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# A Literature Review with Application for the Eurozone

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**Abstract**

The question of whether central banks should bear responsibility for financial stability is still unanswered. Regarding interest rate implementation, it is thus not clear if and how the Taylor rule should be augmented by an additional financial stability term. This paper reviews the normative and positive literature on Taylor rules augmented with exchange rates, asset prices, credit, and spreads. These measures have developed as common indicators of financial (in)stability in the Taylor rule literature. In addition, our own analysis describes the development of these indicators for the core and the periphery of the Eurozone. Given the large degree of heterogeneity between euro area countries, the conclusion here is that an interest rate reaction to instability by the European Central Bank would be inappropriate in times of crisis. However, this conclusion is somewhat weakened if there is no crisis.

**JEL Classification:**
E52, F33, F42

**Keywords:**
Taylor rule, financial stability, sovereign debt crisis, Eurozone heterogeneity, exchange rates, asset prices, credit spreads

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# 1. Introduction

Concerns regarding financial (in)stability have gained importance from the start of the global financial crisis in 2007. Considering the role of monetary policy, it has not been determined whether central banks should be responsible for financial stability in addition to their usual objectives. This normative debate has been carried out intensively, but to date without an ultimate solution. Proponents argue that a financial stability objective would be a welcome supplement to a flexible inflation targeting framework. In particular, it is argued that central banks should actively use the interest rate to lean against the wind of financial imbalances (see, e.g., Woodford 2012). At the same time, other prominent researchers are more skeptical and attribute the preservation of financial stability primarily to regulatory instruments rather than interest rates (see, e.g., Svensson 2012). Despite the natural role that central banks might have in preserving financial stability for several reasons (see, e.g., Schinasi 2003), this task is complicated by the fact that financial stability is seen as a public good whose provision might generate a trade-off with the achievement of other public policy goals (Allen and Wood 2006). As a result, the legal basis for promoting financial stability should be as clear as possible to define the responsibility and to evaluate the performance of the central bank. In practice, even though there are some aspects that can be ascribed to financial stability considerations, those linkages are rather vague for most central banks and are also heterogeneous among them. Compared to the generally agreed objectives of price and output stability, financial stability is rarely seen as an explicit policy objective within their statutes (Oosterloo and de Haan 2004). However, this topic has recently gained importance in the debate on whether central banks still act within the scope of their mandates. It is sometimes argued that if financial stability serves as a precondition for monetary and macroeconomic stability, then no explicit formulation of such an objective would be required at all to act within statutory boundaries (Baxter 2013).

Consequently, this unresolved normative discussion then extends to the level of policy implementation. For two decades, interest rate setting has tended to be illustrated with policy rules based on the famous work of Taylor (1993). Taylor rules concerned with price and output stability are now widely acknowledged. However, in the light of recently increasing concerns for financial stability the question emerges if, and if yes, how central banks could pursue such a goal. As a part of the central banks actions, a large body of literature has

focused on the inclusion of various kinds of stability measures in the Taylor rule. This paper gives a structured and detailed review of these stability measures in the context of the Taylor rule.

This survey contributes to the existing literature on the Taylor rule in two important ways. To begin with, it is the first attempt to give a structured overview on the possible range of measures of financial stability employed in the Taylor rule. This is done in four subsections for exchange rates, asset prices, credit or leverage, and credit spreads. Because of the enormous amount of literature that has cumulated in this field, this survey is unavoidably selective to derive the main conclusions. We first review very basic and also some supplementary theoretical papers in each subsection. In addition, a review of selected empirical papers is provided. Second, we evaluate the stability measures in relation to the Eurozone and in the light of the ongoing sovereign debt crisis. It seems to be common for central banks to react to financial instability through interest rate cuts. Hence, we ask whether a special measure could have been a useful guide to the European Central Bank (ECB) during their recent interest rate setting. By looking at the empirical development in each subsection, our findings are time-dependent. There would have been little or no benefit for the ECB to be guided by those main measures of financial (in)stability in times of crisis as developments have been too heterogeneous among euro area countries. While many price-based stability indicators have shown pronounced boom-bust-tendencies in the Eurozone periphery, they have been rather stable until recently in the core, especially in Germany. This finding tends to support discretional monetary policy in times of crisis. However, this result is weakened in more stable times with only minor disruptions inside of the Eurozone. There is at least a great degree of homogeneity among stock price movements in Europe, thus supporting a rule-like preemptive reaction to this measure. This part of the paper shares some elements of the financial integration literature,[1] especially among the price-based investigations of stock prices and sovereign spreads. However, although it is also a common finding in this literature that financial integration is in general time-varying, it is not within the scope of this paper to answer explicitly the question of whether European financial markets have become more integrated or segmented in recent years.

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[1] See, e.g., Baele et al. (2004) and ECB (2013) as very basic works in this strand considering a broad spectrum of financial submarkets.

The paper is structured as follows: Section 2 reviews the main arguments in the normative debate concerning whether central banks should bear responsibility for financial stability. It also gives a very brief description of the Taylor rule to explain its functioning in the light of financial stability considerations. Section 3 then reviews the scientific literature on Taylor rule extensions incorporating financial stability concerns among the described subsections and evaluates these measures in the light of their practicability for the Eurozone. Section 4 provides conclusions.

## 2. Monetary policy, financial stability, and the Taylor rule

Considerations about financial stability in monetary policy are not at all new. To begin with, there is broad consensus that no common agreed definition of financial (in)stability exists. This can be interpreted as a mirror image of the wide range of central bank responsibilities with respect to financial stability, again resulting from the uncertainty in the normative debate on whether this should be an explicit central bank objective. Nevertheless, it is at least necessary to define what is meant by this term in the scope of this paper.[2] We follow the definition given by Allen and Wood (2006) as their proposal seems very appealing for our purposes. They define financial instability as episodes in which many entities suffer from a financial crisis which is not due to their responsibility. This crisis is not necessarily financial in its origin. What is more, the crisis has to have adverse macroeconomic effects. Financial stability is then given when a crisis is improbable. The definition might be criticized as being too broad, but it is precisely this feature that makes it attractive, because it works without being overly specific about the causes of instability. Financial instability *is* multifaceted and thus elusive. Against this background, the measures addressed in the remainder of this work (as well as their possible modifications) have developed as the most tangible stability indicator subset. Because of the broad spectrum of financial submarkets they cover, they *need* a flexible working definition of financial stability.

The role of financial stability considerations in monetary policy can be roughly divided in two separate views: The first view, which is often labeled the conventional or reactive view, is represented for example by Bernanke (2002) and Posen (2006). According to this view, the best a central bank can do is to focus on price stability and output stability. In this way, they

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[2] Another thorough discussion on the range of possible definitions is provided by Issing (2003), who claims that the chosen definition also predetermines the actions the central bank is allowed to take.

already react to 'all relevant information'. Crisis prevention is a task for regulatory instruments rather than the interest rate. If financial imbalances occur nevertheless, the central bank is asked to clean up afterwards. The second and opposing view, the alternative or proactive view, is represented for example by Borio and White (2004), Roubini (2006), and Woodford (2012). Authors favoring this view question that all relevant information is already included in the forecasts of inflation and output.[3] Furthermore, they regard price stability as a necessary but not sufficient condition for financial stability. While stable prices in the last years did not prevent financial instability from occurring, it is hard to imagine a stable and well-functioning financial system without price stability.[4] Hence, central banks should actively lean against financial instability.

What is especially interesting about this debate is that authors representing both views employ almost the same arguments – albeit from different sides and with varying emphasis. According to the aforementioned authors, which view one prefers depends, as almost always in economics, on underlying assumptions. The arguments most frequently used are as follows:[5] The first concern is the identification of financial imbalances. Proponents of the conventional view argue that it is not possible to detect a bubble with certainty, and hence there should be no leaning against the wind. The advocates of the alternative view, however, emphasize that it is not at all necessary to know whether there is indeed a bubble. According to them, it suffices to know roughly if there is a buildup of imbalances that could be addressed by monetary policy. In addition, it would be no more complicated to identify financial imbalances than to estimate the output gap correctly. The second common argument relates to the influence of the central bank on financial instability. From the conventional viewpoint, it is often argued that the interest rate would be too blunt an instrument to address specific imbalances, which means that it is questionable whether the interest rate can have any influence at all on specific parts of the financial markets. The opposing view is that an economy-wide rise in the costs of external finance would be adequate to avoid further growth of instability, without addressing isolated market segments. The third argument,

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[3] Forecasting relations of different measures for inflation and output are unstable (see, e.g., Stock and Watson 2003). Assenmacher-Wesche and Gerlach (2010) interpret this as evidence against the proactive view. However, this is not necessarily the case as considerations of financial stability are more than just worrying about inflation and output. Hence, their attempt to forecast 'adverse macroeconomic conditions', defined as strong deviations in output and inflation does not solve this problem.

[4] See also Issing (2003) for an evaluation of this debate.

[5] This assessment is clearly subjective. More detailed overviews with additional arguments for each side are given by Agénor and Pereira da Silva (2012) and White (2009).

which is closely connected to the second one, is about the costs and benefits of monetary intervention. The argument against a monetary reaction is that often the rise in the interest rate needs to be quite high in order to have an influence on financial markets, which could in turn generate high fluctuations in inflation and output.[6] The proactive counter-argument instead emphasizes on the one hand that not every interest rate rise has to be followed by an economic recession, while on the other hand refraining from a monetary policy reaction would produce even higher costs further down the road, even in terms of inflation and output. As a consequence of these arguments, authors from both sides have different preferences regarding the use of monetary policy to deal with financial (in)stability.

Authors such as Issing (2011), White (2009) and Woodford (2012) argue that the pre-crisis consensus, dominated by the conventional or reactive view, seems to be eroded. Since the U.S. subprime crisis and the European sovereign debt crisis, the proactive view of monetary policy and financial stability has gained many proponents. Thus, it seems clear to many authors that if central banks care about financial stability more than already mirrored in output and inflation, then simple policy rules might no longer suffice.

