Why Do Monetary Policymakers Lean With the Wind During Asset Price Booms?

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Abstract

In this paper we explore the optimal policy reaction to an asset price boom. Empirical evidence shows that the monetary policy stance is typically loose during asset price booms. Employing a modified New Keynesian sticky price model we show that this policy of leaning with the wind can be attributed to the forward-looking nature of the private sector's expectations. Agents incorporate the macroeconomic consequences of a looming asset price bust in their expectations. The expectation-induced deviations of output and inflation from their targets enforce a monetary loosening before the bust occurs. Furthermore, we argue that a policy of benign neglect towards asset price movements, as often advanced by monetary practitioners, is (generally) not optimal in welfare terms.

Keywords: monetary policy, asset prices, credit crunch, boom bust cycles, forward-looking behavior

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1- Introduction

How should central bankers deal with potentially detrimental asset price booms? A lively debate has evolved around this question in the recent literature. Rising asset prices may be a threat to monetary policy objectives when asset prices reach unsustainable levels. A precipitous drop in prices can threaten financial stability and lead to both poorer price stability and undesired real economic fluctuations. However, not all asset price booms result in busts, and asset price busts are not always associated with severe consequences for output and inflation. Given the difficulties to identify a costly asset price boom ex ante, central bankers generally have a choice between two main monetary policy options when they observe rapidly rising asset prices: they choose either the pro-active or the reactive policy strategy.

Basically, the pro-active strategy involves a policy of leaning against the wind. Monetary policy is severely tightened during the boom phase already. The basic idea behind the pro-active strategy is to counter pre-emptively the build-up of a crisis scenario that may jeopardize macroeconomic stability in the future. According to the reactive policy, however, central bankers only mitigate the consequences of an expected or actual asset price bust.

Hence, asset price booms can be expected to be associated either with a tightening of monetary conditions or with no clear systematic policy response. Empirical evidence, however, suggests that monetary policy is typically loose during asset price booms. Borio and Lowe (2003) conclude that excess credit and asset price booms often tend to occur as a pair. Detken and Smets (2004) find evidence that asset price booms are supported by high money and credit growth rates and low interest rates relative to a Taylor rule benchmark. Furthermore, they claim that high-cost booms, i.e. booms that are followed by recessions, are associated with significantly looser monetary policy conditions than low-cost booms. The monetary policy stance is loosened in particular towards the end of high-cost booms. These results are somewhat puzzling, since they suggest that policymakers typically lean with the wind during asset price booms and contribute actively to a prolongation of an unsustainable asset price inflation. Gruen, Plumb and Stone (2005), however, provide an explanation by stressing the role of time lags in the monetary transmission mechanism. As monetary policy affects the economy with a lag, there may be strong incentives for policymakers to accommodate pre-emptively an anticipated asset price crash once the probability of its occurrence is sufficiently high.

In this paper we present an additional explanation for a loose monetary policy stance during high cost booms. We rely on the forward-looking nature of agents' expectations and argue that the policymaker's optimal response to changes in private expectations results in a loosening of the monetary policy stance. In our approach, an asset price crash entails the risk of a bust-induced credit crunch that may cause a contraction of output. Forward-looking agents incorporate the macroeconomic consequences of a looming asset price bust in their expectations. A deterioration of forward-looking expectations in the boom period has an immediate impact on output and inflation and thus calls for a monetary easing. Furthermore, we argue that a policy of benign neglect towards asset price movements as often advanced by monetary practitioners is (generally) not optimal in welfare terms. Owing to the private sector's forward-looking behavior, disregarding asset price movements when deciding about the monetary policy stance does therefore not constitute a sensible policy option in our model.

The explanation advanced by Gruen, Plumb and Stone (2005) and our approach are not mutually exclusive. But while Gruen, Plumb and Stone's (2005) argumentation is in line with a pro-active policy strategy, our model assumes that monetary policy is conducted in a reactive manner. The reactive policy in our model, however, is not to be equated with a policy of 'benign neglect' towards asset price inflation as in the work of Bordo and Jeanne (2002a, b).

The remainder of the paper is structured as follows: In the second section the model is developed and the policy rule governing the optimal choice of the monetary policy strategy is derived. We modify a standard New Keynesian sticky price model by allowing for an endogenous financial market shock along the lines of Bordo and Jeanne (2002a, b). Bordo and Jeanne introduce the idea that monetary policy may affect the likelihood of a future bust-induced credit crunch by influencing the corporate sector's current debt accumulation. In contrast to their reduced form model we explicitly allow for forward-looking expectations of the private sector. In the third section, the model's main results and its policy implication are discussed. Monetary policy is loosened during asset price booms as a result of an optimal response to a deterioration of private sector's forward-looking expectations. Section 4 concludes.

