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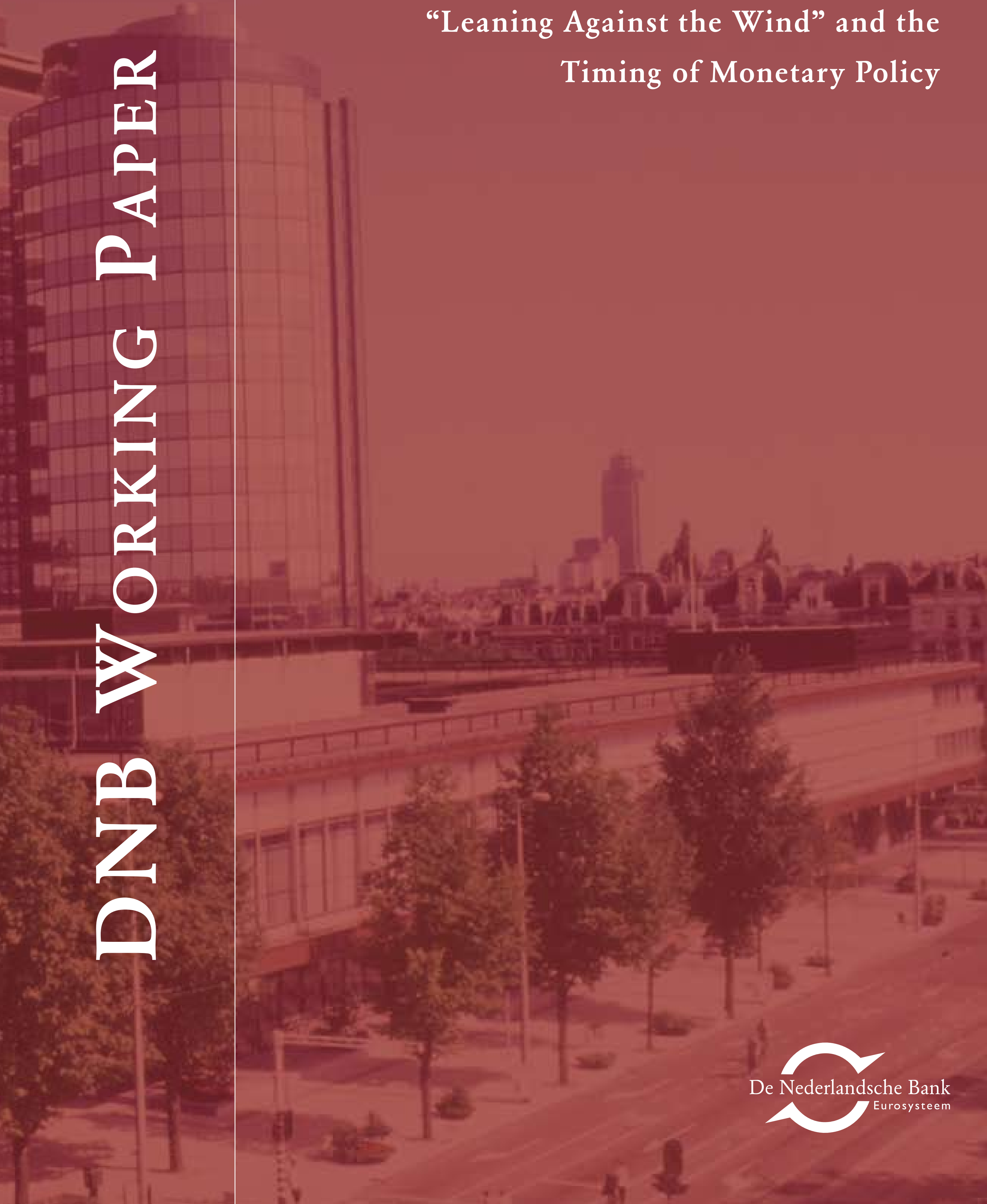

De Nederlandsche Bank
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“Leaning Against the Wind” and the Timing of Monetary Policy

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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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"Leaning Against the Wind" and the Timing of Monetary Policy*

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Abstract

If monetary policy is to aim also at financial stability, how would it change? To analyze this question, this paper develops a general-form, axiomatic framework. Financial stability objectives are shown to make a monetary authority more aggressive. By that we mean that in reaction to negative shocks, cuts are deeper but shorter-lived than otherwise. Keeping cuts brief is crucial as bank risk responds primarily to rates that are kept "too low for too long". Within this shorter time span, cuts must then be deeper than otherwise to also achieve standard objectives.

