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Globalization and Asset Prices: Which Trade-Offs Do Central Banks Face in Small Open Economies?

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-Abstract-

How can globalization affect the optimal choice of monetary policy strategy during asset price booms in a small open economy? Globalization can have an impact on both the supply and the demand side of the economy. Focusing on the supply side of globalization, it has been shown that a flattening of the Phillips curve makes the proactive policy of curbing asset price inflation the more favorable option. However, by additionally introducing the demand effects of globalization, this paper demonstrates that – in contrast to the above result – globalization broadens the case for a reactive policy that loosens monetary policy conditions during the boom phase. Using numerical simulations and considering both effects simultaneously, we show for baseline parameter values that the demand effect favoring the reactive strategy dominates the supply effect.

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

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1. Introduction

Does globalization alter the constraints for monetary policy when reacting to asset price booms? Recently, it has often been claimed that the trade-off between output and inflation, i.e. the slope of the Phillips curve, has changed. There is growing theoretical and empirical evidence for a flatter Phillips curve.[1] Different reasons are put forward for this development: increased central bank credibility, lower trend inflation, and globalization. In this paper we focus on the impact of globalization.

Using a simple New-Keynesian open economy model with forward-looking expectations, Berger, Kißmer and Knütter (2007) (based on Berger, Kißmer and Wagner (2007)) have shown that the globalization-induced flattening of the Phillips curve broadens the case for a proactive policy of curbing asset price inflation. In their approach, which builds on Bordo and Jeanne (2002 a,b) and only considers the supply effects of globalization, a smaller slope of the Phillips curves implies smaller losses of such a proactive strategy, while at the same time it increases the losses that are associated with an alternative reactive policy strategy.

In addition, however, globalization may have an impact on the demand curve as well. Although there are various theoretical models which show that openness affects the interest elasticity of demand (see for example Galí and Monacelli (2005), Clarida, Galí and Gertler (2001), (2002)), there is not much literature concerning a globalization-induced change in demand curve parameters and hence the slope of the demand curve.[2] We try to fill this gap by considering, in addition to the flattening of the Phillips curve, a flattening of the demand curve (IS curve) due to a higher interest elasticity of demand and show that this is important for the decision of central banks how to behave during boom-bust cycles in asset prices.

In order to do so we are using a small open economy model along the lines of Clarida, Galí and Gertler (2001) and Berger, Kißmer and Wagner (2007). Regarding the open economy policy problem Clarida et al. (2001) show that the monetary policy choice for a small open economy is isomorphic to the one of the closed economy. In order to keep our analysis simple we follow their approach. However, we enrich the model by explicitly focusing on the

[1] For theoretical evidence see for example Razin and Yuen (2002), Khan (2005), Galí and Monacelli (2005) and Sbordone (2008). For empirical evidence see for example Borio and Filardo (2007), Ihrig et al. (2007), BIS (2006) and IMF (2006).

[2] Fuhrer and Rudebusch (2004) stress that estimates of the New Keynesian demand equation have been extremely rare. Using quarterly U.S. data, they estimate the IS curve for the period of 1966-2000. However, regarding the interest elasticity of demand they get only weak or negligible estimates, sometimes even with the wrong sign.

influence of globalization on both the slope of the Phillips curve and of the demand curve.[3] Thus, we are enabled to analyze the effects of a higher degree of openness on the slope of the Phillips curve and of the demand curve and on the policy trade-off in the case of boom-bust-cycles in asset prices.

Which trade-offs do central banks face in a globalized world during asset price booms? We show that – apart from the trade-off between the costs of a proactive and a reactive stance – there are two contrary effects. In addition to the "Phillips curve effect" favoring a proactive policy there is now the "demand curve effect", which broadens the case for a reactive strategy. The reason for the latter is that with globalization – captured by an increase in the degree of openness – the sensitivity with which aggregate demand reacts to real interest rate changes is increasing. Since the proactive strategy is characterized by an interest rate hike in the boom period, it is now associated with higher losses than before due to inflation and output diverging from equilibrium to a larger extent. Allowing for both effects, we show that there is no unambiguous analytical result. Furthermore, however, we demonstrate in numerical simulations for baseline parameter values that a reactive strategy that loosens monetary policy conditions in the boom period is the optimal choice. Only in very exceptional situations the proactive strategy can be the favorable monetary policy stance.

The remainder of the paper is structured as follows. In section 2 we give a short overview of the discussion about the impact of globalization on the slope of the Phillips curve and on the slope of the demand curve. Employing a small open economy model, we analyze in section 3 the consequences of the supply and demand effects of globalization on the policy trade-off for monetary policy during asset price booms and get an ambiguous analytical result. However, in section 4, when using a numerical simulation with baseline parameter values we get the unambiguous result that reactive policy dominates proactive policy. Section 5 concludes.

2. The Impact of Globalization on the Phillips Curve and the Demand Curve

2.1 The Phillips Curve

There is a growing debate about the impact of globalization on the Phillips curve and on inflation dynamics, see e.g. Bernanke (2007), Woodford (2007), Sbordone (2008). Recently it has been emphasized that the slope of the Phillips curve has changed. Whereas authors like Rogoff ((2003), (2006)) argue that increased competition has led to a steeper Phillips curve

[3] Berger, Kißmer and Knütter (2007) used the model of Clarida et al. (2001) as well. However, they focused on the supply effects of globalization only and hence did not consider all parameters of the Clarida et al. (2001) model in detail.

due to higher price flexibility, there is growing theoretical and empirical evidence for a flatter Phillips curve.

Evidence for a flatter Phillips curve

Ball (2006) and Mishkin (2007), (2008) see robust evidence for a decrease of the slope of the Phillips curve. Deutsche Bundesbank (2007) reports on a flatter Phillips curve in many countries, for instance in the Euro Area. Weber (2007) emphasizes that globalization may influence the Phillips curve by changing the wage- and price-setting behavior of households and firms, by affecting the way price shocks hit the economy, and by a larger response of domestic inflation to global slack.

Regarding the growing theoretical[4] and empirical[5] evidence for a flatter Phillips curve, several reasons have been listed, in particular lower trend inflation, higher credibility of monetary policy[6] and globalization.[7] It should be noted that these reasons are not mutually exclusive. Rather, they are possibly interlinked and may even amplify one another. However, in this paper we focus solely on globalization, which itself offers a variety of channels: the price-setting behavior, the higher competition on markets for goods, services and factors, and a higher degree of openness. Here, we are focusing on globalization captured by a higher degree of openness.

Impact of the degree of openness on the slope of the Phillips curve

The slope of the Phillips curve can be affected through the related increase in the degree of openness. In a New Keynesian model with Calvo price setting, Galí and Monacelli (2005) show that increased trade openness curbs the terms of trade-adjustment necessary for absorbing a shift in domestic output. Increased openness therefore lowers the impact of domestic output on marginal costs and inflation and makes domestic inflation more sensitive to world output, resulting in a flatter Phillips curve.[8] Moreover, Razin and Yuen (2002) show

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[4] See for example Galí and Monacelli (2005), Khan (2005), Razin and Yuen (2002), Razin and Binyamini (2007), Razin and Loungani (2005 a, b), Binyamini and Razin (2008) and Clarida et al. (2002).

[5] See for example IMF (2006), Borio and Filardo (2007), Pain et al. (2006), Gamber and Hung (2001), Gadzinski and Hoffmann (2007), Ciccarelli and Mojon (2005), Loungani et al. (2001), Wynne and Kersting (2007), Guerrieri et al. (2008), Eickmeier and Moll (2008) and Guilloux and Kharroubi (2008).

[6] See Rogoff (2003), Ball (2006), Mishkin (2007), Roberts (2006), Williams (2006) and Papademos (2007).

