stabilizing the economy as implied by the assumption that the outlook is known in advance with certainty. Because outlook uncertainty hampers the effectiveness of monetary policy, it is desirable for the central bank to raise the policy interest rate more gradually from the ZLB.

As the literature has shown, facing a ZLB constraint, monetary-policy frameworks that involve inertia, that is history-dependent policies, can lead to a better economic performance. Eggertsson and Woodford (2003), Jung, Teranishi and Watanabe (2005), Wolman (2005), and others, studied the ZLB and history-dependent policies but in the absence of outlook uncertainty.⁷ The interaction between the ZLB and outlook uncertainty was studied by Orphanides and Wieland (2000), Adam and Billi (2006, 2007), Nakov (2008), Levin et al. (2010), Nakata (2013), Basu and Bundick (2014, 2015), Johannsen (2014), Plante, Richter and Throckmorton

⁶However, if demand shock are more persistent than in the baseline calibration, there is more scope for the simple policy rule to mitigate outlook uncertainty and, therefore, the deterioration in economic performance from outlook uncertainty is then worst under the simple policy rule.

⁷Svensson (1999), Vestin (2006), and Giannoni (2014) argued for price-level targeting versus inflation targeting in the absence of the ZLB constraint. Related to this, the desirability of a price-level target when the ZLB is a constraint was stressed by Eggertsson and Woodford (2003), Svensson (2003), Wolman (2005), and Evans (2012), among others. A shortlist of recent proponents of nominal-GDP-level targeting includes Hatzius and Stehn (2011, 2013), Sumner (2011, 2014), Woodford (2012, 2013), Frankel (2013), and others. There is also an extensive literature on the notion of nominal income *growth* targeting, at first suggested by Meade (1978) and Tobin (1980) and then studied by Bean (1983), Taylor (1985), West (1986), McCallum (1988), Hall and Mankiw (1994), Jensen (2002), Walsh (2003), and others.

(2014), Evans et al. (2015), Seneca (2016), and others.⁸ Relative to the existing literature, this article shows that the central bank mitigates outlook uncertainty more effectively under strict-price-level targeting than under nominal-GDP-level targeting. Thus, in a comparison between the two alternatives, a concern for risk management is a reason for central banks to prefer a target for the price level.

Section 2 describes the model and Section 3 introduces the monetary-policy frameworks. Section 4 describes the different environments, as regards the outlook for the economy. Section 5 presents the model outcomes and policy evaluation. Section 6 concludes. The Appendix contains technical details on the model solution.

2 The model

I use a small New Keynesian model as described in Woodford (2010), but I take into account that the nominal policy rate occasionally hits the ZLB. The behavior of the private sector is summarized by two structural equations, log-linearized around zero inflation, which describes the demand and supply sides of the economy.

On the demand side of the model economy, the Euler equation describes the representative household's expenditure decisions,

$$y_t = E_t y_{t+1} - \varphi (i_t - r - E_t \pi_{t+1} - v_t), \quad (1)$$

where E_t denotes the expectations operator conditional on information available at time t . y_t is output measured as the log-deviation from trend. π_t is the inflation rate, the log-change of prices from last period, $p_t - p_{t-1}$. Moreover, $i_t \geq 0$ is the short-term nominal interest rate constrained by a ZLB, whereas $r > 0$ is the steady-state real interest rate.⁹ $\varphi > 0$ is the interest elasticity of real aggregate demand, capturing intertemporal substitution in household spending. The *demand shock*, v_t , represents other spending, such as government

⁸Evans et al. (2015) also provide statistical evidence, based on Federal Reserve communications in recent decades, that risk-management considerations have been quite influential for actual monetary policy.

⁹Thus, $i_t - r - E_t \pi_{t+1}$ is the real interest rate in deviation from steady state.

spending, which has asymmetric effects on the economy due to the ZLB. A positive demand shock can be countered entirely by raising the nominal interest rate, whereas a large adverse shock that leads to hitting the ZLB causes an economic downturn.

On the supply side of the economy, the Phillips curve describes the optimal price-setting behavior of firms, under staggered price changes à la Calvo,

$$\pi_t = \beta E_t \pi_{t+1} + \kappa x_t + u_t, \quad (2)$$

where $\beta \in (0, 1)$ is the discount factor of the representative household, determined as $1/(1+r)$. The slope parameter $\kappa > 0$ is a function of the structure of the economy.¹⁰ $x_t \equiv y_t - y_t^n$ is the output gap in the economy. y_t^n is the natural rate of output, or potential output, the output deviation from the trend that would prevail in the absence of any price rigidities, which represents a *technology shock*. A positive technology shock implies slack in economic activity and downward pressure on prices, whereas a negative shock implies a strong economy and puts upward pressure on prices. Moreover, u_t is a cost-push shock, or a *mark-up shock* resulting from variation over time in the degree of monopolistic competition between firms, which creates an inflation-output tradeoff for monetary policy.

In the model economy, the three types of exogenous shocks (y_t^n, u_t, v_t) are assumed to follow AR(1) stochastic processes, with first-order autocorrelation parameters $\rho_j \in (-1, 1)$ for $j = y^n, u, v$. Moreover, $\sigma_{\varepsilon_j} \varepsilon_{jt}$ are the innovations that buffet the economy, which are independent across time and cross-sectionally, and normally distributed with mean zero and standard deviations $\sigma_{\varepsilon_j} \geq 0$.

Finally, the policy frameworks to be considered are evaluated based on the model's social welfare function, a second-order approximation around zero inflation of the lifetime utility function of the representative household,

¹⁰In this model $\kappa = (1 - \alpha)(1 - \alpha\beta)\alpha^{-1}(\varphi^{-1} + \omega)(1 + \omega\theta)^{-1}$, where $\omega > 0$ denotes the elasticity of a firm's real marginal cost. $\theta > 1$ is the price elasticity of demand substitution with firms in monopolistic competition, and thus the seller's desired markup is $\theta/(\theta - 1)$. Moreover, $\alpha \in (0, 1)$ is the share of firms keeping prices fixed each period, so the implied duration between price changes is $1/(1 - \alpha)$.

$$E_0 \sum_{t=0}^{\infty} \beta^t [\pi_t^2 + \lambda (x_t - x^*)^2], \quad (3)$$

where $\lambda = \kappa/\theta$ is the weight assigned to stabilizing the output gap relative to inflation. x^* is the target level of the output gap, which stems from monopolistic competition and distortion in the steady state. Output subsidies are assumed to offset the monopolistic distortion so that the steady state is efficient, $x^* = 0$. As a result, in the analysis, there is no inflation bias but a stabilization bias due to discretionary policy.

3 The policy frameworks

The conduct of monetary policy is first described by a simple rule, to be used for the calibration of the model. It is then described by optimal discretion with a nominal-level target, namely a target for the price level or nominal-GDP level, hardwired into the central bank's objective function. Finally, monetary policy is represented by optimal commitment, used as a benchmark for the evaluation. Thus, in total, four different policy frameworks are considered in this analysis.

The *simple policy rule* employed is a version of the Taylor rule subject to the ZLB constraint, along the lines of Taylor and Williams (2010):

$$i_t = \max \{0, \phi_i i_{t-1}^u + (1 - \phi_i) [r + \phi_\pi \pi_t + \phi_x (y_t - y_t^n)]\}, \quad (4)$$

where ϕ_π and ϕ_x are positive response coefficients on inflation and the output gap, respectively. The rule incorporates smoothing in the behavior of the interest rate, through a positive value of the coefficient ϕ_i . Moreover, i_{t-1}^u denotes an unconstrained or notional interest rate, the preferred setting of the policy rate in the previous period that would occur absent the ZLB constraint. Such an approach implies that the central bank compensates to some extent for the lost monetary stimulus due to the existence of the ZLB, even though the central bank does not commit to making up for past shortfalls from a nominal-level target.

Under optimal discretion, the central bank has an objective function rather than a simple

rule and re-optimizes its policy decision in each period.¹¹ In such a setting, two monetary policy frameworks are considered. First, with *strict-price-level targeting* the objective function is assumed to take the form:

$$\min_{i_t \geq 0} E_t \sum_{j=0}^{\infty} \beta^j p_{t+j}^2,$$

where p_t is the log of the price level, which is equal to $p_{t-1} + \pi_t$. In this framework, the policymaker seeks to stabilize prices without concern for output stability and, therefore, transfers the entire burden of shocks onto output. The framework involves inertia in the behavior of policy, because the current policy decision depends on the past price level.

Second, with *nominal-GDP-level targeting*, the objective function now takes the form:

$$\min_{i_t \geq 0} E_t \sum_{j=0}^{\infty} \beta^j n_{t+j}^2,$$

where n_t is nominal GDP measured as the log-deviation from trend, which is equal to $p_t + y_t$. In this framework, the policymaker seeks to stabilize both prices and output, as opposed to focusing entirely on price stability, which now requires the burden of shocks to be shared by prices and output. As a consequence, however, the current policy decision involves relatively less dependence on the past price level, and the policymaker acts less in accordance with a precommitment to price stability, relative to strict-price-level targeting.

Finally, as a benchmark for the policy evaluation, I use the optimal plan, the *optimal commitment policy*. In such a framework, rather than re-optimizing a policy decision in each period as under optimal discretion, the policymaker is assumed able and willing to fully commit to its policy announcements, to maximize the welfare of the representative household. The central bank's objective function, in this ideal framework, is then the social welfare function, equation (3), described in the previous section.¹²

¹¹In this analysis, as in Woodford (2010), the outcome under optimal discretion corresponds to a Markov perfect equilibrium of the noncooperative game among successive policymakers, which implies that the central bank rationally accounts for how the current state of the economy affects future decisions.

¹²The planner chooses $\{\pi_t, x_t, i_t \geq 0\}_{t=0}^{\infty}$ to achieve $\min E_0 \sum_{t=0}^{\infty} \beta^t [\pi_t^2 + \lambda x_t^2]$.