The starting point for the relation between monetary policy and financial stability is the famous policy rule of Taylor (1993). According to his rule, the central bank sets the interest rate $i_t$ depending on the equilibrium real interest rate $\bar{r}$ and the inflation rate $\pi_t$. In addition, the bank considers the distance of the inflation rate from the desired inflation target $\pi^*$ and actual output $y_t$ from target $y^*$.[7] This is represented by equation (1), where $\alpha$ and $\beta$ are the respective weights:

$$i_t = \bar{r} + \pi_t + \alpha(\pi_t - \pi^*) + \beta(y_t - y^*) \tag{1}$$

Assigning weights of 0.5 to the inflation and output gap as well as an inflation target of 2 %, Taylor shows that his rule fits the behavior of the Federal Reserve from 1987 to 1992 reasonably well. However, as Clarida et al. (1998), among others, point out, it is the real interest

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[6] Among others, Assenmacher-Wesche and Gerlach (2010) show in the latter part of their paper that monetary policy can influence asset prices, but this influence is small relative to the movements triggered in inflation and output. Hence, they are skeptical about using the interest rate to lean against financial imbalances.

[7] Strictly speaking, Taylor uses the lagged inflation rate over the previous four quarters. Being aware of the fact that this is a simplification, we consider a Taylor rule depending on the current rate of inflation as well as the current output gap. As we undertake no empirical or theoretical exercises of our own, this seems to be justified.

rate that matters in economic decisions, and the central bank can influence this rate in the presence of nominal wage and/or price rigidities. The real interest rate is given by:

$$r_t = i_t - \pi_t = \bar{r} + \alpha(\pi_t - \pi^*) + \beta(y_t - y^*) \tag{2}$$

As Taylor notes, the policy implications are as follows: If $\pi_t > \pi^*$ or $y_t > y^*$ (or both), then $r_t > \bar{r}$.[8] In this case, the central bank should raise the nominal interest rate to slow the economy. Of course, this mechanism also works the other way round. However, Taylor also remarks that this rule need not be followed mechanically in practice.

This rule has been the subject of debate for two decades, but it is beyond the scope of this paper to mention all possible directions of thought.[9] Concerning this paper, one relevant question is whether the Taylor rule has any normative meaning as the original weights $\alpha$ and $\beta$ were chosen arbitrarily by Taylor (1993). However, Rotemberg and Woodford (1997) show that central banks' loss functions can be micro-founded to derive the optimal reaction of monetary policy. Thus, weights are no longer chosen arbitrarily but depend on the households' preferences, the production technology and the degree of price rigidity to maximize welfare. Hence, although financial stability is not a consideration in their micro-foundation, the Taylor rule may in general be used in the normative debate on whether central banks should respond to financial instability.

Nevertheless, many papers are concerned with some *implicit* stability issues (see, e.g., Clarida et al. 2000). The first issue (which is not connected to *financial* stability) relates to the strength of the monetary reaction to inflation. To stabilize the economy, the real interest rate must be raised more than the inflation rate, implying $\alpha > 0$. This is known as the 'Taylor Principle'. The second stability issue is instead already quite close to financial stability considerations. It is about the smoothing of interest rates, which means that the central bank is concerned with the speed of interest rate adjustments. Policymakers are aware of the fact that abrupt interest rate changes might put the stability of the financial markets at risk, and hence set the rate as a weighted sum of the actual Taylor rule rate and the lagged interest rate.

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[8] For the ease of explanation, we abstract from shocks which lead inflation and output in different directions.
[9] A recent attempt to give a brief review about the most relevant discussion points regarding the Taylor rule in the practice of central banking is the work of Kahn (2012). A discussion of the advantages and disadvantages of the Taylor rule is given e.g. by Kohn (2007).

However, these considerations are not the point of this paper. Rather, the issue here is about *explicit* financial stability considerations in the Taylor rule. Formally speaking, one can augment equation (1) with a term related to some measure of financial stability, which is given by $x$. Here, $x_t$ is the actual value of this measure, whereas $x^*$ is the respective 'target' value. The weight of this term in the Taylor rule is given by $\gamma$. Hence, the augmented Taylor rule is:

$$i_t = \bar{r} + \pi_t + \alpha(\pi_t - \pi^*) + \beta(y_t - y^*) + \gamma(x_t - x^*) \tag{3}$$

However, how exactly this extension of the rule should look like remains an open question. Hence, although there are now numerous papers that present augmented Taylor rules, it remains unclear which of those measures would be best to safeguard financial stability. As a consequence, several recent papers employ financial stability indices that comprise a wide range of indicators (see, e.g., Albulescu et al. 2013, Baxa et al. 2013 or Castro 2011). On the one hand, these papers are appealing because they allow reactions to a wide range of financial imbalances and are thus more realistic. On the other hand, they greatly complicate policy communication and anticipation. Regarding this paper, they also come at the cost of complicating classification.[10] Furthermore, it is not at all a trivial matter to define a target or equilibrium value for the chosen measure. Formally speaking, what would be the best value for $x^*$? If these problems could be solved, which weight $\gamma$ should be assigned to the stability measure by the central bank? And finally, might $\gamma$ be time-varying at different stages of a crisis, implying a regime-switching, non-linear reaction by the central bank? These are some of the questions guiding the papers presented in the main part of this work, whose main contribution will be to structure the literature, and then try to assess the challenges faced by the common monetary policy in the Eurozone in the light of these measures. If the ECB decided to react to financial (in)stability via the interest rate, what measure would probably do best? We shed some light on all of these questions below.

## 3. Taylor rule extensions

This section constitutes the main part of the paper. Here, the four main directions of Taylor rule extensions with financial stability considerations are reviewed. The topics are ordered

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[10] Clearly, this also applies to some of the non-index-papers reviewed in this work. These papers consider more than one indicator in their research and are thus assigned to the subsection that fits best. To conserve space, we do not explicitly point to this in the affected parts in the remainder of the paper.

chronologically according to their appearance in the scientific literature. We start with exchange rates in section 3.1 as this was the topic of one of the earliest discussions concerning extensions of the Taylor rule. Closely connected, and probably the most intensively discussed of all the measures, are Taylor rules with asset prices, which are examined in section 3.2. In section 3.3, the focus is on credit and leverage, whose exaggerations tend to be closely connected to asset price bubbles. Both latter subsections have gained renewed interest since the U.S. subprime crisis. The last section is 3.4, which addresses the role of credit spreads in the rule. This is especially interesting in the light of the current European sovereign debt crisis as elevated spreads might have been one of the reasons for the ECB to cut interest rates recently.[11]

## 3.1 Taylor rules with exchange rates

The interplay between monetary policy and the exchange rate is extensively laid out by Ho and McCauley (2003) for example. First, there is an impact on inflation. The exchange rate determines the price of imported goods as well as inflation expectations. Second, the competitiveness of domestic firms abroad is influenced by the exchange rate. An appreciation in the domestic currency makes foreign products cheaper and domestic products more expensive. Consequently, the demand for domestic products should fall (and vice versa). But it is clear that these two impacts are only linked to the usual arguments of the Taylor rule, inflation and output, and not financial stability. On the one hand, capital flows induced by the exchange rate can trigger credit and asset price bubbles in the inflowing country, which in turn generates the danger of a subsequent collapse (this highlights the connection to subsections 3.2 and 3.3). On the other hand, if firms' or banks' liabilities are sufficiently 'dollarized' (i.e., their liabilities are to a large extent denominated in a foreign currency) and not evenly matched with their foreign exchange assets, then exchange rate depreciations can increase the burden of outstanding debt and eventually force those firms into bankruptcy. Both arguments are able to produce significant financial instability. Based upon these argu-

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[11] This outline does not account for monetary aggregates for several reasons: First, it is generally agreed among most authors that money has lost some of its meaning in monetary policy (see, e.g., Borio and Lowe 2004; Adrian and Shin 2008). Second, and even more important, there is no literature strand that explicitly considers the role of monetary aggregates for financial stability. Third, if monetary aggregates are expected to have some meaning for financial stability, then this is implemented via bank balance sheets, where monetary aggregates on the liabilities side mirror credit on the asset side (Kim et al. 2013). As outlined by Woodford (2008), it seems more appropriate to account for the initiator of instability directly, which is credit. This conclusion is supported by Schularick and Taylor (2012) and the Deutsche Bundesbank (2013), who show that money and credit are not always closely related, especially not in financial crises.

ments, Ho and McCauley (2003) conclude that emerging markets are most affected by such fears as they are usually heavily dependent on exchange rate movements. Their conclusion is also supported, among others, by Mohanty and Klau (2004) and Aizenman et al. (2011). According to this broad consensus, most of the studies below focus on emerging markets, which in turn implies a limited applicability for the euro area. Thus, it seems reasonable to keep this part of the review as short as possible.

Among the basic theoretical papers that consider the role of the exchange rate in the Taylor rule are Ball (1999), Svensson (2000), and Batini et al. (2003). The main finding of these three papers is that a Taylor rule reaction to the exchange rate seems advantageous for the central bank. Nevertheless, Ball (1999) and Batini et al. (2003) highlight that the weight given to the exchange rate should be considerably smaller than the weights of inflation and output. Moreover, all three papers reach their conclusions with respect to rather conventional loss functions, which are not extended with the exchange rate itself.

