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-Abstract-

Can central bank communication act as a second instrument when policymakers are facing boom-bust cycles? Against the background of the current discussion about introducing an additional instrument when dealing with asset price misalignments, we argue that one of the core instruments of monetary policy should be considered: central bank communication. In a stylized model, communicating the future path of policy can change the trade-off between the proactive policy of curbing asset price inflation and the reactive policy of loosening monetary policy conditions during the boom phase. We show that the additional use of communication supports the proactive strategy.

Keywords: Monetary Policy, Asset Prices, Credit Crunch, Boom-Bust Cycles, Communication.
JEL Codes: E52, E58, E44, F41

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1. Introduction

Can central bank communication act as a second instrument when policymakers face boom-bust cycles? The topic of whether and how monetary policy should take asset price developments into account is currently being re-evaluated with several authors arguing for a stronger role of financial factors and for the "leaning against the wind" approach.[1] At the same time, there is a growing literature suggesting macroprudential regulation for dealing with asset price misalignments. It is argued that monetary policy should move on and integrate new instruments when facing boom-bust-cycles. In particular, some authors call for a second instrument beside the policy rate of the central bank. The exact details are still being controversially debated. Although it is argued by several authors that regulation should be the "first line of defence", Carney (2009) emphasizes that there is still a role for monetary policy in the case of boom-bust cycles. One reason may be that macroprudential tools might not be both timely and effective in any case. However, we argue that policymakers should focus on central bank communication as a second instrument, since one possible instrument could be proper communication regarding bubbles in asset markets (Dudley 2008).

There is empirical evidence that central bank communication can help financial market participants in times of financial turmoil (ECB 2009b, Ehrmann and Fratzscher 2007, 2009). However, the discussion focuses mainly on the situation in the bust phase (see for example ECB 2008, 2009b). In contrast, in this paper we focus on the situation for policymakers during the boom period of asset prices. Recently, the discussion regarding the meaning of communication in boom-bust cycles has intensified. As several authors (Mishkin 2009, Svensson 2009, Meyer 2008, Dudley 2008 and Carney 2009) have pointed out, communication can play an important role when policymakers are faced with asset price misalignments. Hattori, Shin and Takahashi (2009) argue that booms and busts have occurred over several centuries independently of the state of financial instruments and regulation. They show that during the Japanese bubble some financial indicators did not show any sign of warning, and conclude therefore that policymakers should be cautious in assessing financial conditions using certain indicators.[2] Therefore, Hattori et al. (2009) see an important role for communication: policymakers should "point to some excesses in financial markets and the behavior of financial institutions as part of their communication strategy". Warnings by policymakers could have value when markets cannot correct themselves. A famous example is Greenspan's "irrational

[1] See for example Yellen (2009), Trichet (2009), White (2009), Weber (2009), Cúrdia and Woodford (2009), de Fiore and Tristani (2009), Adrian and Shin (2008) and Lipsky (2008). Even Svensson (2009) can be interpreted in a way that leaning against the wind can be synonymous with flexible inflation targeting.

[2] As stressed by the authors, in the case of Japan neither the liquidity ratio nor the capital asset ratio showed any signs of warning during the bubble phase.

exuberance" (Greenspan 1996).[3] Moreover, Greenspan's 'jaw boning' of the stock market from December 1996 was interpreted by Hayford and Malliaris (2001) as "an attempt to find another policy instrument to influence the stock market in the direction of estimates of fundamentals". In addition, central banks are regularly perceived as influencing exchange rate markets with words.[4]

In this paper, we argue that central banks could combine the communication about their future policy (interest rate) path with possible actions regarding asset price misalignments. This view is supported by Svensson (2010). Whether central banks should communicate about their future policy path is a controversially debated question, see for example Rudebusch (2008). However, it could be argued that communication of central banks is a 'management of expectations' (see Woodford 2005), using a certain code to influence the expectations and the behavior of financial markets. Here, to be transparent about the future policy path enables central banks to steer the behavior of financial markets in the case of boom-bust-cycles. Therefore, when policymakers announce interest rate increases due to excessive credit growth, financial markets might adjust their behavior. Central bank communication should reflect the respective state of the financial system (see Carney 2009). If the state is exuberant, communication about the future path of policy should be adapted. For example, the proper communication strategy could curb excessive credit growth (ECB 2009 argues that "central banks' communication can contribute to curbing asset price developments").

Against the background of the discussion about another instrument during or before boom-bust cycles we argue that policymakers should focus at the core instruments of monetary policy: the interest rate and the central bank communication. In a stylized New Keynesian model building on Bordo and Jeanne (2002) and Berger, Kißmer and Wagner (2007) we focus on the situation for central bankers during the boom period. They can choose between the proactive strategy of curbing asset price inflation and the reactive strategy of loosening monetary conditions during the boom period. In addition, we integrate a communication channel that is characterized by communicating the future path of the policy of central bankers during the boom period. We show that the additional use of this communication channel broadens the scope for the proactive strategy because it decreases the 'insurance premium' of this policy choice and therefore its losses.

[3] Greenspan used this phrase in a speech. It was understood as a warning, and stock markets worldwide reacted with losses.

[4] In October 2009, several observers noted that the ECB obviously tried to use words of warning against the strong euro.

The remainder of the paper is structured as follows. In section 2 we give a short overview of central bank communication and asset prices. Employing a stylized New Keynesian model, we analyze in section 3 the impact of central bank communication on the policy trade-off for monetary policy during asset price booms. In a numerical simulation with baseline parameter values we show that central bank communication can broaden the scope for the proactive policy choice. Section 4 concludes.

2. Central Bank Communication during Boom-Bust Cycles

A topic of special interest regarding the communication of monetary policy strategy is the question of how central banks should communicate during boom-bust-cycles in asset prices. Whether and how central banks should react to asset prices has been an element of an intensive debate during the last decade or so. Broadly speaking, there seem to be two conflicting positions: curbing asset price inflation during the boom period (proactive strategy) and "to mitigate the fallout when it occurs"[5] (reactive strategy) which corresponds to a policy of 'benign neglect'. In this regard, three main problems are usually referred to: the identification problem, the instrument problem and the credibility problem. The first two issues make clear how difficult it is for monetary policy to optimally respond to asset price booms and bubbles. The latter can be linked to central bank communication: How should central banks communicate when they consider asset prices when setting monetary policy, especially when their objectives are only the stabilization of output and inflation? As long as central banks change interest rates when inflation is above or below target and asset prices as well, there might not be a credibility problem. However, considering the case when inflation and output are on target, but there is a non-sustainable asset price boom – when central banks react to asset prices although the targets are only inflation and output stabilization, credibility problems might arise. In this regard, central bank communication is very important. In the face of asset price movements, there are huge challenges for policymakers regarding communication during boom-bust-cycles. However, there might be a channel for communication where policymakers can use their communication as a second instrument, in addition to their policy rate. Using a long enough policy horizon, communication of the future path of policy can help to dampen overoptimistic expectations. During a boom phase in asset prices, policymakers might be able to steer the inclination of firms and private subjects to issue debt. White (2009) argues that central bank communication can be important when dealing with imbalances: "credible statements of official concern and determination to act" can affect private behavior in a stabilizing

[5] Cf. Greenspan (2002).

way, possibly preventing excessive misalignments in credit and asset prices. A similar development has been observed after central banks became more serious about fighting inflation: the different policy stance was communicated and led, amongst others, to a change in inflationary expectations.