4 Outlook uncertainty

Regarding the outlook for the economy, for each policy framework introduced above, two distinct environments are considered. In one environment the outlook is assumed to be known with absolute certainty, but in the other the outlook is known to be inherently uncertain.

In both economic environments, at equilibrium, the policymaker chooses a policy based on a response function $\mathbf{y}(\mathbf{s}_t)$ and a state vector \mathbf{s}_t . The corresponding expectations function is then given by

$$\mathbf{E}_t \mathbf{y}(\mathbf{s}_{t+1}) = \int \mathbf{y}(\mathbf{s}_{t+1}) f(\varepsilon_{t+1}) d(\varepsilon_{t+1}),$$

where $f(\cdot)$ is a probability density function of the future innovations that buffet the economy, with a standard deviation of $\sigma_\varepsilon \geq \mathbf{0}$. In such a setting, an equilibrium is then given by a response function and expectations function, $\mathbf{y}(\mathbf{s}_t)$ and $\mathbf{E}_t \mathbf{y}(\mathbf{s}_{t+1})$, which satisfy the equilibrium conditions of the model, derived in Appendix A.1.

Naive expectations. In the first environment, the future state of the economy is assumed to be known in advance with absolute certainty ($\sigma_\varepsilon = \mathbf{0}$). In such a setting, agents expect no further shocks to the economy, regardless of the existence of future shocks and the ZLB. As a consequence, the ZLB constraint affects expectations and the setting of policy only when the constraint binds in the economy, as shown by Eggertsson and Woodford (2003), Jung, Teranishi and Watanabe (2005), Adam and Billi (2006, 2007), Nakov (2008), and others. By ignoring the existence of uncertainty about the evolution of the economy, the model can be solved with a standard numerical method, as done in Orphanides and Wieland (2000), Reifschneider and Williams (2000), Williams (2009), Coibion, Gorodnichenko, and Wieland (2012), and Guerrieri and Iacoviello (2015), among others.¹³

Rational expectations. The second environment, however, takes into account the existence of uncertainty about the future state of the economy ($\sigma_\varepsilon > \mathbf{0}$). When the ZLB threatens, the mere possibility of hitting the ZLB causes expectations of a future economic downturn

¹³Setting $\sigma_\varepsilon = \mathbf{0}$, then $\mathbf{E}_t \mathbf{y}(\mathbf{s}_{t+1})$ simplifies to $\mathbf{y}(\mathbf{s}_{t+1})$. Thus, as noted by Reifschneider and Williams (2000), expectations for future values of policy are fully consistent with the model's predictions for future economic conditions, subject to the assumption that all future shocks to the economy are zero.

and therefore prompts for adding policy stimulus today. But if the existence of uncertainty is ignored, as in the first environment, the effects of the ZLB are smaller because naive agents expect higher future inflation, which boosts economic activity and inflation during ZLB episodes. Thus, uncertainty in the outlook for the economy is important for economic performance because of the asymmetric risk imposed by the presence of the ZLB constraint. It is an asymmetric risk because the economic downturn from an unanticipated shock is larger than the effect of a shock of opposite sign. Such effects of uncertainty and the ZLB constraint were shown by Adam and Billi (2006, 2007), and Nakov (2008), among others. To solve the model accounting for outlook uncertainty, I use the same numerical procedure as in Billi (2011, 2016).¹⁴

5 The effects of outlook uncertainty

After calibrating the model, I study the impact of outlook uncertainty on the economic performance of the two targeting frameworks, relative to the optimal commitment policy. I also consider the performance of the inertial Taylor rule used for the model calibration. By comparing the model outcomes under the different frameworks, I show that outlook uncertainty hampers the ability of the central bank to stabilize the economy during ZLB episodes. I also show that the extent to which the central bank mitigates outlook uncertainty depends crucially on its policy framework.

5.1 Baseline calibration

The model economy is calibrated to U.S. data for recent decades, as in Billi (2016), with the conduct of monetary policy described by the inertial Taylor rule (4) that features prominently in Federal Reserve discussions. The values of the rule coefficients are taken from English, Lopez-Salido and Tetlow (2015), with ϕ_π set to 1.5, ϕ_x set to 1/4 (quarterly rates) and ϕ_i set to 0.85. The rule thus accounts for smoothing in the setting of the policy interest rate.

The values of the structural parameters of the model are also standard in the related

¹⁴See Appendix A.2 for a description of the algorithm used to solve the model in both environments. The second environment is obtained by setting $\sigma_\varepsilon = \mathbf{0}$.

literature. Specifically, β is set to 0.99, to imply a steady-state interest rate of 4% annual. φ is set to 6.25.¹⁵ The implied parameters κ and λ are then equal to 0.024 and 0.003 (quarterly), respectively. Finally, regarding the calibration of the shocks, $\rho_{y^n, u, v}$ are set to 0.8 to generate persistent effects on the economy. At the same time, $\sigma_{y^n, v}$ are set to 0.8% (quarterly) to try to replicate respectively the volatility of output and nominal interest rates in the data, whereas σ_u is set to 0.05% (quarterly) to match the inflation volatility in the data.¹⁶

Overall, as Billi (2016) showed, with the simple policy rule and baseline calibration, the model does a fairly good job in replicating the relevant features of recent U.S. data.¹⁷ Moreover, accounting for persistent supply and demand shocks buffeting the economy, the ranking of the simple policy rule and two targeting frameworks was shown, in Billi (2016), to be robust to a wide range of alternate calibrations of the model.

5.2 Liftoff from the ZLB

Adverse demand shocks lead to ZLB episodes in this analysis. Using the calibrated model, Figure 1 shows the expected liftoff of the nominal interest rate from the ZLB after an adverse demand shock.¹⁸ In each of the four panels of the figure, only one of the policy frameworks is considered. For example, the bottom-right panel shows the expected liftoff under the optimal commitment policy, both with naive expectations (dashed green line) and rational expectations (solid blue line), as regards the outlook for the economy, as well as the difference between the two economic environments (dash-dotted red line). In both environments, given the size of the shock, the weakness of the economy prompts the central bank to cut the nominal interest rate

¹⁵ α is set to 0.66, so the duration between price changes $1/(1 - \alpha)$ is 3 quarters. θ is set to 7.66, so the markup over marginal costs $\theta/(\theta - 1)$ is 15%. Moreover, ω is set to 0.47.

¹⁶The sample period used to calibrate the shocks is the same as in Billi (2016), 1984Q1-2014Q4, which ensures the results are directly comparable. Moreover, extending the sample to the latest available data does not affect the good fit of the model to the data.

¹⁷Still, output and inflation are somewhat less persistent in the model results than in the data, because this basic model, for the sake of simplicity, does not allow for structural propagation mechanisms that give rise to output and inflation inertia. As a consequence, the stylized model may understate the frequency and duration of ZLB episodes. Under the simple policy rule and baseline calibration, the model predicts that the policy rate hits the ZLB less than 3 percent of the time, and the expected duration of a ZLB episode is about three quarters (Table 2). In actuality, the federal funds rate has been near the ZLB from the end of 2008 to the end of 2015. See Section 2.4 of Billi (2016) for further details of the model calibration and fit to the data.

¹⁸Shown are expected paths after a -3.5 standard deviation demand shock, using the baseline calibration described in Section 5.1. The expected paths are obtained by averaging across 10,000 stochastic simulations.

all the way to the ZLB. However, as the panel shows, under the optimal commitment policy, outlook uncertainty results in a slower pace of policy normalization, as the nominal interest rate rises more gradually.

[Figure 1 about here]

Similarly, as the other panels in Figure 1 show, outlook uncertainty leads to a slower pace of policy normalization also under the other policy frameworks considered in the analysis, that is strict-price-level targeting, nominal-GDP-level targeting, as well as the simple policy rule.¹⁹ In each of the policy frameworks, the reason for the slowdown of the pace of policy normalization is that, as noted earlier, the expectation of further adverse shocks hitting the economy prompts the central bank to provide additional policy stimulus to the economy.

To illustrate the economic performance of the policy frameworks, Figures 2 and 3 show the expected paths of the price level and nominal GDP level, respectively, during a ZLB episode.²⁰ As the bottom-right panels show, under the optimal commitment policy, prices and nominal GDP rise permanently, both with naive and rational expectations about the outlook for the economy.²¹ The reason for the permanent increase in the price level is that, under the optimal commitment policy, the central bank's objective function is the social welfare function, which does not imply the price level as a policy goal. At the same time, prices and nominal GDP rise by more under rational expectations, because of the greater policy stimulus provided to the economy after the liftoff of the nominal interest rate from the ZLB (Figure 1).

[Figures 2 and 3 about here]

Regarding the economic performance of the simple policy rule and targeting frameworks, as the other panels in Figures 2 and 3 show, prices and nominal GDP fall after the liftoff from the ZLB, both with naive and rational expectations. In both environments, ironically,

¹⁹Under the simple policy rule and naive expectations, in the top-left panel of Figure 1, the expected path of the nominal interest rate does not quite reach the ZLB for a three-standard-deviation shock (not shown). For this reason, the policy response to a somewhat larger shock is shown.

²⁰Shown are expected paths after a -3 standard deviation demand shock, using the baseline calibration.

²¹Under the optimal commitment, during the first part of the ZLB episode, nominal GDP falls despite an increase in the price level (Figures 2 and 3). The reason is that, at the same time, real GDP falls (not shown).

nominal-GDP-level targeting results in a larger fall in nominal GDP, compared to strict-price-level targeting. The reason is that, as noted earlier, strict-price-level targeting implies a greater dependence of current policy decisions on the past price level, and thus a surge in economic activity and prices after the ZLB episode.²² At the same time, in each of the policy frameworks, the downturn in the economy is deeper under rational expectations, because the expectation of further adverse shocks hitting the economy hampers the effectiveness of the central bank in stabilizing the economy during ZLB episodes. In sum, for each of the policy frameworks, outlook uncertainty and the ZLB constraint prompt the central bank to provide additional policy stimulus to the economy.