2 - The model

We consider an economy that exists for three periods.[1] In period 1, asset prices are driven up.[2] Firms issue debt to finance the purchase of a productive asset. Firms need this asset to be able to produce, but it may also serve as collateral in the second period. In period 2, a credit crunch may or may not occur. Firms can only obtain further credit if the required new credit remains below the real value of their collateral minus the ex post debt burden. Hence, the credit constraint that firms face is directly linked to asset prices. In period 3, the economy moves into a new steady state.

2.1 Aggregate demand and aggregate supply

Our model closely resembles the standard New Keynesian sticky price model.[3] We modify the well-known standard model by adding a random disturbance to the aggregate supply equation that we interpret as a shock emanating from the financial sector (see below).[4] The two building blocks of our model are given in equations (1) and (2).

$$\pi_t = \beta E_t \pi_{t+1} + \alpha x_t + v_t \tag{1}$$

$$x_t = E_t x_{t+1} - \left(i_t - E_t \pi_{t+1} - r^*\right) / \sigma \tag{2}$$

[1] The model is laid out in more detail in Berger, Kißmer and Wagner (2007). As discussed in the Introduction, our model is related to Bordo and Jeanne (2002a, b). But 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 and the microeconomic foundations of the collateral-induced credit crunch are therefore referred to their work.

[2] In contrast to other work such as, e.g., Bean (2003), Cecchetti et al. (2000), Gruen, Plumb and Stone (2005) and Kontonikas and Montagnoli (2006), our focus is not on asset price bubbles but on asset price booms. To us, the key problem for the monetary authority is how to deal with a possible asset price reversal irrespectively of whether the boom is fundamentally driven or caused by a bubble.

[3] We confine ourself to the macroeconomic side of the New Keynesian approach. See, e.g., Galí (2002) and Woodford (2003) for detailed expositions and discussions of the microeconomic foundation of the New Keynesian models.

[4] Bordo and Jeanne (2002a, b) introduced this idea. We abstract from the "usual" demand and supply shocks. In order to sharpen our results we focus exclusively on the financial shock, v_t (see equation (1)). Including the usual demand and supply shocks would complicate the derivation of the optimal monetary policy without changing the results qualitatively.

Equation (1) is the New Phillips Curve (NPC), giving aggregate supply, while equation (2) represents aggregate demand. All variables are expressed as percentage deviations around their non-stochastic steady state values. The NPC posits that current inflation, π_t, has a forward-looking component depending on expected future inflation (with E_t denoting the rational expectation operator on the basis of all information available up to period t). This forward-looking component is of course rooted in the assumption that firms set prices in a staggered fashion.[5] When firms decide about their optimal prices they must be concerned about future inflation, because they might be unable to reset their prices for several periods. In addition, current inflation depends on the output gap, x_t, defined as the deviation of current output from its flex-price level and on the shock v_t. β is households' discount factor.

Following Bordo and Jeanne (2002a, b) we concentrate on the supply side effects of financial sector shocks and abstract from effects working through the demand side.[6] As Bordo and Jeanne (2002a, b) point out, there is evidence that asset price busts lead to a fall in output by generating a credit crunch.[7] Owing to moral hazard considerations, firms can only borrow against collateral. Assets serve as collateral, so that soaring asset prices facilitate the accumulation of debt in the corporate sector. Falling asset prices, however, reduce firms' collateral bases, thus tightening their credit constraint (a credit crunch occurs). Hence, an asset price reversal may provoke financial distress in the corporate sector, forcing firms to stop producing and giving rise to bankruptcies in the corporate sector. The macroeconomic result is a reduction in the goods supply. With respect to its supply side effects, a credit crunch is therefore treated as a negative productivity shock that leads to a slowdown in economic activity. To examine the implication of asset price booms and busts for monetary policy we employ the simplest possible distribution for v_t. The financial shock can only occur in the middle period 2, so that the distribution of v_t can be defined as

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[5] Staggered price setting was introduced by Calvo (1983).

[6] Other authors stress the demand side effects of asset price busts; see, e.g., Kontonikas and Montagnoli (2006) and Nistico (2005).