This basic normative work is supplemented by several authors. Among them is Adolfson (2007). Applying basic as well as exchange rate adjusted Taylor rules with common coefficient settings, she shows that exchange rate inclusion yields slight improvements compared to basic rules in an inflation/output-oriented central bank. The advantages rise as pass-through from exchange rates to prices increases because the impact of the exchange rate change is then transmitted more quickly to prices. Another interesting extension of the basic papers is that of Leitemo and Söderström (2005), who focus on uncertainty regarding the degree of exchange rate pass-through, the persistence of the foreign exchange risk premium, adaptive exchange rate expectations, and the real exchange rate level. They detect that including the exchange rate under the baseline as well as under the uncertainty scenarios improves welfare, but only to a small extent.[12] Wollmershäuser (2006) also considers exchange rate uncertainty but, as probably the most important difference, to a larger degree and finds a more pronounced role for an active exchange rate management. All in all, as pointed out by Leitemo and Söderström (2005) and Taylor (2001), a common result in the

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[12] Leitemo and Söderström (2005) obtain the same result as Adolfson (2007) two years later, as both emphasize the growing advantage of exchange-rate-adjusted Taylor rules with rising degrees of pass-through. However, Adolfson also highlights that the inclusion of the exchange rate yields no improvement at all in an optimized model setting.

normative literature seems to be that including the exchange rate in the Taylor rule yields only very slight improvements.[13]

Clearly, all of these theoretical papers, including their conclusions and explanations,[14] also point to an important drawback concerning this paper: They incorporate only very few, if any, explicit considerations of financial stability. A notable exception is the work of Morón and Winkelried (2005). They focus on heavily liability-dollarized economies, which they classify as vulnerable, and their innovation is the dependence of the entrepreneurs' risk premium on the degree of liability dollarization. According to this, vulnerable countries suffer more from depreciation than they benefit from it. The authors employ six different policy rules to minimize a standard loss function concerned with inflation and output variances. The model shows that Taylor rules augmented by the exchange rate are able to increase welfare. Moreover, the positive effect of the variance reduction is larger in vulnerable economies.

Let us now consider the empirical evidence, which is also reviewed by Aizenman et al. (2011). An early indication for active exchange rate stabilization is given by the work of Calvo and Reinhart (2002).[15] Their well-known 'fear of floating' hypothesis reveals a divergence between the words and actions of central banks. As unusually low exchange rate volatilities among pretending floaters go along with high volatilities in reserves and interest rates, the authors conclude that there is active exchange rate management in a number of countries, especially in developing ones. Their findings are supported by Mohanty and Klau (2004), whose own empirical investigation of 13 emerging markets shows a negative correlation between interest rates and exchange rates, and a strong reaction to exchange rates in augmented Taylor rules. A more recent paper is that of Aizenman et al. (2011). Their Taylor rule regression tests data for 16 emerging markets from 1989 to 2006 and confirms significant reactions by the central banks to the exchange rate. This feature is particularly strong in non-inflation targeting countries as well as in commodity exporting countries. Regarding the

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[13] Further interesting normative work supporting this conclusion is given by Cecchetti et al. (2000) and Garcia et al. (2011) for example.

[14] See, e.g., Taylor (2001).

[15] Of course, there have already been earlier attempts to estimate the reaction of interest rates to exchange rates; for example, Clarida et al. (1998) claim that the Bundesbank and the Bank of Japan reacted to the exchange rate, but only to a small extent.

strength of the response, it is always smaller than the reaction to inflation, albeit this dominance is not very pronounced in non-inflation targeting countries.

So, what is the consensus? As mentioned above, the normative literature mostly suggests small reactions of the interest rate to the exchange rate. This finding seems to be supported by the positive literature, as this usually states significant, but rather small responses. Hence, let us now turn to the Eurozone and reflect on what these findings imply for the common monetary policy of the ECB. The literature reviewed above can be interpreted as a first hint that an exchange rate objective for the ECB would be inappropriate as the Eurozone as a whole is all but a small and emerging economy (see also Gaspar and Issing 2002). We try to back this interpretation with some empirical evidence on European banking dollarization as this is one important exchange rate aspect connected to financial (in)stability. The existing literature on dollarization is also primarily concerned with emerging economies and is thus not fully applicable to an analysis of developed euro area countries. Our own research starts with figure 1, which shows the external liabilities to creditors from outside the euro area for euro area banks, normalized to 100 at the end of January in 1999 to make them comparable across countries.[16] To keep the graphical analysis manageable, we focus on the periphery of the euro area and show only the indices of Greece, Ireland, Italy, Portugal, and Spain compared to the most important core countries, France and Germany. This picture shows some remarkable heterogeneity across euro area countries, with external liabilities rising most impressively in Ireland and Greece.[17]

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[16] From the literature on banking dollarization, it is clear that asset dollarization also matters to banks. A transfer of dollarized liabilities into dollarized assets hedges the bank itself against currency risk but leaves it vulnerable to the credit risk of their debtor, who is now exposed to the currency risk (see, e.g., Arteta 2003, De Nicoló et al. 2005, or Levy Yeyati 2006). Nevertheless, in what follows the focus is on liability dollarization.

[17] The data for Greece show a very abrupt rise from May to June 2010. We cannot explain this shift, but it does not alter the interpretation of euro area heterogeneity.
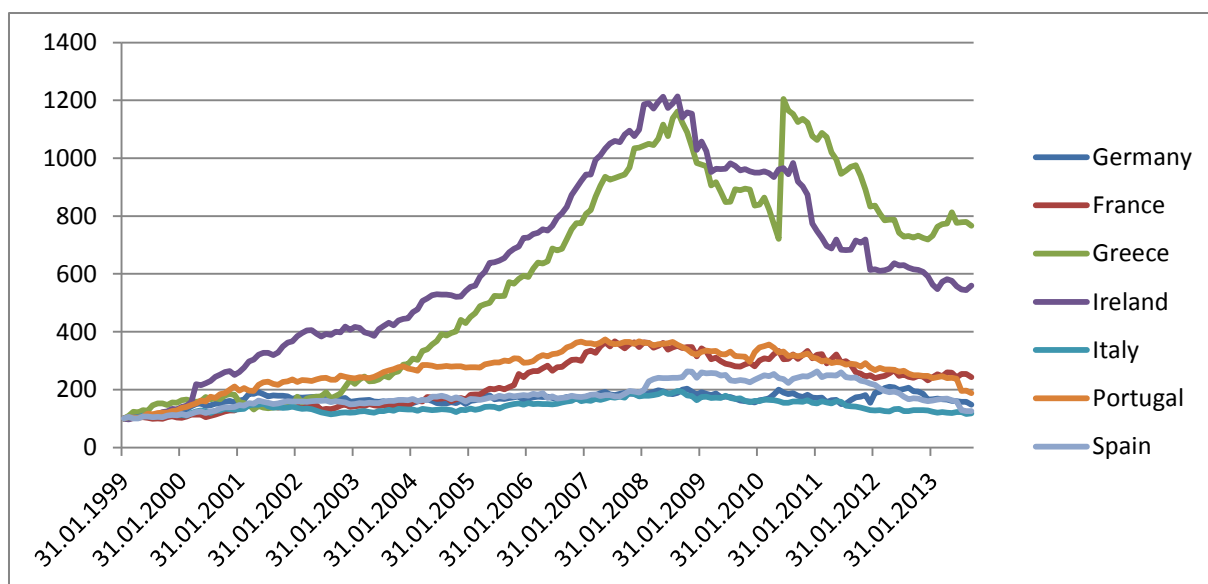
*Figure 1: External liabilities of the national banking sector*
*Source: ECB, own calculations*
*Note: Monthly data normalized to 100 at end of January 1999*

We also computed the relation of external liabilities to the balance sheet total. This share resembles the common working definitions of dollarization in the literature, but it is not equal to them for two reasons. First, as will be shown soon, external liabilities are not necessarily dollarized. Second, a large part of the literature uses the share of dollarized deposits to total deposits (see, e.g., Arteta 2003, De Nicoló et al. 2005, or Levy Yeyati 2006). However, for ease of explanation and to circumvent classification problems, we rely on the balance sheet total in the denominator. From figure 2, one can see that external liabilities range between 5% and 20% of the balance sheet for most of the countries for most of the time. A remarkable exception is Ireland, with a share of external liabilities being mostly larger than 35%. The conclusion is again that heterogeneity matters.
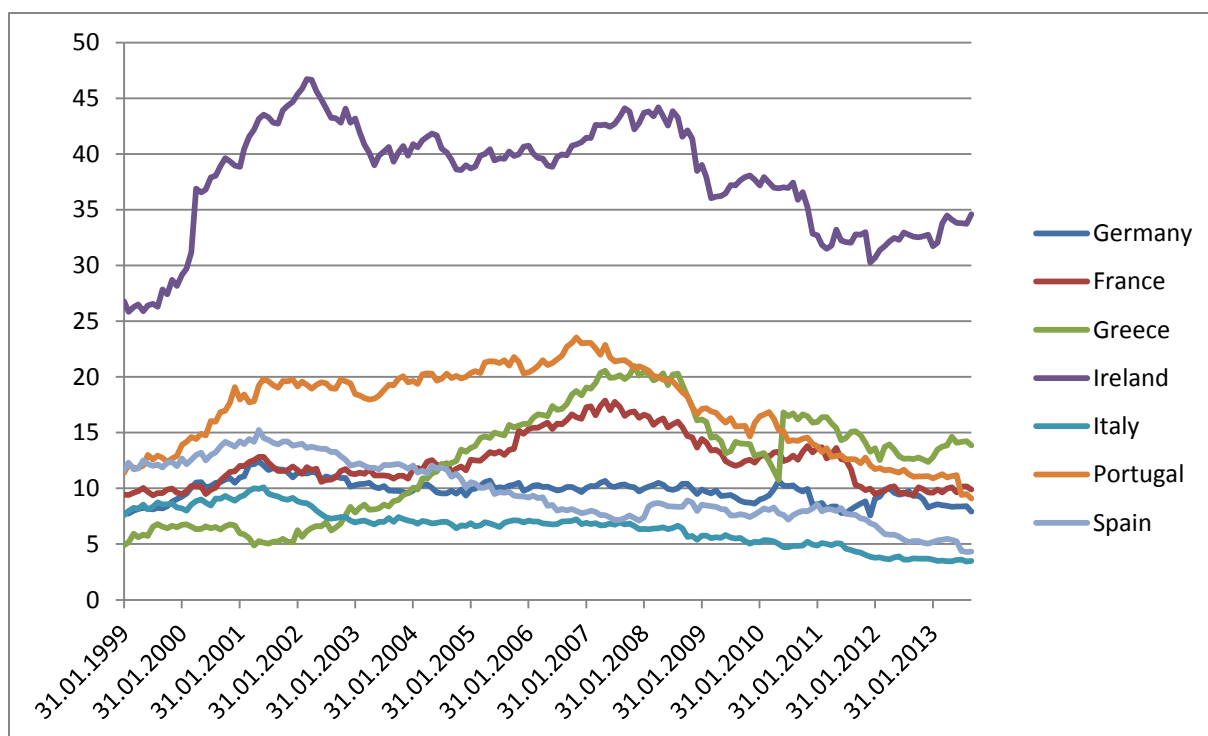
*Figure 2: Ratio of banks' external liabilities to balance sheet total (in percent)*
*Source: ECB, own calculations*