5.3 Effectiveness of monetary policy

The ability of the central bank to stabilize the economy depends on its policy framework. I rank the policy frameworks, considering supply and demand shocks. To start, Table 1 summarizes the performance of each policy framework in the presence of only supply shocks, namely technology shocks and mark-up shocks only, by setting σ_v to zero in the baseline calibration. The table reports the expected frequency and duration of ZLB episodes, as well as the welfare loss due to business cycles.²³ In the table, the top panel shows the results with naive expectations, the middle panel shows the outcome with rational expectations, and the bottom panel shows the difference between the two environments because of outlook uncertainty.

[Table 1 about here]

As the table shows, in each of the policy frameworks, there is no difference in economic performance between the two environments in the presence of supply shocks only. The reason is that, even though supply shocks generally result in a welfare loss due to fluctuations in

²²Under strict-price-level targeting, the real interest rate falls deeper below its equilibrium value (not shown), which implies a greater degree of monetary policy stimulus to the economy.

²³To calculate the welfare loss, first the value of the objective function (3) is obtained by averaging across 10,000 stochastic simulations each 1,000 periods long after a burn-in period. This value is then converted into a permanent consumption loss, as explained in Appendix A.3.

inflation and output, supply shocks do not lead to ZLB episodes in this analysis.²⁴ Still, performance is different under the two targeting frameworks, with strict-price-level targeting resulting in a smaller total welfare loss from the supply shocks relative to nominal-GDP-level targeting. This difference in performance occurs because, as noted earlier, nominal-GDP-level targeting fails to insulate the economy from technology shocks and results in fluctuations in inflation and output. In addition, under nominal-GDP-level targeting, persistent mark-up shocks give rise to costly inflation fluctuations. However, inflation volatility is even larger under the simple policy rule. Thus, both targeting frameworks lead to a better economic performance regarding total welfare relative to the simple policy rule, even if the economy is hit by supply shocks only.

I now introduce also demand shocks in the policy evaluation. Table 2 summarizes the performance of each policy framework in the presence of both supply and demand shocks, using the baseline calibration. As the table shows, adding the demand shocks into the analysis does not change the ranking of the policy frameworks. However, because demand shocks lead to ZLB episodes, economic performance is now different in the two environments because of outlook uncertainty. In each of the policy frameworks, outlook uncertainty leads to an increase in both the frequency and duration of ZLB episodes, because outlook uncertainty hampers the effectiveness of the central bank in stabilizing the economy during ZLB episodes.

[Table 2 about here]

As the table also shows, because demand shocks lead to ZLB episodes, outlook uncertainty has adverse effects on economic performance. In each of the policy frameworks, the expectation of further shocks to the economy now causes an increase in the volatility of both inflation and output. However, the deterioration in economic performance from outlook uncertainty is different under the two targeting frameworks, with strict-price-level targeting resulting in a smaller welfare loss from outlook uncertainty, relative to nominal-GDP-level targeting. The reason is that, both with naive and rational expectations, strict-price-level targeting implies

²⁴As a robustness check, the standard deviations of the technology shock and mark-up shock were each raised by 50% relative to the baseline calibration, but the larger supply shocks still did not lead to ZLB episodes in the simulations (not shown). Absent the ZLB constraint the model displays certainty equivalence.

greater policy inertia and, therefore, improves the tradeoffs faced by the central bank. At the same time, nominal-GDP-level targeting results in a smaller welfare loss from outlook uncertainty, relative to the simple policy rule. Both with naive and rational expectations, there is less scope for the simple policy rule to mitigate outlook uncertainty, because the simple rule leads to substantially less frequent encounters with the ZLB.²⁵

To increase the impact of outlook uncertainty on the economic performance of the policy frameworks, I raise the likelihood of hitting the ZLB. To do so, I first increase the volatility of the demand shock, relative to the baseline. Table 3 summarizes the performance of each policy framework in the presence of both supply and demand shocks, but demand shocks are assumed to be substantially larger than in the baseline.²⁶ The table shows that, even in the presence of much larger demand shocks, the ranking of the policy frameworks is still the same as in the baseline. Moreover, the deterioration in economic performance from outlook uncertainty is still worst under nominal-GDP-level targeting, followed by the simple policy rule and then by strict-price-level targeting.

[Table 3 about here]

I also increase the persistence of the demand shock relative to the baseline, with Table 4 summarizing the results.²⁷ As the table shows, increasing the persistence of the demand shock does not change the ranking of the policy frameworks, relative to the baseline. However, the deterioration in economic performance from outlook uncertainty is now worst under the simple policy rule, followed by the targeting frameworks. The different ranking occurs because, under this calibration, there is now somewhat more scope for the simple policy rule to mitigate outlook uncertainty. In fact, the simple policy rule leads to more frequent encounters with the ZLB under this calibration, compared to the other tables.

²⁵With rational expectations and persistent shocks, as Billi (2016) showed, the ranking of the simple policy rule and two targeting frameworks is robust to a wide range of alternate calibrations. For this reason, the article does not report results of other calibrations besides changes to the demand shock.

²⁶The standard deviation of the demand shock was raised by 50% relative to the baseline.

²⁷The autocorrelation of the demand shock was raised from 0.8 to 0.85. At the same time, because the numerical procedure then failed to converge under the simple policy rule, the response coefficient on inflation in the rule was raised a little, from 1.5 to 2.5, to ensure greater policy stimulus and obtain a numerical solution. In the model the nominal interest rate is the only available policy instrument, so the model does not account for other policies used in actuality to stabilize output such as balance-sheet policies and fiscal spending.

[Table 4 about here]

Finally, as a comparison of the results in Tables 2 to 4 shows, in the presence of larger or more persistent demand shocks than in the baseline, there is a greater difference in economic performance between the two environments in each of the policy frameworks, because of more frequent and protracted ZLB episodes. Overall, because the central bank faces a ZLB constraint, the deterioration in economic performance from outlook uncertainty is worse under nominal-GDP-level targeting than under strict-price-level targeting.

6 Concluding remarks

This article sheds light on recent proposals to apply a risk management approach to monetary policy during ZLB episodes. Namely, it would be prudent for a central bank to raise the policy interest rate gradually from the ZLB, because the outlook for the economy is inherently uncertainty. The article compares the impact of outlook uncertainty on the economic performance of two alternatives to inflation targeting, a target for the price level or the level of nominal GDP. The setting is a standard model, calibrated to recent U.S. data, which offers a clear illustration of the tradeoffs faced by the central bank. As the analysis clarifies, in the presence of persistent supply and demand shocks, a concern for risk management is a reason to prefer a price-level target. Still, as the analysis is conducted in a stylized model, further study is needed to extend the results to a broader class of models.

A Appendix

A.1 Equilibrium conditions

I first derive the equilibrium conditions and then summarize them in a table.

The targeting frameworks. To solve the model, recall the definition of the price level,

$$p_t \equiv p_{t-1} + \pi_t. \tag{5}$$

Using this identity, the problem can be written as

$$\begin{aligned}
V(\mathbf{s}_t) &= \max \left[- (p_t + Iy_t)^2 + \beta E_t V(\mathbf{s}_{t+1}) \right] \\
&\text{subject to (1), (2), (5) and } i_t \geq 0 \\
&\text{and } \mathbf{E}_t \mathbf{y}(\mathbf{s}_{t+1}) \text{ given,}
\end{aligned}$$

where I represents an indicator function, which is equal to 1 for nominal-GDP-level targeting and equal to 0 for strict-price-level targeting. Write the period Lagrangian

$$\begin{aligned}
L_t &= - (p_t + Iy_t)^2 + \beta E_t V(\mathbf{s}_{t+1}) \\
&\quad + m_{1t} [\pi_t - \beta E_t \pi_{t+1} - \kappa (y_t - y_t^n) - u_t] \\
&\quad + m_{2t} [-y_t + E_t y_{t+1} - \varphi (i_t - r - E_t \pi_{t+1} - v_t)] \\
&\quad + m_{3t} [-p_t + p_{t-1} + \pi_t] \\
&\text{and } \mathbf{E}_t \mathbf{y}(\mathbf{s}_{t+1}) \text{ given.}
\end{aligned}$$

The Kuhn-Tucker conditions are

$$\partial L_t / \partial \pi_t = m_{1t} + m_{3t} = 0 \tag{6}$$

$$\partial L_t / \partial y_t = -2I(p_t + Iy_t) - \kappa m_{1t} - m_{2t} = 0 \tag{7}$$

$$\partial L_t / \partial i_t \cdot i_t = -\varphi m_{2t} \cdot i_t = 0, \quad m_{2t} \geq 0, \quad i_t \geq 0 \tag{8}$$

$$\begin{aligned}
\partial L_t / \partial p_t &= -2(p_t + Iy_t) + \beta \partial E_t V(\mathbf{s}_{t+1}) / \partial p_t \\
&\quad - (\beta m_{1t} - \varphi m_{2t}) \cdot \partial E_t \pi(\mathbf{s}_{t+1}) / \partial p_t + m_{2t} \cdot \partial E_t y(\mathbf{s}_{t+1}) / \partial p_t - m_{3t},
\end{aligned} \tag{9}$$

whereas the Envelope condition is

$$\partial V(\mathbf{s}_t) / \partial p_{t-1} = m_{3t},$$

which implies that

$$\beta \partial E_t V(\mathbf{s}_{t+1}) / \partial p_t = \beta E_t m_{3t+1}.$$

Optimal commitment policy. The problem can be written as

$$\begin{aligned} V(\mathbf{s}_t) = \max & \left[-\pi_t^2 - \lambda (y_t - y_t^n)^2 + \beta E_t V(\mathbf{s}_{t+1}) \right] \\ & \text{subject to (1), (2) and } i_t \geq 0. \end{aligned}$$

Write the period Lagrangian

$$\begin{aligned} L_t = & -\pi_t^2 - \lambda (y_t - y_t^n)^2 + \beta E_t V(\mathbf{s}_{t+1}) \\ & + m_{1t} [\pi_t - \kappa (y_t - y_t^n) - u_t] - m_{1t-1} \pi_t \\ & + m_{2t} [-y_t - \varphi (i_t - r_{ss} - \pi^* - v_t)] + m_{2t-1} \beta^{-1} (y_t + \varphi \pi_t). \end{aligned}$$