Keywords: Monetary policy, Financial stability

JEL Classification: E52, G01, G21

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1 Introduction

One of the prime suspects for the cause of the recent financial crisis is the extended period of low monetary policy rates in the preceding years. Various authors have argued that the US Fed's prolonged accommodative policies spurred risk taking incentives among the financial intermediaries that were at the heart of the crisis.[1] Empirically, Maddaloni and Peydro (2011) use data from the Euro Area Bank Lending Survey to show that lower overnight rates soften lending standards. This softening is beyond what can be explained by other factors affected by the rates, like the quality of the borrower's collateral. They also find evidence that keeping rates "too low for too long" reduces credit standards even further. Similarly, Altunbas, Gambacorta and Marquez-Ibanez (2010) find that keeping rates low for an extended period of time significantly raises banks' risk profiles. They obtain this result from a data set that includes quarterly balance sheet information on listed banks in the EU and the US.[2]

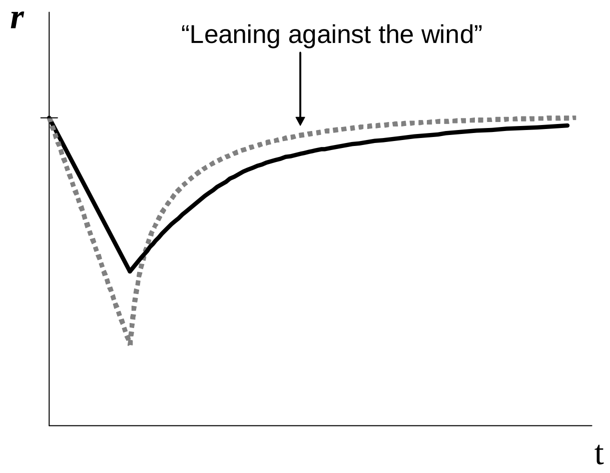
In this paper we model how this "too low for too long" effect comes about, on the basis of the maturity mismatch between long term assets and short term liabilities on banks' balance sheets. In a general form approach, in which we take the objectives of the monetary authority as given, we show that there are two main effects on optimal policy rates following a shock: the first is upon impact, and the second refers to the dynamic path of interest rates. These are summarized in figure 1, which represents the response of the monetary authority to a negative economic shock. The dotted line graphs the policy of an authority whose objectives include financial stability, while the solid line is that of an authority with standard-objectives.

Faced with a negative shock, the authority that "leans against the wind" would cut interest rates deeper upon impact, than absent of a financial objective. However, its dynamic response will be to return to the equilibrium level quicker. Intuitively, this short-lived cut is there to

[1] See Borio and Zhu (2008), Dell'Ariccia, Igan and Laeven (2008), Calomiris (2009), Brunnermeier (2009), Brunnermeier et al. (2009), Taylor (2009), Allen, Babus and Carletti (2009), Adrian and Shin (2009a), Diamond and Rajan (2009) and Kannan, Rabanal and Scott (2009).

[2] Other empirical papers that focus on the relationship between monetary policy and bank risk taking are Jiménez et al. (2009), Ioannidou, Ongena and Peydro (2009), Dell'Ariccia, Laeven and Marquez (2010), Buch, Eickmeier and Prieto (2010), Delis and Brissimis (2010) and Delis and Kouretas (2010). Unlike the two papers cited in the text, however, these papers do not analyze the relation to the duration of a rate change.