Different results were obtained in theoretical analyses. As already mentioned, one alternative is ‘benign neglect’ during asset price booms, not only regarding the actual stance of monetary policy, but regarding communication as well. However, it is doubtful whether central banks should really communicate this way. When a central bank communicates ‘benign neglect’, the risk of moral hazard is involved (‘Greenspan put’ – Miller, Weller, Zhang 2001 and the risk of interest rate gap, Illing 2004). The ‘Greenspan put’ can be described by the fact, that due to the assured intervention of monetary policy in case of a bust, the observed risk premium in the stock market may be reduced. Therefore, investors could possibly believe that they are insured against downside risk and behave this way (moral hazard). One solution for this situation could be a “clear announcement that prices are irrational and that the market will not in fact be supported at any level”, Miller et al. (2001). During the bust phase (in one asset market) the central bank may face the “risk of interest rate gap” (Illing 2004). A monetary tightening may be associated with the risk of encouraging investors to build up a bubble in another asset market. Illing (2004) recommends a communication strategy that is characterized by the fact that only very high leveraged investors are given clear signals, so that they can unwind their positions in an orderly manner. All other subjects do not receive this information in order to prevent financial instability. However, “that requires an extremely precarious intertemporal communication strategy“, Illing (2004).

As already mentioned, the reactive strategy usually corresponds to a policy of ‘benign neglect’. However, if forward-looking expectations are taken into account, things may be different: In this case, the optimal policy differs from ‘benign neglect’ and even a purely reactive policy responds to asset prices (Berger et al. 2007). Communication in this case has to be two-way: since ‘benign neglect’ is not longer an option, policymakers may be forced already to react to a deterioration of the public’s forward-looking expectations in the boom period (and to communicate this). That ‘benign neglect’ is therefore not a sensible option for central banks is shown by Berger et al. (2007).

There have been various approaches in central banking practice: the communication of the Federal Reserve Bank with its Chairman Alan Greenspan seemed to be twofold: external communication was obviously consistent with ‘benign neglect’, but internal communication was not, as shown by Cecchetti (2003). Analyzing minutes and transcripts of FOMC meetings in the period 1981-1997, Cecchetti (2003) concluded that in the case of FOMC meetings, the participants talked about the stock market and took asset price misalignments into account when they set the federal funds rate. In addition, Lansing (2008) shows by integrating stock market variables that the fit of an estimated Taylor rule (measured with the actual Federal Funds rate) is improved compared with an estimated Taylor rule without stock market variables. However, even in this case the actual rate was still below the estimated rule in the years 2003-2005, as already shown by Taylor (2007). At the ECB, there is still the monetary pillar (monetary analysis) that serves as an indicator for boom-bust-cycles, Issing (2005). Furthermore, at the Bank of England changes in strategy have been discussed, such as the extending of the forecast horizon, see Bean (2003) and King (2002).[6]

In this paper we argue that central bankers can include their communication during boom-bust-cycles in their future path of policy rates. Several authors stress the advantages of publishing projections of future policy (Svensson 2002, Woodford 2005):

- Public understanding of monetary policy could be improved,
- The public would be able to better evaluate the quality of central bank forecasts,
- This would increase the incentive for central banks to deliver high quality forecasts.

However, regarding the feasibility of strategy transparency it is argued that a high degree of transparency could complicate the decision-making process of financial market participants (Goodhart 2001). Furthermore, the private subjects could put too much weight on public information (delivered by the central bank) and less weight on possibly useful private information (and therefore forecast risks), see Morris and Shin (2002). The authors show that public information is beneficial when private subjects do not have sufficient private information, but if there is already valuable private information, the disclosure of public information can be detrimental. However, Svensson (2006) shows that this result is only achieved under very rare circumstances, and in most cases disclosure of public information is beneficial.[7]

Van der Cruijsen et al. (2008) argue that too much transparency could deteriorate the quality of private forecasts due to uncertainty, too much information and respective confusion and plead for an “intermediate degree of transparency“. Furthermore, financial market participants

[6] For a more detailed survey of central bank communication see Wagner (2007).

[7] For this discussion see as well Morris and Shin (2005), Cornand and Heinemann (2008), Pearlman (2005) and Amador und Weill (2008). Furthermore, Crowe and Meade (2008) show in an extensive empirical study that greater transparency of central banks has led to a larger use of public information and qualitatively better forecasts.

could confuse the forecasts with a promise of a future interest rate path. In the case of a deviation financial market instabilities could be the result, which could endanger the credibility of the central bank, see Rudebusch (2008) and Kohn (2008). As the Bank of Japan (2008) shows, the forecast errors can be considerable, so that a clear communication of the own uncertainty (and ignorance) is very important.[8] One way of doing this is to use fan charts, like the Bank of England. Ueda (2009) shows in a simple model that multiple equilibriums might exist when the central bank communicates with money market traders in the financial market. In one equilibrium, traders reveal their information and thus induce policymakers to make better forecasts. However, if the central bank is too transparent, a "dog-chasing-its-tail" equilibrium in the sense of Blinder (1998) with increased inflation variability can be the result.

Another reason against the publication of the future path of interest rates might be that it is associated with a high degree of uncertainty, Rudebusch (2008). There are several studies with ambiguous results, e.g. Rudebusch and Williams (2006) and Gersbach and Hahn (2008). The latter analyze theoretically the impact of the publication of monetary policy forecasts. In a dynamic model with an extended objective function (enhanced by deviations of announcements) they show that the publication of future interest rates is always associated with lower welfare, whereas inflation forecast can lead to higher welfare in the medium term. In a similar vein, Walsh (2008) shows in a New Keynesian model that higher transparency is basically welfare-increasing, because the central bank is enabled to pursue a more effective stabilization policy. One exception is the publication of the expected inflation and output path. In this case, additional information could make the expectations of private subjects more volatile and hence reduce welfare. This result holds in particular when private subjects only have poor information. Correspondingly, Adrian and Shin (2009) assume that monetary policy can affect the risk-taking of central banks and, in turn, the supply of credit. In their framework, the short term interest rate becomes an important price variable in its own right (in contrast to the usual assumption that central banks are primarily interested in steering long-term interest rates by managing expectations). The authors show that if forward looking communication about the future path of policy compresses uncertainty, then risk-taking may increase, with detrimental effects for stabilization.