[7] Berger, Kißmer and Wagner (2007) also allow for the potential impact of financial sector shocks on aggregate demand in a similar model. Incorporating additional demand side effects of an asset price bust gives rise to a more plausible transmission mechanism. However, the results of this paper remain valid even when the demand side effects of an asset price bust are taken into account (see ibid.). For simplification, we therefore exclusively focus on the supply side here.

$$v_t = \left\{ \begin{array}{llll} 0 & \text{in} & t \neq 2 & \\ 0 & \text{in} & t = 2 & \text{if} \quad \text{no credit crunch} \\ \varepsilon > 0 & \text{in} & t = 2 & \text{if} \quad \text{credit crunch} \end{array} \right\} \qquad (3)$$

Equation (2) is the standard New Keynesian aggregate demand equation derived from household's optimal intertemporal consumption allocation. An increase in the expected future output stimulates current output, since households seek to smooth consumption across their lifetime. The output gap decreases for an increasing deviation of the real interest rate (defined as the nominal interest rate, (i_1 - $E_1\pi_2$), minus expected future inflation) from its flex-price level denoted by r*.

2.2 Crisis probability, policy instrument and policy objectives

In contrast to conventional models, v_t is not an entirely exogenous shock, but is instead assumed to be a financial sector shock that partly depends on the first period's monetary policy. Policymakers can influence the likelihood of a future credit crunch with their policy instrument, the current nominal interest rate.[8] By varying the interest rate i_1 policymakers are able to influence real interest rates and thus the corporate sector's debt accumulation. A timely (i.e. period 1) real interest rate increase (i_1 - $E_1\pi_2$) discourages debt accumulation in the corporate sector in the boom period thus curbing the risk of a future (period 2) credit crunch.[9]

As explained above, we assume that firms can only borrow against collateral. If the asset price boom turns out to be sustainable in period 2, the credit constraint will not bind, because the debt burden accumulated so far will still be sufficiently low relative to the real value of the collateral. If, however, asset prices crash, the real value of the collateral that firms are

[8] In other studies, however, the central bank can influence the probability that a bubble continues to grow. See e.g. Kent and Lowe (1997), Gruen, Plumb and Stone (2005) and Filardo (2004).

[9] For a monetary contraction in period 1 to have the desired effect on firms' debt accumulation, the semi-elasticity of borrowing in period 1 with respect to the real interest rate must be strictly lower than -1. Only then does the debt burden in period 2 resulting from the period 1 credit decrease in the real interest rate and a pre-emptive monetary policy may make sense, since a sufficiently steep interest rate increase eliminates the prerequisite for a credit crunch in period 2.

able to offer collapses. Firms now do not receive further credits if their collateral is too low relative to the debt burden resulting from the period 1 credit. In this case, a credit crunch occurs.

The probability of a collateral-induced credit crunch (μ) is thus directly linked to the level of corporate sector debt and hence to monetary policy in the first period.[10] Contingent on the policy choice in period 1, the credit crunch probability can now be formulated as

$$\mu = \text{prob}(v_2 = \varepsilon \mid i_1 - E_1\pi_2) = \begin{Bmatrix} 0 & \text{if} & i_1 - E_1\pi_2 \geq \underline{r} > r^* \\ & & \\ 0 < \mu < 1 & \text{if} & i_1 - E_1\pi_2 < \underline{r} \end{Bmatrix} \quad (4)$$

In (4), $\underline{r}$ denotes the minimum real interest rate required to eliminate completely the probability of a future credit crunch.[11]

Finally, monetary policy aims at minimizing the following time additive objective function:

$$V_t = E\left(\sum_{t=1}^{3} \beta^{t-1} L_t\right), \quad (5)$$

where the period loss function L_t is quadratic in the inflation rate and in the output gap[12]

$$L_t = \pi_t^2 + \lambda x_t^2. \quad (6)$$

2.3 Monetary policy and high cost booms

Basically, policymakers face the choice between two monetary policy approaches: the pro-active and the reactive approach. In the first case, monetary policy aims at avoiding a future credit crunch in any case. Thus, the interest rate in period 1 is raised so high that the accumulation of a debt burden that may jeopardize financial stability in period 2 is

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[10] We abstract from the possibility that monetary policy may influence the real value of collateral in period 2 and thus may change the credit constraint via this ex-post channel.

[11] In our macroeconomic model the value $\underline{r}$ is taken as given. See Bordo and Jeanne (2002a) on how $\underline{r}$ (and μ) may be related to firms' initial wealth, first period debt or the degree of market optimism.