Figure 1: The timing of monetary policy



prevent the buildup of risks, as banks adjust their portfolio only when they anticipate cuts to last long. This is the "too low for too long" argument. However, in the short time span that the authority has to cut rates, it must then go deeper in order to alleviate the effects of the shock on its other objectives. This underlies the more aggressive move upon impact.

As already argued, we assume that the monetary authority has a financial objective and then examine how it affects the timing of optimal policy. In the policy debate, various authors have called for the formulation of a monetary policy that explicitly considers bank risk taking and financial stability.[3] But also in the academic literature, several recent papers model a reason for monetary authorities to do so. Agur and Demertzis (2011) use a banking model to show how exogenous changes in monetary policy affect bank risk taking, and how an optimizing regulator is not in the position to neutralize this effect. The reason is that monetary policy affects both sides of the regulator's trade-off, namely financial stability and credit growth, so that a rate change essentially tilts the regulatory possibilities frontier. With a regulator that is unable to neutralize the risk-taking channel of monetary policy, there is justification for a joint regulatory-monetary policy. Acharya and Naqvi (2010) introduce an agency consideration into the analysis of monetary transmission: bank loan officers are compensated on the basis of generated loan volume. This causes an asset bubble, which a monetary authority can prevent

[3] Borio and White (2004), Borio and Zhu (2008), Adrian and Shin (2008, 2009a,b) and Disyatat (2010).

by "leaning against liquidity". Loisel, Pommeret and Portier (2009) construct a model in which it is optimal for the monetary authority to lean against asset bubbles by affecting entrepreneurs' cost of resources in order to prevent herd behavior.[4] A different approach is taken within the DSGE macro literature. Rather than providing a qualitative story, the models of Angeloni and Faia (2009), Angeloni, Faia and Lo Duca (2010) and Gertler and Karadi (2009) make a quantitative comparison of welfare under different central bank objectives, showing numerically that financial objectives can be valid.[5]

2 Model

We describe the economy by the general aggregate demand function:

$$y_t\left(\alpha_t, \varepsilon_t, r_t^f, r_{t-1}^f, ..., r_0^f\right), \tag{1}$$

where $y_t(\cdot)$ is the output gap; $r_t^f, r_{t-1}^f, ..., r_0^f$ are the current and all past interest rates. The standard arguments of the IS equation imply that:

$$\frac{\partial y_t\left(\alpha_t, \varepsilon_t, r_t^f, r_{t-1}^f, ..., r_0^f\right)}{\partial r_{t-s}^f} < 0 \qquad \forall s \leq t. \tag{2}$$

Variable ε_t represents a persistent demand shock:

$$\varepsilon_t = \theta\varepsilon_{t-1} + \nu_t, \tag{3}$$

[4] Other papers that model the transmission from monetary policy to bank risk, but without focussing on an argument for why this would affect monetary policy strategy, are Dell'Ariccia, Laeven and Marquez (2010), De Nicolò (2010), Drees, Eckwert and Várdy (2010), Dubecq, Mojon and Ragot (2010) and Dell'Ariccia and Marquez (2006).

[5] There have been many other papers that build on the framework of Bernanke, Gertler and Gilchrist (1999) by incorporating financial frictions into DSGE models. These are reviewed in Gertler and Kyotaki (2010). However, banks are usually a passive friction in this literature, with the exception of the papers cited in the text, and Cociuba, Shukayev and Ueberfeldt (2011), who numerically analyze monetary transmission on banks' incentives to "search for yield", but do not focus on the optimality of "leaning against the wind".

with $\theta \in (0,1)$ the persistence parameter, and ν_t an iid shock. The impact on the business cycle is such that:

$$\frac{\partial y_t(\cdot)}{\partial \varepsilon_t} > 0. \tag{4}$$

Finally, α_t represents the bank risk profile, taken by financial institutions. Although we do not attempt to model risk explicitly here, the types of concepts that we have in mind for risk are, for example, the share of risky loans in a bank's portfolio, or the extent of financial innovation, which may bestow both benefits and costs on society (Tufano, 2003; Lerner and Tufano 2011). This would suggest that there is an optimal level of risk taking in as far as welfare is concerned. We denote this as α_t^w. Any negative deviations from it would imply missing out on welfare enhancing opportunities; any positive deviations would be identified with "excessive risk taking".