However, in our paper we show that clarity in the boom period can prevent losses and improve macroeconomic results. In this context, Lipsky's comment is interesting. He argues that "excessive certainty about the future path of interest rates" is not the real problem in causing

[8] The Bank of Japan (2008) shows that for some large economies the forecast error is 1.0% concerning GDP growth and between 0.5% and 1.0% concerning inflation. For the difficulties of central banks communicating their own ignorance, see for example Wagner (2007).

an excessive build-up of debt (and possibly causing a disorderly unwinding), but rather an incentive problem in the financial sector that needs to be addressed in a regulatory way (Lipsky 2008). Furthermore, he agrees with Adrian and Shin (2009) in that central banks should take account of some measure of financial stress when conducting monetary policy.

To sum up, there are several theoretical and empirical analyses of central bank communication during boom-bust cycles in asset prices. In this paper, we want to link the practical consideration of “warning the markets” with theoretical considerations, using the future path of policy rates, a field that has not been analyzed to our knowledge.

3. The Model: Asset Prices and Communication

Our model is related to Bordo and Jeanne (2002), e. g. in allowing for an endogenous financial market shock, but in contrast to them, we employ a standard forward-looking Phillips curve based on Calvo’s (1983) staggered price adjustment. Furthermore, in contrast to Bordo and Jeanne (2002) we are not interested in the microeconomic foundation of the collateral-induced credit crunch. We focus exclusively on macroeconomic effects and on macroeconomic policy. Readers who are interested in the microeconomics of the lending and borrowing decisions of households and firms are therefore referred to their work. We do not explicitly model asset prices, but rather take them into account by the occurrence of a credit crunch and financial instability.[9]

In our model we consider three periods. There are two reasons for this. First, to better illustrate the boom-bust-cycle, and second, to stress that central banks only face boom-bust cycles in exceptional situations: the question of behaving reactively or proactively in the face of boom-bust-cycles is only relevant in exceptional cases and is not a matter for daily monetary policy. In period 1, the boom period, firms contract debt to finance the acquisition of a productive asset. Firms need this asset for production, but it may also serve as collateral in the second period. The more euphoric firms are, the higher is their debt. Policymakers have to decide which strategy they choose. In period 1, future asset prices are still unknown. In period 2, an asset price bust (associated with a steep drop in collateral) may or may not occur. Firms only get new credit if the required credit remains below the real value of their collateral less the debt burden from period 1. Therefore, the credit constraint firms are exposed to is directly linked to asset prices. In period 3, the economy moves into a new steady state.[10]

[9] See also Bean (2004) who studies the impact of a credit crunch in a New Keynesian model and not explicitly assumes asset prices, but rather let them move “in sympathy with investment and borrowing”.

[10] It should be noted that the process in our model has some similarity to the work of Minsky (1977) and Kindleberger (1978), e.g. easy credit, euphoria and crisis.

We consider a stylized macroeconomic model, based on Bordo and Jeanne (2002) and Berger et al. (2007), with equations (1) to (3).

$$x_t = E_t x_{t+1} - \frac{1}{\sigma}(rr_t - rr^*) \quad (1)$$

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

$$rr_t = r_t - E_t \pi_{t+1} \quad (3)$$

with $t = 1, 2, 3$

All parameters are positive, with agents' discount factor β satisfying $0 \leq \beta \leq 1$.

The IS curve equation (1) relates the current output gap to the expected future output gap $E_t x_{t+1}$ and the real interest rate rr_t. The output gap is defined as $x_t = y_t - y^*$ with y^* as the natural level of output. The parameter rr^* is defined as the domestic real interest rate that would prevail in the absence of shocks.[11] $1/\sigma$ is the elasticity of aggregate demand concerning changes of the real interest rate, where σ is the coefficient of the relative risk aversion.

The New Keynesian Phillips curve (2) with its slope κ relates current inflation π_t to expected future inflation $E_t \pi_{t+1}$, the output gap x_t and a financial shock u_t. The financial shock of the supply side is associated with a possible credit crunch.[12] Since firms can only borrow against collateral (assets), a steep fall in asset prices induces a sharp decrease of firms' collateral, resulting in some firms' net worth being too small for them to obtain further credit. These firms must stop production. Hence, a collateral-induced credit crunch leads to a decline in economic activity.[13]

The Fisher equation (3) makes the real interest equal to the difference of nominal interest rate r_t and the expected next period's inflation. Policymakers can influence the real interest rate by variations of their policy instrument r_t.

[11] Since there is no growth in our model, rr^* is set constant across the periods.

[12] The financial shock in (2) can be interpreted as a cost-push-shock. This is supported by Cúrdia and Woodford (2009): In their model, a negative financial shock leads to higher costs of intermediation between borrowers and savers, inducing an increase in the credit spread. In the New Keynesian Phillips curve, the credit frictions have cost-push effects since the real resource cost of loan origination and monitoring, and the measure of inefficiency of financial intermediation, are part of the New Keynesian Phillips curve and are positively related to inflation.

[13] Since the financial shock has the character of a cost-push shock, it leads to higher inflation at the same time. This outcome is supported by the comprehensive survey of Schularick and Taylor (2009), who show that in financial crises in the second half of the 20th century inflation was positive.

Following Bordo and Jeanne (2002) and Berger et al. (2007), we assume that the financial shock can only occur in period 2. Thus, the distribution of u_t can be defined as

$$u_t = \begin{cases} 0 & in\ \ t \neq 2 \\ 0 & in\ \ t = 2 \quad if\ no\ credit\ crunch \\ \varepsilon > 0 & in\ \ t = 2 \quad if\ credit\ crunch \end{cases} \tag{4}$$

where ε is the extent of an asset price bust in terms of output losses. Note that, in contrast to conventional models, u_t is partly endogenous.

In our model, central bankers can affect the probability that a credit crunch will occur in the second period through their chosen policy in period 1. In period 2, the probability of a credit crunch depends on the difference between the firms' collateral and their debt burden, for given asset prices. A higher debt burden makes an asset price bust resulting in a credit crunch more likely. Therefore, policymakers are able to influence the costs of a debt burden by changing the nominal, and hence the real interest rate. We assume that firms' debt burden is smaller the higher the real interest rate in the first period.