[7] See for instance Borio and Filardo (2007) and Guilloux and Kharroubi (2008). In contrast, there are papers which doubt the growing influence of global factors for domestic inflation, cf. Woodford (2007) and Calza (2008) with the latter presenting opposing results to Borio and Filardo (2007) for the Euro area. However, employing a traditional Phillips curve framework, Eickmeier and Moll (2008) argue that central banks should take global forces into account when dealing with inflation; indeed, they find that central banks have reacted to global components recently.

[8] This result therefore stands in sharp contrast to Romer's early study (1993), which stresses that more trade openness causes a steeper Phillips curve.

in a similar model that more financial openness and higher capital mobility makes consumption smoothing easier for households, thus raising the intertemporal elasticity of substitution and the degree of strategic complementarity in price setting.[9] With consumption becoming less sensitive to changes in domestic output, inflation responds less sensitively to output. Again, prices become more inflexible and the Phillips curve is flattening. Razin and Loungani (2005a), (2005b) analyze the impact of both more trade and more financial openness on the Phillips curve trade-off. They show that the opening of an economy to international trade in goods is inversely related to the slope of a New Keynesian Phillips curve. In addition, for reasons already explained in Razin and Yuen (2002) the Phillips curve becomes flatter when the economy opens up to the international financial markets.

To sum up, there are several theoretical and empirical reasons for a flatter Phillips curve. Furthermore, we listed theoretical reasons for an inverse impact of the degree of openness on the slope of the Phillips curve.

2.2 The Demand Curve

Having considered the supply effects we now focus on the demand effects of globalization. Here, the slope of the demand curve did not get so much attention as the slope of the Phillips curve. There are several reasons, one of them being the lack of empirical evidence and another reason being the lack of meaning of the demand curve for monetary policy due to the fact that only supply shocks are usually generating a trade-off for monetary policy. However, the demand curve can also be important for the conduct of monetary policy. In this paper, we are considering this case: Focusing on the trade-off central banks are facing during asset price boom-bust cycles, we show that changes in the slope of the demand curve have important implications for the central bank´s decision to act proactively or reactively.

Evidence for a flatter demand curve

Is there any evidence for a change in the demand curve due to globalization? Recently, there has been a discussion about the effectiveness of monetary policy[10], focusing on the ability of central banks to influence long term interest rates, hence the question of whether monetary

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[9] Woodford (2003) emphasizes that the degree of strategic complementarity in price setting is a key parameter in determining the slope of the New Keynesian Phillips curve. Strategic complementarity refers to the interaction between price setters on the macroeconomic level. It implies that a firm's optimal product price increases when other firms raise their prices. Given Calvo's price adjustment, the higher the degree of strategic complementarity the higher is inertia. Since only a subset of all firms is able to adjust their prices, even flexible-price suppliers change prices relatively less in response to disturbances. See also Khan (2005).

[10] See, for example, Wagner (2002), who stresses that the transmission mechanism of monetary policy is likely to change due to (financial) globalization.

policy has lost some of its effectiveness.[11] This might be caused by the integration of financial markets (Bean (2006a)). Usually, central banks use the short term interest rate as their policy instrument, mainly to influence the long term interest rates in a similar fashion. The long term rates affect consumption and investment and hence may help to control inflation. Whereas Yellen (2006) and Weber (2007) reason that monetary policy has even gained effectiveness during the past few years, Papademos (2007) argues that it has at least not been reduced. These considerations are supported by empirical findings of Boivin and Giannoni (2006) who find that monetary policy has become more effective due to a more aggressive inflation stabilization. However, Boivin and Giannoni (2008) find that some variables, in particular long term interest rates and prices, display more correlation with global forces.

Yet, there is empirical evidence for a weakened link between the short term rate of central banks and long term rates. During the period June 2004 to July 2006 the Fed raised the funds rate from 1 % to 5.25 %. At the same time, the long term interest rates, which normally should have increased as well, did not increase as much as they used to do – they even declined in 2004 and 2005. Greenspan (2005) called this divergence of short and long term rates a "conundrum". Long term rates around the world showed this behavior, declining to very low levels, cf. Reichlin (2006). According to Wu (2006), many economists think that globalization might play a role. Rudebusch et al. (2006) analyze the "conundrum" using two macro-finance models and find that these models confirm that the behavior of long-term yields has been unusual (it cannot be explained by the models). Considering other factors, they see the decline in long-term bond volatility as the main reason and not the purchase of U.S. treasuries by foreign central banks, as is usually assumed.

Furthermore, there is evidence that national bond yields are increasingly determined by global factors, see Giannone, Lenza and Reichlin (2007) and Papademos (2007). In addition, U.S., German and Japanese bond yields have had a very high degree of synchronization during the last years (Ferguson et al. (2007) and Papademos (2007)). Rogoff (2006) argues that increasing financial integration has already led to a vanishing of the influence central banks have on medium and long term real interest rates. Wu (2006) stresses that the ability of central banks to affect long term interest rates might have weakened. Some authors see the "global saving glut" (cf. Bernanke (2005)), which holds real interest rates down, and the higher real and monetary stability (low inflation) during the last decades as main reasons (see Wu (2006) and Deutsche Bundesbank (2007), Ang, Boivin and Dong (2008) for evidence of

[11] For a discussion see, for instance, Deutsche Bundesbank (2007).

the impact of monetary policy for the term structure of interest rates).[12] The meaning of global factors for real interest rates is not new, but the correlation between nominal capital market rates has become stronger recently, as Deutsche Bundesbank (2007) notes it (cf. Brüggemann and Lütkepohl (2005)). Wu (2006) argues that globalization has led to a "higher interest elasticity of bond demand". In consequence, monetary policy has lost some of its influence on aggregate demand. Gnan and Valderrama (2006) stress that monetary policy has lost effectiveness in influencing inflation through the demand channel.

Impact of the degree of openness on the slope of the demand curve

Concerning the question of whether globalization has led to a structural change of the demand curve, one has to distinguish between two channels:

- The interest rate elasticity of demand
- The ability of monetary policy to influence the domestic real interest rate (Is the domestic real interest rate no longer set by domestic monetary policy, but rather by a world interest rate because of complete financial integration?)

The discussion about the effectiveness of monetary policy has so far mainly referred to the second channel. As shown above, there seems to be some evidence for a greater correlation between domestic and international real interest rates. However, in this paper we abstract from such considerations and assume, according to the standard workhorse model of monetary policy – the New Keynesian framework – that central banks are still able to set the domestic real interest rate. Moreover, we suppose that globalization is affecting the economy through the first channel: As shown in several theoretical models, economies with a higher degree of openness are characterized by a higher interest elasticity of demand due to the influence of exchange rates and the terms of trade (see Galí and Monacelli (2005), Clarida et al. 2002)). In our model, an increasing degree of openness leads directly to a higher sensitivity of aggregate demand to real interest rate changes, which in turn decreases the slope of the IS curve, since an interest rate hike is associated with higher output losses than before. Hence, we argue that globalization leads to a flatter demand curve.

To sum up, there are several theoretical and empirical reasons for a flatter demand curve. Furthermore, we listed theoretical reasons for an inverse impact of the degree of openness on

[12] See White (2008) for a discussion of the meaning of the global saving glut for lower inflation and for (tentative) considerations of the meaning of the slope of the IS curve for the effectiveness of monetary policy.

the slope of the demand curve. Empirical evidence for a higher degree of openness is indicated in section 2.3.

2.3 Empirical Evidence for a Higher Degree of Openness

Now we focus on the issue of whether there is – in addition to the theoretical reasons for a higher degree of openness – empirical evidence for a higher degree of openness in the context of globalization. The degree of openness is arguably one of the most common explanations of globalization. It comprises trade openness and financial openness.