$$\begin{aligned} \frac{\partial y_t(\cdot)}{\partial \alpha_t} &> 0, \quad \forall\, \alpha_t \in [0, \alpha_t^w), \\ \frac{\partial y_t(\cdot)}{\partial \alpha_t} &< 0, \quad \forall\, \alpha_t \in (\alpha_t^w, 1]. \end{aligned}$$

The monetary authority combines its two objectives in the inter-temporal function, like in Disyatat, (2010):

$$\begin{aligned} \min_{r_t^f,\quad t\geq 0} \mathbb{E}[L] &= \min_{r_t^f,\quad t\geq 0} \left\{ E \sum_{t=0}^{\infty} \delta^t \left[(1-\rho) f(y_t(\cdot)) + \rho g(\alpha_t - \alpha_t^w)\right] \right\} \\ \text{s.t.:} &\qquad y_t(\cdot). \end{aligned} \tag{5}$$

Here, $(\alpha_t - \alpha_t^w)$ is the distance between bank risk and socially optimal risk. The monetary authority places a weight of ρ on preventing the costs arising from excessive risk, captured by the function $g(\alpha_t - \alpha_t^w)$. And it places a weight of $(1-\rho)$ on the "standard" objective of minimizing output gap fluctuations, represented by the function $f(y_t(\cdot))$.[6]

[6] We ignore inflation without any loss of generality. As we will only be looking at demand shocks, a policy

Within this economy we introduce a banking sector that is modelled based on the following three axioms:

Axiom 1 Bank optimal risk taking is larger than the social optimum.

Axiom 2 Risk taking is procyclical.

Axiom 3 Risk is persistent.

Each of these can be obtained from various of specific functional forms. In particular, the first axiom relates to bank moral hazard, which is quite a standard feature of the banking literature in general (Freixas and Rochet, 1997). The bank does not fully internalize the social costs of its risky loans. Part of the cost of its potential insolvency is borne by society rather than by bank shareholders, through limited liability, bailouts, deposit insurance or lost bank-specific relations to its customers. Therefore, the bank takes more risk than socially optimal. The second axiom comes about when the returns on risky projects are positively influenced by the state of the business cycle. Procyclicality is a well-established feature of banking empirical studies. The literature survey of Drumond (2009) discusses various mechanism through which procyclicality is found to come about. Finally, the third axiom holds whenever risky projects are of relatively long maturity. Maturity mismatch has always between assets and liabilities has always been a key feature of banking, and gained particular prominence in the buildup to the previous crisis (Brunnermeier, 2009; Adrian and Shin, 2009a), as even 30-year mortgages were often financed using very short-term instruments. Maturity mismatch implies that building down risk on the asset side is a time consuming process.

We model one bank, whose management is risk neutral. This bank can be seen as representing the banking sector's aggregate balance sheet. The bank chooses a risk profile α_t to maximize its profit, $P_t(\alpha_t, y_t(\cdot))$. We call the bank's profit maximizing risk profile, α_t^b, and operationalize the first axiom as

$$\alpha_t^b > \alpha_t^w. \tag{6}$$

effort to close the output gap will at the same time close the inflation gap.

The second axiom, on the procyclicality of risk taking, is given by:

$$\frac{\partial \alpha_t^b}{\partial y_t(\cdot)} > 0. \tag{7}$$

Finally, the third axiom is operationalized with the constraint

$$\alpha_t \geq \beta \alpha_{t-1}. \tag{8}$$

Here, $\beta \in (0,1)$: the bank can only gradually shed risk from its balance sheet.[7]

3 A brief but deep cut

We examine next the effects of a persistent shock on the dynamic path of the interest rate (r_t^f, $\forall t$) and bank risk taking (α_t, $\forall t$). At time $t = 1$ a random shock ν_1 occurs, which determines the path of ε_t through the persistence parameter θ. We assume that the central bank commits to the pre-announced interest-rate path that results from its optimization.[8] Since we consider a one period shock only, the dynamic aspect of our exercise relates to how an authority chooses to 'spread' a given policy across time. When a negative shock hits, will it choose a short, deep cut or a longer, smoother response?