Moreover, in contrast to Bordo and Jeanne (2002) and Berger et al. (2007), in our model an additional communication channel is integrated into the model by assuming that policymakers can affect private sector's behavior by their communication. Suppose that policymakers encounter a boom in asset prices and excessive credit growth in period 1. They can choose to raise real interest rates to curb the boom (and, when reaching the minimum interest rate to avoid a credit crunch, completely preventing the negative results of a bust), but this is associated with losses in output and inflation. In our model, we assume that policymakers can substitute a part of a potential interest rate increase by a proper communication strategy. As can be seen from the following equations, a warning of policymakers that the current situation is not sustainable and there is 'irrational exuberance' which might lead in the policy horizon to deviations of output and inflation might help to weaken (over)-optimistic expectations. In turn, firms issue less debt than before. Thus, we assume that policymakers are able to steer the behavior of private agents by their communication of the future policy path via a 'management of expectations'. They can use their words to substitute for an otherwise costly interest rate hike (see White 2009). In consequence, central bank communication (CBC) can decrease the real interest rate which is necessary to surely prevent a credit crunch. Formally, the probability of a collateral-induced credit crunch in the second period can be written as

$$\mu \equiv prob(u_2 = \varepsilon \mid rr_1) = \begin{cases} 0 & if \quad rr_1 \geq \underline{rr} > rr^* \\ \\ 0 < \mu < 1 & if \quad rr_1 < \underline{rr} \end{cases} \tag{5}$$

$$\text{with } \underline{rr} = \begin{cases} \underline{rr}^{CBC} & if \;\; Central \;\; Bank \;\; Communication \\ \underline{rr}^{Op} > \underline{rr}^{CBC} & if \;\; Opacity \end{cases}$$

where $\underline{rr}$ denotes the minimum real interest rate which is necessary to completely eliminate the probability of a future credit crunch. If the first period's real interest rate exceeds the minimum interest rate, the debt burden from period 1 will always be low relative to the value of firms' collateral. As can be seen from equation (5), the probability of a credit crunch depends on the chosen real interest rate by the central bank. Moreover, when the central bank is additionally using central bank communication in form of the future policy path, policymakers are able to decrease the level of the real interest rate which is necessary to completely eliminate the probability of a credit crunch ($\underline{rr}^{CBC} < \underline{rr}^{Op}$) since communicating the future policy path can dampen excessive optimism. The reason is that a credibly communicated future interest rate hike can induce private agents to issue less debt than in the case of opacity. When policymakers make clear that the current state of the economy is irrational and not expected to last, the firms will – under given circumstances (for instance the level of asset prices and the real interest rate) – issue less debt. Similar to Bordo and Jeanne (2002a, b) we relate the probability of credit crunch μ in a positive way to the degree of optimism: A credit crunch is more likely to occur if firms are more confident and in an excessively way optimistic.

Policymakers minimize an intertemporal loss function V_t where L_t denotes the period losses.

$$V_t = E\left(\sum_{t=1}^{3} \beta^{t-1} L_t\right) \tag{6}$$

$$L_t = \pi_t^2 + \lambda x_t^2 \tag{7}$$

The period loss function (7) is quadratic in inflation and output gap, where the parameter λ measures the relative weight that central bankers attach to the output gap. Equations (6) and (7) are related to an inflation-targeting regime. Note that $\lambda > 0$ $(\lambda = 0)$ is associated with a regime of flexible (strict) inflation targeting (see Svensson 2003).

If central bankers face an exceptional asset price boom, they can decide between two alternatives: they can immediately raise the interest rate in order to prevent a future financial crisis, which may induce unnecessary high losses during the boom period because the first period's output and inflation may fall sharply below their target values. Alternatively, policymakers may adopt the reactive policy strategy that is not associated with these costs. However, a bust in period 2 can still occur, and in this case policymakers will be unable to stabilize both inflation and the output gap at the same time. In addition, when assuming forward-looking expectations the reactive strategy may be associated with immediate losses. The decision as to which policy is implemented involves a comparison of the expected losses of both strategies. In section 3.1 we consider the reactive strategy and in section 3.2 the proactive strategy. In section 3.3 we derive the optimal policy choice in an analytical and numerical way.

3.1 The Reactive Policy

By adopting a reactive policy strategy, policymakers take the probability of a future credit crunch as given and stabilize the consequences of actual or expected shocks if and when they occur. The model is solved through standard backward induction. In period 3 no shocks can occur and the economy moves into a new steady state. As there is no real growth and the steady state lasts forever, $E_3\pi_4 = 0$ holds. Furthermore, we assume discretionary policymaking, which means that policymakers are not committed to react to the previous period's shocks. In period 3, policymakers thus set the interest rate equal to the equilibrium value. Given $r_3 = rr_3 = rr*$, output and inflation correspond to the target values. Therefore, the expected losses of period 3 are zero (see Table 1 in the Appendix).

In period 2, however, the occurrence of a credit crunch is possible. In the event that it does not occur, policymakers are able to completely stabilize the economy and prevent losses. Then, the second period's equilibrium equals the steady state solution. However, in the case of a credit crunch, central bankers will have to trade off inflation against output losses. As can be seen from Table 1, optimal monetary stabilization in that case results in increasing inflation and decreasing output. Furthermore, the expected losses in the second period are positive due to the strictly positive $(\mu > 0)$ probability of a credit crunch under the reactive strategy.

In period 1, forward-looking agents will allow for the possibility of a credit crunch and the expected future stabilization policy in their expectations. These expectations enter the current inflation rate and the current output gap, so that central bankers have to respond to them by setting their policy instrument in a way that the first period's real interest rate falls below the flex-price equilibrium level rr^*. Although reactive central bankers do not pursue a policy of "leaning against the wind", it follows that forward-looking expectations force them to abandon the flex-price equilibrium during the boom phase.

Thus, allowing for forward-looking expectations has two main implications for the optimal design of a reactive policy strategy. First, in our model the reactive strategy diverges from a policy of 'benign neglect' towards asset price booms. Our interpretation of a reactive strategy implies that the optimal reactive policy reacts in a timely manner if an asset price boom signals current or future changes in the target variables. Second, in our model the optimal reactive policy response induces policymakers to choose a "leaning-with-the-wind" strategy which is associated by a decline in the real interest rate during the boom period.