There is widespread evidence for an increase in both trade and financial openness. IMF (2002b) shows that trade openness and financial openness have increased during the past decades in advanced and developing economies. Kose et al. (2006), analyzing 71 countries, report on a sharp increase of financial openness. This is supported by Quinn (2003), who shows for every region of the world an increased degree of financial openness, especially since 1990, and by Chinn and Ito (2006) for a sample of 108 countries. Furthermore, Alesina et al. (2000) report on a strong increase in the degree of trade openness during the time period 1946-1995. The degree of openness – measured as the volume of imports plus exports as a share of world GDP – has increased by 40 %. For empirical evidence see Table 1a.

Table 1a

Trade openness			
Year	**World**	**Advanced and industrial economies**	**Emerging and developing economies**
1985	20.52	30.71	17.82
1990	26.54	43.40	21.06
1995	31.15	48.13	29.36
2000	31.13	46.21	29.48
2005	37.93	55.21	37.83
2007	43.09	62.76	43.01

Note: Trade openness is measured as the sum of exports and imports relative to GDP (in percent).
Source: IFS, IMF World Economic Outlook Database 2008

As can be seen in section 3, the degree of openness in our model is captured by the parameter γ, which can be interpreted as the share of imports relative to GDP. Empirical evidence for this development is given in Table 1b.

Table 1b

Trade openness			
Year	**World**	**Advanced/industrial economies**	**Emerging and developing economies**
1985	10.48	15.47	10.48
1990	13.47	21.79	10.44
1995	15.73	23.72	15.18
2000	15.81	23.41	14.29
2005	19.15	28.13	17.85
2007	21.76	31.82	20.59

Note: Trade openness is measured as the share of imports relative to GDP (in percent).
Source: IFS, IMF World Economic Outlook Database 2008

To sum up, there is evidence for a flatter Phillips curve and for a flatter demand curve due to globalization. Changes in the structure of the Phillips curve are important for the conduct of monetary policy, for example for the behavior of central banks during boom-bust-cycles on asset markets, as shown by Berger, Kißmer and Knütter (2007). Furthermore, for the policy choice during boom periods the demand curve is important as well. Hence we concentrate on the question of how a flatter Phillips curve and a flatter demand curve (due to a higher interest elasticity of demand) influence the central banks´ decision to respond to boom-bust-cycles, an important area and intensively debated question, lately in context with the crisis on the U.S. property and subprime markets in 2007 and 2008.

3. Globalization and Asset Price Booms

The discussion about whether and how monetary policy should react to asset prices mainly focused on two positions - the so-called reactive and proactive strategy. The proponents of the reactive strategy (e.g. Bernanke and Gertler (1999), (2001)) argue that central banks should take asset prices only insofar into account as they influence inflation and output. Furthermore, a reactive strategy seems to be synonymous in many cases to a policy of `benign neglect`, in the sense that central banks do not react pre-emptively in the boom phase but rather ease monetary policy reactively if and when an asset price crash occurs.

The advocates of the reactive strategy point to three issues justifying their approach. First, central banks may not be able to identify asset price misalignments. Second, monetary policy is often regarded as a blunt tool. A small interest rate increase could even further fuel the boom; the increase necessary to slow the boom or prick the bubble may lead to a severe recession. Third, monetary policy behaving in an active manner may raise credibility problems: central banks with the primary objective of stabilizing inflation might have problems in communicating markets a monetary tightening, especially in the case of low inflation.

In contrast, the proponents of the proactive strategy (brought forward e.g. by Cecchetti et al. (2000), (2003)) argue that monetary policy should raise interest rates in a proactive manner in order to prevent bubbles from growing. Using the (modified) model of Bernanke and Gertler ((1999), 2001)), Cechetti et al. (2000) show that the inclusion of asset prices in the Taylor rule may enhance macroeconomic performance. Regarding the identification problem, they argue that other variables used in conducting monetary policy, like the output gap, are hard to assess too.

Following this debate, Bordo and Jeanne (2002a, b) and Gruen et al. (2005) show that there are no simple rules for solving this problem. Rather, the decision of whether and how monetary policy should react to asset prices depends on several parameters and leads therefore to a trade-off between the costs of the reactive and proactive strategy. Our model resembles Bordo and Jeanne (2002a, b), for instance 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. This price setting behavior is consistent with a flattening of the Phillips curve (see Khan (2005)).

The Model

In our model the central bank is facing rapidly rising asset prices and policymakers can choose between two main policy options. They can pursue a proactive policy or a reactive policy. Adopting a proactive stance implies that policymakers want to reduce the risk of a credit crunch by raising interest rates, whereas choosing reactive policy implies ignoring their influence on the likelihood of a future credit crunch. Rather, they try to mitigate the consequences of an expected or an actual crisis if and when it occurs.

To better illustrate the boom-bust-cycle, we consider only three periods.[13] In period 1, the boom period, firms contract debt to finance the aquisition of a productive asset. Firms need this asset for production, but it may also serve as collateral in the second period. 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.

We consider a stylized macroeconomic model, based on Berger, Kißmer and Wagner (2007) and Clarida, Galí and Gertler (2001)[14], with equations (1) to (3).[15]

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

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

$$(3) \qquad rr_t = r_t - E_t \pi_{t+1} \qquad\qquad t = 1, 2, 3$$

with

$$w = \gamma(\sigma\eta - 1)(2-\gamma)$$

$$\kappa_w = \delta\left(\frac{\sigma}{1+w} + \phi\right)$$

[13] A closed economy version of the model is laid out in more detail in Berger, Kißmer and Wagner (2007). In contrast to Bordo and Jeanne (2002a, b) to which their model is related, they focus solely on macroeconomic effects and on macroeconomic policy. Readers who are interested in the microeconomics details are therefore referred to their work.

[14] Regarding the open economy, Clarida, Galí and Gertler (2001) show that the monetary policy problem for a small open economy is isomorphic to the one of the closed economy. In order to keep our analysis simple, we follow their approach.

[15] We do not explicitly consider the equation of the terms of trade because, in our model, it would be of the form $s_t = \frac{\sigma}{1+w} x_t + s^*$ and hence not be important for any other endogenous variables. (The terms of trade are positively related to the output gap. When domestic output is increasing relative to foreign output, it follows that the terms of trade have to depreciate. In order to clear the markets, domestic goods have to become cheaper relative to foreign goods. s^* are the terms of trade that prevail in the frictionless equilibrium. Since they are not important for our results, we assume them to be exogenous.)

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

The forward-looking demand 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.[16] The parameter rr^* is defined as the domestic real interest rate that would prevail in the absence of shocks.[17] $(1+w)/\sigma$ is the elasticity of aggregate demand concerning changes of the real interest rate, where σ is the coefficient of the relative risk aversion. The smaller σ is and the higher w is, the larger is the decline in aggregate demand that a given rise in the real interest rate causes.[18] The degree of openness γ is defined as the share of foreign goods consumed by domestic households.[19] As only consumption goods are produced and traded, we are able to equate the empirical measure of the degree of trade openness (see Table 1b in section 2.3) with the degree of openness in our model in an analogous way.[20]

Globalization - captured by an increase in the degree of openness γ - leads to a higher w[21] and therefore to a higher interest elasticity of demand.[22] This is the standard result in (New Keynesian) small open economy models[23]: the output effect of monetary policy is greater in open economies since the effect of expansive monetary policy is amplified through the

[16] In contrast to Clarida et al. (2001) we assume the natural level of output to be exogenous. This is possible due to our assumption of no growth.

[17] We assume rr^* to be exogenous in our model. In Clarida et al. (2001) this variable (in their model rr_t^0) is the domestic real interest rate that prevails in the frictionless equilibrium and is therefore endogenous. It depends on the foreign real interest rate and the expected growth of the natural rate level of output. One can show that taking account of the foreign real interest rate times $w/(1+w)$ like in Clarida et al. (2001) does not influence our results (see Appendix A). For that reason and since there is no growth in our model, rr^* is set constant across the periods.

