MONETARY POLICY CONDITIONS IN SPAIN BEFORE AND AFTER THE CHANGEOVER TO THE EURO: A TAYLOR RULE BASED ASSESSMENT

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Abstract: This paper analyzes monetary policy conditions in Spain before and after the changeover to the Euro as the single European currency. We use forward-looking Taylor-type rules to describe the Banco de España's pre-Euro monetary policy and find that it was clearly inflation stabilizing. Compared to this we find that the monetary policy stance of the European Central Bank (ECB) since 1999 which was appropriate for the euro area as a whole was too expansionary for Spain's economy. The resulting cheap credit conditions for real estate must be seen as an important explanation for Spain's housing boom.

JEL classifications: E52, D84

Keywords: Spanish monetary policy, European Central Bank, euro area, interest rate setting, Taylor rules

1. INTRODUCTION

Spain's economic crisis starting in 2008 clearly has to be seen in the context of the world economic crisis triggered by the burst of the U.S. subprime housing bubble.[1] However, especially the Spanish pre-2008 growth cycle and the associated housing bubble seems to originate – at least partly – east of the Atlantic Ocean. Besides governmental regulations, which for example include that 15 per cent of mortgage payments are deductible from personal income, low interest rates for real estate probably played a major role. Figure 1 shows the development of three mortgage interest rates in Spain. Whereas the average mortgage rate was between 10 and 12 per cent for 1995, it dropped down to about 5 per cent in 1999 and remained at a fairly low level. Additionally, Table 1 shows that at the same time the credit conditions were associated with a sharp increase in the volume of house purchase loans. From 1997 to 2007 the volume of house purchase loans more than sextupled from 104 Billion Euro to 645 Billion Euro. Weighted by GDP this value almost tripled form a ratio of .21 to .61.

Figure 1: Mortgage Interest Rates (1995 – 2007)
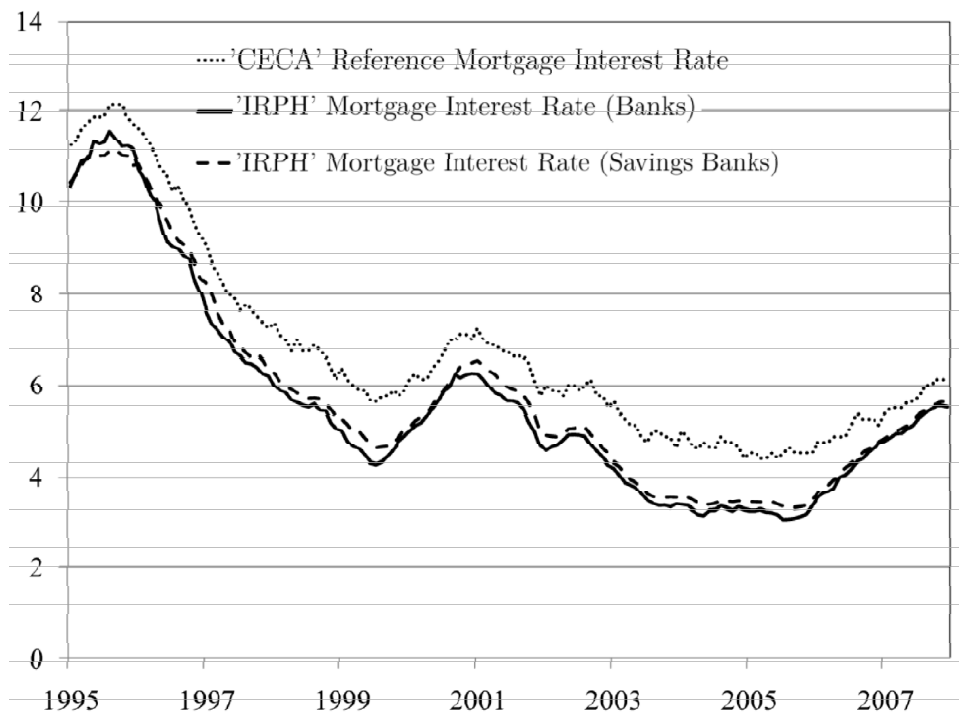
Note: Figure 1 shows mortgage interest rates. The *'CECA' Reference Mortgage Interest Rates* (fine dotted line) is
         an average interest rate based on personal loans and mortgage loans provided by the Spanish Confederation of
         Savings Banks. The *'IRPH' Mortgage Interest Rate (Banks)* (dotted line) is the obtained average mortgage
         interest rate with a duration of more than three years offered by banks. The *'IRPH' Mortgage Interest Rate*
         (Savings Banks) (solid line) is the obtained average mortgage interest rate with a duration of more than three
         years offered by savings banks.

Table 1
House Purchase Loans (1997 – 2007)

Year	House purchase loans (in Billion Euro)	House purchase loans to GDP (Ratio)
1997	104	0.21
1998	126	0.23
1999	151	0.26
2000	183	0.29
2001	215	0.32
2002	250	0.34
2003	304	0.39
2004	375	0.45
2005	474	0.52
2006	570	0.58
2007	645	0.61

Source: OECD (2010)

The surge in housing demand is mirrored by a surge in house prices. Figure 2 shows the development of the Spanish house price index. In addition, the consumer price index (CPI) is displayed as a benchmark for comparison. Whereas the CPI increased by about 50 per cent from 1995 to 2008, the house price index rocketed up by more than 200 per cent. Interestingly, the two indices started to drift apart around the date of the changeover to the Euro in January 1999. By this visual evidence one might be tempted to argue that with the changeover to the Euro Spain lost the ability of conducting national autonomous monetary policy and depended on the European Central Bank's (ECB) single monetary policy that only focuses on euro-area wide developments. We take this claim as our motivation for analyzing Spain's monetary policy conditions before and after the changeover to the Euro. In particular, we address the problem of the ECB's euro-area wide one-size-fits-all monetary policy and investigate what would have happened if a central bank only responsible for the Spanish economy had conducted a monetary policy based on the Banco de España's pre-Euro monetary policy.