The Kuhn-Tucker conditions are

$$\partial L_t / \partial \pi_t = -2\pi_t + m_{1t} - m_{1t-1} + \beta^{-1} \varphi m_{2t-1} = 0 \quad (10)$$

$$\partial L_t / \partial y_t = -2\lambda (y_t - y_t^n) - \kappa m_{1t} - m_{2t} + \beta^{-1} m_{2t-1} = 0 \quad (11)$$

$$\partial L_t / \partial i_t \cdot i_t = -\varphi m_{2t} \cdot i_t = 0, \quad m_{2t} \geq 0, \quad i_t \geq 0. \quad (12)$$

The equilibrium conditions of the model are summarized as follows:

| Policy framework | Equilibrium conditions | State vector \mathbf{s}_t |
|----------------------|------------------------|---|
| Simple policy rule | (1), (2) and (4) | $(y_t^n, u_t, v_t, i_{t-1}^u)$ |
| Targeting frameworks | (1), (2) and (5)-(9) | $(y_t^n, u_t, v_t, p_{t-1})$ |
| Optimal commitment | (1), (2) and (10)-(12) | $(y_t^n, u_t, v_t, m_{1t-1}, m_{2t-1})$ |

A.2 Numerical procedure

I find a numerical solution, as in Billi (2011, 2016), as a fixed point in the equilibrium conditions. To do this, the state vector is discretized into a grid of interpolation nodes, with a support of ± 4 standard deviations for each state variable, which is large enough to avoid erroneous extrapolation. If the state is not on this grid, the response function is evaluated with multilinear interpolation. The approximation residuals are evaluated at a finer grid, to ensure the accuracy of the results. The expectations function is evaluated with Gaussian-Hermite quadrature, and the derivatives are evaluated with a standard two-sided approximation. The initial guess is the linearized solution that ignores the ZLB constraint.

A.3 Permanent consumption loss

I obtain the permanent consumption loss as in Billi (2011, 2016). The expected lifetime utility of the representative household is validly approximated by

$$E_0 \sum_{t=0}^{\infty} \beta^t U_t = \frac{U_c \bar{C}}{2} \frac{\alpha \theta (1 + \omega \theta)}{(1 - \alpha)(1 - \alpha \beta)} L, \quad (13)$$

where \bar{C} is steady-state consumption; $U_c > 0$ is steady-state marginal utility of consumption; and $L \geq 0$ is the value of objective function (3).

At the same time, a steady-state consumption loss of $\mu \geq 0$ causes a utility loss of

$$E_0 \sum_{t=0}^{\infty} \beta^t U_c \bar{C} \mu = \frac{1}{1 - \beta} U_c \bar{C} \mu. \quad (14)$$

Equating the right sides of (13) and (14) gives

$$\mu = \frac{1 - \beta}{2} \frac{\alpha\theta(1 + \omega\theta)}{(1 - \alpha)(1 - \alpha\beta)} L.$$

References

- ADAM, K., AND R. M. BILLI (2006): “Optimal Monetary Policy under Commitment with a Zero Bound on Nominal Interest Rates,” *Journal of Money, Credit, and Banking*, 38(7), 1877–1905.
- (2007): “Discretionary Monetary Policy and the Zero Lower Bound on Nominal Interest Rates,” *Journal of Monetary Economics*, 54(3), 728–752.
- BASU, S., AND B. BUNDICK (2014): “Uncertainty Shocks in a Model of Effective Demand,” Research Working Paper 2014-15. Federal Reserve Bank of Kansas City (U.S.).
- (2015): “Endogenous Volatility at the Zero Lower Bound: Implications for Stabilization Policy,” Research Working Paper 2015-1. Federal Reserve Bank of Kansas City (U.S.).
- BEAN, C. R. (1983): “Targeting Nominal Income: An Appraisal,” *Economic Journal*, 93(372), 806–819.
- BILLI, R. M. (2011): “Optimal Inflation for the U.S. Economy,” *American Economic Journal: Macroeconomics*, 3(3), 29–52.
- (2016): “A Note on Nominal GDP Targeting and the Zero Lower Bound,” *Macroeconomic Dynamics*, forthcoming.
- COIBION, O., Y. GORODNICHENKO, AND J. WIELAND (2012): “The Optimal Inflation Rate in New Keynesian Models: Should Central Banks Raise Their Inflation Targets in Light of the ZLB?,” *The Review of Economic Studies*, 79(4), 1371–1406.

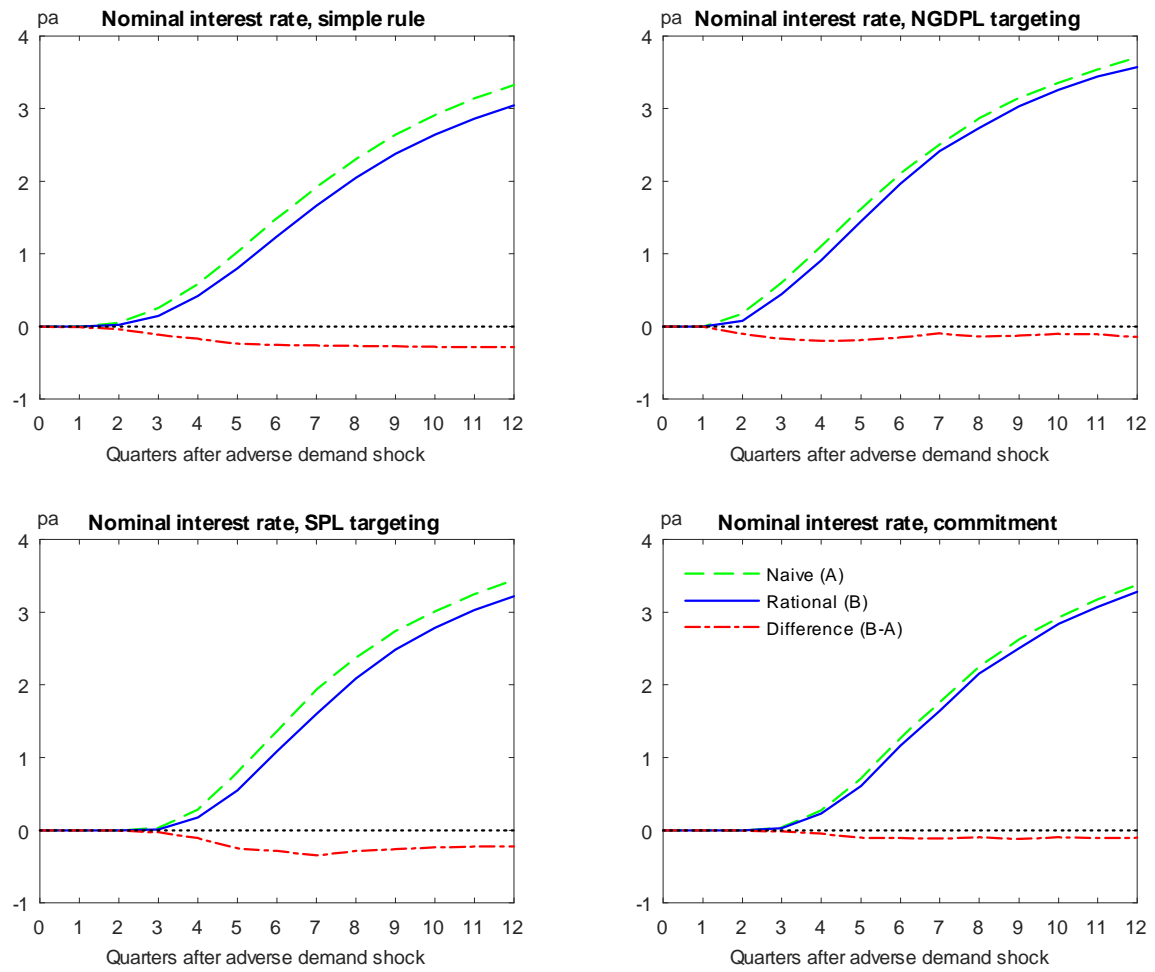
- EGGERTSSON, G. B., AND M. WOODFORD (2003): “The Zero Bound on Interest Rates and Optimal Monetary Policy,” *Brookings Papers on Economic Activity*, 34(1), 139–235.
- ENGLISH, W. B., J. D. LOPEZ-SALIDO, AND R. J. TETLOW (2015): “The Federal Reserve’s Framework for Monetary Policy: Recent Changes and New Questions,” *IMF Economic Review*, 63(1), 22–70.
- EVANS, C. L. (2012): “Monetary Policy in a Low-Inflation Environment: Developing a State-Contingent Price-Level Target,” *Journal of Money, Credit, and Banking*, Supplement to 44(1), 147–155.
- EVANS, C. L., J. D. M. FISHER, F. GOURIO, AND S. D. KRANE (2015): “Risk Management for Monetary Policy Near the Zero Lower Bound,” *Brookings Papers on Economic Activity*, Fall 2015, forthcoming.
- FRANKEL, J. (2013): “Nominal-GDP targets, without losing the inflation anchor,” in *Is Inflation Targeting Dead? Central Banking After the Crisis*, ed. by L. Reichlin, and R. Baldwin, pp. 90–94. London: CEPR, VoxEU.org.
- GIANNONI, M. P. (2014): “Optimal Interest Rate Rules and Inflation Stabilization versus Price-Level Stabilization,” *Journal of Economic Dynamics & Control*, 41, 110–129.
- GUERRIERI, L., AND M. IACOVIELLO (2015): “OccBin: A toolkit for solving dynamic models with occasionally binding constraints easily,” *Journal of Monetary Economics*, 70, 22–38.
- HALL, R. E., AND N. G. MANKIW (1994): “Nominal Income Targeting,” in *Monetary policy*, ed. by N. G. Mankiw, pp. 71–93. Chicago and London: University of Chicago Press.
- HATZIUS, J., AND S. J. STEHN (2011): “The Case for a Nominal GDP Level Target,” *Goldman Sachs US Economics Analyst*, no. 11/41, October 14.
- (2013): “A Nominal GDP Level Target in All but Name,” *Goldman Sachs US Economics Analyst*, no. 13/03, January 20.