[18] We abstract from the "usual" demand and supply shocks. In order to sharpen our results we exclusively focus on the financial shock, u_t (see equation (2)). Including the usual demand and supply shocks would complicate the derivation of the optimal monetary policy without changing the results qualitatively.

[19] Hence, $c_t = (1-\gamma)c_t^h + \gamma c_t^f$, see Clarida et al. (2001).

[20] See also Galí and Monacelli (2005) who define the degree of openness as the domestic consumption allocated to imported goods (in the calibrated version of their model they set the degree of openness for the small open economy to 0.4, which, as they note, "corresponds roughly to the share of imports in GDP for Canada").

[21] Note that $\frac{\partial w}{\partial \gamma} = (\sigma\eta - 1)\left[(2-\gamma) - \gamma\right] = 2(1-\gamma)(\sigma\eta - 1)$ and $\frac{\partial w}{\partial \gamma} > 0$ due to $0 < \gamma < 1$ and $\sigma\eta > 1$.

[22] One might argue that globalization can be captured by the elasticity of substitution between home and foreign goods η as well, because increasing integration can induce a higher elasticity of substitution between home and foreign goods. In this case we would get the same results as obtained above with globalization captured by a higher degree of openness. However, the converse effect of increasing competition leading to higher specialization among different goods and hence to a decline of the elasticity of substitution between home and foreign goods cannot be excluded. Furthermore, the empirical results regarding the elasticity of substitution are mixed. See for example Broda and Weinstein (2006), Feenstra (2006) and Cox and Ruffin (2008).

[23] See for example Clarida et al. (2002) and Galí and Monacelli (2005).

depreciation of the exchange rate, which in turn boosts exports and domestic output in addition to the (positive) output effect of monetary policy. According to Clarida, Galí and Gertler (2001), restrictive monetary policy is followed by a depreciation of the terms of trade and the expenditure-switching effect on demand is captured by the parameter w in the interest sensitivity of x_t.[24] This effect amplifies the overall impact on demand, if $\sigma\eta > 1$ (implying $w > 0$), as seems empirically reasonable (cf. Clarida et al. (2001)). Then, it is evident that globalization (captured by a higher degree of openness γ and hence a higher w) induces a higher interest elasticity of demand and hence a flattening of the IS curve.

As in Berger, Kißmer and Wagner (2007), we allow for the influence of the financial shock on the demand side as well. There is empirical evidence for the link between asset prices and consumption. Households´ wealth correlates with asset prices. The reason is that households use assets like houses as collateral to finance consumption. If asset prices fall then collateral values and households´ wealth fall as well, resulting in decreasing consumption, see IMF (2003), (2004) and (2008a), ECB (2003), Bordo and Jeanne (2002a, b) and Muellbauer (2008) for highly developed credit markets.[25] Allowing for the demand side effect of the financial shock results in plausible interest rate movements in response to a credit crunch, hence in an interest rate reduction (see below).[26]

The New Keynesian Phillips curve (2) with its slope κ_w 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. As can be seen from (2) and footnote 20, globalization (captured by a higher degree of openness γ and hence a higher w) induces a flattening of the Phillips curve. ϕ is the inverse of the labor-supply elasticity and η the elasticity of substitution (between home and foreign goods). The financial shock of the supply side is associated with a possible credit crunch.[27] 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 to get further credit. These firms must stop their production. Hence, a collateral-induced credit crunch leads to a decline in economic activity.

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[24] The meaning of changes in the degree of openness, for the specification of aggregate demand and supply blocks is stressed, amongst others, by Woodford (2007).

[25] A typical example for collateral used by households is real estate. For a theoretical analysis of the link between house prices and consumption see e.g. Aoki et al. (2004).

[26] In a recent contribution, Gochoco-Bautista (2008) shows for eight east Asian countries that especially asset price booms in housing markets significantly raise the probability that the output gap will be in the left tail of its distribution, hence significantly below trend.

[27] The financial shock in (2) can be interpreted as a cost-push-shock.

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.

Hence, in contrast to Bordo and Jeanne (2002a, b), a steep fall in asset prices can be seen as a simultaneous occurence of a supply and a demand shock. In order to analyze the policy trade-off induced by an asset price boom we assume the simplest possible distribution for u_t. The financial shock can only occur in period 2. Thus, the distribution of u_t can be defined as

$$(4) \qquad u_t = \begin{Bmatrix} 0 & in \ t \neq 2 & \\ 0 & in \ t = 2 & if \ no \ credit \ crunch \\ \varepsilon > 0 & in \ t = 2 & if \ credit \ crunch \end{Bmatrix}$$

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. Formally, the probability of a collateral-induced credit crunch in the second period can be written as

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

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 $\underline{rr}$, the debt burden from period 1 will always be low relative to the value of firm´s collateral.

As can bee seen from equation (5), the probability of a credit crunch depends on the choosen real interest rate by the central bank.

Policymakers minimize an intertemporal loss function V_t where L_t represents immediate periodical losses.

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

(7) $$L_t = \pi_t^2 + \lambda x_t^2$$

The standard loss function (7) is quadratic in inflation and the 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. If $\lambda > 0$ $(\lambda = 0)$ then a regime of flexible (strict) inflation targeting predominates (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 might induce unnecessary high losses during the boom period because first period's output and inflation may fall sharply below their target values. Alternatively, policymakers may adopt the reactive policy strategy which is not associated with these costs. However, then 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 about which policy is implemented involves comparing the expected losses of both strategies. Berger, Kißmer and Knütter (2007) have focused on the supply effect of globalization in altering the slope of the Phillips curve. They have shown that a globalization-induced flattening of the Phillips curve makes the proactive strategy the more favorable option. Extending their analysis, we additionally consider the demand effect of globalization and show that there is a contrary effect which favors the reactive strategy.

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 and show that the analytical result is not unambiguous. Furthermore, we discuss which assumptions are necessary to get an unambiguous result.

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. Central bankers assume they cannot influence the probability of the future credit crunch and hence mitigate only the consequences of a financial crisis when they occur ("to mitigate the fallout when it occurs…", Greenspan (2002)).

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 2 below).

Table 2

Reactive Policy		
t = 1	**t = 2**	**t = 3**
$r_1^{REA} = rr^* + \frac{\left[\left(\lambda(1+w)-\kappa_w\sigma\right)\Delta+\beta\lambda\kappa_w\sigma\right]\mu\varepsilon}{(1+w)\Delta^2}$ $rr_1^{REA} = rr^* - \frac{\left[\lambda\left(1-\beta\right)+\kappa_w{}^2\right]\sigma\kappa_w\mu\varepsilon}{(1+w)\Delta^2}$	*crisis*[28] $r_2^{REA} = rr_2^{REA} = rr^* - \frac{\sigma\varepsilon(\psi\Delta-\kappa_w)}{(1+w)\Delta}$ *no crisis* $r_2^{REA} = rr_2^{REA} = rr^*$	$r_3^{REA} = rr_3^{REA} = rr^*$
$\pi_1^{REA} = \beta\mu\varepsilon\left(\lambda/\Delta\right)^2$ $x_1^{REA} = -\kappa_w\beta\lambda\mu\varepsilon/\Delta^2$	*crisis* $\pi_2^{REA} = \lambda\varepsilon/\Delta$ $x_2^{REA} = -\kappa_w\varepsilon/\Delta$ *no crisis* $\pi_2^{REA} = x_2^{REA} = 0$	$\pi_3^{REA} = x_3^{REA} = 0$
$L_1^{REA} = \left(\beta\mu\varepsilon\right)^2\left(\lambda/\Delta\right)^3$	*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 $\Delta = \lambda + \kappa_w^2$.