[12] Woodford (2003) and Rotemberg and Woodford (1997) show that a period loss function that is quadratic in inflation and the output gap can be derived as an approximation of households' period utility losses that result from deviations from the non-stochastic steady state allocation.

prevented. The pro-active policy is implemented by setting the period 1 real interest rate equal to $\underline{r}$ (see equation (4)). The reactive policy, however, takes the probability of a future credit crunch as given and stabilizes the consequences of actual or expected shocks if and when they occur.[13] This policy choice involves a trade-off between period 1 and period 2 objectives. If policymakers want to realize the flex-price allocation in period 2, they must tolerate the losses associated with a high real interest rate in period 1. On the other hand, if policymakers prefer to minimize the loss in period 1, they run the danger of ending up with a severe loss in period 2. The optimal policy can be derived by comparing the expected losses associated with both strategies. Generally, both monetary policy strategies may be optimal. The one that should be adopted depends on the economic conditions.

The reactive monetary policy is optimal if a policy of forestalling a future credit crunch is associated with unacceptably high costs in terms of immediate deflation and output losses. Formally, the reactive policy approach is chosen if the minimum real interest rate $\underline{r}$ required to completely eliminate the possibility of a future credit crunch is above the threshold level $\overline{r}$. $\overline{r}$ is defined as the maximum real interest that central bankers are willing to endure in order to avoid a future credit crunch (see the Appendix for a detailed exposition of the analytical solution).[14]

$$\underline{r} > \overline{r} = r^* + \frac{\sigma\varepsilon}{\Delta}\sqrt{\beta\lambda\mu\left[1+\beta\mu\left(\lambda/\Delta\right)^2\right]} \tag{7}$$

with $\Delta = \lambda + \alpha^2$.

Our model implies that, intuitively, the reactive policy approach tends to be the optimal choice if the probability of a credit crunch (μ) and the extent of the asset price bust (ε) are comparatively small (see the Appendix). Moreover, policymakers' willingness to act reactively increases in the degree of time preference (i.e. a fall in β), as well as in the sensitivity with which output reacts to interest rate changes ($1/\sigma$) and inflation to output changes (α). In order to analyze the monetary policy in a (high-cost) asset price boom, we assume in the following that condition (7) is fulfilled, so that the policymaker decides to adopt the reactive policy.

[13] This definition is very much in line with Rudebusch's (2005) differentiation between a "Bubble Policy" and a "Standard Policy". Our focus, however, is on the relation between monetary policy and the occurrence of a credit crunch, while Rudebusch (2005) analyzes monetary policy and asset price bubbles.

[14] See also Bordo and Jeanne (2002a, b).

The probability of a credit crunch is therefore non-zero and the asset price boom may turn out to be a high-cost boom.[15]

The model is solved by looking at each period in turn, starting with the last one.[16] As the steady state lasts forever, it seems natural to assume that private agents expect all variables to remain at their steady state values. No shock is assumed to occur. Hence, we impose the terminal condition $E_3\pi_4 = \pi_3$ to solve the model for the third period. The period 3 nominal interest rate is therefore set equal to the flex-price real interest rate, $i_3 = r^*$. It follows that $\pi_3 = 0$ and $x_3 = 0$. In period 3, all variables are at their target values and the policymaker is able to reach the efficient flex-price result.

From the results for period 3, it follows that $E_2\pi_3 = E_2x_3 = 0$ under rational expectations. Given a reactive strategy, a credit crunch may or may not occur in period 2. If no credit crunch occurs, the policymaker is able to implement the efficient flex-price allocation in the second period, too, i.e. $i_2 = r^*$ so that $\pi_2 = 0$ and $x_2 = 0$. If, however, a credit crunch develops in the aftermath of an asset price collapse, the policymaker will adjust the interest rate to contain the deviations of output and inflation from its target values, i.e. $i_2 = r^* + \alpha\sigma\varepsilon / \Delta$.[17] In case of a credit crunch, the

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[15] By definition, adopting a pro-active strategy prevents a credit crunch from occurring. Hence, in our model only a reactive policy may be associated with a *high-cost* boom. But concentrating on the reactive strategy also seems to be in line with actual policy practice, because monetary policymakers seem to dislike the idea of acting pre-emptively in an asset price boom. Central bankers usually contend that they follow a reactive strategy (see, e.g., Greenspan (2002), Trichet (2003)).