3.2 The Proactive Policy

The proactive strategy is characterized by policymakers trying to avoid a future credit crunch. Following Bordo and Jeanne (2002a, b), we assume that policymakers know how they have to set the interest rate in period 1 to prevent a future credit crunch.[14] In period 3 there are no differences to the reactive policy case. Central bankers set the real interest rate at rr^* so that inflation and output gap are at their target values. In contrast to the reactive case, proactive policymakers may attain this favorable solution in the period 2 as well, since a credit crunch only occurs under a reactive policy regime (see Table 2 in The Appendix). However, to obtain this outcome, an insurance premium has to be paid during the boom period. Policymakers must choose for the first period's interest a value of $\underline{rr}$, inducing inflation and the output gap falling below their target values during the boom phase. Consequently, the main difference in our model between both policy stances is not the timing of the policy response but the direction in which the real interest rate is moved during asset price booms. In case of a proactive strategy, policymakers have to lean against the wind by raising the real interest rate during the boom phase. In contrast to this, a reactive strategy implies leaning with the wind.

[14] This is of course a simplifying assumption. Opponents of a proactive strategy regularly stress that the link between monetary policy instruments and the probability of a future financial crises is unknown to central bankers.

3.3 The Optimal Policy Choice

Now we are able to derive the policy rule that determines the optimal choice of the monetary policy strategy. From our results presented in Tables 1 and 2, it follows that

(Reactive) $$V^{REA} = \left(\beta\lambda\mu\varepsilon^2 / \Delta\right) + \left(\beta\mu\varepsilon\right)^2 \left(\lambda / \Delta\right)^3 \quad (8)$$

(Proactive) $$V^{PRO} = \left(\frac{z}{\sigma}\right)^2 \Delta \quad (9)$$

$$z = \underline{rr} - rr^* > 0$$

$$\underline{rr} = \begin{cases} \underline{rr}^{CBC} & \text{if Central Bank Communication} \\ \underline{rr}^{Op} > \underline{rr}^{CBC} & \text{if Opacity} \end{cases}$$

Main Result

In general, both strategies may turn out to be the optimal policy in response to an asset price boom. Formally, the proactive policy is optimal if $V^{PRO} < V^{REA}$, which is the case if condition (10) is fulfilled:

$$\underline{rr}^{CBC} < \underline{rr}^{Op} < \overline{rr} = rr^* + \frac{\sigma\varepsilon}{\Delta}\sqrt{\beta\lambda\mu\left[1 + \beta\mu\left(\lambda/\Delta\right)^2\right]} \quad (10)$$

with $\Delta = \lambda + \kappa^2$

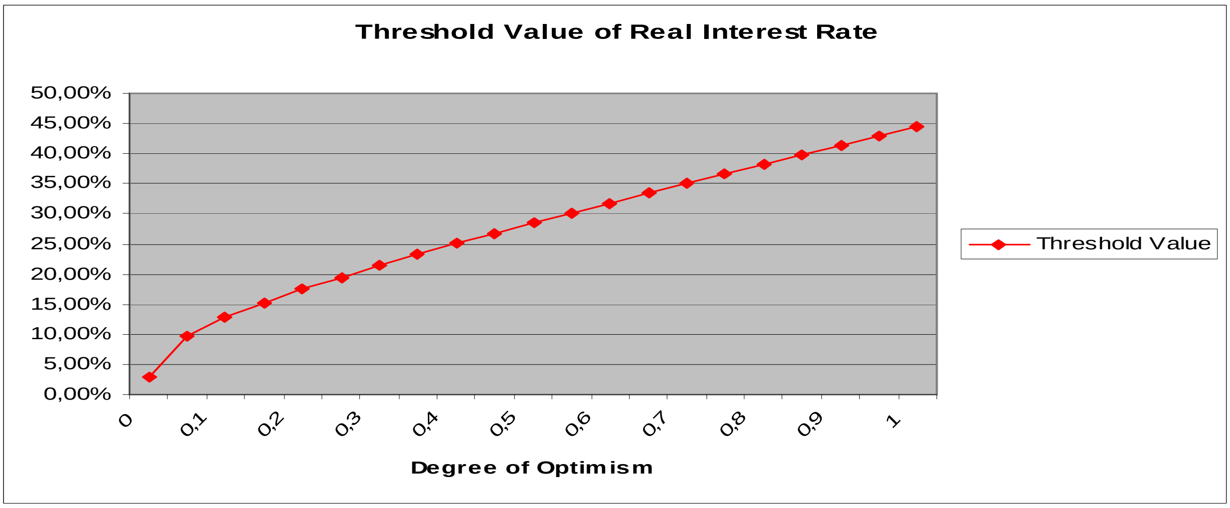
In equation (10), $\overline{rr}$ is defined as the maximum level of the real interest rate that central bankers are willing to endure in order to avoid a future credit crunch. If this threshold value is larger than the real interest rate required to avoid a credit crunch, $\underline{rr}$, monetary policymakers will pay the insurance premium and choose the proactive strategy. As can be easily seen from equation (10), our model implies that adopting a proactive policy tends to be the optimal choice if the probability of a credit crunch (μ) and the extent of the asset price bust in terms of output losses (ε) are comparatively large. In contrast, policymakers' willingness to act proactively is negatively affected by a higher degree of time preference (that is a fall in β).

How does central bank communication – captured by communicating the future path of policy – influence the policy choice? As already mentioned, we assume that policymakers are able by using communication to curb the excessive optimism of markets. In this case, as can be seen from equation (10), the minimum real interest rate necessary to prevent a credit crunch is smaller than in the case of opacity. Therefore, the case for the proactive strategy is broadened.

Since for a wider range of optimism the losses of the proactive strategy are smaller than the losses of the reactive strategy, the communication channel enables policymakers to employ the proactive strategy within a wider range.

To make our results clearer, we analyze the effects of communication numerically and graphically. The parameter values we use are shown in Table 3 (see the Appendix).[15]
First, we display the results of equation (10). In figure 1, the threshold value of the real interest rate is illustrated. It can be seen that with a higher degree of optimism, the threshold value is increasing. The reason is that the losses of the reactive strategy increase, whereas the losses of the proactive strategy are not changing. Hence, with a higher probability of credit crunch and a higher degree of optimism, policymakers are increasingly disposed to curb the asset price boom by raising interest rates.