So far, this issue has not been explicitly addressed in the Literature. Andrés *et al.* (2010) claim that the evolution of the Spanish economy has been remarkably different from that of the rest of the euro area. In particular, they find that the European Monetary Union (EMU) membership has had a non-negligible effect on observed growth and inflation differentials, which results from a combination of asymmetric country-specific shocks and asymmetric

Figure 2: Consumer Price Index and House Price Index (1995 – 2007)
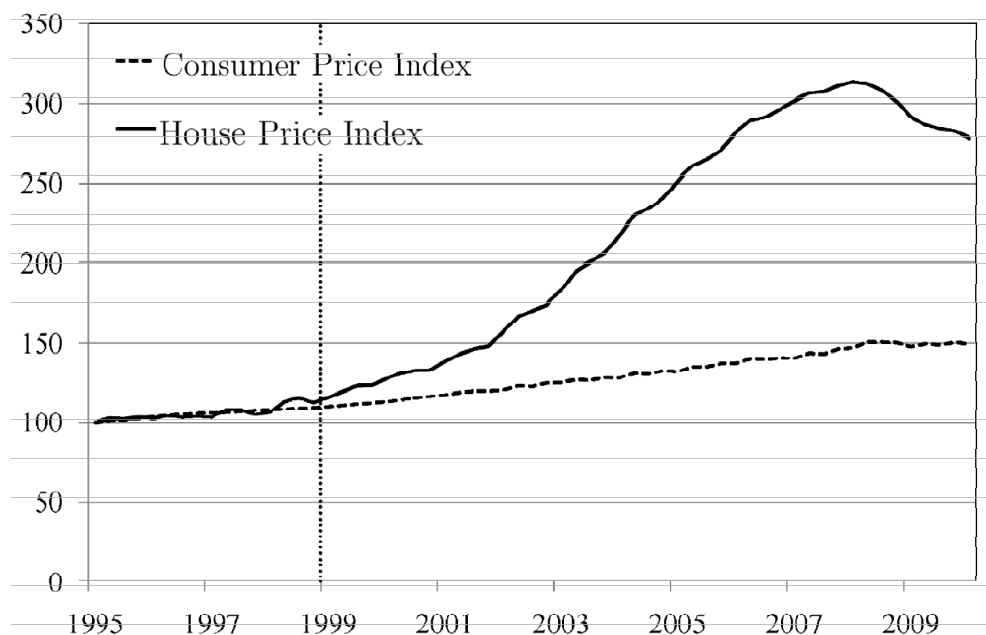
Note: Figure 2 shows the Consumer Price Index (1995=100, dotted line) and the House Price Index (1995=100, solid line) for Spain from the first quarter of 1995 to second quarter 2010. The fine dotted vertical line indicates the date of the changeover to the Euro in January 1999. The data has been taken from the OECD (2010) and the Ministerio de Viviendas (2010) in Spain, respectively.

structure. In this paper, we complement the study by Andrés *et al.* (2010) and analyze how EMU membership and associated with it the ECB's single European monetary policy for the euro area as a whole affected monetary conditions in Spain. In doing so, we base our assessment on estimated Taylor rules for the Spanish economy.

The paper has the following structure. Section 2 briefly reviews the commonly applied empirical Taylor-type rules.[2] Section 3 introduces the data set. In Section 4 we estimate Taylor-type rules to analyze the Banco de España's pre-Euro monetary policy. In Section 5 we turn to the ECB's monetary policy, compare this to the Banco de España's pre-Euro monetary policy and demonstrate that the ECB's monetary policy was inadequate for Spain's economy. Section 6 briefly discusses the consequences for the credit conditions in Spain's real estate sector. Finally, section 7 concludes.

2. A QUICK GUIDE TO TAYLOR-TYPE RULES

All major central banks in industrial and emerging economies currently conduct monetary policy by using market-oriented instruments in order to influence the short-term interest rate. Since the seminal paper of Taylor (1993) it has virtually become a convention to describe the interest rate setting behavior of central banks in terms of monetary policy reaction functions. In its plain form, the so-called Taylor rule states that the short-term interest rate, i.e., the instrument of a central bank, reacts to deviations of inflation and output from their respective target levels. Although the Taylor rule started out as an empirical exercise, there is a clear theoretical link between optimal (inflation targeting) monetary policy and Taylor rules. Among others, Svensson (1997, 2003) showed that within stylized macro models (contemporaneous and forward-looking) Taylor rules can be derived as the explicit solution of an optimal control problem.

For the purpose of empirical exercises, in a seminal paper Clarida *et al.* (1998) propose a specific forward-looking variant of the Taylor rule which takes into account the pre-emptive nature of monetary policy as well as interest smoothing behavior of central banks. This particular type of reaction function has become very popular in applied empirical research. Although it is still in the spirit of the Taylor rule, specifications of this type represent a modification of the original Taylor rule and, thus, the literature often refers to them as Taylor type rules. Following Clarida *et al.* (1998, 2000) and Taylor (1999) the baseline forward looking policy rule takes the form:

$$i_t^* = \bar{\imath} + \alpha_x E_t(\pi_{t+k} - \pi^*) + \alpha_{\bar{y}} E_t(y_{t+k} - y_{t+k}^*), \tag{1}$$

where i^* is the desired level of the nominal short-term interest rate, and $\bar{\imath}$ is its equilibrium level. The second term on the right-hand side is the expected deviation of the k-period ahead inflation rate (π) from the target rate (π^*) which is assumed to be constant over time. The third term is the expected deviation of the k-period ahead level of output (y) from its natural level (y^*) i.e., the expected output gap $E(\bar{y})$. The coefficients α_π and $\alpha_{\bar{y}}$ which are to be estimated represent the reaction coefficients.