Finally, the ECB also offers data on the currency composition of deposit liabilities by European banks. This allows us to draw some conclusions on the importance of foreign currency for those institutions. The results are given in table 1, in which the bandwidth of currency compositions is laid out from the beginning of 1999 until the middle of 2013. First, the euro is by far the most important currency in banking liabilities to other banks as well as to non-banks inside the euro area. Second, deposit liabilities from creditors outside the euro area are also to a considerable degree denominated in euro, although to a lesser extent. All in all, table 1 highlights the importance of the euro, especially in internal liabilities, but also in external liabilities. Unsurprisingly, the leading role among the other currencies is held by the U.S. dollar, which accounts for approximately two thirds of their share (results not shown here).

| To euro area banks | | To euro area non-banks | | To non-euro area banks | | To non-euro area non-banks | |
|---|---|---|---|---|---|---|---|
| Euro | Other currencies | Euro | Other currencies | Euro | Other currencies | Euro | Other currencies |
| 86.87 to 93.76 | 6.24 to 13.13 | 96.10 to 97.31 | 2.69 to 3.90 | 36.53 to 60.98 | 39.02 to 63.47 | 41.73 to 59.05 | 40.95 to 58.27 |

*Table 1: Currency compositions of euro area banking liabilities*
*Source: ECB*
*Note: Bandwidth of quarterly data from Q1/1999 to Q2/2013 in percent*

Taken together, if external liabilities are only of minor importance to euro area banks, if those liabilities evolve heterogeneously among them, and if the euro is by far the most important currency in their total liabilities, then this implies that an exchange rate objective for the ECB would be not justified to ensure financial stability.

## 3.2 Taylor rules with asset prices

The most intensively discussed subpart of the augmented Taylor rule literature relates to asset prices, which are usually grouped into stock and house prices. Much of the discussion concerning whether central banks should take responsibility for financial stability in general is put on the same level as the question of whether they should consider asset prices.[18] However, we do not intend here to evaluate whether this simplification is correct. Before reviewing some of the important theoretical and empirical papers regarding monetary policy and asset prices, it seems helpful to state what meaning the latter have for the former. First of all, asset prices may have an impact on inflation and output. These relations are outlined and evaluated in much greater detail by Gilchrist and Leahy (2002) for example. In short, a hike in asset prices increases the wealth of households and this in turn allows them to consume more. Regarding the firm side and the Tobin's Q ratio, higher stock prices indicate more profitable investment opportunities. In addition, a rise in the value of their assets increases the value they can pledge as collateral, in line with the 'financial accelerator' literature (see, e.g., Bernanke et al. 1999). Hence, their access to external financing improves, which again enhances investment and spending opportunities. As a result, rising asset prices can be an indicator of future inflationary pressures, even if asset prices are not considered to be part of the inflation measure itself. Adding to those ideas, Caruana (2005) points out that strongly rising asset prices can endanger financial stability, even without threatening price or output stability in the first instance, as they have the potential to form fundamentally unjustified bubbles that can burst further down the road. This could in turn result in a serious economic slowdown. And if these asset hikes are financed by excessive credit growth, they are even more dangerous.[19]

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[18] In contrast to empirical research, the theoretical discussion does not always distinguish between asset prices in general and stocks or housing in particular. Disaggregating assets into its components does not seem to be necessary for this debate.

[19] This highlights the well pronounced interplay between financial stability, asset prices and credit aggregates (see, e.g., Agénor and Pereira da Silva 2012, Borio and Lowe 2004, Detken and Smets 2004, and Goodhart and Hofmann 2008). However, credit aggregates are discussed in subsection 3.3.

The normative dispute concerning asset prices, monetary policy and financial stability looks very much like a battle over two rounds between Bernanke and Gertler (1999, 2001) and Cecchetti et al. (2000, 2002). The well-known work of Bernanke and Gertler (1999) starts the debate. Based upon the financial accelerator approach of Bernanke et al. (1999), they regard asset prices as a financial friction. Bernanke and Gertler (1999) test the performance of different policy rules in this setting. More concretely, they compare pure inflation targeting policy rules (i.e., the central bank does not react to output in addition to inflation) with versions also including stock prices. Following the simulation of several shocks to this setting, they find that an aggressive pure inflation targeting strategy without any further reaction to stock prices performs best as measured by the impact on the variances in inflation and the output gap. Hence, there should be no further reaction to asset prices than is already included in the inflation measure. However, they are soon answered by the equally important work of Cecchetti et al. (2000). They claim that it is strongly advisable for central banks to react to asset prices in addition to inflation and output, although they emphasize that central banks should not target them. To show this, they extend the work of Bernanke and Gertler (1999) along several dimensions. Most important are the inclusion of an output gap measure in the policy rule, an explicit inflation/output objective function for the central bank that can be minimized to estimate optimal reaction coefficients, and some degree of interest rate smoothing. With those modified assumptions, the results of Cecchetti et al. (2000) challenge those of Bernanke and Gertler (1999) as they show significant advantages from reacting to stock prices in addition to output and inflation. As mentioned, this is not the end of the story. Bernanke and Gertler (2001) respond to the work of Cecchetti et al. (2000) by pointing out that the latter authors rely solely on one special shock scenario, which is an exact five-period bubble, and ignore other possible shock properties. Hence, Bernanke and Gertler (2001) now consider random draws of the shocks as well as a reaction to the output gap. However, they still do not optimize coefficients and find that adding a small response to stock prices may help somewhat in reducing output variance while at the same time increasing inflation variability. They ascribe this result to a temporary adjustment of the real interest rate, which in turn is something to which monetary policy should always respond, not only in the face of stock market volatility. Finally, Cecchetti et al. (2002) review the debate and reiterate that they never claimed to target asset prices. Admittedly, they acknowledge that the results depend on the assumptions concerning the underlying shocks. Thus, the

authors still believe that reacting to asset prices might be useful, but the reaction should not be mechanical. What is most interesting is that they claim that both positions do not differ that much, which points to a merely semantic problem. As both views recommend the inclusion of asset price information in different ways, the issue of how much 'relevant information' can be detected and how much of this is already included in the inflation and output measure remains unsolved.

Both the proactive and reactive views receive support from several other papers. From these, one can also derive implications regarding the appropriateness of rule-like responses to financial imbalances. Building upon earlier bubble modeling approaches, Gruen et al. (2005) compare the reactions of proactive and reactive central bankers in different setups of their model (e.g., differing probabilities of the bubble collapsing or endogenous bubble growth). Their result is that reacting strongly to asset bubbles is in general advantageous for small bubbles, but this advantage becomes questionable as the bubble grows and the costs of a burst increase. Unfortunately, in the early stage, uncertainty concerning the existence of a bubble is especially high. All in all, they emphasize that the optimal response to asset bubbles depends on the characteristics of the bubble process and the perceptions of the central bank, so there is no unique rule for response. The adequacy of policy rules is even more thoroughly considered in Bordo and Jeanne (2002). In their setting, monetary policy is able to influence borrowing by setting the interest rate. Small asset bubbles will presumably not trigger credit crunches, whereas very large asset bubbles would require the central bank to tighten interest rates too much to avoid them, which would itself induce a credit crunch. Thus, the bottom line of their two-period model is that monetary policy should act in a non-linear fashion only in intermediate cases, implying that Taylor rule-like behavior is not appropriate. However, there are also normative papers that do not ascribe a separate role to asset prices in the conduct of monetary policy. Gilchrist and Leahy (2002) build upon and extend the work of Bernanke and Gertler (1999). They employ shocks to expectations and net worth in a real business cycle model, a New Keynesian sticky price model and a financial accelerator model. They also find that a strong inflation targeting strategy in general keeps the economy close to the desired path.

Following the normative work, it is now time to see what the empirical results add to the understanding of this subsection. A starting point is again the work of Bernanke and Gertler

(1999). The regressions in the latter part of their paper estimate reaction functions for the U.S. Federal Reserve (Fed) and the Bank of Japan (BOJ) from 1979 on. They conclude that the Fed reacted largely in line with their recommendations, putting strong emphasis on inflation and also paying some attention to the output gap, but making no considerable effort on stock returns as the resulting coefficient is small, insignificant, and has the wrong sign. The results for Japan are more mixed as they indicate significant reactions to stock returns, although with different signs for the two subsamples. Whereas the results support stabilization thoughts in the latter period, they seem counterintuitive for the earlier period. At least, this points to further objectives for monetary policy besides inflation and output. Opposing evidence for the U.S. is presented by Cecchetti (2003). He first counts stock market key words in the Federal Reserve's Open Market Committee minutes and transcripts, and shows that the use of those key words increased considerably in boom times. Building upon this, his regression indicates that the Fed responded significantly and in a stabilizing manner to the excess equity risk premium (i.e., the deviation of the risk premium from its long-run trend), which serves as a measure for asset price misalignments for the period 1990–2003. Comparable results are also reported for Germany and Japan. Further support comes from Chadha et al. (2004), who show small but significant stabilizing reactions to stock prices for the Fed's and the Bank of England's (BOE) augmented Taylor rule for the period 1979–2000. In addition, they also find slight significant stabilizing behavior for the exchange rate for both countries as well as Japan. They interpret their results as a reaction to both factors from time to time when it is necessary to avoid large fluctuations, but not as a systematic targeting.[20] Concerning the Eurozone, as in all subsections, this exercise suffers from the relatively short time span with only one monetary policy for the whole euro area. However, a relatively recent contribution that overcomes the data problem is that of Botzen and Marey (2010). They use Eurozone data from 1999 to 2005 to show that the ECB considered stock prices in addition to output and inflation even before the recent financial crises. Adding a stock price measure improves overall regression fit and yields strongly significant results. Moreover, the coefficient is of considerable magnitude although it does not reach the importance of the inflation or output coefficients. All in all, Botzen and Marey (2010) interpret this as evidence

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[20] Further, more elaborate empirical research has been conducted, for example by Rigobon and Sack (2003) and Fuhrer and Tootell (2008) for the U.S. Both find significant reactions of monetary policy to asset market information and both, but especially the latter, emphasize that this is only to the extent the information impacts on inflation and output. They are supported by Siklos et al. (2004) for selected European central banks in the run-up to the Eurozone.

of an active stock market reaction and, what is even more important, as an indication of financial stability concerns for the ECB.