Definition 1: *Define λ as the profile of the monetary authority's policy response, where a higher λ means a deeper but shorter-lived policy. More specifically:*

- *assign $\lambda = 0$ to the optimal policy of the monetary authority with $\rho = 0$. This is the baseline case of an authority that does not lean against the wind;*
- *define a higher λ as a policy that shifts forward part of the rate cut.*

[7] In fact, given that riskier projects generally involve longer maturities, we could write in more general notation: $\beta(\alpha_t)$, with $\beta'(\alpha_t) > 0$. That is, the riskier a bank's profile, the longer the maturities of its loans, the fewer loans terminate each period and, therefore, the more persistent its balance sheet becomes. However, this complicates notation, while not making a qualitative difference to the proofs.

[8] In the Appendix we explain why (and how) this is a time-consistent policy.

Then: *Policy profile i has a higher λ than policy profile j if:*

$$\exists \widehat{t}: \quad \left(\left|r_{t,i}^{f}-\overline{r}^{f}\right| \geq \left|r_{t,j}^{f}-\overline{r}^{f}\right| \quad \forall t<\widehat{t}\right) \wedge \left(\left|r_{t,i}^{f}-\overline{r}^{f}\right| \leq \left|r_{t,j}^{f}-\overline{r}^{f}\right| \quad \forall t>\widehat{t}\right),$$

and for some $t<\widehat{t}$ and some $t>\widehat{t}$ the respective conditions are strictly binding. Here, $\overline{r}^{f}$ is the steady state interest rate and policy is thus defined in deviations from that steady state.

We can now state this section's main result:

Proposition 1 *Following a negative shock ($\nu_1<0$), a monetary authority that leans against the wind ($\rho>0$) chooses a profile $\lambda>0$ for its interest rates. It thus opts for a deeper but shorter response, compared to an authority, which only has standard objectives ($\rho=0$). Generally, $\frac{d\lambda}{d\rho}>0$.*

Proof. We outline our proof in figures 2 and 3 where we plot, respectively, the interest rates and the associated levels of risk taking for different λ. In figure 3 the dashed (red) line represents how the constraint on risk ($\alpha_t \geq \beta\alpha_{t-1}$) prevents the reduction of risk from one period to the next. Consider first $\beta=0$, i.e. no dynamic constraint on risk taking. First, by $\frac{\partial \alpha_t^b}{\partial y_t(\cdot)}\frac{\partial y_t(\cdot)}{\partial \varepsilon_t}=(+)(+)>0$ a negative shock, $\nu_1<0$, implies that α_t^b decreases and then, as $\varepsilon_t \to 0$, gradually returns to $\overline{\alpha}^b$, the bank's steady state optimal risk taking. This is true for any policy irrespective of λ. Then, for $\beta>0$, the constraint $\alpha_t \geq \beta\alpha_{t-1}$ will be binding from $t=0$ up to a t', at which point $\alpha_{t'}^b\big|_{\beta=0}=\beta\alpha_{t'-1}^b (\text{or} =\beta^{t'}\overline{\alpha}^b)$.