The coefficient for the inflation gap, α_π, is of particular importance. In order to act in a stabilizing manner it has to exceed unity, which is referred to as the well-known *Taylor principle.*

The central bank has to react with its nominal policy rate more than one-to-one to the underlying inflation shocks in order to increase the real interest rate. If the *Taylor principle* does not hold, the central bank's reaction leads to a declining real interest rate in the case of rising inflation which clearly is at odds with stabilization efforts.

The additional assumption of interest rate smoothing behavior implies that:

$$i_t = (1-\rho)i_t^* + \rho i_{t-1} + v_t,$$ (2)

with the parameter ρ representing the degree of interest rate smoothing (with $0 < \rho < 1$) and v_t represents an i.i.d. exogenous random shock to the interest rate. Combining equations (1) and (2) leads to

$$i_t = (1-\rho)\left(\bar{\imath} + \alpha_\pi E_t(\pi_{t+k} - \pi^*) + \alpha_{\bar{y}} E_t(y_{t+k} - y_{t+k}^*)\right) + \rho i_{t-1} + v_t,$$ (3)

Equation (3) represents the econometric specification which is commonly used to describe central bank behavior.[3] It reduces to the original Taylor rule when ρ is zero and the horizon of the forward-looking behavior of the central bank, k, is also set equal to zero in econometric exercises.

The main messages generated by a huge body of empirical studies focusing on central bank behavior in industrial countries can be summarized as follows. First, forward-looking specifications seem to fit the central banks' behavior better than contemporaneous versions. Here the forward-looking feature is most relevant for the inflation gap with the horizon (k) being about one year. Second, the relevance of the *Taylor principle* for stability is well demonstrated and its presence is a strong feature for most central banks. Third, the reaction coefficient for the output gap is mostly statistically significant but has a lower level compared to the inflation gap coefficient.[4] Fourth, persistence in the short-term interest rate is a strong feature found in the data. However, what is not yet clear is whether this is due to an intended interest rate smoothing or whether it is due to a strong autocorrelation in the shocks upon which monetary policy reacts.[5]

Subsequently, we estimate variants of equation (3) based on reported forecasts of financial market participants. We believe that for several reasons to be discussed below private forecasts on inflation and output are suitable for the estimation of forward-looking Taylor rules. Gorter *et al.* (2008), for example, use private sector forecasts to show that the ECB is Taylor-rule based. Because our choice of the particular forms of the Taylor-type rule that we are going to estimate is driven by our dataset, the next section briefly introduces our data set before we explicitly present these specific forms as well as the empirical results.

3. THE DATA SET

We use inflation and output forecasts published in the survey conducted by Consensus Economics for the time period between January 1995 and December 2007. We choose to start our sample period when Spain introduced inflation targeting. As indicated before, it is appropriate to describe the Banco de España's (inflation targeting) monetary policy by Taylor-type rules for the time period from January 1995 until the changeover to the Euro in January 1999. Our sample period

ends in 2007 to avoid that our results are influenced by the world economic and financial crisis and its monetary policy reactions starting in 2008.

There are several reasons why the data set of the Consensus Economic poll should be of interest for the central bank and hence, is suitable to estimate a forward-looking monetary policy rule.[6] First, the survey participants work with the private sector in the respective country[7] and hence, should report a true notion of the expected economic development. The fact that we use private sector forecasts is also of advantage compared to the forecasts of international institutions or even the central bank itself. While the latter might have an incentive to report strategic forecasts consistent with their macroeconomic policy, the private sector should have an incentive to provide an accurate forecast rather than a strategic forecast. As a matter of fact, Batchelor (2001) shows that the Consensus Economics forecasts are less biased and more accurate in terms of mean absolute error and root mean square error compared to OECD and IMF forecasts. Moreover, the individual forecasts are published along with the names of the forecaster and their affiliation. Analysts are bound in their recommendations to clients by their survey answers, because an analyst may find it hard to justify why (s)he gave a recommendation different to the one in the survey. Given that this allows everybody to evaluate the performance of the individual participants, the accuracy of the forecasts can be expected to have an effect on the reputation of the forecasters.[8]

Second, the forecasts are currently observed data that are not revised and, hence, are not exposed to the real-time data critique. Orphanides (2001) shows that it is crucial to distinguish between real-time and revised data to correctly assess the information set on which the central bank bases its interest rate decisions. In addition, because monetary policy works with a lag, effective monetary policy should focus on forecasted values of the goal variables, rather than the current values. Interestingly, Bernanke (2010) emphasizes these issues when analyzing the link between monetary policy and the U.S. housing bubble. Thus, our data set seems to be particular suitable for the purpose of our paper. Third, the data set is consistent over the pre-Euro time period when the Banco de España was responsible for conducting monetary policy and the time period since Spain adopted the Euro in 1999. Hence, our analysis does not suffer from problems arising from different reporting standards over time.

Consensus Economics publishes forecasts for two different time horizons, namely the current and the subsequent year. We weighted the current year forecasts with the number of remaining months of the year at the time of the forecast and the subsequent year forecast with 12 minus the current year's remaining month to obtain a fixed forecast horizon of twelve months.[9] The length of the forecast horizon of twelve months can be justified by the time-lag of the monetary policy transmission which is about twelve months (George *et al.*, 1999). This procedure is quite common in the literature (Gorter *et al.* 2008, Heppke-Falk and Hüffner, 2004, and Beck, 2001).

For the subsequent estimations we can directly use the twelve-month-ahead CPI forecast without any further adjustments. However, for the output variable we cannot do so. Since Consensus Economics only provides output growth forecasts but we need data for the output gap forecasts, $\tilde{y}_{t+12}$, some further adjustments are necessary. To obtain the twelve-month-ahead natural output level, y_{t+12}^{*}, we smooth monthly data for Spain's industrial production taken from the IMF's International Financial Statistics with a Hodrick-Prescott-Filter and forward

the resulting time series by twelve month.[10] For the twelve-month ahead output forecast, y_{t+12}, we multiply the actual industrial production by $(1 + \Delta y)$, where Δy is the twelve-month ahead output growth forecast constructed by using Consensus Economics' GDP forecasts. By subtracting the twelve-month-ahead natural output level, y^*_{t+12}, from the twelve-month ahead output forecast, y_{t+12}, we obtain a twelve-month-ahead output gap forecast, $\tilde{y}_{t+12}$.