- JENSEN, H. (2002): “Targeting Nominal Income Growth or Inflation?,” *American Economic Review*, 92(4), 928–956.
- JOHANSEN, B. K. (2014): “When are the Effects of Fiscal Policy Uncertainty Large?,” Finance and Economics Discussion Series 2014-40. Board of Governors of the Federal Reserve System (U.S.).
- JUNG, T., Y. TERANISHI, AND T. WATANABE (2005): “Optimal Monetary Policy at the Zero-Interest-Rate-Bound,” *Journal of Money, Credit, and Banking*, 37(5), 813–835.
- LEVIN, A., D. LÓPEZ-SALIDO, E. NELSON, AND T. YUN (2010): “Limitations on the Effectiveness of Forward Guidance at the Zero Lower Bound,” *International Journal of Central Banking*, 6(1), 143–189.
- MCCALLUM, B. T. (1988): “Robustness properties of a rule for monetary policy,” *Carnegie-Rochester Conference Series on Public Policy*, 29, 173–204.
- MEADE, J. E. (1978): “The meaning of internal balance,” *Economic Journal*, 88(351), 423–435.
- NAKATA, T. (2013): “Uncertainty at the Zero Lower Bound,” Finance and Economics Discussion Series 2013-09. Board of Governors of the Federal Reserve System (U.S.).
- NAKOV, A. (2008): “Optimal and Simple Monetary Policy Rules with Zero Floor on the Nominal Interest Rate,” *International Journal of Central Banking*, 4(2), 73–127.
- ORPHANIDES, A., AND V. WIELAND (2000): “Efficient Monetary Policy Design Near Price Stability,” *Journal of the Japanese and International Economies*, 14, 327–365.
- PLANTE, M., A. W. RICHTER, AND N. A. THROCKMORTON (2014): “The Zero Lower Bound and Endogenous Uncertainty,” Working Paper 2014-05. Federal Reserve Bank of Dallas (U.S.).
- REIFSCHNEIDER, D., AND J. C. WILLIAMS (2000): “Three Lessons for Monetary Policy in a Low-Inflation Era,” *Journal of Money, Credit, and Banking*, 32(4), 936–966.

- SENECA, M. (2016): “Risk shocks close to the zero lower bound,” Staff Working Paper No. 606. Bank of England (U.K.).
- SUMNER, S. B. (2011): “Re-Targeting the Fed,” *National Affairs*, Fall, no. 9, 79-96.
- (2014): “Nominal GDP Targeting: A Simple Rule to Improve Fed Performance,” *Cato Journal*, 34(2), 315–337.
- SVENSSON, L. E. O. (1999): “Price-Level Targeting versus Inflation Targeting: A Free Lunch?,” *Journal of Money, Credit and Banking*, 31(3), 277–295.
- (2003): “Escaping from a Liquidity Trap and Deflation: The Foolproof Way and Others,” *Journal of Economic Perspectives*, 17(4), 145–166.
- (2010): “Monetary Policy and Financial Markets at the Effective Lower Bound,” *Journal of Money, Credit and Banking*, Supplement to 42(6), 229–242.
- TAYLOR, J. B. (1985): “What Would Nominal GNP Targeting Do to the Business Cycle?,” *Carnegie-Rochester Conference Series on Public Policy*, 22, 61–84.
- TAYLOR, J. B., AND J. C. WILLIAMS (2010): “Simple and Robust Rules for Monetary Policy,” in *Handbook of Monetary Economics*, ed. by B. M. Friedman, and M. Woodford, vol. 3, chap. 15, pp. 829–859. Amsterdam: Elsevier B.V.
- TOBIN, J. (1980): “Stabilization Policy Ten Years After,” *Brookings Papers on Economic Activity*, 11(1), 19–90.
- VESTIN, D. (2006): “Price-Level Versus Inflation Targeting,” *Journal of Monetary Economics*, 53(7), 1361–1376.
- WALSH, C. E. (2003): “Speed Limit Policies: The Output Gap and Optimal Monetary Policy,” *American Economic Review*, 93(1), 265–278.
- WEST, K. D. (1986): “Targeting Nominal Income: A Note,” *Economic Journal*, 96(384), 1077–1083.

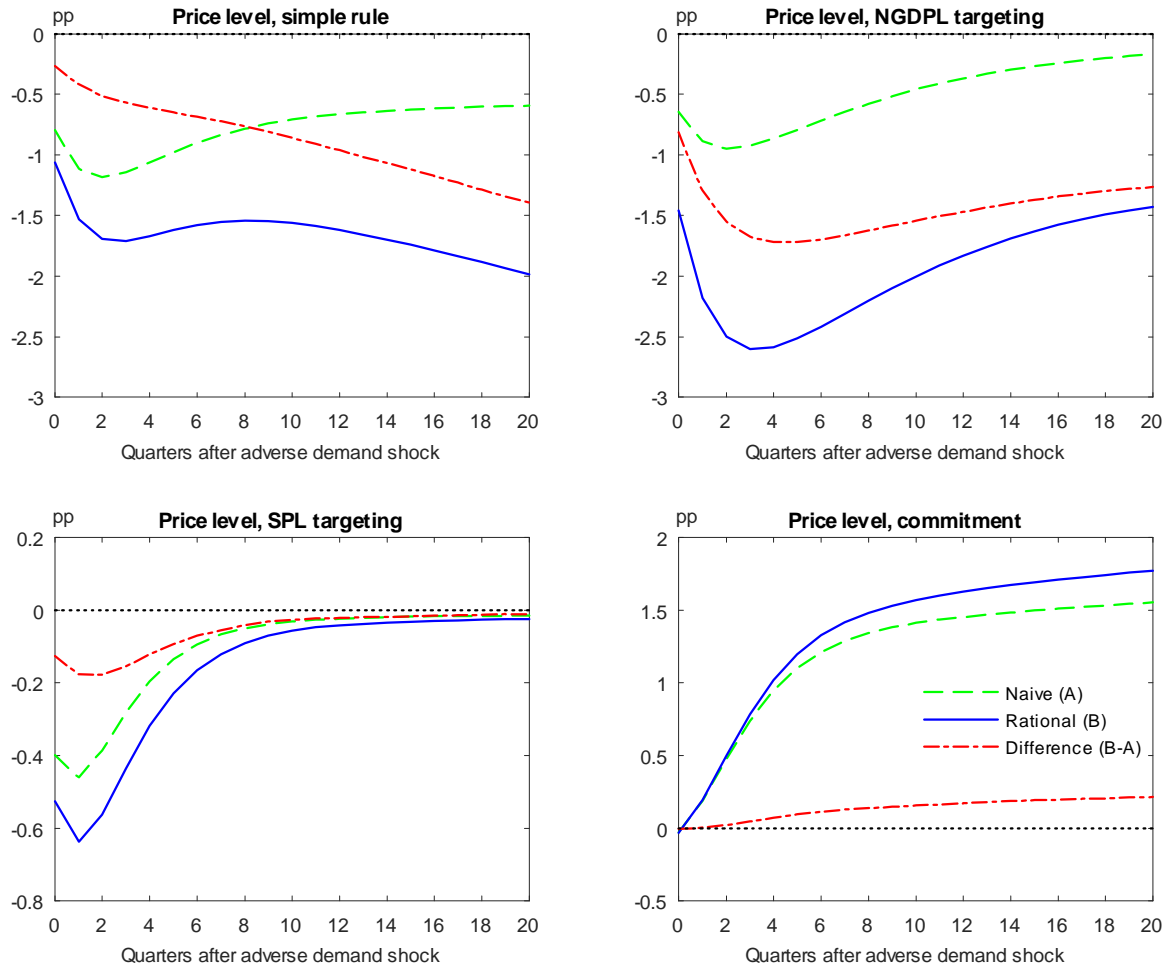
- WILLIAMS, J. C. (2009): “Heeding Daedalus: Optimal Inflation and the Zero Lower Bound,” *Brookings Papers on Economic Activity*, 40(2), 1–45.
- WOLMAN, A. L. (2005): “Real Implications of the Zero Bound on Nominal Interest Rates,” *Journal of Money, Credit, and Banking*, 37(2), 273–296.
- WOODFORD, M. (2010): “Optimal Monetary Stabilization Policy,” in *Handbook of Monetary Economics*, ed. by B. M. Friedman, and M. Woodford, vol. 3, chap. 14, pp. 723–828. Amsterdam: Elsevier B.V.
- (2012): “Methods of Policy Accommodation at the Interest-Rate Lower Bound,” in *Jackson Hole Economic Policy Symposium Proceedings*, pp. 185–288. Federal Reserve Bank of Kansas City.
- (2013): “Inflation Targeting: Fix It, Don’t Scrap It,” in *Is inflation Targeting Dead? Central Banking After the Crisis*, ed. by L. Reichlin, and R. Baldwin, pp. 74–89. London: CEPR, VoxEU.org.