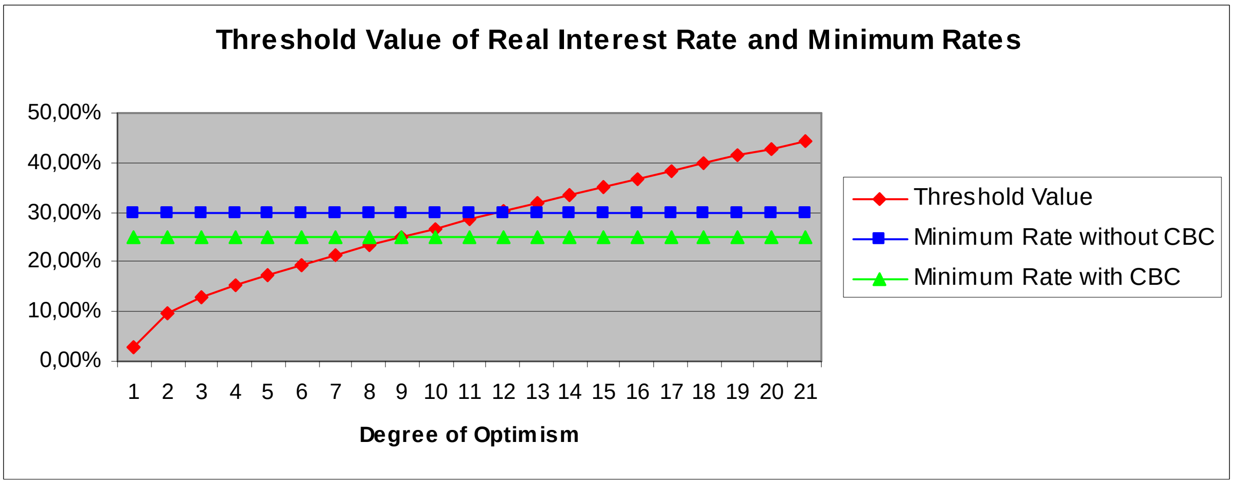
Figure 1



Depending on the minimum real interest rate to completely eliminate a credit crunch, policymakers choose either the proactive or the reactive strategy. However, since central banks are able by communicating their future path of policy to decrease the minimum real interest rate, central bank communication widens the scope for the proactive strategy. This can be seen in figure 2 when assuming arbitrary exogenous values for the minimum rates in order to illustrate the policy choice problem.

[15] Regarding our choice of parameter values we draw in particular on the following papers: Galí and Gertler (1999), Galí and Monacelli (2005), Anderson and van Winccop (2004) and Woodford (2003).

Figure 2



Further Results (Endogenous Minimum Interest Rate)

Up to now, we have assumed that the minimum interest rate is exogenous and showed the impact of central bank communication on the policy trade-off. In the next step we extend the model to a feature already analyzed by Bordo and Jeanne (2002), albeit on the micro level. They assume that the minimum interest rate depends positively on the optimism and the probability of a credit crunch. In our model, we introduce this feature on a macro level. We want to know which influence an endogenous minimum interest rate has on the question of whether central banks should act proactively or reactively and the degree to which communication can play a role. Hence, in contrast to Berger et al. (2007) and following Bordo and Jeanne (2002), we assume the minimum real interest rate to be endogenous. Bordo and Jeanne (2002) relate the minimum real interest rate in a positive way to the degree of optimism. We assume that the minimum real interest rate depends on the probability of a credit crunch and since the degree of optimism has a positive impact on this probability, therefore, in turn, on the degree of optimism:

$$\underline{rr} = \underline{rr}(\mu), \quad \partial \underline{rr} / \partial \mu > 0 \qquad (11)$$

Then, it follows that

$$\mu \equiv prob(u_2 = \varepsilon \mid rr_1) = \begin{cases} 0 & if \quad rr_1 \geq \underline{rr}(\mu) > rr^* \\ 0 < \mu < 1 & if \quad rr_1 < \underline{rr}(\mu) \end{cases}$$

$$\text{with } \underline{rr}(\mu) = \begin{cases} \underline{rr}^{CBC}(\mu) & \text{if Central Bank Communication} \\ \underline{rr}^{Op}(\mu) > \underline{rr}^{CBC}(\mu) & \text{if Opacity} \end{cases}$$

The losses of both strategies are repeated here. Note that the the variable z now contains the endogenous minimum rates.

$$\text{(Reactive)} \qquad V^{REA} = \left(\beta\lambda\mu\varepsilon^2 / \Delta\right) + \left(\beta\mu\varepsilon\right)^2 \left(\lambda / \Delta\right)^3 \tag{8}$$

$$\text{(Proactive)} \qquad V^{PRO} = \left(\frac{z}{\sigma}\right)^2 \Delta \tag{9}$$

$$z = \underline{rr}(\mu) - rr^* > 0$$

How does central bank communication – captured by communicating the future path of the policy rate – influence the policy choice? As already mentioned, it is assumed that policymakers are able by using their communication to curb the (excessive) optimism of the markets. In this case, the minimum real interest rate necessary to prevent a credit crunch is decreasing:

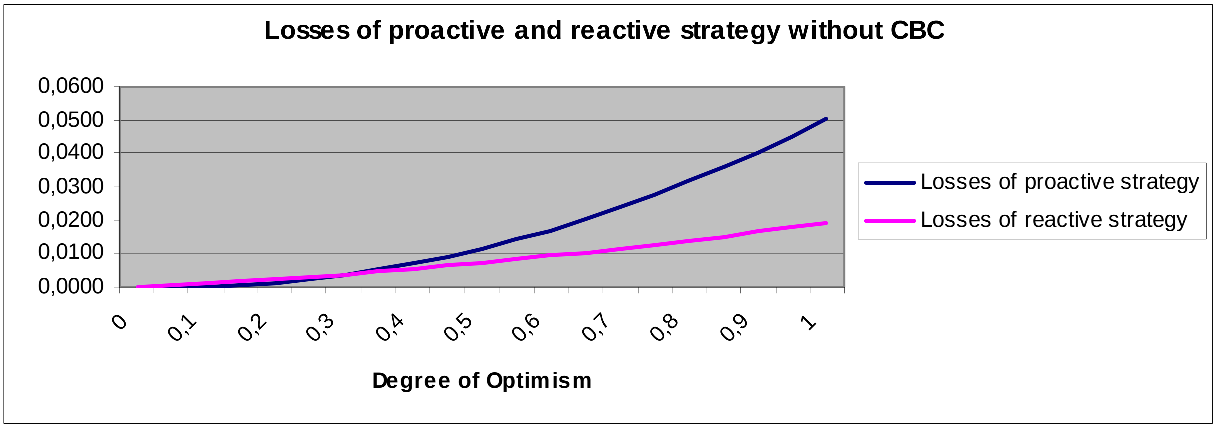
$$\underline{rr}^{CBC}(\mu) < \underline{rr}^{Op}(\mu) < \overline{rr} = rr^* + \frac{\sigma\varepsilon}{\Delta}\sqrt{\beta\lambda\mu\left[1 + \beta\mu\left(\lambda/\Delta\right)^2\right]} \tag{12}$$

However, since the minimum real interest rate is endogenous now, a second channel emerges: the minimum interest rate itself is now dependent on the degree of optimism. Hence, now there are two channels. First, with the increasing probability of a credit crunch, the right side of equation (12) increases, therefore raising the maximum interest rate. Second, with higher optimism, the minimum interest rate on the left side of equation (12) increases as well. The reason is that it is harder for policymakers to convince private subjects that their behavior and the implications for the markets are not sustainable. In addition, it can be seen from equation (12) that the minimum real interest rate in the communication case is lower than in the opacity case. Thus, communicating the future policy path makes the proactive strategy a more favorable option. To show these results graphically, we again use the parameter values.