In addition to the time-invariant approaches above, the (quite vague) suggestion of a nonlinear reaction to asset prices given by Bordo and Jeanne (2002) and Gruen et al. (2005) is reflected in more recent empirical research. First of all, Baxa et al. (2013) use time-varying coefficients and find that some central banks reacted to a financial instability index only in times of stress. However, due to the limited identification of stress phases, this finding does not allow conclusions to be drawn on whether monetary policy reacts preemptively to asset price booms. The findings of Lee and Son (2013) are more differentiated with respect to this judgment. They highlight that their estimated time-varying stock price reaction coefficient for the Fed is positive from 1991 onwards, but rises strongly only at the very end of boom periods, suggesting reactions to the stock market in the bust rather than in the boom. Supporting evidence comes from Hoffmann (2013). Distinguishing between booms and busts via dummy variables in his regression, he finds that the Fed has reacted to stock prices only by lowering the interest rate in busts while not increasing it in booms. In contrast, the ECB has not reacted to stock prices. Thus, both latter papers contain an implicit affirmation of the reactive policy view from the empirical side, at least for the Fed.

To sum up, the only broad consensus in the literature is that asset prices should not be a target for monetary policy and rule-like reactions to them seem inappropriate.[21] Beyond this, theoretical work does not agree on what meaning asset prices should have for monetary policy. Notwithstanding these issues, the majority of empirical work exhibits some reaction of the interest rate to asset prices although there is some debate on whether this reaction is really in addition to inflation and output deliberations. Unfortunately, this is the question that matters if one wishes to decide whether the central banks show some responsibility for financial market stabilization.

What does this imply for the Eurozone in the light of the market turmoil during the last years? As mentioned in the introduction, the evaluation of stock market measures across countries is a common research topic in the financial integration literature, which has gained particular prominence in the light of the European monetary unification. The general finding

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[21] See also ECB (2005) for this conclusion in addition to the above-cited references.

of time-varying financial integration is confirmed for the stock market by Mylonidis and Kollias (2010) and the ECB (2013), amongst others.

However, explicit financial integration judgments are not intended here; hence, we do not elaborate on this question and limit the analysis to descriptive patterns. To proxy for national stock prices, we use the respective general stock indices.[22] Figure 3 plots these for selected European countries from January 1, 1999 to September 30, 2013, on a daily basis. The data are taken from Thomson Reuters Datastream for the same range of countries as in the former subsection. Indices are normalized to 100 as of the beginning of 1999. Several interesting features stand out. After rising somewhat unevenly after the introduction of the euro, all indices show a striking co-movement from the middle of 2000 onwards; rising and falling together even through the subprime crisis. From this, we conclude that a rule-like reaction to stock prices might be advisable in times without significant market stress. This feature holds until 2009. From then on, no clear-cut picture emerges. While the German index heads towards all-time highs, the indices of France and Spain hover around their baseline value from January 1999. In contrast, the remaining peripheral countries experienced no sustainable recovery after the subprime crisis. Only the Irish index has recently seemed to be able to close the gap to France and Spain.

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[22] This subpart of the paper is very similar to the work of the ECB (2013). Certainly, the analysis conducted here is somewhat more detailed as it does not operate with min–max ranges but uses concrete countries.
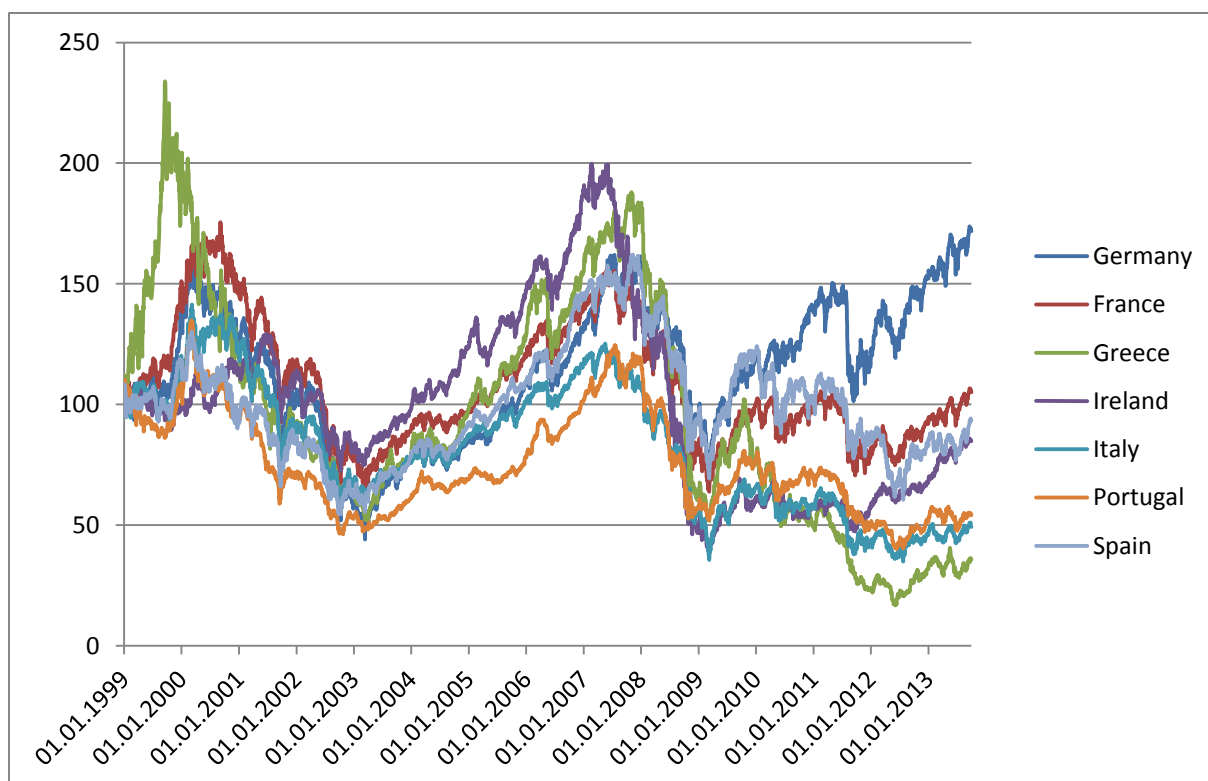
*Figure 3: National stock indices*
*Source: Thomson Reuters Datastream, own calculations*
*Note: Daily closing prices of major national stock indices normalized to 100 at January 1, 1999. Indices are DAX 30 (Germany), CAC 40 (France), Athex Composite (Greece), ISEQ 20 (Ireland), FTSE MIB (Italy), PSI 20 (Portugal), IBEX 35 (Spain)*

A similar picture emerges if one looks at house price developments. Although there is some convergence of housing markets in Europe, structural heterogeneity is still a very important issue, making the transmission of monetary policy unequal across countries (see, e.g., Calza et al. 2013 and ECB 2009). As a consequence, house price booms are primarily seen as a national phenomenon, which leads to the conclusion that the common monetary policy in the Eurozone is not very well suited to combat them (ECB 2009, Goodhart and Hofmann 2008).

We support this conclusion using recent house price index data compiled by Eurostat on a quarterly basis from 2005 onward. Our research thus extends the work of the ECB (2009), which considers average price developments from 1999 to 2007. The data are normalized by Eurostat to 100 at 2010. Alas, individual time series have different start and end points, which reduces the explanatory power somewhat.[23] Nonetheless, several interesting conclu-

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[23] In general, heterogeneity of house price data across countries and over time is a shortcoming that is also observed by other authors (see, e.g., Goodhart and Hofmann 2008). The data in this analysis are taken from Eurostat, as they seem to be quite well suited for the purpose of this subsection.