Figure 1: Slower pace of policy normalization because of outlook uncertainty



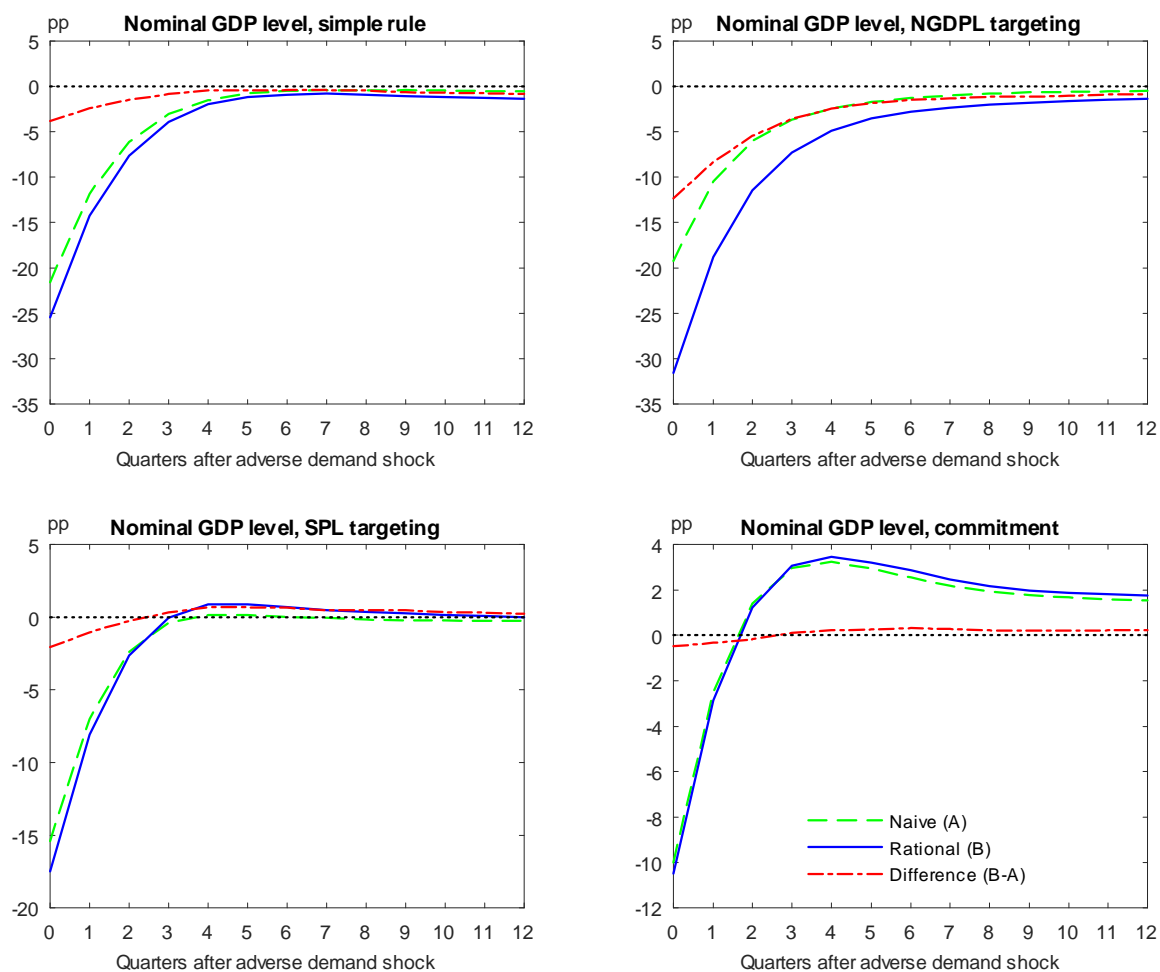
Notes: Shown are expected paths after a -3.5 standard deviation v_t shock, using the baseline calibration of Section 5.1. Values are expressed as percent annual (pa).

Figure 2: Outlook uncertainty and price stability during a ZLB episode



Notes: Shown are expected paths after a -3 standard deviation v_t shock, using the baseline calibration of Section 5.1. Values are in percentage points (pp).

Figure 3: Outlook uncertainty and economic stability during a ZLB episode



Notes: Shown are expected paths after a -3 standard deviation v_t shock, using the baseline calibration of Section 5.1. Values are in percentage points (pp).

Table 1: Outlook uncertainty and economic performance, with supply shocks only^a

| | ZLB episodes | | Welfare loss ^b | | |
|------------------------------|--------------------|-----------------------|---------------------------|-----|------|
| | Freq. ^c | Duration ^d | π | x | Tot. |
| Naive (A) | | | | | |
| Simple policy rule | 0.0 | 0.0 | 10.4 | 0.4 | 10.8 |
| Nominal-GDP-level targeting | 0.0 | 0.0 | 5.7 | 1.0 | 6.7 |
| Strict-price-level targeting | 0.0 | 0.0 | 0.0 | 5.3 | 5.3 |
| Optimal commitment | 0.0 | 0.0 | 0.9 | 1.9 | 2.8 |
| Rational (B) | | | | | |
| Simple policy rule | 0.0 | 0.0 | 10.4 | 0.4 | 10.8 |
| Nominal-GDP-level targeting | 0.0 | 0.0 | 5.7 | 1.0 | 6.7 |
| Strict-price-level targeting | 0.0 | 0.0 | 0.0 | 5.3 | 5.3 |
| Optimal commitment | 0.0 | 0.0 | 0.9 | 1.9 | 2.8 |
| Difference (B-A) | | | | | |
| Simple policy rule | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Nominal-GDP-level targeting | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Strict-price-level targeting | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Optimal commitment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

a. Baseline calibration of Section 5.1 but with $\sigma_v = 0$.

b. Permanent consumption loss (basis points).

c. Expected percent of time at the ZLB.

d. Expected number of consecutive quarters at the ZLB.

Table 2: Outlook uncertainty and economic performance, with supply and demand shocks^a

| | ZLB episodes | | Welfare loss ^b | | |
|------------------------------|--------------------|-----------------------|---------------------------|------|------|
| | Freq. ^c | Duration ^d | π | x | Tot. |
| Naive (A) | | | | | |
| Simple policy rule | 1.4 | 2.8 | 21.3 | 25.9 | 47.2 |
| Nominal-GDP-level targeting | 6.0 | 1.8 | 6.8 | 4.4 | 11.2 |
| Strict-price-level targeting | 8.6 | 2.9 | 0.5 | 7.6 | 8.1 |
| Optimal commitment | 9.7 | 3.1 | 1.7 | 3.1 | 4.8 |
| Rational (B) | | | | | |
| Simple policy rule | 2.5 | 3.1 | 24.9 | 28.6 | 53.5 |
| Nominal-GDP-level targeting | 11.1 | 2.1 | 11.9 | 10.8 | 22.7 |
| Strict-price-level targeting | 15.4 | 3.1 | 1.0 | 9.2 | 10.2 |
| Optimal commitment | 12.7 | 3.2 | 2.0 | 3.5 | 5.5 |
| Difference (B-A) | | | | | |
| Simple policy rule | 1.1 | 0.3 | 3.6 | 2.7 | 6.3 |
| Nominal-GDP-level targeting | 5.1 | 0.3 | 5.1 | 6.4 | 11.5 |
| Strict-price-level targeting | 6.8 | 0.2 | 0.5 | 1.6 | 2.1 |
| Optimal commitment | 3.0 | 0.1 | 0.3 | 0.4 | 0.7 |

a. Baseline calibration of Section 5.1.

b. Permanent consumption loss (basis points).

c. Expected percent of time at the ZLB.

d. Expected number of consecutive quarters at the ZLB.

Table 3: Outlook uncertainty and economic performance, with larger demand shocks^a

| | ZLB episodes | | Welfare loss ^b | | |
|------------------------------|--------------------|-----------------------|---------------------------|------|------|
| | Freq. ^c | Duration ^d | π | x | Tot. |
| Naive (A) | | | | | |
| Simple policy rule | 2.2 | 3.0 | 23.9 | 32.1 | 56.0 |
| Nominal-GDP-level targeting | 7.1 | 1.9 | 7.5 | 6.8 | 14.3 |
| Strict-price-level targeting | 10.8 | 3.2 | 0.9 | 9.3 | 10.2 |
| Optimal commitment | 12.8 | 3.2 | 2.4 | 4.0 | 6.4 |
| Rational (B) | | | | | |
| Simple policy rule | 5.3 | 3.6 | 35.0 | 39.2 | 74.2 |
| Nominal-GDP-level targeting | 14.3 | 2.3 | 16.5 | 17.7 | 34.2 |
| Strict-price-level targeting | 20.1 | 3.5 | 1.9 | 12.2 | 14.1 |
| Optimal commitment | 15.7 | 3.6 | 2.8 | 4.5 | 7.3 |
| Difference (B-A) | | | | | |
| Simple policy rule | 3.1 | 0.6 | 11.1 | 7.1 | 18.2 |
| Nominal-GDP-level targeting | 7.2 | 0.4 | 9.0 | 10.9 | 19.9 |
| Strict-price-level targeting | 9.3 | 0.3 | 1.0 | 2.9 | 3.9 |
| Optimal commitment | 2.9 | 0.4 | 0.4 | 0.5 | 0.9 |

a. Baseline calibration of Section 5.1 but with $\sigma_v = 0.88$.

b. Permanent consumption loss (basis points).

c. Expected percent of time at the ZLB.

d. Expected number of consecutive quarters at the ZLB.

Table 4: Outlook uncertainty and economic performance, with more persistence in the demand shocks^a

| | ZLB episodes | | Welfare loss ^b | | |
|------------------------------|--------------------|-----------------------|---------------------------|------|------|
| | Freq. ^c | Duration ^d | π | x | Tot. |
| Naive (A) | | | | | |
| Simple policy rule | 3.6 | 3.7 | 20.6 | 24.5 | 45.1 |
| Nominal-GDP-level targeting | 5.8 | 2.0 | 7.5 | 5.9 | 13.4 |
| Strict-price-level targeting | 9.1 | 3.7 | 0.9 | 8.6 | 9.5 |
| Optimal commitment | 10.0 | 3.9 | 2.2 | 3.3 | 5.5 |
| Rational (B) | | | | | |
| Simple policy rule | 8.3 | 4.7 | 36.4 | 36.8 | 73.2 |
| Nominal-GDP-level targeting | 12.2 | 2.4 | 17.0 | 15.2 | 32.2 |
| Strict-price-level targeting | 17.4 | 3.9 | 2.0 | 11.1 | 13.1 |
| Optimal commitment | 12.7 | 3.9 | 2.6 | 3.7 | 6.3 |
| Difference (B-A) | | | | | |
| Simple policy rule | 4.7 | 1.0 | 15.8 | 12.3 | 28.1 |
| Nominal-GDP-level targeting | 6.4 | 0.4 | 9.5 | 9.3 | 18.8 |
| Strict-price-level targeting | 8.3 | 0.2 | 1.1 | 2.5 | 3.6 |
| Optimal commitment | 2.7 | 0.0 | 0.4 | 0.5 | 0.8 |

a. Baseline calibration of Section 5.1 but with $\rho_v = 0.85$ and $\phi_\pi = 2.5$.

b. Permanent consumption loss (basis points).

c. Expected percent of time at the ZLB.

d. Expected number of consecutive quarters at the ZLB.