In period 2, however, the occurrence of a credit crunch is possible. In the case it does not occur, policymakers are in a position to completely stabilize the economy and prevent losses. Then, the second period's equilibrium equals the steady state solution. However, in the case

[28] We assume that $\psi > 1/\kappa_w$ so that the optimal monetary policy response to a credit crunch in period 2 unambiguously consists in an interest rate reduction. Thus, we follow Berger, Kißmer and Wagner (2007) in assuming the policy response to a crisis to be more plausible than in the model of Bordo and Jeanne (2002a, b) who suppose the central bank being restrictive in the face of a bust because the resulting credit crunch reduces supply without affecting demand. In this respect, our result is more in line with empirical evidence that asset price busts tend to be deflationary.

of a credit crunch, central bankers will have to trade off inflation against output losses. As can be seen from Table 2, 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 (see Table 2).

In period 1, forward-looking agents will allow for the possibility of a credit crunch, and the expected future stabilization policy reacting to a credit crunch, 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 leave the path of maintaining 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.[29] This contrasts the views of Bordo and Jeanne (2002a, b) and Greenspan (2002), who see the optimal reactive strategy as an asymmetric policy that only reacts in the aftermath of a boom when and if a bust occurs. That `benign neglect` is not a sensible option for central banks in the case of forward-looking private agents is shown by Berger, Kißmer and Wagner (2007) and Berger and Kißmer (2008) in a recent contribution. 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.[30]

[29] Hence, the reactive strategy can be seen as the 'standard policy' under flexible inflation targeting. Cf. Rudebusch (2005) who introduces the term 'standard policy' to describe central bankers' conventional response to asset price booms. See also Bean (2003).

[30] 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 (Greenspan (2002)).

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 3). 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.

Table 3

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

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

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 (decline of the real interest rate in the boom period).

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 Table 2 and 3 above, it follows that

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

$$V^{PRO} = \left(\frac{1+w}{\sigma}\right)^2 z^2 \Delta \quad \text{with } z = \underline{rr} - rr^* > 0 . \qquad (9) \quad \text{(Proactive)}$$

In general, both strategies may emerge to be the optimal policy preventing a future credit crunch. Formally, the proactive policy is optimal if $V^{PRO} < V^{REA}$, which is the case if condition (10) is fulfilled.

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

with
$$\Delta = \lambda + \kappa_w^2$$
$$\kappa_w = \delta\left(\frac{\sigma}{1+w} + \phi\right)$$
$$w = \gamma(\sigma\eta - 1)(2-\gamma)$$

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 (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 globalization – captured by a higher degree of openness γ – influence the policy choice? As can be seen from the definition of $w = \gamma(\sigma\eta - 1)(2-\gamma)$ and the footnote 20, the degree of openness γ has a positive impact on w. Which impact, in turn, does this have on the threshold value of the real interest rate? As already mentioned, there are two contrary channels. On the one hand, globalization makes the Phillips curve flatter, as confirmed by empirical findings. A smaller slope of the Phillips curve κ_w increases the threshold value, therefore favoring the *proactive strategy*, as shown by Berger, Kißmer and Knütter (2007).

On the other hand, globalization induces a smaller slope of the IS curve. It can easily be seen that the slope of the IS curve is positively related to the threshold value (10). Globalization (higher value of γ and w) has thus a negative effect on $\overline{rr}$. Therefore, the flattening of the IS curve is favoring the reactive policy. There is one main reason for this result. Since the sensitivity with which aggregate demand reacts to real interest rate changes is increasing in the open economy ($(1+w)/\sigma$ with $w > 0$ due to $\sigma\eta > 1$ instead of $1/\sigma$ in the case of $\gamma = 0$ and hence $w = 0$), the proactive strategy is associated with higher losses. Hence, if the effects on the demand curve are considered separately from the Phillips curve effect, higher globalization – captured by an increase in the degree of openness – clearly favors the *reactive strategy*.

Which policy choice predominates if we allow for both effects simultaneously? Since in that case there is no unambiguous analytical result, we calibrate the model in section 4.

4. Numerical Simulation

In section 3, we have shown that there are two contradicting effects concerning the policy choice during boom-bust-cycles in the boom period. In this section we try to find out which of these effects is the dominating one: the supply effect favoring the proactive strategy or the demand effect favoring the reactive strategy. Since there is no unambiguous analytical solution, we calibrate the model in order to get a solution. Hence, the numerical simulation delivers support in analyzing the impact of the degree of openness on the threshold value of the real interest rate. The parameter values we are using are shown in Table 4.

Table 4

Baseline parameter values[31]			
β discount factor	0.99	ϕ inverse of labor supply elasticity	1
$\delta = \frac{(1-\alpha)(1-\alpha\beta)}{\alpha}$ degree of price stickiness[32]	0.08583	η elasticity of substitution between home and foreign goods	5
ε extent of asset price bust	0.01	λ output weight in loss function	0.25
σ coefficient of relative risk aversion	1.5	μ probability of credit crunch	0.02

As can be clearly seen from Figure 1, for the chosen baseline parameter values the threshold value $\overline{rr}$ is decreasing with a higher degree of openness, thus favoring the reactive strategy. The reason is that with globalization – captured by an increase in the degree of openness – the sensitivity with which aggregate demand reacts to real interest rate changes is increasing. Since the proactive strategy is characterized by an interest rate hike in the boom period, it is

[31] Regarding our choice of parameter values we draw in particular on the following papers: Galí and Gertler (1999), (2007), Galí and Monacelli (2005), Anderson and van Winccop (2004) and Woodford (2003). See Appendix B for further explanation.

[32] The parameter α is the probability that firms are not allowed to adjust their prices in a certain period, see Calvo (1983).

now associated with higher losses than before due to inflation and output diverging from equilibrium to a larger extent. The more open the economy the stronger is the demand effect – hence the larger the losses of the proactive strategy relative to the reactive strategy.

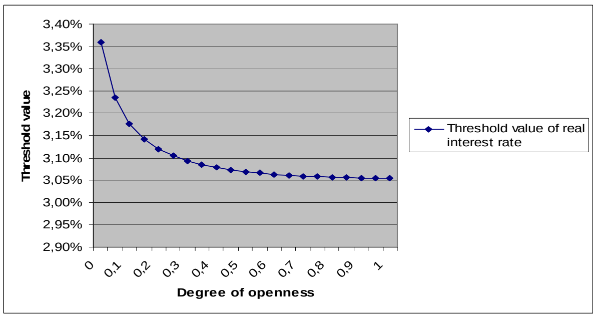

Figure 1 – Threshold value of real interest rate in dependence of the degree of openness (baseline values of parameters)

In order to test for robustness, we employ not only the baseline parameter values shown in Table 4, but also a wide range of parameter values found in the literature as can be seen from Table 5 in Appendix B. Additionally, we choose different values for μ and ε. Regarding the probability of a credit crunch μ, we try to cover a relatively wide range of possible values. Barro (2006) reports on a disaster probability of 1.50 to 2.00 % per year. It should be stressed that Barro (2006) analyzes disasters, hence low-probability events like global wars.[33] However, we argue that the probability of a credit crunch can be higher than 2.00 % and hence we choose values of 0.001, 0.02 and 0.1.

Concerning the extent of an asset price bust ε we select 0.001, 0.01 and 0.1.[34] Bordo and Jeanne (2002a, b) show for several industrial countries that the decline in the output gap after a boom is in the majority of cases between 2 % and 5 %.[35] In a similar way, Adalid and Detken (2007) deliver evidence for high- and low-cost-booms. Their definition of high-cost booms implies an annual relative decline of GDP of at least 2.4 % over three years.[36] Greenlaw et al. (2008) provide an estimate for the losses associated with the recent subprime crisis: they guess the losses will be about 500 billion $, which is equivalent to about 3.5 % of the U.S. GDP. IMF (2008b) estimates potential losses of the financial sector (bank writedowns and losses) of the 2007/2008 financial crisis to be about 1.4 trillion $ and 9-10 %

[33] Barro (2006) defined a macroeconomic disaster as an event which leads to a decline in per capita GDP by at least 15 % over some years.