sions can be drawn from figure 4.[24] Before 2010, house prices in most of the countries tend to move around a value of 100. Notable exceptions are Spain and Ireland, especially with the latter country experiencing a pronounced house price boom. This picture reverses at the beginning of the subprime crisis, with house prices falling in both countries. As the problems in the Eurozone became an increasing concern for the financial markets from 2010 on, a distinct heterogeneity can be observed in European house prices. Both listing between 70% and 80% of the reference value from 2010, Spain and Ireland suffer under remarkable house price corrections. Some declines can also be seen in Italy and Portugal, but the magnitude is smaller. Once again, developments in the core Eurozone are quite different. House prices in France are above the reference value but quite stable in the last two years, whereas house prices in Germany show signs of an incipient boom during the same period.
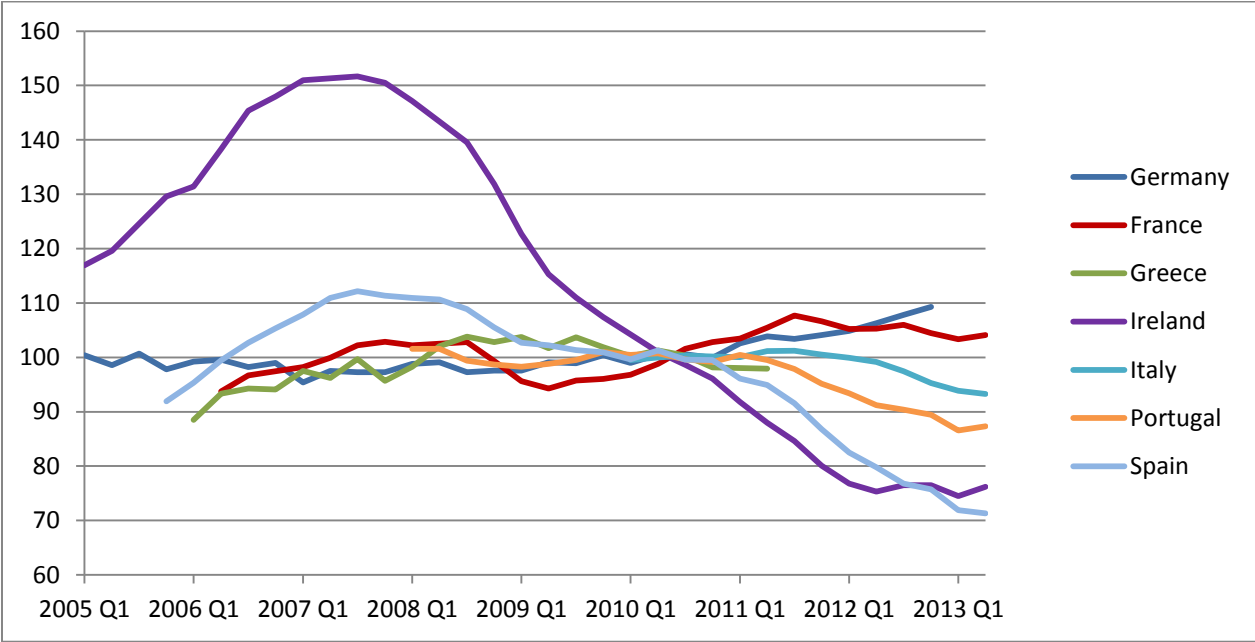


*Figure 4: National house price indices*
*Source: Eurostat*
*Note: Quarterly house price indices normalized to 100 at 2010*

Viewed as a whole, if asset price stabilization from a stock or a housing perspective was one goal of the ECB's interest rate cuts in recent crisis years, this came at the cost of contributing to boosting asset prices in the core of the euro area, with an especially pronounced impact on Germany. Thus, from an asset price perspective, a crisis regime seems to call for discretionary monetary policy.

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[24] Our conclusions related to house prices (and later on credit) are also shared by Smets (2012), who considers euro area imbalances in a broader context.

## 3.3 Taylor rules with credit/leverage

The previous subsection highlighted that asset prices could be of importance to central banks even beyond their implications for inflation and output. However, this might not be the whole story. Some authors argue that asset price bubbles themselves are not the most urgent problem for financial stability. Rather, it is the dangerous two-way interplay between asset prices and credit aggregates that matters. Credit growth can fuel asset price booms but rising asset prices imply higher collateral values to boost credit growth (ECB 2005, Gerdesmeier et al. 2010). That is, Borio and Lowe (2002, 2004), Detken and Smets (2004), and Gerdesmeier et al. (2010) ascribe a prominent role to credit in asset price booms, which might then lay the grounds for costly financial crises. What is more, Adrian and Shin (2008) claim stocks are often held by unleveraged investors, which makes credit – as a closer indicator of instability – even more important from a financial stability point of view. Thus, the following subsection elaborates on the role of credit aggregates more closely. This also allows us to take a closer look at banks, which have once more proven to be of critical relevance to the functioning of the financial system.

There are many theoretical papers that leave a role for credit in the conduct of monetary policy. Three common features of the papers in the normative literature stand out: First, most of them are papers of the dynamic stochastic general equilibrium (DSGE) modeling type, relying on financial frictions such as a collateral channel. Second, many also leave a role for regulatory instruments. This is very important because it is closely connected to the normative discussion concerning the role of the central bank. Nevertheless, the focus here is on the use of the interest rate for stability reasons. Thus, we dwell on regulatory instruments as little as possible in this paper, although we certainly reference work that is also concerned with regulation besides interest rate policy. Third, many authors connect their credit concerns to asset prices, which again highlights the importance of this link. One of these is the work of Agénor et al. (2013). Their model employs a house price shock to generate a credit expansion implied by the built-in collateral/accelerator mechanism. They employ a Taylor rule augmented with credit as well as countercyclical capital regulation to this setting and find that monetary policy is often sufficient to stabilize the economy if it is unrestricted in its actions. Otherwise, for example, if the central bank is interested in avoiding strong interest rate movements, monetary policy should be accompanied by capital regulation. Another paper that relates asset price booms and credit is that of Christiano et al. (2010). They ob-

serve that inflation is often low while credit growth is high in stock market booms. Hence, a pure inflation targeting strategy would give no hint to raise interest rates during the boom and might be actually destabilizing. They show this effect by employing a news shock in their setup of the New Keynesian framework. The authors then include an accelerator mechanism in the model, as well as credit growth in the policy rule, and show that the central bank is able to stabilize key components of the economy if it reacts to credit over and above its meaning for inflation. In contrast, Gambacorta and Signoretti (2013) employ a DSGE model with collateral and capital constraints. Reacting to asset prices counteracts exaggerations induced by the financial frictions and thus reduces shock-induced distortions, whereas reacting to credit yields no improvement. In another paper, Aydin and Volkan (2011) test the performance of Taylor rules using the nonfinancial sector borrowing spread, banks' foreign exchange leverage, credit volume, and house prices in their DSGE model calibrated for the Korean economy. They find that reacting to financial instability may be beneficial, but the outcome is shock dependent, with advantages in the case of supply shocks and no improvement when the economy is hit by demand shocks. The IMF's (2009) modeling exercise also gives rise to skepticism. This also allows for an accelerator mechanism and focuses on house price booms. The IMF claims that by responding to financial shocks (a relaxation in lending standards), a credit-augmented rule does indeed outperform the baseline Taylor rule regarding inflation and output variance, whereas in the case of productivity shocks, the standard rule is superior.[25] Still more skeptical are Gelain et al. (2013) as they consider the issue of credit and monetary policy in a setting of bounded rationality. A fraction of household decisions are formed by a weighted average between rational and adaptive expectations in the DSGE model. Two results should be mentioned here: First, the hybrid expectations scenario generally increases volatility compared to rational expectations. Second, the results indicate that direct reactions from the central bank either to credit growth or house prices in the policy rule might stabilize some variables, while at the same time increasing the variances of others, e.g., inflation and output. Finally, a very strong position in the normative debate is presented by the recent contribution of Biggs and Mayer (2013). As credit growth statistics could be biased by the maturity date structure, they demand that the so-called 'credit impulse' be targeted. This is given by the second derivative of credit and thus describes the

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[25] Shock dependency in a comparable setting is also found by Boivin et al. (2010). Furthermore, the IMF (2009), Boivin et al. (2010) and Gelain et al. (2013) also discuss the role of regulation.

change in credit growth. Assuming that it is new borrowing that matters for the economy, the credit impulse could serve as a substitute for the output gap, which suffers from well-known estimation problems. In such a way, they question the usual claim that credit should be considered, but not targeted (see, e.g., Borio and Lowe 2002, 2004). Monetary policy would then be extended to financial stability as an intermediate target and maybe even simplified.

The work of Borio and Lowe (2004) is probably the most influential empirical paper concerning the role of credit for monetary policy. After showing the high predictive content of credit volume and asset prices for financial imbalances, the authors augment a Taylor rule with credit gaps and equity gaps for the U.S., Australia, Japan, and Germany. The results are all but uniform across those countries, with the clearest evidence for some financial stability considerations in the case of the U.S. Moreover, the reaction seems to be asymmetric, so monetary policy seems to react only in busts but not in booms, implying at best a reaction along the line of the reactive policy view. Mixed evidence is also given by Cecchetti (2003). He includes bank leverage as measured by the ratio of total bank assets to total bank capital, which implies credit as the difference between them. In doing so, he interprets leverage as an indicator for banking system stress. He finds a significant negative reaction for the U.S. as well as for Germany, indicating that monetary policy lowered interest rates in the face of rising leverage. Yet, this reaction is not found for Japan. The importance of bank balance sheets from both the macroeconomic and the financial stability perspective is examined in greater detail by Adrian and Shin (2008). Although most of their results are not very pronounced for commercial banks, they first show that the balance sheets of broker-dealers have an important impact on macroeconomic development. In turn, the policy rate is an important determinant of institutes' balance sheets. Based upon these findings, they show that the asset growth regression coefficient, which proxies the leverage of market-based intermediaries, is indeed negative. This means that the Fed funds rate falls as leverage rises. Importantly, this relationship is reversed in times of crisis.[26] On the whole, the results lead

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[26] With the results of Adrian and Shin (2008) in mind, Cecchetti's (2003) conclusion that rising leverage signals rising balance sheet pressure and is thus counteracted by lower interest rates must therefore not necessarily be true. Rising leverage could either be due to eroding equity (which would support his conclusion) or be due to rising asset values, which is still part of a boom. In the latter case, lower interest rates would actually be destabilizing.

them to conclude that monetary policy and financial stability cannot be viewed as discon-nected.

To summarize, there is no clear-cut answer when evaluating the role of credit for monetary policy, either from the theoretical or from the empirical perspective. At the very least, it is widely accepted that credit would serve as a useful amendment to asset prices, i.e., those two measures should not be seen separately. Beyond this, no consensus emerges. Theoreti-cal work highlights the dependence on shock origins and the importance of weights for different policy objectives. Uncertainty along those dimensions influences the outcome and complicates the deduction of the optimal monetary policy, which is even trickier with many policy objectives. This originally demanded a careful and gradual reaction of monetary poli-cy, an issue that has long ago been derived from the work of Brainard (1967).

Once again, we ask what meaning this subsection has for the monetary policy of the ECB in the light of the sovereign debt crisis. Given that bank lending accounts for the vast majority of private sector external finance in the Eurozone compared to the U.S. (see, e.g., ECB 2008), this might naturally be of special interest to central banks. The literature on financial integra-tion is not very helpful in this case as it is largely concerned either with cross-border lending or interest rate dispersion across countries (see, e.g., Baele et al. 2004 and ECB 2013). Both areas are ill-suited for our purposes at this stage because cross-border lending seems to be an improper choice to evaluate national credit evolution, whereas interest rate dispersion is a feature considered in the subsection on spreads.