For a sufficient proof set $\widehat{t}=t'$. We observe that for $t<t'$ policy cuts $\left|r_t^f-\overline{r}^f\right|$ are less deep for $\lambda=0$, generating risk taking that is closer to society's optimal. For $t>t'$, policy cuts $\left|r_t^f-\overline{r}^f\right|$ implied by $\lambda>0$ however, generate risk taking that is closer to society's optimal. Then up to t' the constrained paths of $\lambda=0$ and $\lambda>0$ are equivalent. But, subsequently, $\lambda>0$ has lower risk taking. In terms of financial stability, the $\lambda>0$ thus offers an unambiguous gain on the financial stability objective, i.e.: $\frac{d}{d\lambda}\sum_{t=0}^{T}\delta^t\left[g\left(\alpha_t-\alpha_t^w\right)\right]<0$. However, it is also an unambiguous loss on $\sum_{t=0}^{T}\delta^t\left[f\left(y_t(\cdot)\right)\right]$ by the definition that $\lambda=0$ is the path of the $\rho=0$ authority, which minimizes $f\left(y_t(\cdot)\right)$. It follows that the more weight the authority puts on preventing financial imbalances (higher ρ), the more it is willing to give up on minimizing $f(y_t(\cdot))$ to achieve a lower $g(\alpha_t - \alpha_t^w)$, which implies that $\frac{d\lambda}{d\rho} > 0$.

Figure 2: Interest rate paths for λ

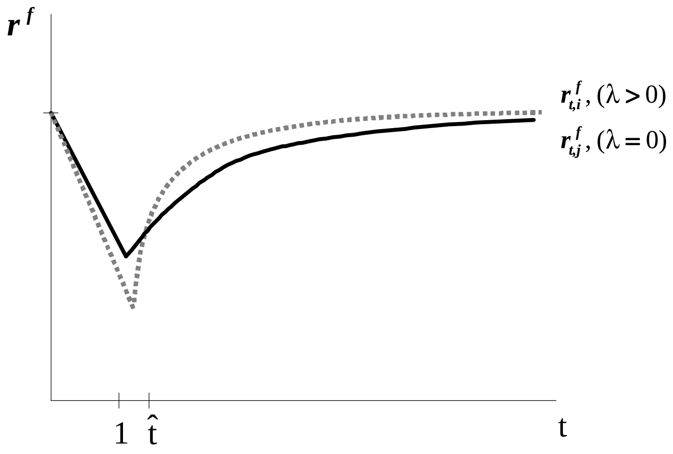
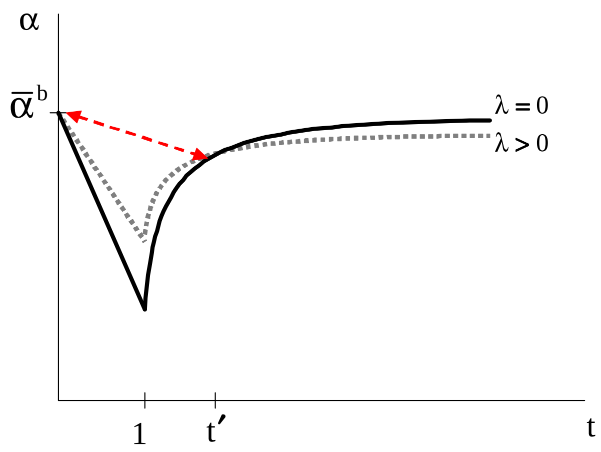


Figure 3: Risk taking paths for λ



■

Intuitively, banks build up risk when the economy picks up again, while rates are still low. This is the pattern that some argue was observed in the aftermath of the 2001-2003 recession, and contributed to the current crisis (see footnote 1). An authority that leans against the wind wants to prevent this type of pattern. By raising rates quickly after an initial cut incentives to buildup risk later are mitigated. This comes at a cost in terms of the optimal output gap stabilization. The more an authority cares about preventing excessive risk, the more of such costs it is willing to bear. Thus, the larger the weight on the financial stability objective, the shorter are its rate cuts. Given the short window of time in which rates are lowered, the authority then chooses a relatively deep cut, in order to sufficiently stimulate the economy. Overall, this yields figure 1, where the dotted line represents $\rho > 0$ and the solid line $\rho = 0$.