Comparison of Losses

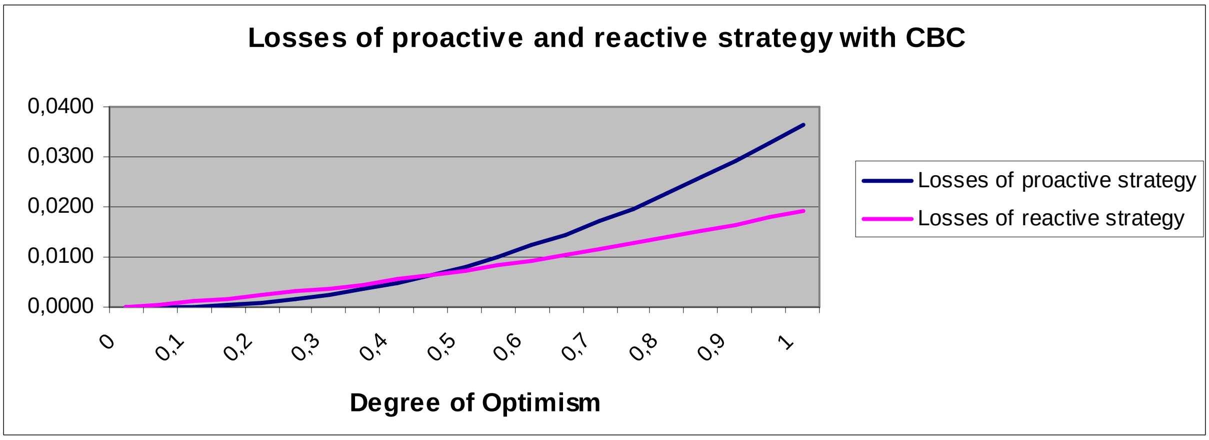
To test for the favorability of both strategies, it is necessary to compare their losses. As can be seen in figure 3, for small values of optimism the reactive strategy is associated with higher losses than the proactive strategy. However, for larger values of optimism the proactive strategy is less favorable, due to absolute higher losses. The reason is that the optimism is already so high that policymakers would have to set the interest rate very high in order to curb the boom. In turn, this would be associated with very high losses in terms of inflation and output.

Figure 3



However, when policymakers use their communication channel, they are able to decrease the minimum real interest rate and hence the losses of the proactive strategy and therefore broaden the case of the proactive strategy. This can be seen in figure 4.

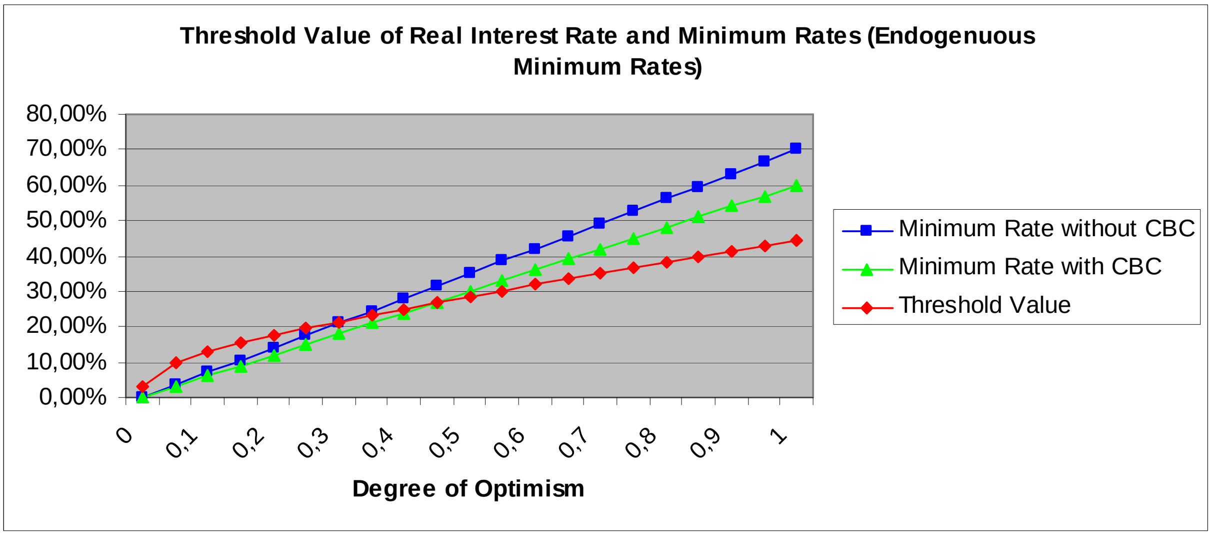
Figure 4



Threshold Value and Minimum Interest Rates

As can be clearly seen from figure 5, for the chosen parameter values the minimum real interest rate in case of central bank communication is smaller than the minimum real interest rate with no extra communication. The minimum interest rate in case of opacity is smaller than the maximum interest rate up to a value of 0.3, whereas the minimum interest rate in the CBC case is smaller than the maximum interest rate up to a value of 0.45.

Figure 5



Furthermore, as can be seen from figure 6, without central bank communication there is a range for relatively low values of optimism where central bankers choose the proactive strategy and set the minimum real interest rate so that it is increasing with higher optimism of private subjects.[16] However, when communicating the future path of policy, central bankers are able to pursue the proactive strategy for a wider range of optimism. In all other cases, they set the real interest rate according to