[34] Note that $\pi_2^{REA} = \lambda\varepsilon/\Delta$. Since λ/Δ is nearly 1 by definition, π and ε have to be very similar and the value of ε can be expressed in percentage points.

[35] They analyze 15 countries in the period 1970-1998 (property prices) and 1970-2001 (stock prices).

[36] Analyzing 18 OECD countries since the 1970s, they identify 42 booms, of which 20 are high-cost booms. See also Detken and Smets (2004).

of GDP up to October 2008. Therefore, our range between 0.1 % and 10 % seems justified for most situations.
Our results are robust to nearly all changes of the parameters in the chosen range (see the figures in Appendix B) - the only exception is a situation with a very low degree of price stickiness in the chosen parameter range (relatively large values of δ=0.15…0.17, see the Appendix B). Hence, the result of our analysis is that for a wide range of parameter values, globalization – captured by a higher degree of openness – leads central banks facing boom-bust-cycles to consider the reactive strategy the more favorable choice. The reason is that the incorporation of the demand effects of globalization increases the losses of the reactive strategy to a lesser extent than the losses of the proactive strategy. Furthermore, the resulting increase in both the losses of the reactive and the proactive strategy stands in sharp contrast to the results of Berger, Kißmer and Knütter (2007) – in their model the supply effects of globalization increase the costs of the reactive strategy and decrease the costs of the proactive strategy. Therefore, monetary stabilization policy becomes less effective in a small open economy.

It is important to stress that the focus of our paper is on the relative comparison between both strategies – hence we answer the question of whether globalization makes one of them a more favorable option over the other. However, if we want to know which of them is the better option in absolute terms, we have to compare the losses of both strategies, using again our parameter values. An important value for the comparison between the losses of both strategies is *z*. As mentioned above, $z = \underline{rr} - rr^* > 0$. The value of *z* can be understood as the "insurance premium" of the proactive strategy and is associated with the losses of this policy choice. We set $rr^* = 3\%$ which corresponds to the value of the discount factor. We choose values for the insurance premium of 10 %, 20 % and 100 %, getting values for the real interest rate required to avoid a credit crunch, $\underline{rr}$, of 13 %, 23 % and 103 %.[37] As can be seen from figure 2, for baseline parameter values (and *z* = 10 %) the proactive strategy is associated with losses higher than the reactive strategy. The losses of both strategies increase with a higher degree of openness, but to a lesser degree for the reactive strategy.

[37] We draw the values from empirical evidence of overnight rates during the banking and currency crises in Sweden (1990-1995) and Asia (1997/1998).

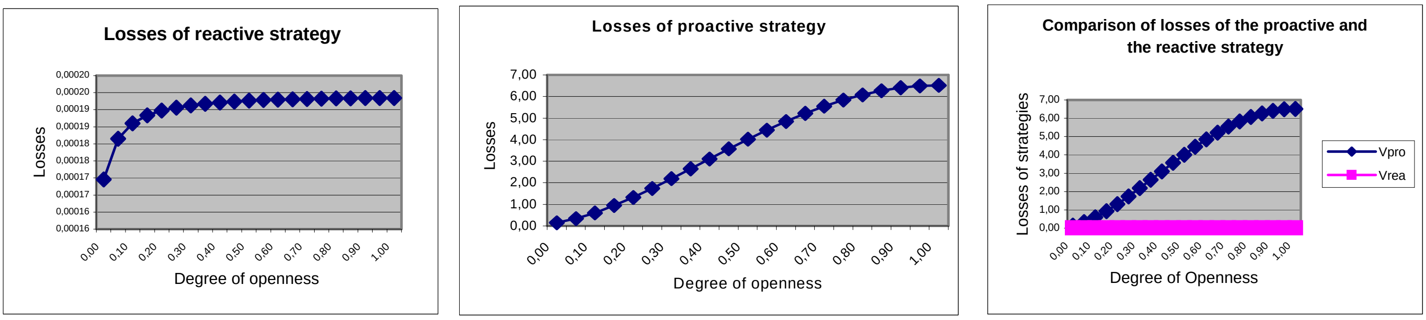

Figure 2 – Comparison of Losses (using baseline values of parameters)

Hence, for the baseline parameter values the reactive strategy is the favorable policy outcome. Again, this result is robust to the wide range of parameter values reported in Table 5 in the Appendix B.[38]

Yet, there might be exceptional circumstances in which this result does not hold, according to Rudebusch (2005) who distinguishes between *standard* policy and *bubble* policy.[39] The reactive policy can be seen as the standard case, which is prevalent in most situations, contrary to the proactive stance, which might be the optimal choice in exceptional circumstances. These circumstances may arise when the probability of a credit crunch (μ) and the extent of the asset price bust (ε) are very high. If we use considerably higher values than above (see Table 4 and Appendix B) for μ and ε, a different picture may emerge. For instance, a higher probability of a credit crunch might arise in very special situations like the one of an already long lasting boom and first signs of the ending of that boom, such as the situation on U.S credit and housing markets in 2007. Hence, values for μ between 0.2 and 0.5 might be possible. Concerning the extent of a possible bust, Barro (2006) reports on declines in per capita GDP between 15 and 64 %. In addition, IMF (2008b) estimates the losses in GDP of the Asian banking crisis to be about 35 %. In a recent contribution, Laeven and Valencia (2008) deliver a comprehensive database on banking crises for the period 1970-2007 – they find an average output loss (share of GDP) of 20.1 %, with extreme values up to 50-60 %. Hence values for ε between 0.1 and 0.4 (output losses) may be justified.

Figure 3 clearly shows that in the case of μ=0.4 and ε=0.3 and using the baseline values the proactive strategy can be the optimal choice in absolute terms, especially for relatively low values of the "insurance premium" (z = 10 %, 20 %). This result can be seen in line with Rudebusch (2005): In our model, the reactive strategy is the standard policy under flexible

[38] An exceptional example is given in Appendix B (in this – extreme – example, the loss of the proactive strategy is partly lower in the case of a relatively high degree of price stickiness, e.g. a relatively low value of δ=0.052…0.10).

[39] The standard policy is the usual response of central banks to asset price bubbles – central banks only respond to them insofar as they influence the goals of monetary policy, inflation and output. The bubble policy, however, tries to exert influence on the bubble in order to contain or reduce it.

inflation targeting, as supported by our numerical results. However, in extraordinary circumstances (very high probability of a credit crunch, high expected extent of an asset price bust), it might be optimal to follow the proactive strategy and raise interest rates during asset price booms. Interestingly in this context, a recent speech of the Fed Chairman Bernanke was interpreted by several economists as a rethinking of the stance that the Fed should not try to prick bubbles.[40]

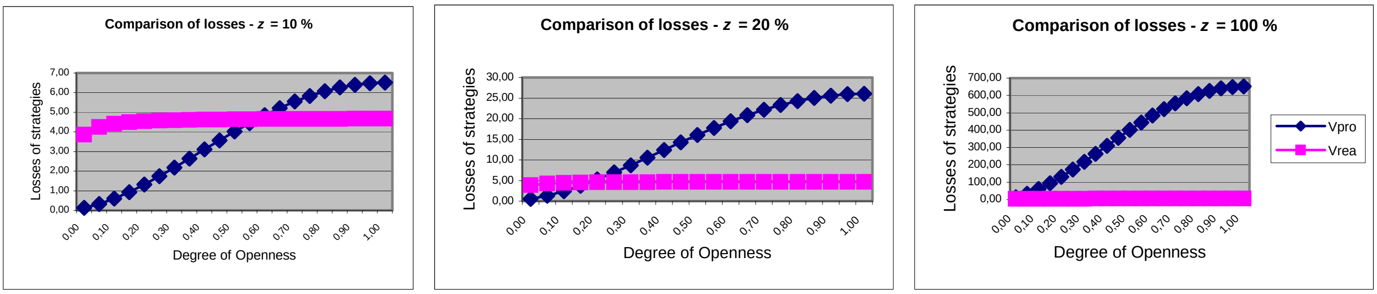

Figure 3 – Comparison of Losses for *z*=10 %, 20 % and 100 %

5. Conclusion

Globalization can change the constraints of monetary policy in the case of boom-bust-cycles in asset prices.