We use two different interest rates. For the pre-Euro period from January 1995 to December 1998 we use the Spanish interbank overnight rate. For the time period since the changeover to the Euro we use the European Over Night Index Average (EONIA).

4. MONETARY POLICY BEFORE THE CHANGEOVER TO THE EURO

In this section we analyze Spain's monetary policy in the pre-Euro period from January 1995 to December 1998. More precisely, we estimate two slightly modified versions of Taylor-type rules introduced in section 2. These modifications are necessary to fit our particular data set. In order to arrive at a testable relationship, the unobservable terms in equation (3) have to be eliminated. Since we have data for the interest rate, the expected inflation rate and the expected output gap, we only lack information on the equilibrium interest rate and the inflation target. In a first step, consistent with Clarida *et al.* (1998), we treat these two variables as time-invariant and aggregate both of them into the constant.[11] Thus, we rewrite equation (3) as:

$$i_t = \alpha(1-\rho) + \alpha_\pi(1-\rho)E_t\pi_{t+12} + \alpha_{\tilde{y}}(1-\rho)E_t\tilde{y}_{t+12} + \rho i_{t-1} + v_t \qquad (4)$$

where

$$\alpha = \bar{\iota} - \alpha_\pi E\pi^* \qquad (5)$$

The first column of Table 2 reports results based on the Generalized Methods of Moments (GMM) with minimum asymptotic variance that are heteroscedasticity- and autocorrelation-consistent (Baum *et al.*, 2007). As instruments for the forecast variables we use the third, sixth, ninth and twelfth lag of the actual inflation rate, the output gap and the real effective exchange rate. The p-value of the Hansen J-statistic of .67 suggests that the instruments are uncorrelated with the error term, since the null cannot be rejected at a ten per cent level. The inflation coefficient, α_π, is 2.05 and it is significantly greater than unity. This reflects that the Banco de España increased its interest rate by about two percentage points whenever the expected inflation rate increased by one percentage point. Hence, the real interest rate increases by approximately one percentage point. This implies that the *Taylor principle* holds during the considered time period. Moreover, the results reported in the first column in Table 2 also show that the Spanish central bank had a substantial degree of interest rate smoothing of about .63 and did not systematically respond to changes in the expected output gap, since the output gap coefficient, $\alpha_{\tilde{y}}$, is not significantly different from zero.

We next expand the analysis and allow the inflation target to be time-varying. Since Spain adopted inflation targeting between January 1995 and December 1998, the Banco de España publicly announced inflation targets to be used in the subsequent analysis.[12] If the Banco de

Table 2
Taylor-type Rules based on the GMM Estimator

Specification	constant implicit IT	time varying IT
α	.08	4.86
	(.47)	(.63)
α_π	2.05	4.14
	(.15)	(.94)
$\alpha_{\bar{y}}$	-.99	-4.63
	(.68)	(3.76)
ρ	.63	.89
	(.05)	(.03)
$\alpha_\pi > 1$	.00	.00
$\alpha_{\bar{y}} > 0$	.94	.89
R^2	.91	.89
Obs.	48	48
Hansen J statistic	.67	.50

Notes: Estimated equation (first column) (4) $i_t = \alpha(1-\rho) + a_\pi(1-\rho)E_t\pi_{t+12} + \alpha_{\bar{y}}(1-\rho)E_t\bar{y}_{t+12} + \rho i_{t-1} + v_t$; estimated
equation (second column) (6) $i_t = \alpha(1-\rho) + \alpha_\pi(1-\rho)(E_t\pi_{t+12} - \pi_t^{tar}) + \alpha_{\bar{y}}(1-\rho)E_t\bar{y}_{t+12} + \rho i_{t-1} + v_t$; values
in parentheses represent standard errors; GMM estimates are based on two-step feasible GMM estimation with
minimum asymptotic variance that are heteroscedasticity- and autocorrelation-consistent; as instruments for the
forecast variables we use the third, sixth, ninth and twelfth lag of the actual inflation rate, the output gap and the
real effective exchange rate; the Hansen J statistic tests the null hypothesis whether the instruments are uncorrelated
with the error terms; for this test we present the p-values; $\alpha_\pi > 1$ represents the significance level of a Chi^2 test to
test whether the Taylor-principle holds with the null hypothesis that $\alpha_\pi \le 1$; $\alpha_{\bar{y}} > 0$ represents the significance
level of a Chi^2 test to test with the null hypothesis whether $\alpha_{\bar{y}} \le 0$; R^2 refers to the overall coefficient of
determination.

España consistently responded to its inflation target, we should find that the *Taylor principle* still holds. This finding can then be interpreted as evidence in favor of a consistent central bank strategy.

Starting from Equation (4) we now treat the inflation target as observable and time-varying. Therefore we slightly depart from the former specification (4) and estimate

$$i_t = \alpha(1-\rho) + \alpha_\pi(1-\rho)E_t(\pi_{t+12} - \pi_t^{Tar}) + \alpha_{\bar{y}}(1-\rho)E_t\bar{y}_{t+12} + \rho i_{t-1} + \varrho_t \qquad (6)$$

with $\alpha = \bar{\iota}$ and π_t^{Tar} reflecting the official inflation target.

The second column of Table 2 reports the results based on a GMM estimation with the same set of instruments as before. The Hansen J-statistic of .50 is again in favor of our instruments. The inflation coefficient of about 4.86 together with the p-value of .00 for the test $\alpha_\pi > 1$ indicates that the *Taylor principle* still holds. Consistent with our estimates with a constant implicit inflation target (as shown in the first column of Table 2), the output gap coefficient is still not significantly different from zero. However, the interest rate smoothing parameter now has a higher value.