[16] The model can be solved through backward induction. We assume discretionary stabilization policies, i.e. policymakers who cannot credibly commit to a future reaction on current shocks even if they would like to do so. In period 3, policymakers do not pay attention to their past behavior and will not react to past shocks. Thus, in period 2 discretionary policy may suffer from the usual stabilization bias related to time-inconsistency problems in models with forward-looking expectations. Note, however, that in our model a stabilization bias can only occur in period 2 because we assume $v_t = 0$ for all periods $t \neq 2$. See, e.g. Bean (2003), on how the possibility of a credit crunch may influence the optimal policy under commitment (from the "timeless perspective") in a New Keynesian model.

[17] Some readers may regard an increase in the interest rate as a counter-intuitive policy reaction to the occurrence of a credit crunch. Note, however, that this reflects an easing of monetary policy: In case of a credit crunch, the interest rate hike would not be strong enough to prevent inflation in the second period. As already mentioned by Bordo and Jeanne (2002a) and shown by Berger, Kißmer and Wagner (2007), integrating the demand-side effects of a credit crunch in the model (i.e. modelling a credit crunch as the simultaneous occurrence of a negative supply and demand shock) would make the model

optimal stabilization policy results in an increase in inflation and a decrease in output, $\pi_2 = \lambda\varepsilon / \Delta$ and $x_2 = -\alpha\varepsilon / \Delta$. Since the credit crunch does not have any demand side effects in our model, a falling supply meets an unchanged demand so that inflation immediately increases.[18]

Of course, the monetary policy adjustment and the resulting allocation in the boom period (period 1) deserve special attention. In period 1, forward-looking agents will incorporate the possibility of a credit crunch, and the expected future monetary policy in response to such a credit crunch, in their expectations. As these expectations feed into the current inflation rate and current output gap, the policymaker responds by setting

$$i_1 = r^* + \left[\left(\lambda - \alpha\sigma\right)\Delta + \beta\lambda\alpha\sigma\right]\mu\varepsilon / \Delta^2 . \tag{8}$$

Output and inflation in period 1 thus take on the values

$$x_1 = -\beta\alpha\lambda\mu\varepsilon / \Delta^2 , \tag{9}$$

$$\pi_1 = \beta\mu\varepsilon\left(\lambda / \Delta\right)^2 . \tag{10}$$

Owing to the forward-looking character of the model, the impact of a (possible) credit crunch on inflation and output will be partly brought forward in time and materialize in period 1. The reactive policymaker is forced to adjust the current interest rate to contain both the expectation-induced increase in inflation and the expectation-induced decrease of output.[19] Given forward-looking agents, the optimal monetary policy implies an adjustment in the short-term (period 1) nominal/real interest rate, even though the economy is not hit by a shock in the boom period.

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more consistent with the evidence that a credit crunch should usually be followed by a decrease in interest rates.

[18] However, Berger, Kißmer and Wagner (2007) show that inflation in period 2 eventually increases, too, if negative demand side effects are explicitly taken into account. The intuition underlying this result is that the policymaker completely stabilizes the aggregate demand effects of the asset price bust through a monetary expansion. Of course, this result is based on the assumption that the nominal interest rate does not reach the zero lower bound.

[19] Note that the expectations channel considered here is quite different from the "moral hazard channel" that is discussed in the literature. The latter is based on the assumption that private agents take more risks when they expect future stabilization of an asset price bust [see e.g. Miller, Weller and Zhang (2002)]. Our expectations channel, however, points out that the risk of a future credit crunch induces changes in current output and inflation through current behavioral changes.

3. Policy implications and discussion

In this section, we discuss the policy implications of our model by explicitly distinguishing between two questions. First, we propose an answer to the paper's key question why the monetary stance is typically loose during high cost asset price booms.[20] Our model implies that private agents' forward-looking behavior as suggested by the New Keynesian framework may give rise to a monetary policy reaction that is consistent with this stylized fact. Second, we clarify what an optimal reactive policy strategy should look like. In the debate on the optimal monetary policy reaction to asset price busts, pursuing a reactive policy approach is, at least implicitly, often narrowly interpreted as a policy of benign neglect towards asset price movements (see, e.g., Bordo and Jeanne (2002a, b)). Generally, however, the optimal reactive policy and a policy of benign neglect lead to different results.

3.1 Interest rate policy: Why is the monetary policy loose during high-cost booms?

As discussed above, empirical studies document that the overall monetary policy stance in the run-up to a high-cost asset price bust can be characterized as loose. Our model gives a reasoning for these stylized facts by assigning a key role to agents' forward-looking expectations. While forming their expectations in the boom period (period 1), private agents consider the possibility of a future crisis. Agents expect the discretionary policy response - should a credit crunch occur - to result in an increase in the next period's inflation and a decrease in the next period's output gap. Owing to the forward-looking nature of output and inflation, the current values of both variables change immediately (see equations (9) and (10)). An increase in expected inflation induces firms to set higher prices at once, since they are unsure when they will be able to adjust their prices again. Current inflation therefore increases (see equation (1)).