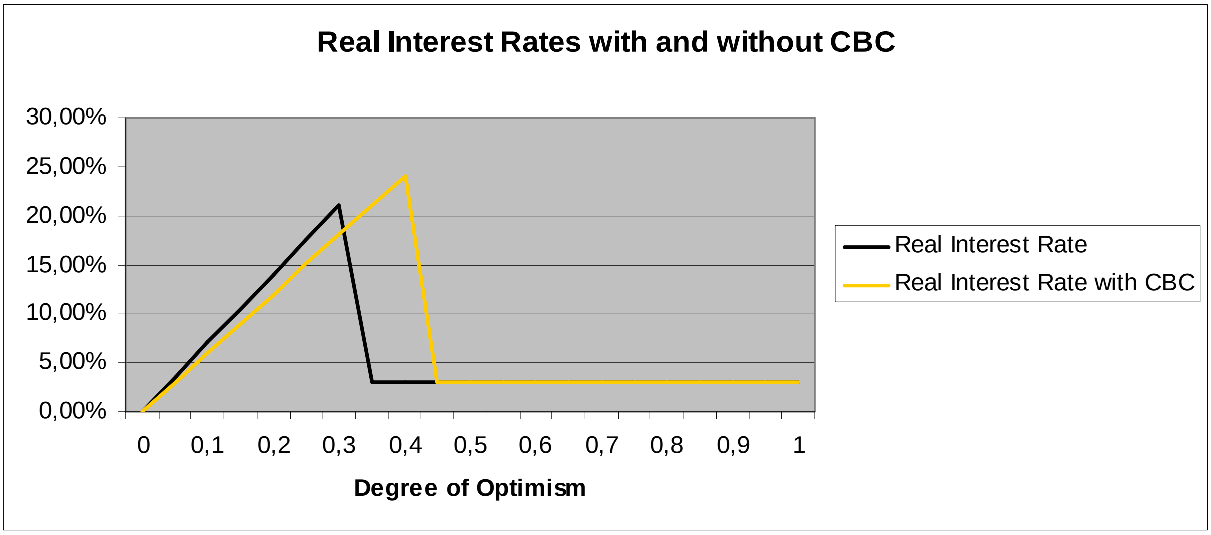
$$rr_1^{REA} = rr^* - \frac{\left[\lambda(1-\beta)+\kappa^2\right]\sigma\kappa\mu\varepsilon}{\Delta^2} \text{ (see Table 1).}$$

In order to test for robustness, we employ not only the baseline parameter values, but also a wide range of parameter values found in the literature (see Table 3 in the Appendix). Our results are robust to changes of the parameters in the chosen range. Therefore, the result of our analysis is that for a wide range of parameter values, communication – captured by

[16] Note that both lines have the same distribution in the range from 0.47 to 1 for the degree of optimism.

communicating the future path of the policy rate – is able to decrease the minimum interest rate to completely avoid a credit crunch and therefore is broadening the scope for the proactive strategy. The reason is that the losses of the proactive strategy get smaller since the 'insurance premium' of this policy choice is decreasing with smaller optimism.

Figure 6



4. Conclusion

Communication can be important for central banks when facing boom-bust-cycles. When communicating their future policy rate path, central banks can affect the private sector's behaviour: when policymakers announce interest rate increases due to excessive credit growth, financial markets might adjust their behavior. Central bank communication should reflect the respective state of the financial system. If the state is exuberant, communication about the future path of policy should be adapted. For example, the proper communication strategy could curb excessive credit growth. In our model we focus on the situation for policymakers during the boom period. They can choose between the proactive strategy of curbing asset price inflation and the reactive strategy of loosening monetary conditions during the boom period. In addition, we integrate a communication channel that is characterized by a 'management of expectations'. A warning of policymakers that the current situation is not sustainable and there is 'irrational exuberance' which might lead in the policy horizon to deviations of output and inflation might help to weaken the (over)-optimistic expectations. In turn, firms issue less debt than before. Thus, we assume that policymakers are able to steer the behavior of private agents by their communication of the future policy path. They can use their words to substitute for an otherwise costly interest rate hike. Hence, communication can decrease the real interest rate which is necessary to surely prevent a credit crunch. We show that the additional use of this communication channel broadens the scope for the proactive strategy because it decreases the 'insurance premium' of this policy choice and therefore its losses.

Future research could focus on integrating costs of a failed warning. Furthermore, the inclusion of uncertainty and ambiguity could enrich the analysis.

Appendix – Tables

Table 1

Reactive Policy		
t = 1	**t = 2**	**T = 3**
$r_1^{REA} = rr^* + \frac{[(\lambda-\kappa\sigma)\Delta + \beta\lambda\kappa\sigma]\mu\varepsilon}{\Delta^2}$ $rr_1^{REA} = rr^* - \frac{[\lambda(1-\beta)+\kappa^2]\sigma\kappa\mu\varepsilon}{\Delta^2}$	*crisis* $r_2^{REA} = rr_2^{REA} = rr^* + \frac{\sigma\kappa\varepsilon}{\Delta}$ *no crisis* $r_2^{REA} = rr_2^{REA} = rr^*$	$r_3^{REA} = rr_3^{REA} = rr^*$
$\pi_1^{REA} = \beta\mu\varepsilon(\lambda/\Delta)^2$ $x_1^{REA} = -\kappa\beta\lambda\mu\varepsilon/\Delta^2$	*crisis* $\pi_2^{REA} = \lambda\varepsilon/\Delta$ $x_2^{REA} = -\kappa\varepsilon/\Delta$ *no crisis* $\pi_2^{REA} = x_2^{REA} = 0$	$\pi_3^{REA} = x_3^{REA} = 0$
$L_1^{REA} = (\beta\mu\varepsilon)^2(\lambda/\Delta)^3$	*crisis* $L_2^{REA} = \lambda\varepsilon^2/\Delta$ *no crisis* $L_2^{REA} = 0$ *Expected losses* $E(L_2^{REA}) = \mu\lambda\varepsilon^2/\Delta$	$L_3^{REA} = 0$

With $\Delta = \lambda + \kappa^2$.

Table 2

Proactive Policy		
t = 1	**t = 2**	**t = 3**
$r_1^{PRO} = rr_1^{PRO} = \underline{rr}$	$r_2^{PRO} = rr_2^{PRO} = rr^*$	$r_3^{PRO} = rr_3^{PRO} = rr^*$
$\pi_1^{PRO} = -\frac{1}{\sigma}\kappa z$ $x_1^{PRO} = -\frac{1}{\sigma}z$	$\pi_2^{PRO} = x_2^{PRO} = 0$	$\pi_3^{PRO} = x_3^{PRO} = 0$
$L_1^{PRO} = \left(\frac{1}{\sigma}\right)^2 z^2\Delta$	$L_2^{PRO} = 0$	$L_3^{PRO} = 0$

with $z = \underline{rr} - rr^* > 0$ and $\Delta = \lambda + \kappa^2$.

Table 3

Parameter	Low value	High value	Baseline value
β discount factor	0.99	0.99	0.99
λ output weight in loss function	0.05	1	0.25
σ coefficient of relative risk aversion	1.1	2	1.5
κ slope of the Phillips curve	0.01	0.2	0.05
ε extent of asset price bust	0.01	0.2	0.1

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