For a graphical illustration Figure 3 shows the Spanish interbank overnight rate, the expected inflation rate, π_{t+12}, and the inflation targets announced by the Banco de España. Whereas the interest rate falls from about 8 per cent in January 1995 to about 3 per cent in December 1998,

the inflation expectations only fall disproportionately from about 4.5 per cent to about 3 per cent. Thus, one could be temped to draw the conclusion that our findings do not actually reflect an inflation stabilizing monetary policy, since there was no need to increase policy rates during the considered time period. However, in the first half of 1995 a rise in inflation expectation prompted the Banco de España to an aggressive rise of the interest rate. Moreover, in times when inflation expectations lie above the inflation target (1995 and beginning of 1998), the interest rate tends to increase and in times when inflation expectations lie below the inflation target (1996 and 1997), the interest rate tends to decrease.

Figure 3: Inflation Expectations and Nominal Interest Rates (1993 – 1998)
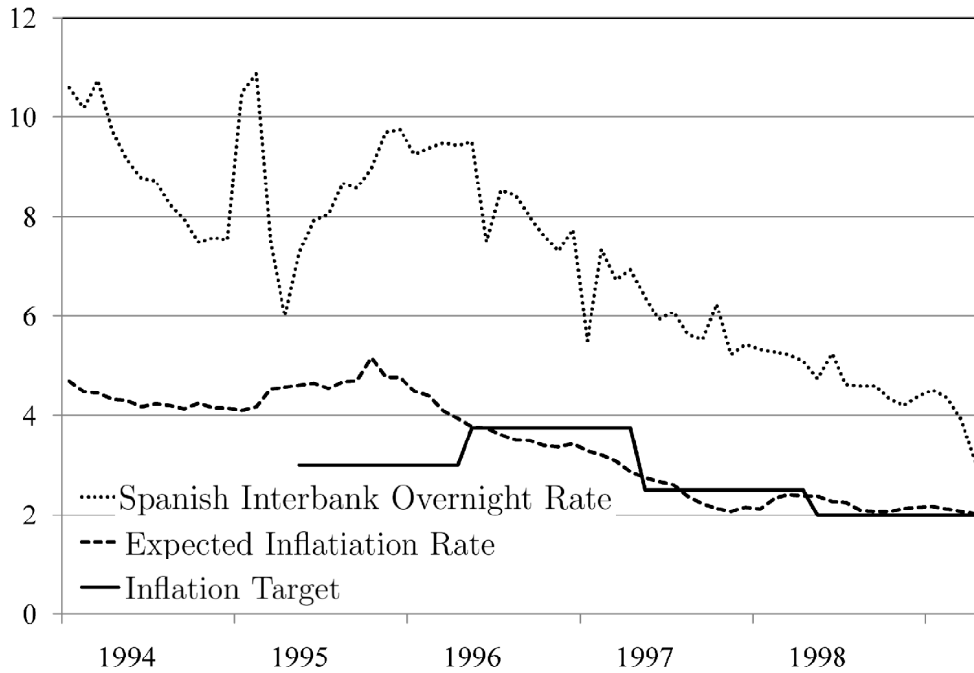
Note: Figure 3 shows the interest rate (fine dotted line), the expected inflation rate (dotted line), and the inflation target (solid line).

To summarize, we take these results as strong evidence that the Banco de España followed an inflation stabilizing monetary policy in the time period from January 1995 to December 1998.

5. MONETARY POLICY AFTER THE CHANGEOVER TO THE EURO

We now construct a hypothetical interest rate that potentially could have prevailed in Spain since 1999 if a central bank responsible for only the Spanish economy had followed a monetary policy that mirrowed the Banco de España pre-Euro monetary policy.[13] In order to do so, we calibrate the Taylor-type rule given by (4) with the point estimates reported in the first column of Table 2. Thus, we take and $\alpha_\pi = 2.05$ and $\alpha_{\bar{y}} = 0.00$, since the output gap parameter is not

significantly different from zero. The constant is calculated from $\alpha = \bar{\imath} - \alpha_\pi E\pi^*$. The average interest rate for the time period 1999 to 2007 is given by $\bar{\imath} = 3.08$. For the inflation target we use $\pi^* = 2$ which was the last inflation target announced by the Banco de España for the year 1998 and, moreover, also reflects the ECB's objective to keep inflation below but close to two per cent. Consequently, the constant is given by $\alpha = -1.02$.[14] The interest rate smoothing parameter is set to $\rho = .63$. The inflation forecasts, π_{t+12}, is based on Consensus Economics forecast data for the Spanish economy for the time period of January 1999 to December 2007.[15]

The dotted line in Figure 4 shows the hypothetical interest rate obtained by the outlined procedure. Additionally, we also calculate a hypothetical interest rate without interest rate smoothing (that is $\rho -.00$) shown as the dashed line which, however, does not change our results noticeably. Figure 4 also shows the actual interest rate (i.e. EONIA) that prevailed during the considered time period. As can be seen from Figure (4) the EONIA never really exceeds the hypothetical interest rate. However, from 1999 until the end of 2001 the hypothetical and actual interest rates do not differ by more than about one percentage point and move quite jointly. In contrast to this, since 2002 the interest rates drifted apart: whereas the hypothetical interest rate fluctuates between 4 and 6 per cent, the EONIA falls to about 2 per cent until the middle of