[20] As stressed above in footnote 2, we concentrate on the policy problem of a central banker who faces the risk of an asset price reversal regardless of whether the reversal reflects a bursting bubble or fundamentals. Our findings that the reactive policymaker should lean with the wind is therefore not confined to a specific scenario but describes a policy recommendation that is generally valid for a policymaker who faces rapidly increasing asset prices.

The net effect on aggregate demand in the first period is less clear (see equation (2)). On the one hand, current demand tends to increase, since an increase in inflation expectations reduces the real interest rate. But, on the other hand, a reduction in expected future output depresses demand today, so that the net effect on the economy's demand side remains ambiguous. The overall policy reaction, i.e. the nominal interest rate optimally chosen in period 1, i_1, depends on parameter values. If the real interest rate channel predominates on the demand side, an increase in both demand and inflation calls unambiguously for an increase in i_1 above its flex-price value. Intuitively, this is the more likely the more sensitively current output responds to changes in the real interest rate, i.e. the smaller σ is (see equation (8), which is reproduced here from section 2).

$$i_1 = r^* + \left[\left(\lambda - \alpha\sigma\right)\Delta + \beta\lambda\alpha\sigma\right]\mu\varepsilon / \Delta^2 \tag{8}$$

If, however, aggregate demand decreases, it may be optimal for the policymaker to leave the policy instrument unchanged or even to reduce i_1 below r^* despite the possibility of a credit crunch in the next period. A monetary policy that is loose as defined with respect to the *nominal* interest rate is more likely to occur if the sensitivity of output to changes in the real interest rate is relatively low, i.e. σ is quite large.

While the adjustment of the period 1 nominal interest rate is not defined unambiguously under the reactive policy strategy, the real interest rate is unambiguously smaller than r*. Defining $r_1 = i_1 - E_1\pi_2$ as the first period's real interest rate associated with the reactive strategy, we have

$$r_1 = r^* - \left[\lambda\left(1-\beta\right) + \alpha^2\right]\alpha\sigma\mu\varepsilon / \Delta^2 . \tag{11}$$

The reactive monetary policy should allow the current real interest rate to fall below the flex-price equilibrium value r*.[21] In this sense, monetary policy becomes unambiguously expansionary in the boom phase in our model. Leaning with the wind during asset price booms therefore is

[21] The monetary stance is interpreted with reference to the real interest rate in our model. A declining real interest rate implies a loosening of the monetary stance. A discrepancy between our theoretical results and the empirical finding of Detken and Smets (2004) must be noted here. Detken and Smets (2004) reach the conclusion that monetary policy becomes looser during boom periods than in normal times, as pointed out above. But in their work, several indicators are considered to define the monetary stance. They find no significant movement of the real interest rate, while the nominal interest rate typically seems to rise modestly.

the optimal policy response to the private sector's belief that an ongoing asset price boom may not be sustainable.[22]

3.2 Can a policy of "benign neglect" be optimal?

Among monetary policy practitioners, a prominent view concerning the appropriate reaction to asset price boom-bust cycles seems to be that central banks should deal with the consequences of asset price busts but abstain from policy adjustments in the run-up to a crisis.[23] As Greenspan puts it (with reference to the late 1990s): "*(I)t was far from obvious that bubbles, even if identified early, could be pre-empted short of the central bank inducing a substantial contraction in economic activity – the very outcome we would be seeking to avoid. [...] Instead, we ... need to focus on policies to mitigate the fallout when it occurs and, hopefully, ease the transition to the next expansion.*" (Greenspan 2002).[24]

Greenspan's remarks suggest that the policy approach chosen by policymakers can best be described as a policy of benign neglect. Monetary policy is only adjusted when asset prices actually collapse in an attempt to stabilize the economy. However, this policy view can be interpreted in two different ways.