Globalization can affect the economy on the supply side. This supply effect leads to a flatter Phillips curve and decreases the costs of stabilizing the economy in the boom phase by raising interest rates. Hence, a smaller slope of the Phillips curves implies smaller losses of such a proactive strategy, while at the same time it increases the losses that are associated with an alternative reactive policy strategy.

However, when additionally focusing on the demand effects of globalization, a different situation may arise. We show that globalization – captured by a higher degree of openness – induces a higher interest elasticity of demand and therefore a flatter demand curve as well. Considering only the demand effect, we show that the reactive strategy turns out to be the optimal choice. The main reason for this result is that with the increasing sensitivity of aggregate demand to changes in the real interest rate, the proactive strategy which raises interest rates in the boom period is associated with higher losses in an open economy. This additional effect is due to an appreciation of the terms of trade when the central bank raises its interest rate. The terms of trade-effect gives rise to an expenditure-switching effect on

[40] See the Wall Street Journal´s article „Fed Rethinks Stance on Popping Bubbles“, 17th of October 2008. In response to a question after the speech (Bernanke (2008)), Bernanke said: „[O]bviously, the last decade has shown that bursting bubbles can be an extraordinarily dangerous and costly phenomenon for the economy, and there is no doubt that as we emerge from the financial crisis, we will all be looking at that issue and what can be done about it."

demand which in turn amplifies the (negative) impact on demand due to its impact on net exports. Hence, if the effects on the demand curve are considered separately from the Phillips curve effect, globalization – captured by an increase in the degree of openness – clearly favors the reactive strategy.

Using a small open economy model we show the consequences of a simultaneous consideration of the supply and demand effects of globalization on the optimal decision of central banks facing boom-bust-cycles in asset prices. It can be shown that there is no unambiguous analytical result. In a numerical simulation of the model we show that for a wide range of parameter values the reactive strategy is the more favorable choice. The reason is that the incorporation of the demand effects of globalization increases the losses of the reactive strategy to a lesser extent than the losses of the proactive strategy.[41] Because of the relative deterioration of the proactive strategy monetary stabilization policy becomes less effective in a small open economy.

Extensions for future research may want to focus on more sophisticated models of the small open economy or to extend the analysis to open economies which are large enough to influence each other. Furthermore, the inclusion of lags and uncertainty could enrich the analysis. Another approach could incorporate additional sources of globalization. As already mentioned, it might be possible to capture globalization by the elasticity of substitution between home and foreign goods as well, because increasing integration can induce a higher elasticity of substitution between home and foreign goods. In this case, we would get the same results as obtained above with globalization captured by a higher degree of openness. However, the converse effect of increasing competition leading to higher specialization among different goods and hence to a decline of the elasticity of substitution between home and foreign goods cannot be excluded. Maybe future research regarding the influence of globalization on the elasticity of substitution between home and foreign goods can bring some more clear-cut results to this open question.

[41] In addition, this result stands in sharp contrast to the findings of Berger, Kißmer and Knütter (2007). As already mentioned, in their analysis the supply effects of globalization increase the costs of the reactive strategy and decrease the costs of the proactive strategy.

Appendix A

IS curve

The IS curve in Clarida, Galí and Gertler (2001) is given by:

$$(A1)\ x_t = E_t x_{t+1} - \frac{1+w}{\sigma}(rr_t - rr_t^0)$$

with rr_t^0 $\left(rr_t^0 = \frac{w}{1+w} rr_t^* + \frac{\sigma}{1+w} E_t(y_{t+1}^0 - y_t^0)\right)$ as the domestic real interest rate in the frictionless equilibrium and y_t^0 being the natural level of output. Since there is no growth in our model, we can write $rr_t^0 = \frac{w}{1+w} rr^*$

It is possible to transform the second term of (A1) into:

$$\begin{aligned}
&-\frac{1+w}{\sigma}(rr_t - rr_t^0) \\
&= -\frac{1+w}{\sigma}(rr_t - \frac{w}{1+w} rr^*) \\
&= -\frac{1+w}{\sigma}(rr_t - rr^* + rr^* - \frac{w}{1+w} rr^*) \\
&= -\frac{1+w}{\sigma}(rr_t - rr^*) - \frac{1+w}{\sigma} rr^* (1 - \frac{w}{1+w}) \\
&= -\frac{1+w}{\sigma}(rr_t - rr^*) - \frac{1+w}{\sigma} rr^* (\frac{1+w-w}{1+w}) \\
&= -\frac{1+w}{\sigma}(rr_t - rr^*) - \frac{rr^*}{\sigma}
\end{aligned}$$

Hence, the second term of the IS curve can easily be transformed in a form similar to the one used in our model. The only difference is the term $\frac{rr^*}{\sigma}$, which is exogenous. Therefore we can neglect it and use a IS curve of the following form:

$$(A2)\ x_t = E_t x_{t+1} - \frac{1+w}{\sigma}(rr_t - rr^*)$$

which corresponds, except for the financial shock, to (1).

Appendix B – Range of used parameter values

Table 5

Parameter	Low value	High value	Baseline value[42]
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	2	1.5
$\delta = \frac{(1-\alpha)(1-\alpha\beta)}{\alpha}$ degree of price stickiness[43]	0.052 (with $\alpha = 0.8$)	0.17 (with $\alpha = 0.66$)	0.08583 (with $\alpha = 0.75$)
ϕ inverse of labor supply elasticity	0.8	10	1
η[44] elasticity of substitution between home and foreign goods	2	10	5
μ probability of credit crunch	0.001	0.1	0.02
ε extent of asset price bust	0.001	0.1	0.01

Regarding our choice of parameter values, we drew in particular on Galí and Gertler (1999), (2007), Galí and Monacelli (2005), Anderson and van Winccop (2004) and Woodford (2003). Below we give some examples for parameter values found in the literature. As Jensen (2002) stresses, in most papers a value of 0.99 for β is chosen, irrespective of the considered time period. For λ, the following values are reported: McCallum and Nelson (2004) [0.016…1.6] (transformed in annual values to make it comparable to the other papers), Rotemberg and Woodford (1998) 0.05, Ravenna and Walsh (2006) and Jensen (2002) 0.25, Walsh (2005) 0.048 and 1, Svensson (2005) 1, Giannoni and Woodford (2005) and Woodford (2003) 0.048, Adolfson et al. (2008) 0.5 and 1.1. Walsh (2002) reports on values between 0.25 and 1.

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[42] Baseline values are the values of the parameters which are commonly found in the literature and/or which we regularly use in our calibration unless stated otherwise.

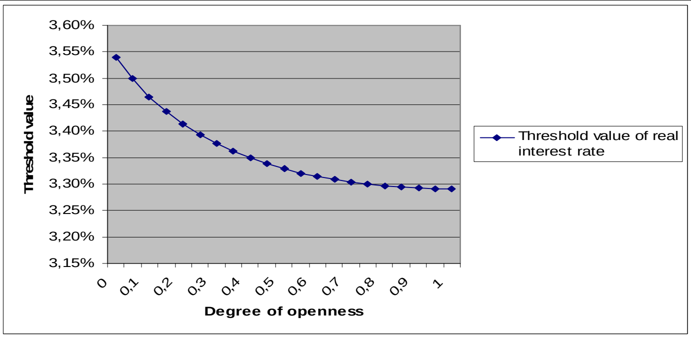
[43] See Clarida et al. (2002) and Galí and Monacelli (2005).