Earlier Working Papers:

For a complete list of Working Papers published by Sveriges Riksbank, see www.riksbank.se

| | |
|--|----------|
| Estimation of an Adaptive Stock Market Model with Heterogeneous Agents <i>by Henrik Amilon</i> | 2005:177 |
| Some Further Evidence on Interest-Rate Smoothing: The Role of Measurement Errors in the Output Gap <i>by Mikael Apel and Per Jansson</i> | 2005:178 |
| Bayesian Estimation of an Open Economy DSGE Model with Incomplete Pass-Through <i>by Malin Adolphson, Stefan Laséen, Jesper Lindé and Mattias Villani</i> | 2005:179 |
| Are Constant Interest Rate Forecasts Modest Interventions? Evidence from an Estimated Open Economy DSGE Model of the Euro Area <i>by Malin Adolphson, Stefan Laséen, Jesper Lindé and Mattias Villani</i> | 2005:180 |
| Inference in Vector Autoregressive Models with an Informative Prior on the Steady State <i>by Mattias Villani</i> | 2005:181 |
| Bank Mergers, Competition and Liquidity <i>by Elena Carletti, Philipp Hartmann and Giancarlo Spagnolo</i> | 2005:182 |
| Testing Near-Rationality using Detailed Survey Data <i>by Michael F. Bryan and Stefan Palmqvist</i> | 2005:183 |
| Exploring Interactions between Real Activity and the Financial Stance <i>by Tor Jacobson, Jesper Lindé and Kasper Roszbach</i> | 2005:184 |
| Two-Sided Network Effects, Bank Interchange Fees, and the Allocation of Fixed Costs <i>by Mats A. Bergman</i> | 2005:185 |
| Trade Deficits in the Baltic States: How Long Will the Party Last? <i>by Rudolfs Bems and Kristian Jönsson</i> | 2005:186 |
| Real Exchange Rate and Consumption Fluctuations following Trade Liberalization <i>by Kristian Jönsson</i> | 2005:187 |
| Modern Forecasting Models in Action: Improving Macroeconomic Analyses at Central Banks <i>by Malin Adolphson, Michael K. Andersson, Jesper Lindé, Mattias Villani and Anders Vredin</i> | 2005:188 |
| Bayesian Inference of General Linear Restrictions on the Cointegration Space <i>by Mattias Villani</i> | 2005:189 |
| Forecasting Performance of an Open Economy Dynamic Stochastic General Equilibrium Model <i>by Malin Adolphson, Stefan Laséen, Jesper Lindé and Mattias Villani</i> | 2005:190 |
| Forecast Combination and Model Averaging using Predictive Measures <i>by Jana Eklund and Sune Karlsson</i> | 2005:191 |
| Swedish Intervention and the Krona Float, 1993-2002 <i>by Owen F. Humpage and Javiera Ragnartz</i> | 2006:192 |
| A Simultaneous Model of the Swedish Krona, the US Dollar and the Euro <i>by Hans Lindblad and Peter Sellin</i> | 2006:193 |
| Testing Theories of Job Creation: Does Supply Create Its Own Demand? <i>by Mikael Carlsson, Stefan Eriksson and Nils Gottfries</i> | 2006:194 |
| Down or Out: Assessing The Welfare Costs of Household Investment Mistakes <i>by Laurent E. Calvet, John Y. Campbell and Paolo Sodini</i> | 2006:195 |
| Efficient Bayesian Inference for Multiple Change-Point and Mixture Innovation Models <i>by Paolo Giordani and Robert Kohn</i> | 2006:196 |
| Derivation and Estimation of a New Keynesian Phillips Curve in a Small Open Economy <i>by Karolina Holmberg</i> | 2006:197 |
| Technology Shocks and the Labour-Input Response: Evidence from Firm-Level Data <i>by Mikael Carlsson and Jon Smedsaas</i> | 2006:198 |
| Monetary Policy and Staggered Wage Bargaining when Prices are Sticky <i>by Mikael Carlsson and Andreas Westermark</i> | 2006:199 |
| The Swedish External Position and the Krona <i>by Philip R. Lane</i> | 2006:200 |

| | |
|--|----------|
| Price Setting Transactions and the Role of Denominating Currency in FX Markets <i>by Richard Friberg and Fredrik Wilander</i> | 2007:201 |
| The geography of asset holdings: Evidence from Sweden <i>by Nicolas Coeurdacier and Philippe Martin</i> | 2007:202 |
| Evaluating An Estimated New Keynesian Small Open Economy Model <i>by Malin Adolfson, Stefan Laséen, Jesper Lindé and Mattias Villani</i> | 2007:203 |
| The Use of Cash and the Size of the Shadow Economy in Sweden <i>by Gabriela Guibourg and Björn Segendorf</i> | 2007:204 |
| Bank supervision Russian style: Evidence of conflicts between micro- and macro-prudential concerns <i>by Sophie Claeys and Koen Schoors</i> | 2007:205 |
| Optimal Monetary Policy under Downward Nominal Wage Rigidity <i>by Mikael Carlsson and Andreas Westermarck</i> | 2007:206 |
| Financial Structure, Managerial Compensation and Monitoring <i>by Vittoria Cerasi and Sonja Daltung</i> | 2007:207 |
| Financial Frictions, Investment and Tobin's q <i>by Guido Lorenzoni and Karl Walentin</i> | 2007:208 |
| Sticky Information vs Sticky Prices: A Horse Race in a DSGE Framework <i>by Mathias Trabandt</i> | 2007:209 |
| Acquisition versus greenfield: The impact of the mode of foreign bank entry on information and bank lending rates <i>by Sophie Claeys and Christa Hainz</i> | 2007:210 |
| Nonparametric Regression Density Estimation Using Smoothly Varying Normal Mixtures <i>by Mattias Villani, Robert Kohn and Paolo Giordani</i> | 2007:211 |
| The Costs of Paying – Private and Social Costs of Cash and Card <i>by Mats Bergman, Gabriella Guibourg and Björn Segendorf</i> | 2007:212 |
| Using a New Open Economy Macroeconomics model to make real nominal exchange rate forecasts <i>by Peter Sellin</i> | 2007:213 |
| Introducing Financial Frictions and Unemployment into a Small Open Economy Model <i>by Lawrence J. Christiano, Mathias Trabandt and Karl Walentin</i> | 2007:214 |
| Earnings Inequality and the Equity Premium <i>by Karl Walentin</i> | 2007:215 |
| Bayesian forecast combination for VAR models <i>by Michael K. Andersson and Sune Karlsson</i> | 2007:216 |
| Do Central Banks React to House Prices? <i>by Daria Finocchiaro and Virginia Queijo von Heideken</i> | 2007:217 |
| The Riksbank's Forecasting Performance <i>by Michael K. Andersson, Gustav Karlsson and Josef Svensson</i> | 2007:218 |
| Macroeconomic Impact on Expected Default Frequency <i>by Per Åsberg and Hovick Shahnazarian</i> | 2008:219 |
| Monetary Policy Regimes and the Volatility of Long-Term Interest Rates <i>by Virginia Queijo von Heideken</i> | 2008:220 |
| Governing the Governors: A Clinical Study of Central Banks <i>by Lars Frisell, Kasper Roszbach and Giancarlo Spagnolo</i> | 2008:221 |
| The Monetary Policy Decision-Making Process and the Term Structure of Interest Rates <i>by Hans Dillén</i> | 2008:222 |
| How Important are Financial Frictions in the U S and the Euro Area <i>by Virginia Queijo von Heideken</i> | 2008:223 |
| Block Kalman filtering for large-scale DSGE models <i>by Ingvar Strid and Karl Walentin</i> | 2008:224 |
| Optimal Monetary Policy in an Operational Medium-Sized DSGE Model <i>by Malin Adolfson, Stefan Laséen, Jesper Lindé and Lars E. O. Svensson</i> | 2008:225 |
| Firm Default and Aggregate Fluctuations <i>by Tor Jacobson, Rikard Kindell, Jesper Lindé and Kasper Roszbach</i> | 2008:226 |