First, this policy approach can be understood as leaving the *nominal* interest rate unchanged as long as a credit crunch does not occur. In this case, the policymaker ignores the expectation-induced change in output and inflation. The policy instrument, i.e. the nominal interest rate, is not adjusted and remains at its flex price level, $i_1 = r^*$. The short term real interest rate, however, reacts to the change in expectations. Hence, benign neglect in this sense also implies that the real interest rate responds to asset price booms – just like in our model. But, owing to the unchanged nominal

[22] This explanation and other theoretical approaches for a monetary loosening in the run-up to an asset price collapse by, e.g., Gruen, Plumb and Stone (2005), are not mutually exclusive. Our model adds a further argument to the debate on the theoretical explanation for the empirically observed behavior of monetary variables in an asset price boom without contradicting others.

[23] There is a burgeoning literature dealing with the optimal monetary response to asset price booms, see e.g. Bernanke and Gertler (1999, 2001), Cecchetti et al (2000), Cecchetti, Genberg and Wadhwani (2003), Bordo and Jeanne (2002a, b), Gruen, Plumb and Stone (2005), Bean (2003) and Filardo (2004).

[24] Greenspan explicitly refers to asset price bubbles while our model is concerned with asset price reversals no matter whether they are caused by a bursting bubble or by fundamental factors.

interest rate, the movement of the real interest rate will be sub-optimal.[25] Thus, benign neglect is of course welfare inferior to the optimal reactive policy as given in equations (8) – (11).[26]

But Greenspan's remarks may also be interpreted in a second, more subtle way. A policy of benign neglect towards asset price movements may also be characterized with respect to the *real* interest rate. Understood in this sense, benign neglect implies that the real interest rate is kept unchanged. The nominal interest rate, however, is adjusted to offset the impact of expectation-induced changes on the real interest rate. This interpretation can be justified by pointing out that the real interest rate is relevant for stabilization purposes (see equation (2)). Our model, however, clearly suggests that central bankers should refrain from implementing such a policy. As shown above in equation (11), adopting the optimal reactive strategy implies that central bankers should allow the real interest rate to fall in the boom period.[27] This policy of leaning with the wind is necessary exactly in order to prevent "(…) *a substantial contraction in economic activity (...)"* as Greenspan puts it. Benign neglect in both interpretations (i.e. with reference to the nominal or the real interest rate) is therefore not optimal in welfare terms if, as the New Keynesian framework supposes, agents exhibit a forward-looking behavior.[28]

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[25] In the second and third period, the optimal reactive policy and a policy of benign neglect à la Greenspan are identical. A policy of benign neglect involves an asymmetric response to asset price movements. Even though rising asset prices are viewed with benign neglect, i.e. do not induce a policy adjustment, central banks will pursue an active stabilization policy when a bust occurs. Thus, benign neglect, too, implies that monetary policy is optimally adjusted when asset prices collapse so that the macroeconomic results in the second period do not differ between both approaches. Moreover, in the third period no shock occurs and no shock is expected to occur in the future, so that both monetary policy strategies implement the flex-price solution. See the Appendix for details.

[26] Strictly speaking, not adjusting the nominal interest rate in period 1 when following the reactive strategy may be optimal under very special circumstances. i_1 is only independent of the expected value of v, if $(\lambda - \alpha\sigma)\Delta + \beta\alpha\lambda\sigma = 0$. See equation (10) and the discussion above. Furthermore, r_1 will always depend on $\mu\varepsilon$, i.e. there is no benign neglect when we use the real interest rate to characterize the monetary policy stance.

[27] In the boom period, the real interest rates under the reactive strategy and under a pro-active strategy thus move in exactly opposite directions.

[28] See Berger and Kißmer (2008). However,a policy according to the "sit and wait" strategy à la Greenspan may be consistent with the empirical evidence that monetary policy typically loosens somewhat during high-cost asset price booms.

4. Conclusion

Why are high cost asset price booms associated with loose monetary policies? Several explanations have been advanced to elucidate this empirical regularity. We suggest that this finding can be attributed to the forward-looking nature of the private sector's expectations. If policymakers pursue a reactive policy strategy and refrain from eliminating the possibility of a credit crunch in the aftermath of an asset price bust pre-emptively, agents know that a credit crunch might occur in the future. The policy response to a (possible) future credit crunch is therefore incorporated in private expectations thus depressing output and increasing inflation today. Hence, the policymaker is forced to react to this expectations induced change in her target variables. While the direction of the nominal interest rate adjustment is not unambiguous, the real interest rate will unambiguously decline. Monetary policy becomes more expansionary in the run-up to a (possible) asset price bust.

A policy of 'benign neglect' towards asset price booms, i.e. disregarding the possibility of an asset price bust when deciding about the monetary policy stance, is therefore (generally) not optimal. Although this approach, which seems to be favored by monetary practitioners, is also consistent with a looser monetary policy immediately before an asset price collapse, it is unambiguously dominated in welfare terms by our representation of a reactive policy strategy.