**Figure 4: EONIA and Hypothetical Interest Rate (1999 – 2007)**
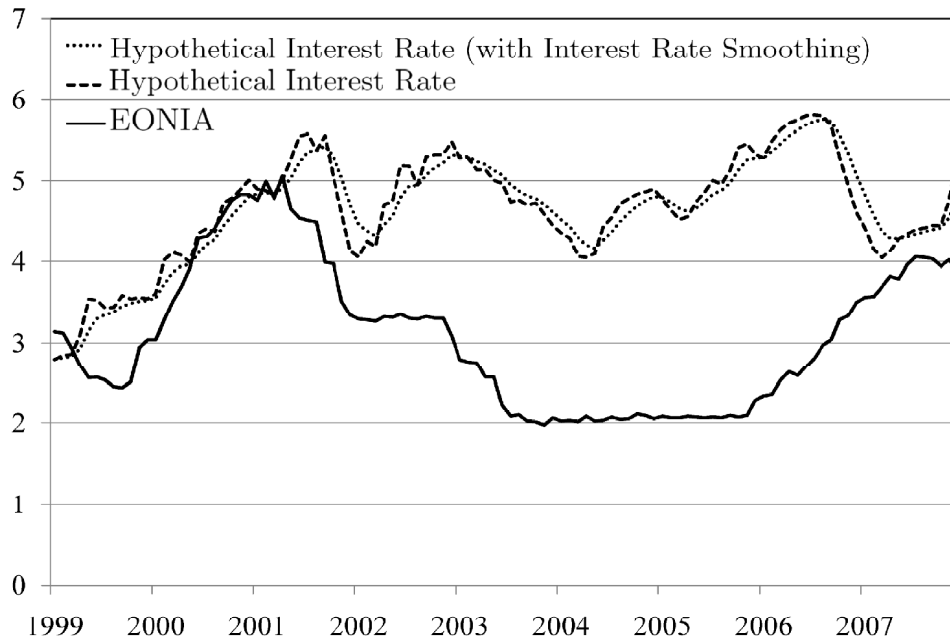
Note: The fine dotted line in Figure 4 shows a Hypothetical Interest Rate (with interest rate smoothing) based on (4)

$$i_t = \alpha(1-\rho) + \alpha_\pi(1-\rho)E_t\pi_{t+12} + \alpha_{\bar{y}}(1-\rho)E_t\tilde{y}_{t+12} + \rho i_{t-1} + v_t \text{ with } \alpha = 1.02, \alpha_\pi = 2.05; \ \bar{y} = .00 \text{ and } \rho = .63$$

reflecting the Banco de España's pre-Euro monetary policy. The dotted line shows the Hypothetical Interest Rate, but without interest rate smoothing – that is $\rho = .00$. The solid line shows the Euro OverNight Index Average (EONIA).

2003 and, subsequently, remains at this level for two and a half years. Interestingly, the gap between the house price index and the consumer price index previously shown in Figure 2 exactly started to accelerate at this time. In the second half of 2005 the gap between the EONIA and the hypothetical interest rate reached its peak with an interest rate differential of about 3.5 percentage points.

Figure 5 shows the spread between interest rates implied by three alternative Taylor-type rules and the EONIA. The solid line gives the difference between the interest rate implied by the Taylor-type rule with constant implicit inflation target and the EONIA, both shown in Figure 4. This difference can be interpreted as a measure of the inadequacy of the actual interest rate (EONIA). The dashed line depicts the spread which we obtained by using the Taylor-type rule with the officially announced time-varying inflation targets shown in the second column of Table 2. As can be seen, this would imply an even higher degree of inadequacy of the EONIA. Compared to this, the dotted line shows the difference between the interest rate based on Taylor's (1993) original rule[16] and the EONIA. The latter measure is also used by Bean (2010) to show the inappropriateness of the U.S. Federal Funds Rate before the financial crisis. Interestingly, our two alternative measures based on the Banco de España pre-Euro monetary policy move quite jointly with the one based on Taylor's original rule.

**Figure 5: Spreads between Interest Rates Implied by Different Taylor Rules and
the EONIA (1999 – 2007)**
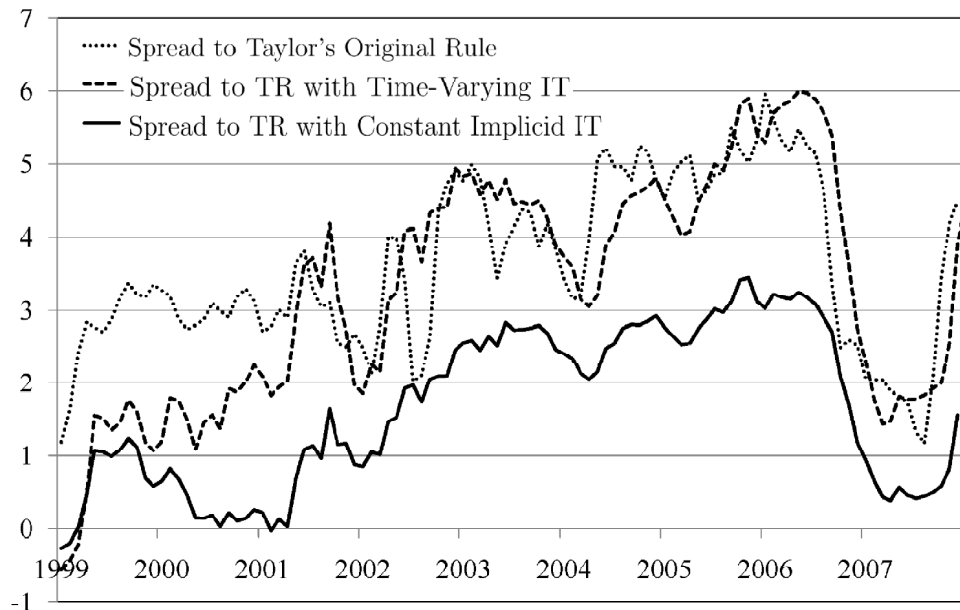
Note: Figure 5 shows the spreads between interest rates implied by different Taylor rules and the EONIA. The fine
           dotted line illustrates the spread between the interest rate based on Taylor's (1993) original rule and the
           EONIA. The dotted line is based on the interest rate obtained from a Taylor Type Rule with a time-varying
           inflation target and without interest rate smoothing (second column of Table 2). The solid line is based on the
           interest rate obtained from a Taylor type rule with a constant implicit inflation target and without interest rate
           smoothing (first column of Table 2).