Corollary 1 *Proposition 1 does not extend to an upturn ($\nu_1 > 0$). No unambiguous statement can be made about the effect of a higher ρ on the dynamics of monetary policy response to a positive shock.*

Proof. The proof of Proposition 1 implies that $\int_t \alpha_t^b dt$ is unambiguously smaller under a higher λ, as α_t^b is the same till $\widehat{t}$, and less afterwards. This does not extend to a positive shock, however. A higher λ, which here implies steeper initial rate hike, does translate into a smaller α_0^b. But for $t > \widehat{t}$: $\alpha_t^b\big|_{\lambda>0} > \alpha_t^b\big|_{\lambda=0}$. Thus, there is a parameter-dependent trade-off, and no general proof can be derived. ∎

Intuitively, moving the asset portfolio from shorter to longer maturities is not very time consuming. But the converse is: building down risk takes time, as risky loans involve long-term commitments. This is implicit in the formalization of the third axiom (equation (8)), which drives the asymmetry between positive and negative shocks.

4 Conclusions

In this paper we examine how monetary policy would be altered if it were to account for financial imbalances. We allow for risk to affect the economy in a procyclical way and then examine how the interaction between bank risk taking and monetary policy would affect the path of interest rates. Our main assumption of risk being persistent implies that banks cannot raise risk as quickly as interest rates fall. This suggests that they will only adjust their portfolios if rates are kept low for significant amounts of time. In response to that we show that, when faced with negative shocks, monetary authorities would be better off keeping rate cuts brief. But then wishing to close the output gap as well would imply that the cut needs to be bigger than otherwise. We acknowledge that while accounting for financial imbalances has a very clear implication for the path of interest rates, the definition and measurement of risk remains a considerable challenge in its implementation.

Appendix: Commitment

We have assumed that the monetary authority fully commits to the interest rate path.

Proposition 2 *If $\rho > 0$, such a commitment is time-consistent and therefore fully credible.*

Proof. The result of relevance is Proposition 1. It is here that, in response to a shock, the authority announces a path from which it could potentially deviate later. Allowing for deviations from the pre-announced path, we let the bank play a tit-for-tat strategy: if the monetary authority ever deviates from the path that it has announced, the bank resorts to risk-taking against the $\lambda = 0$ path. Note that the $\lambda = 0$ path is fully credible as it is the monetary authority's optimal path that minimizes the stabilization objective, $f(y_t(\bullet))$. No monetary authority would wish to deviate to a $\lambda < 0$ as it would unambiguously loose out on both objectives in L. The potential benefit of deviating from an announced $\lambda > 0$ path is gaining on $f(y_t(\bullet))$. If, at the same time, risk behavior remains in accordance with the $\lambda > 0$ path, then the monetary authority sees a clear reduction (improvement) in its losses. We argue however, that this is not possible, as risk behavior will adjust immediately upon observing such deviation. Following the notation of the proof of Proposition 1, split the interest rate path into r_t^f for $t < \widehat{t}$ and $t > \widehat{t}$. For $t > \widehat{t}$ we have that $\alpha_t|_{\lambda>0} < \alpha_t|_{\lambda=0}$. But, the dynamic constraint on risk taking, $\alpha_t \geq \beta\alpha_{t-1}$ is only binding downwards. By the bank's tit-for-tat strategy, then, if the monetary authority deviates from its path at any $t > \widehat{t}$, it loses out unambiguously: the bank can directly adjust risk taking to the $\lambda = 0$ path. For $t < \widehat{t}$ deviation would imply the exact same outcome for the path of α_t as just announcing $\lambda = 0$. The bank follows the same path of α_t for $t < \widehat{t}$ under $\lambda = 0$ and $\lambda > 0$, after all (as depicted in figure 3). But in terms of its $f(y_t(\bullet))$ first announcing $\lambda > 0$ and later following $\lambda = 0$ cannot be an improvement either, by the fact that $\lambda = 0$ minimizes $f(y_t(\bullet))$. Hence, given this reaction from the part of the bank, the monetary authority gains nothing on either of its objectives by deviating from its pre-announced path. ■

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