Appendix

Pro-active versus reactive policy strategy

Policymakers may act pre-emptively and prevent the emergence of a credit crunch, or adopt the reactive policy approach and respond optimally to deviations of output and inflation from their target values in each period. Which policy strategy yields the highest welfare depends on parameter values. A condition governing the optimal policy strategy choice will now be derived. As a first step, the losses in all three periods associated with both policy strategies must be computed.

Table 1: **Monetary policy strategies and macroeconomic outcomes**

	t=1	**t=2**	**t=3**[29]
Pro-active	$i_1 = \underline{r}$, $\pi_1 = -\alpha z/\sigma$, $x_1 = -z/\sigma$, $L_1 = \Delta(z/\sigma)^2$	$i_2 = r^*$, $\pi_2 = 0$ $x_2 = 0$, $L_2 = 0$ *Expected losses:* $E(L_2) = 0$	$i_3 = r^*$, $\pi_3 = 0$, $x_3 = 0$, $L_3 = 0$
Reactive	$i_1 = r^* + \left[(\lambda - \alpha\sigma)\Delta + \beta\lambda\alpha\sigma\right]\mu\varepsilon/\Delta^2$ $\pi_1 = \beta\mu\varepsilon(\lambda/\Delta)^2$, $x_1 = -\beta\alpha\lambda\mu\varepsilon/\Delta^2$, $L_1 = (\beta\mu\varepsilon)^2(\lambda/\Delta)^3$	*crisis*: $i_2 = r^* + \alpha\sigma\varepsilon/\Delta$, $\pi_2 = \lambda\varepsilon/\Delta$ $x_2 = -\alpha\varepsilon/\Delta$, $L_2 = \lambda\varepsilon^2/\Delta$ *no crisis*: $i_2 = r^*$, $\pi_2 = 0$ $x_2 = 0$, $L_2 = 0$ *Expected losses:* $E(L_2) = \mu\lambda\varepsilon^2/\Delta$	$i_3 = r^*$, $\pi_3 = 0$, $x_3 = 0$, $L_3 = 0$

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

In period 1, the policymaker has the option to forestall a future credit crunch by raising the interest rate appropriately, i.e. setting the nominal interest rate (at least) equal to $\underline{r}$. In this pro-active case, rational agents expect output and inflation in period 2 to hit their targets exactly,

[29] As already explained above, we solve the model through backward induction and assume discretionary stabilization policies. Furthermore we use the terminal condition $E_3\pi_4 = \pi_3$ (see section 2.3).

i.e. $E_1\pi_2 = E_1 x_2 = 0$. The possibility of a credit crunch is eliminated.[30] Insuring the economy against a credit crunch in period 2 is only possible at the cost of immediate deflation and output losses. The policymaker, however, may also decide to follow a reactive strategy and stabilize shocks optimally if and when they occur. But now, forward-looking agents will incorporate in their expectations the possibility of a credit crunch, and the expected future monetary policy in response to such a credit crunch. Hence, owing to the forward-looking character of the model, the impact of a (possible) credit crunch on inflation and output will be partly brought forward in time and already materialize in period 1. The reactive policymaker is forced to adjust the current interest rate to contain both the expectation-induced increase in inflation and the expectation-induced decrease of output.

The optimal policy can be derived by comparing the expected losses associated with both strategies (see Table 1):

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

(Pro-active) $\quad V^{PRO} = \Delta(z/\sigma)^2 \qquad$ with $z = \underline{r} - r^* > 0$

Formally, the reactive policy is optimal if $V^{REA} < V^{PRO}$, which is the case if condition (7) is fulfilled.

$$\underline{r} > \overline{r} = r^* + \frac{\sigma\varepsilon}{\Delta}\sqrt{\beta\lambda\mu\left[1 + \beta\mu\left(\lambda/\Delta\right)^2\right]} \quad \text{with } \Delta = \lambda + \alpha^2 \qquad (7)$$

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[30] We solve the pro-active strategy case under the assumption that the occurrence of a credit crunch is impossible. Some readers, however, may prefer the alternative interpretation that, if a pro-active strategy is pursued a credit crunch is unlikely ($\mu = 0$) but not impossible. In this alternative case, only the expected values would coincide with the flex-price values in the credit crunch period. Note, however, that all other results in our paper still remain valid and are completely independent of how the pro-active strategy is interpreted.

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