[44] Anderson and van Wincoop (2004) report in their survey that the elasticity of substitution is likely to be in the range of 5 to 10, Broda and Weinstein´s (2006) estimates for the largest sectors are between 2 and 10.

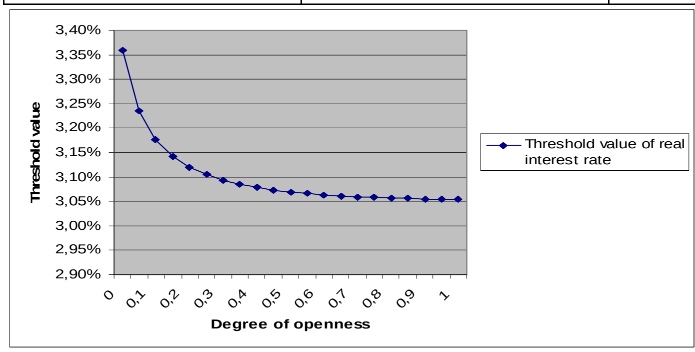
Regarding δ, Rotemberg and Woodford (1998) use a value for α of 0.66 and Galí and Gertler (1999) choose their values between 0.7 and 0.9. For σ, authors usually assume values between 1 and 2, see Ravenna and Walsh (2006) with 1.5, Ravenna and Walsh (2008) choosing 2 and Galí and Monacelli (2005) and Walsh (2006) with 1. However, Rotemberg and Woodford (1998) and Woodford (2003) assume a relatively high value: 6.25. Concerning ϕ, Galí and Monacelli (2005) use the values 3 and 10 for the inverse of labor supply elasticity; a value of 0.8 is assumed in Walsh (2006) and Kuester et al. (2007).

We show for alternative parameter combinations the dependence of the threshold value on the degree of openness. For a wide range of values our result (see above) is robust. The only exception is a situation with a very low degree of price stickiness in the chosen parameter range (relatively large values of δ=0.15…0.17).

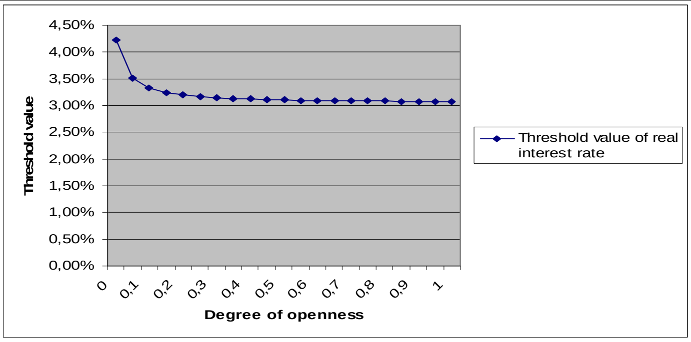
Parameter values (standard values for μ and ε and low values otherwise)			
β	0.99	ϕ	0.8
δ	0.052	η	2
ε	0.01	λ	0.05
σ	1	μ	0.02



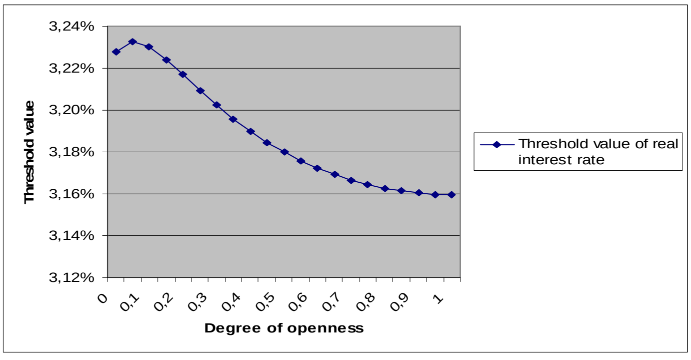
Parameter values (standard values)			
β	0.99	ϕ	1
δ	0.08583	η	5
ε	0.01	λ	0.25
σ	1.5	μ	0.02



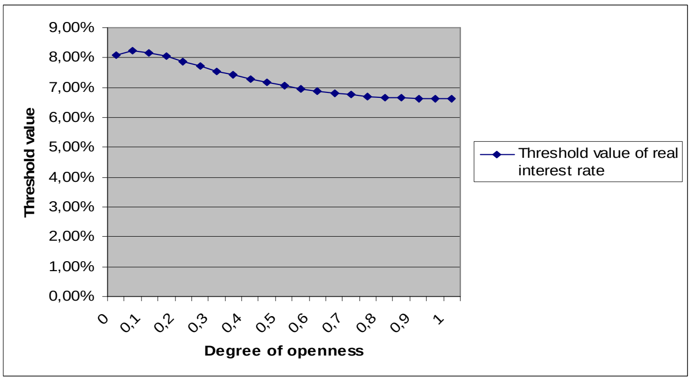
Parameter values (high values)			
β	0.99	ϕ	10
δ	0.17	η	10
ε	0.1	λ	1
σ	2	μ	0.1



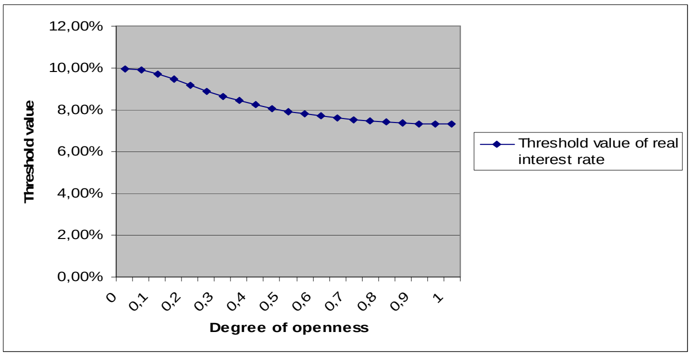
Parameter values (low values for λ, ϕ, η, standard values for μ and ε and high values otherwise)			
β	0.99	ϕ	0.8
δ	0.17	η	2
ε	0.01	λ	0.05
σ	2	μ	0.02



Parameter values (low values for λ, ϕ, η and high values otherwise)			
β	0.99	ϕ	0.8
δ	0.17	η	2
ε	0.1	λ	0.05
σ	2	μ	0.1

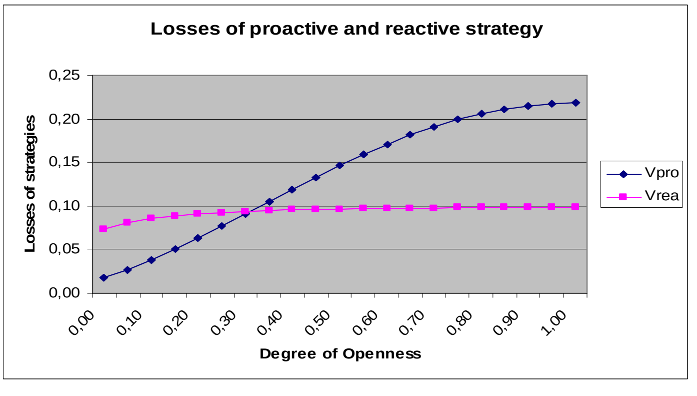


Parameter values (as before but with δ =0.14)			
β	0.99	ϕ	0.8
δ	0.14	η	2
ε	0.1	λ	0.05
σ	2	μ	0.1



Here we show a special example of a parameter value combination where the losses of the proactive strategy are smaller than those of the reactive strategy in a certain range of the degree of openness.

Parameter values			
β	0.99	ϕ	0.8
δ	0.052	η	2
ε	0.1	λ	0.05
σ	2	μ	0.1



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