To examine empirically the behavior of credit in the euro area, we instead decided to focus on the development of bank lending to the private sector in the respective countries, de-picted in figure 5 from January 1999 to September 2013. As the focus in this part of the paper is on the specific development in euro area countries, we abstract from interbank credit. The data have a monthly frequency and are taken from Thomson Reuters Datastream.[27] Again, a core-versus-periphery analysis is conducted. To make the differing volumes among the countries comparable, they were normalized to 100 as of the beginning of 1999. Once more, this shows some impressing heterogeneity in the Eurozone. Over time,

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[27] As a robustness check, we also used the data from the ECB's Statistical Data Warehouse, which allows a distinction to be made between household and corporate credit. The results are qualitatively equivalent and thus we do not report them here.

credit volume rises in all countries but to extremely different degrees. Beginning with core Europe, credit develops in quite a stable manner. Whereas France more than doubles its lending volume from 1999 (but with quite low volatility),[28] the rise in the German credit volume is negligible. Credit growth in Italy and Portugal is more pronounced from the introduction of the common currency onwards, but these countries have not experienced a substantial reversal in recent years. However, this is a distinct feature of credit volume in Greece and Ireland. Both countries show a significant boom-bust shape, with credit volume rising strongly until the end of 2008 and then collapsing. Spain also experienced a remarkable boom, but there is a more muted shrinkage in credit after its peak at the end of 2008.
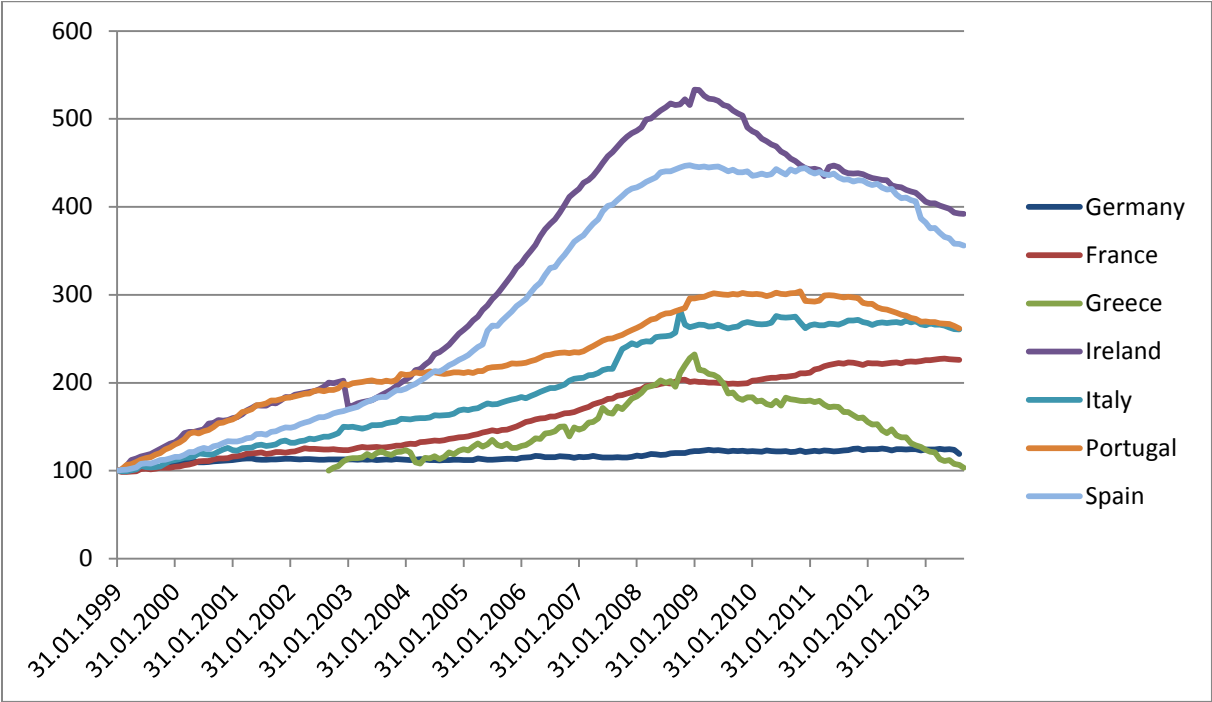


*Figure 5: Bank lending to the private sector*
*Source: Thomson Reuters Datastream, own calculations*
*Note: Monthly data normalized to 100 at the end of January 1999 (except Greece, where data are only available from September 2002 on)*

To conclude, the development of the volume of lending to the private sector has been divergent across euro area countries, again showing some pronounced heterogeneity between core and peripheral countries, both in stable times and times of crisis. This questions once more the adequacy of responding to this kind of imbalances using the common monetary

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[28] We also computed monthly growth rates to gain an intuitive understanding of the volatility of credit development. The results yield relatively more volatility for the peripheral countries compared to Germany and France. To conserve space, the figures are not depicted here.

policy, and a Taylor rule in special.[29] If credit shows boom-bust shapes in the periphery, would it really be desirable to react, given that development in the core is stable? We do not consider this to be the case. At least, there are no boom tendencies in the core despite the very low interest rates in the recent past. This makes the conclusion somewhat weaker than in the case of asset prices in the former subsection.

## 3.4 Taylor rules with spreads

The most recent strand of stability-oriented Taylor rules augments them with different kinds of spreads. Among these are lending/deposit spreads, corporate spreads and sovereign spreads. The European sovereign debt crisis in particular raised awareness that yield differentials are important as it is not the policy rate that is charged for a credit. Normally, a creditor has to pay a risk premium that reflects ability and willingness to repay the debt. This is where monetary policy comes into play. If spreads rise, for example through changed risk perceptions, the interest burden for the creditor increases. Monetary policy can ease the strain by cutting the policy rate, which acts as an anchor for other interest rates and thus lowers the absolute level of interest rates. What is more, Mishkin (2009) argues that although monetary policy is not able to reduce valuation risk, its interest rate policy can influence the probability of severe stress to the economy. Thus, he concludes that the central bank can influence macroeconomic risk and hence the size of the spread to some extent.

The short time span since spreads have become an issue is reflected by the fact that there is relatively little normative work in this line of research. The seminal paper that considers spreads and monetary policy is that of Cúrdia and Woodford (2010). Based upon the conclusion that the Fed's interest rate responses to the subprime crisis could not have been motivated solely on the grounds of inflation and output considerations, they suppose that other indicators could also have been important. As can be seen from subsection 3.3, it might be important to look at financial intermediaries more closely. Thus, they ascribe a role to the rising credit spreads in that time and build a New Keynesian DSGE model that allows for a wedge between lending and deposit rates, justified by costs of intermediation and credit defaults. Monetary policy reacts to spreads in its Taylor rule; i.e., a rise in the spread is answered by lower interest rates. Applying different shocks with differing grades of persistence

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[29] This finding is also shared in the inspection of heterogeneity in national monetary and credit aggregates in the euro area by the Deutsche Bundesbank (2013), the analysis of which is comparable to but more detailed than that conducted here.

in their model shows that augmenting the Taylor rule with credit spreads can improve the outcome in terms of inflation and output, but the optimal spread response is clearly case-dependent. In addition, the authors also show that a policy response to credit is dominated by a response to spreads in their setting. With reference to the recent sovereign debt crisis, an interesting extension of the Cúrdia/Woodford-framework is provided by Corsetti et al. (2013), who include a sovereign spread in the model. This spread impacts on funding conditions in the private sector and is thus preferably to be minimized by the central bank. Certainly, the assumption that monetary policy can always fully neutralize the effects of rising spreads unless it is restricted by the zero lower bound is strong. As a result, the paper's analyses are concerned to a large part with fiscal policy, on which we do not elaborate here. An interesting exception to the usual inflation/output-loss function is given by the work of Teranishi (2012). The four equations model allows for two heterogeneous loan contracts representing differing cost channels dependent on distinct external finance ratios. The loss function then includes the spread between those two loan interest rates besides inflation, the output gap and the smoothed policy rate. This setup enables one to account for differing markups on the policy rate and hence for distortions to the economy. The author concludes that a spread-adjusted Taylor rule constitutes the optimal monetary policy in this setting although the sign of the response to the spread depends on the financial structure, i.e., the detailed properties and the relative importance of each type of loan.

Regarding the empirical aspect, there has also been some emphasis on estimating the reaction of selected central banks to different kinds of spreads. However, most of the empirical spread research is also related to other possible determinants of the interest rate. This research is often conducted via different indices that subsume more than one indicator of financial (in)stability, as was already remarked on in section 2. Thus, classification is difficult. One such study is Belke and Klose (2010). They separately test the interest rate responses to asset prices, spreads, and money and credit growth by the Fed and the ECB from 1999 to 2007 and from 2007 to 2009. In contrast to many other financial stability indicators, the coefficients for interest rate spreads are consistently negative and significant for both central banks during the normal and the crisis subsamples, indicating a stable response from both central banks to counter rising spreads by lowering interest rates. In contrast, a true index-based paper is that of Castro (2011), who finds significant stabilizing reactions from the ECB from 1999 to 2007 to a financial conditions index consisting of spreads, exchange

rates, and asset prices, but no reaction to the sovereign-corporate yield spread in his linear version of the Taylor rule. Interestingly, his results are reversed for the Fed and the BOE, neither of which react to the index but rather to the spread. More work related to spreads is given by Martin and Milas (2013). Using subsamples for the U.K. from 1992–2010, the authors find that the BOE's reaction to inflation and output became insignificant and decreased respectively during the subprime crisis. However, adding different spread indices into their framework leads to a better fit and significant coefficients for those indicators in times of stress. From this, they conclude that the BOE tried to stabilize the financial system in times of stress, which is supported by a switching policy rule. Due to the short time span up to now, one of the few papers that has estimated the role of sovereign spreads in the current sovereign debt crisis is that of Bouvet and King (2011). Among other features, they estimate the reaction of the ECB to Greek and Irish spreads over German yields. Adding financial stability measures improves regression fit in general, but the results show significant but differing signs for both spreads, which sounds counterintuitive. Nonetheless, the authors ascribe this finding to the different kinds of debt problems both countries faced.