| | |
|--|----------|
| Re-Evaluating Swedish Membership in EMU: Evidence from an Estimated Model <i>by Ulf Söderström</i> | 2008:227 |
| The Effect of Cash Flow on Investment: An Empirical Test of the Balance Sheet Channel <i>by Ola Melander</i> | 2009:228 |
| Expectation Driven Business Cycles with Limited Enforcement <i>by Karl Walentin</i> | 2009:229 |
| Effects of Organizational Change on Firm Productivity <i>by Christina Håkanson</i> | 2009:230 |
| Evaluating Microfoundations for Aggregate Price Rigidities: Evidence from Matched Firm-Level Data on Product Prices and Unit Labor Cost <i>by Mikael Carlsson and Oskar Nordström Skans</i> | 2009:231 |
| Monetary Policy Trade-Offs in an Estimated Open-Economy DSGE Model <i>by Malin Adolfson, Stefan Laséen, Jesper Lindé and Lars E. O. Svensson</i> | 2009:232 |
| Flexible Modeling of Conditional Distributions Using Smooth Mixtures of Asymmetric Student T Densities <i>by Feng Li, Mattias Villani and Robert Kohn</i> | 2009:233 |
| Forecasting Macroeconomic Time Series with Locally Adaptive Signal Extraction <i>by Paolo Giordani and Mattias Villani</i> | 2009:234 |
| Evaluating Monetary Policy <i>by Lars E. O. Svensson</i> | 2009:235 |
| Risk Premiums and Macroeconomic Dynamics in a Heterogeneous Agent Model <i>by Ferre De Graeve, Maarten Dossche, Marina Emiris, Henri Sneessens and Raf Wouters</i> | 2010:236 |
| Picking the Brains of MPC Members <i>by Mikael Apel, Carl Andreas Claussen and Petra Lennartsdotter</i> | 2010:237 |
| Involuntary Unemployment and the Business Cycle <i>by Lawrence J. Christiano, Mathias Trabandt and Karl Walentin</i> | 2010:238 |
| Housing collateral and the monetary transmission mechanism <i>by Karl Walentin and Peter Sellin</i> | 2010:239 |
| The Discursive Dilemma in Monetary Policy <i>by Carl Andreas Claussen and Øistein Røisland</i> | 2010:240 |
| Monetary Regime Change and Business Cycles <i>by Vasco Cúrdia and Daria Finocchiaro</i> | 2010:241 |
| Bayesian Inference in Structural Second-Price common Value Auctions <i>by Bertil Wegmann and Mattias Villani</i> | 2010:242 |
| Equilibrium asset prices and the wealth distribution with inattentive consumers <i>by Daria Finocchiaro</i> | 2010:243 |
| Identifying VARs through Heterogeneity: An Application to Bank Runs <i>by Ferre De Graeve and Alexei Karas</i> | 2010:244 |
| Modeling Conditional Densities Using Finite Smooth Mixtures <i>by Feng Li, Mattias Villani and Robert Kohn</i> | 2010:245 |
| The Output Gap, the Labor Wedge, and the Dynamic Behavior of Hours <i>by Luca Sala, Ulf Söderström and Antonella Trigari</i> | 2010:246 |
| Density-Conditional Forecasts in Dynamic Multivariate Models <i>by Michael K. Andersson, Stefan Palmqvist and Daniel F. Waggoner</i> | 2010:247 |
| Anticipated Alternative Policy-Rate Paths in Policy Simulations <i>by Stefan Laséen and Lars E. O. Svensson</i> | 2010:248 |
| MOSES: Model of Swedish Economic Studies <i>by Gunnar Bårdsen, Ard den Reijer, Patrik Jonasson and Ragnar Nymoén</i> | 2011:249 |
| The Effects of Endogenous Firm Exit on Business Cycle Dynamics and Optimal Fiscal Policy <i>by Lauri Vilmi</i> | 2011:250 |
| Parameter Identification in a Estimated New Keynesian Open Economy Model <i>by Malin Adolfson and Jesper Lindé</i> | 2011:251 |
| Up for count? Central bank words and financial stress <i>by Marianna Blix Grimaldi</i> | 2011:252 |

| | |
|---|----------|
| Wage Adjustment and Productivity Shocks <i>by Mikael Carlsson, Julián Messina and Oskar Nordström Skans</i> | 2011:253 |
| Stylized (Arte) Facts on Sectoral Inflation <i>by Ferre De Graeve and Karl Walentin</i> | 2011:254 |
| Hedging Labor Income Risk <i>by Sebastien Betermier, Thomas Jansson, Christine A. Parlour and Johan Walden</i> | 2011:255 |
| Taking the Twists into Account: Predicting Firm Bankruptcy Risk with Splines of Financial Ratios <i>by Paolo Giordani, Tor Jacobson, Erik von Schedvin and Mattias Villani</i> | 2011:256 |
| Collateralization, Bank Loan Rates and Monitoring: Evidence from a Natural Experiment <i>by Geraldo Cerqueiro, Steven Ongena and Kasper Roszbach</i> | 2012:257 |
| On the Non-Exclusivity of Loan Contracts: An Empirical Investigation <i>by Hans Degryse, Vasso Ioannidou and Erik von Schedvin</i> | 2012:258 |
| Labor-Market Frictions and Optimal Inflation <i>by Mikael Carlsson and Andreas Westermarck</i> | 2012:259 |
| Output Gaps and Robust Monetary Policy Rules <i>by Roberto M. Billi</i> | 2012:260 |
| The Information Content of Central Bank Minutes <i>by Mikael Apel and Marianna Blix Grimaldi</i> | 2012:261 |
| The Cost of Consumer Payments in Sweden <i>by Björn Segendorf and Thomas Jansson</i> | 2012:262 |
| Trade Credit and the Propagation of Corporate Failure: An Empirical Analysis <i>by Tor Jacobson and Erik von Schedvin</i> | 2012:263 |
| Structural and Cyclical Forces in the Labor Market During the Great Recession: Cross-Country Evidence <i>by Luca Sala, Ulf Söderström and Antonella Trigari</i> | 2012:264 |
| Pension Wealth and Household Savings in Europe: Evidence from SHARELIFE <i>by Rob Alessie, Viola Angelini and Peter van Santen</i> | 2013:265 |
| Long-Term Relationship Bargaining <i>by Andreas Westermarck</i> | 2013:266 |
| Using Financial Markets To Estimate the Macro Effects of Monetary Policy: An Impact-Identified FAVAR* <i>by Stefan Pitschner</i> | 2013:267 |
| DYNAMIC MIXTURE-OF-EXPERTS MODELS FOR LONGITUDINAL AND DISCRETE-TIME SURVIVAL DATA <i>by Matias Quiroz and Mattias Villani</i> | 2013:268 |
| Conditional euro area sovereign default risk <i>by André Lucas, Bernd Schwaab and Xin Zhang</i> | 2013:269 |
| Nominal GDP Targeting and the Zero Lower Bound: Should We Abandon Inflation Targeting?* | 2013:270 |
| <i>by Roberto M. Billi</i> | |
| Un-truncating VARs* <i>by Ferre De Graeve and Andreas Westermarck</i> | 2013:271 |
| Housing Choices and Labor Income Risk <i>by Thomas Jansson</i> | 2013:272 |
| Identifying Fiscal Inflation* <i>by Ferre De Graeve and Virginia Queijo von Heideken</i> | 2013:273 |
| On the Redistributive Effects of Inflation: an International Perspective* <i>by Paola Boel</i> | 2013:274 |
| Business Cycle Implications of Mortgage Spreads* <i>by Karl Walentin</i> | 2013:275 |
| Approximate dynamic programming with post-decision states as a solution method for dynamic economic models <i>by Isaiah Hull</i> | 2013:276 |
| A detrimental feedback loop: deleveraging and adverse selection <i>by Christoph Bertsch</i> | 2013:277 |
| Distortionary Fiscal Policy and Monetary Policy Goals <i>by Klaus Adam and Roberto M. Billi</i> | 2013:278 |
| Predicting the Spread of Financial Innovations: An Epidemiological Approach <i>by Isaiah Hull</i> | 2013:279 |

| | |
|---|----------|
| Firm-Level Evidence of Shifts in the Supply of Credit <i>by Karolina Holmberg</i> | 2013:280 |
| Lines of Credit and Investment: Firm-Level Evidence of Real Effects of the Financial Crisis <i>by Karolina Holmberg</i> | 2013:281 |
| A wake-up call: information contagion and strategic uncertainty <i>by Toni Ahnert and Christoph Bertsch</i> | 2013:282 |
| Debt Dynamics and Monetary Policy: A Note <i>by Stefan Laséen and Ingvar Strid</i> | 2013:283 |
| Optimal taxation with home production <i>by Conny Olovsson</i> | 2014:284 |
| Incompatible European Partners? Cultural Predispositions and Household Financial Behavior <i>by Michael Haliassos, Thomas Jansson and Yigitcan Karabulut</i> | 2014:285 |
| How Subprime Borrowers and Mortgage Brokers Shared the Piecial Behavior <i>by Antje Berndt, Burton Hollifield and Patrik Sandås</i> | 2014:286 |
| The Macro-Financial Implications of House Price-Indexed Mortgage Contracts <i>by Isaiah Hull</i> | 2014:287 |
| Does Trading Anonymously Enhance Liquidity? <i>by Patrick J. Dennis and Patrik Sandås</i> | 2014:288 |
| Systematic bailout guarantees and tacit coordination <i>by Christoph Bertsch, Claudio Calcagno and Mark Le Quement</i> | 2014:289 |
| Selection Effects in Producer-Price Setting <i>by Mikael Carlsson</i> | 2014:290 |
| Dynamic Demand Adjustment and Exchange Rate Volatility <i>by Vesna Corbo</i> | 2014:291 |
| Forward Guidance and Long Term Interest Rates: Inspecting the Mechanism <i>by Ferre De Graeve, Pelin Ilbas & Raf Wouters</i> | 2014:292 |
| Firm-Level Shocks and Labor Adjustments <i>by Mikael Carlsson, Julián Messina and Oskar Nordström Skans</i> | 2014:293 |
| A wake-up call theory of contagion <i>by Toni Ahnert and Christoph Bertsch</i> | 2015:294 |
| Risks in macroeconomic fundamentals and excess bond returns predictability <i>by Rafael B. De Rezende</i> | 2015:295 |
| The Importance of Reallocation for Productivity Growth: Evidence from European and US Banking <i>by Jaap W.B. Bos and Peter C. van Santen</i> | 2015:296 |
| SPEEDING UP MCMC BY EFFICIENT DATA SUBSAMPLING <i>by Matias Quiroz, Mattias Villani and Robert Kohn</i> | 2015:297 |
| Amortization Requirements and Household Indebtedness: An Application to Swedish-Style Mortgages <i>by Isaiah Hull</i> | 2015:298 |
| Fuel for Economic Growth? <i>by Johan Gars and Conny Olovsson</i> | 2015:299 |
| Searching for Information <i>by Jungsuk Han and Francesco Sangiorgi</i> | 2015:300 |
| What Broke First? Characterizing Sources of Structural Change Prior to the Great Recession <i>by Isaiah Hull</i> | 2015:301 |



Sveriges Riksbank
Visiting address: Brunkebergs torg 11
Mail address: se-103 37 Stockholm

Website: www.riksbank.se
Telephone: +46 8 787 00 00, Fax: +46 8 21 05 31
E-mail: registratorn@riksbank.se