At this point of the analysis we would like to clearly point out the limits of our approach. It is important to be aware that our results are based on a very strong ceteris paribus assumption. Our analysis assumes that potentially higher inflation rates would not have influenced future expectations for the inflation rate nor the output gap. That is, we do not incorporate the fact that alternative interest rates would have influenced the values of the expected inflation rate and the expected output gap. For example, a potentially higher interest rate in a certain point of time probably would have been associated with lower expected inflation rates and these lower expected inflation rates, in turn, would have been associated with a lower interest rate path. As a result, it is not possible to interpret the hypothetical interest rate as an interest rate that really would have prevailed if a central bank responsible for the Spanish economy would have followed the Banco de España's pre-Euro monetary policy from 1999 to 2007. In contrast, what the hypothetical interest rate really shows is how the interest rate would have been set if in a certain point of time a switching from the actual ECB monetary policy to the Banco de España pre-Euro monetary policy had taken place.[17]

As a further experiment we estimated equation (4) with the EONIA as the short-term interest rate and the expected inflation rate and the expected output gap for Spain for the period from 1999 to 2007. Not surprisingly, we do not obtain an inflation coefficient (significantly) greater than one. Hence, the *Taylor principle* does not hold.[18] As a consequence, increasing inflation expectations were associated with a fall in Spain's real interest rate. Put differently, the ECB's monetary policy clearly had an inflation destabilizing impact on Spain's economy. For illustration Figure 6 shows the EONIA and the expected inflation rate. In particular between 2002 and 2006 increasing inflation expectations are not offset by interest rate increases as the *Taylor principle* would have called for.

Figure 6: Inflation Expectations and Nominal Interest Rates (1999 – 2007)
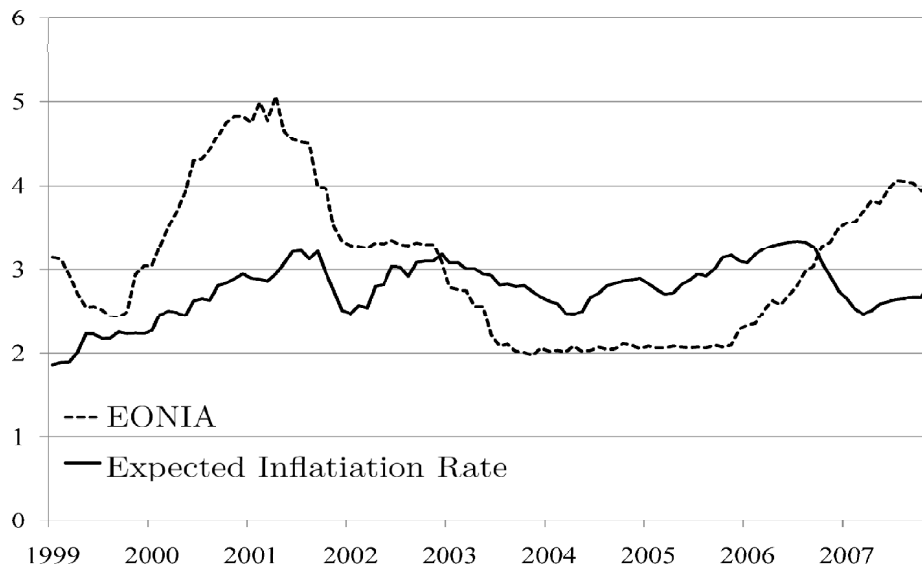
Note: Figure 6 shows the interest rate (fine dotted line), the expected inflation rate (dotted line), and the inflation target (solid line).

Bernanke (2010) generally points out, that a Taylor rule-based description of monetary policy is subject to a number of limitations. First, Taylor rules are only rules of thumb and there is disagreement about important detail regarding the construction of such rules. Second, many relevant factors are left out, for example the consideration of the zero lower bound. Third and in particular for this paper, the interest rate is not related to any asset price variables reflecting developments in the real estate sector. As a consequence, even advocates of Taylor rules point out that these rules are not a substitute for a more complete monetary policy analysis and should be used only as guidelines. However, although being aware of those limitations, our analysis provides clear evidence that the ECB's monetary policy was too expansionary for the Spanish economy.

## 6. SINGLE MONETARY POLICY AND SPANISH REAL ESTATE CREDIT CONDITIONS

Among others, Suarez (2011) relates Spain's expansionary monetary policy to the real estate bubble. He states that "monetary policy could have been a more effective tool to fight the real estate bubble but it was no longer under control of the Spanish authorities" (p. 15). We take this statement as a motivation to relate our findings of the previous chapters to the developments in Spain's real estate sector. We exclusively focus on Spain's credit conditions in the housing sector. In particular, we compare the actual conditions with the hypothetical conditions under a more restrictive monetary policy (conducted by a central bank only responsible for Spain).

We start by considering the mortgage real interest rate, which can be obtained by subtracting the expected inflation rate from the 'IRPH' mortgage interest rate for banks shown in Figure 1. The resulting mortgage real interest rate is shown in Figure 7 for the time period from January 1999 to December 2007. Whereas in the beginning of 2001 the mortgage real interest rate lies above three per cent, it falls under one per cent within the subsequent two years. From the beginning of 2003 to the end of 2005 it remains below one per cent, with a value of even slightly less than zero per cent in October 2005 marking its lowest level. Thus, during this period it was possible to finance real estate at (nearly) no real costs.