On the whole, spreads are certainly the newest field of research among all subsections. This gives rise to some uncertainty regarding the results. The existing normative literature points to the chance of improving the outcome by looking at spread measures, which is supported from the empirical side. However, it is unclear to what extent central banks may be able to reduce the spread itself by cutting the interest rate. And even if they were able to do so, they would soon face the problem of hitting the zero lower bound, which would then eliminate the option of further cuts in the future. Unfortunately, this distinction has become very important in the European sovereign debt crisis with its recent elevated sovereign risk premiums and interest rates close to zero. If reducing the interest rate is no longer feasible, this calls for an increasing use of unconventional policy measures irrespective of the comparative advantage relative to interest rate policy. Regarding spreads, a viable option has been the direct purchase of assets, with central banks acting as buyers on the secondary markets. Despite pronounced public doubts concerning legal and implementation issues, operations such as the Securities Markets Programme (SMP) and the Outright Monetary Transactions

(OMT) program have been crucial elements for calming down sovereign spreads in the Euro-zone, as can be seen below.[30]

To gain an understanding of the magnitude of spreads in the current sovereign debt crisis, we take a closer look at the sovereign bond markets as they have received the most attention during the recent years in Europe. We computed the spread between the 10-year constant maturity bonds of the peripheral countries and France against German sovereign bonds. The results are depicted in figure 6. Again, two interesting features are worth noting. First, starting with some divergence after the introduction of the euro, spreads soon converged and are almost not worth mentioning in the period 2001–2007. The highest value in this time span relates to Greece joining the euro area on January 1, 2001 with a risk premium of around 58 basis points. From 2009, things started to change, and they changed dramatically from 2010 onward. Problems in government finance among the peripheral countries, primarily in Greece, became a concern for financial markets. Spreads in all countries rose until the beginning of 2012, except in Ireland and Spain, where risk premiums peaked in the summer of 2011 and 2012 respectively. This finding is also broadly represented by the financial integration literature. Sovereign bond integration is time-varying and there seems to be an underpricing of sovereign risk in the early years of the euro and some sharp reversal in times of crisis (see, e.g., Cipollini et al. 2013 and the references cited therein). From the peaks in 2012 onward, one can see spreads declining in all countries. This implies the second interesting feature, which is even more important for our work. There is still considerable co-movement of spreads, even in times of stress. Although to (admittedly strong) differing degrees, sovereign spreads moved in the same directions. This feature also holds for the core Eurozone, represented by France, the risk premium of which shows a slight peak at the beginning of 2012.

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[30] See the speech of Draghi (2012) and also the questions asked by journalists at the press conference on the introduction of the OMT regarding implementation issues and concerns. Observe also that OMT are not the same as quantitative easing because the ECB (2012) notes that the operations are 'sterilized', i.e., they do not inject further liquidity into the system.
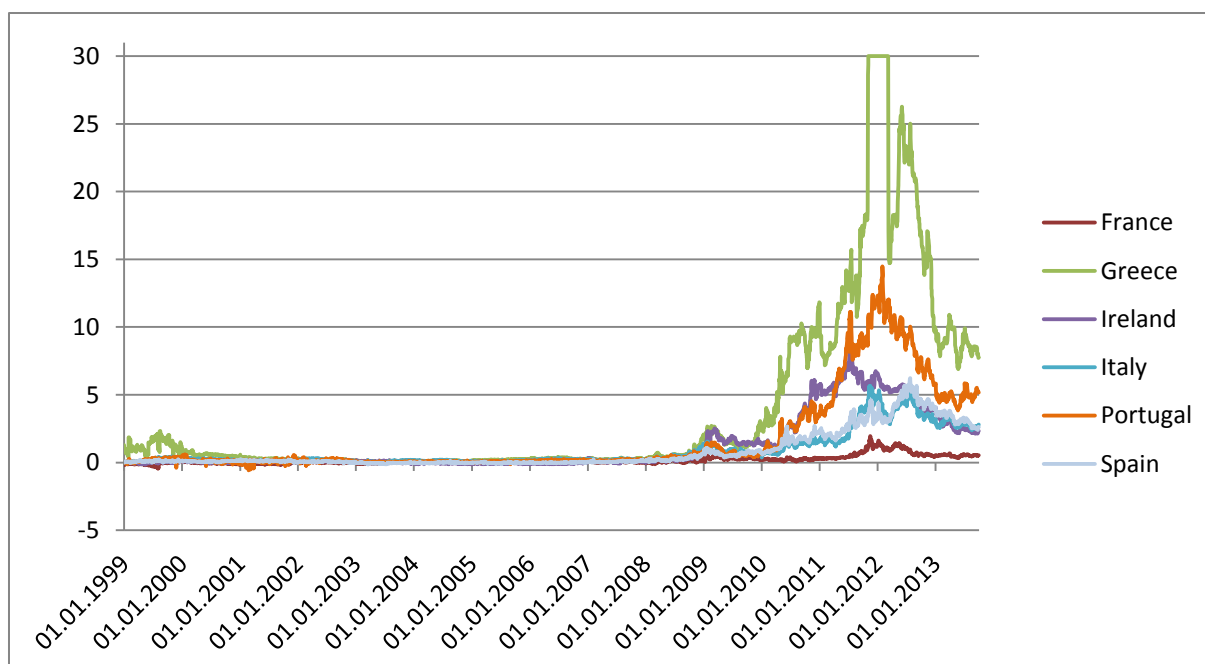
*Figure 6: Spreads of 10-year constant maturity sovereign bonds*
*Source: Thomson Reuters Datastream, own calculations*
*Note: Spreads are calculated on a daily basis against the respective yield of German sovereign bonds. For ease of presentation, Greek spreads are capped at 30% to avoid the graphically distortive effects of outliers. The maximum value of the Greek risk premium moves above 55 percentage points on March 1, 2012.*

Thus, importantly, the conclusions from the previous subsections cannot fully be repeated here. As the spreads show some undeniable co-movement at least in their directions, the common monetary policy seems not necessarily ill-suited to addressing rising spreads, even in times of crisis. Certainly, whether interest rate cutbacks are one or even the only *reason* for the observed recent spread reductions might be questioned given the fact that the ECB already lowered interest rates sharply from the year-end of 2008 onward. Moreover, the aforementioned asset purchase programs presumably also contributed to the observable narrowing of spreads.

## 4. Concluding remarks

All in all, the direction might have changed to favor greater responsibility for financial stability on the part of central banks in recent years. Nevertheless, most authors conclude that this does not challenge the view that inflation and output remain the primary targets of central banks (see, e.g., Blanchard et al. 2010). Another broadly accepted conclusion is that monetary policy should not respond mechanically to financial instability. Certainly, as many authors point out, this was never the intention of Taylor's rule. Alas, the true question of whether financial stability should be an *additional* objective for central banks still remains

unanswered by these conclusions. Rather, it is further complicated by many authors claiming that central banks should react to imbalances, while at the same time they should not target them. However, it is interesting to note that much of this ambiguity seems to be subject to a semantic problem in the debate concerning flexible inflation targeting, as pointed out by Cecchetti et al. (2002) and Visco (2003), for example. But if financial stability is an objective *in itself*, then the usual dispute concerning whether 'all relevant information' is included in the output and inflation measure becomes irrelevant: there is more than inflation and output! However, the statement that central banks should react to financial (in)stability over and above inflation and output is again questionable when the evaluation is based on the grounds of loss functions that only operate with the variances in the two common measures. This seems surprising as it is common practice in theoretical and empirical work to operate with interest rate smoothing. It is in no way clear why central banks should be concerned about smoothing interest rates – which is generally accepted for stability reasons in Taylor rules and also in several loss functions – but not about financial stability itself. There seems to be a logical error, which in our opinion has not received the attention it deserves.[31]

Moreover, based on studies that consider only *one* economy, the scientific literature is not at all clear as to whether it is reasonable to take responsibility for financial stability in the Taylor rule over and above inflation and output. Thus, the problem becomes even more severe for the Eurozone *as a whole*. If one considers the interest rate to be too blunt an instrument at the level of one state (which is micro in this respect), then how could it be appropriate for a whole monetary union (the macro level)? It is one thing to state that 'one size does not fit all', which is a problem that monetary policy always faces, even at the micro level of one state. But this conclusion might become very important if monetary policy is in the rescue mode at a more aggregated level. Saving one member of the union from collapsing unavoidably affects the other members and what helps one economy might harm another one, either via the mechanisms considered in this paper or through the manifold problems arising from interest rates near the zero lower bound over a protracted period of time..

Against this background, we have also analyzed parts of the European financial markets in each of the subsections, claiming that the interest rate reaction of the ECB should be time-varying. There would have been little or no benefit for the ECB to be guided by those main

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[31] Cecchetti et al. (2002) express this possibility in a footnote. However, they do not develop the idea further.

measures of financial (in)stability in times of crisis as developments have been too hetero-geneous among euro area countries in the core and the periphery. This clearly rejects the adequacy of a rule-like reaction to any of the measures in times of crisis, except for spreads. Such a discretionary reaction might then also avoid the problem of hitting the zero lower bound as a consequence of a rule-like response to instability. However, our results are somewhat weakened in more stable times with only minor disruptions inside of the Euro-zone. There is at least a great degree of homogeneity among stock price movements in Europe, thus supporting a rule-like preemptive reaction to this measure.

Finally, acting with the intention to stabilize financial markets in a few countries might also harm the most important asset of a central bank, which is its credibility. It is generally not easy for the ECB to explain their actions to the public, given the still quite heterogeneous national transmission mechanisms. Adding financial stability considerations for some coun-tries might impair transparency and thus render this task impossible.

Evidently, all of these considerations remain interesting fields for further research.

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