Figure 7 also shows an additional hypothetical mortgage real interest rate that we obtained by adding the differential between the hypothetical interest rate and the EONIA from Figure 4 to the real mortgage rate. This hypothetical mortgage real interest rate reflecting our "what if the Spanish Central Bank were still in place-scenario" is relatively stable during the entire time period and fluctuates between 2.7 and 3.9 per cent. Between 2001 and 2002 the gap between the hypothetical and the actual mortgage real interest rate grows to more than two percentage points. Between 2003 and 2005 the gap is always greater than two percentage points. In the second half of 2005 it even exceeded three percentage points. The application of our alternative measures of the inadequacy of monetary policy from Figure 5 would have implied an even higher hypothetical mortgage real interest rate.

We interpret the hypothetical real mortgage interest rate as a measure of how real mortgage interest rates would have developed under what Suarez (2011, p. 15) calls a "more effective monetary policy". The comparison of the actual and hypothetical mortgage real interest rate paths strongly suggests that cheap credit was an important driver of the Spanish housing bubble. Under an alternative more restrictive monetary policy (such as conducted by the Banco de

Figure 7: Mortgage Real Interest Rates and Hypothetical Mortgage Real Interest Rates (1999 – 2007)
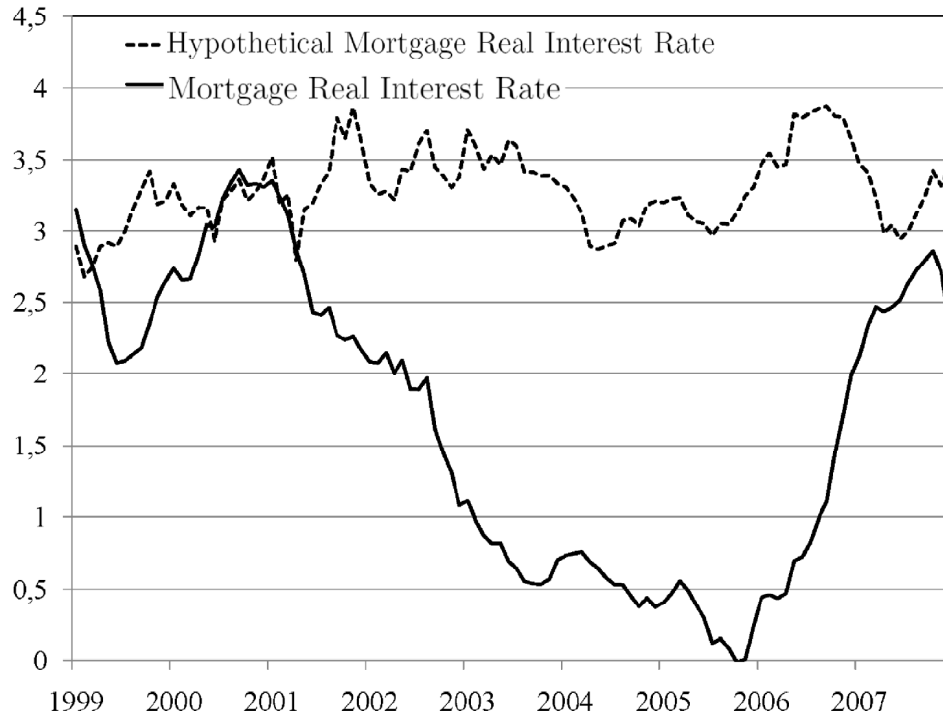
Note: The Solid line of Figure 7 shows a Mortgage Real Interest Rate obtained by subtracting the expected inflation
           rate from the *'IRPH' Mortgage Interest Rate (Banks)*. The dotted line represents a Hypothetical Mortgage
           Real Interest Rate, which is obtained by adding the Spread to the Taylor rule with constant implicit inflation
           target of Figure 7 to the Mortgage Real Interest Rate.

España before the changeover to the Euro) much of the trouble in Spain's housing sector might
had been avoided.

CONCLUSIONS

Based on estimated Taylor-type rules we investigated the Banco de España's monetary policy
before the changeover to the Euro and found that it contributed to stabilizing the Spanish
economy. We further examined how the interest rate would have been set if a central bank
exclusively responsible for the Spanish economy had been able to continue the Banco de España
pre-Euro monetary policy in the EMU period. Comparing this hypothetical interest rate path to
the actually observed path of the interest rate we come to the conclusion that the ECB's single
monetary policy was too expansionary for Spain's economy contributing much to cheap real
estate credit conditions. Thus, our findings has to be considered as an important explanation for
Spain's housing boom.

On a more general level, our analysis can be taken as an example for an asymmetric monetary
policy effect and reflects the "one-size-fits-all" problem of monetary union membership: In the

case of heterogeneous economic developments among the member states, it is impossible for the central bank to conduct an appropriate monetary policy for all members.

Appendix
Calculation of the Weighted Average of Expected GDP and CPI

In order to generate a forecast f_t with a twelve-month forecast horizon, we calculated a weighted arithmetic average of the forecast for the current year f_t^{cur} and the next year f_t^{next}. We weight the forecast f_t with the remaining number of month m (with 1 (= December) $\leq m \leq 12$ (= January)) at the time of the forecast t. The twelve-month *GDP* and *CPI* forecast f_t are as follows:

$$f_t = \frac{f_t^{cur} \cdot m + (12 - m) \cdot f_t^{next}}{12} \qquad (A.1)$$

This procedure is also applied by Gorter *et al.* (2008), Heppke-Falk and Hüffner (2004) and Beck (2001). All studies deal with data of Consensus Economic Forecast poll and construct the arithmetic average outlined above.

NOTES

1. Bean (2010) offers an excellent overview about the causes of the financial crisis and the subsequent recession.

2. Readers that are quite familiar with the literature on Taylor rules might skip this section.

3. Since it contains expectations on the right-hand side that are not directly observable it is common to substitute them by the observed ex-post levels of the respective variables and rearrange the estimation equation into a form that contains the expectation errors of the central bank in the error term. This form is then estimated based on the General Methods of Moments.

4. In particular, for the output gap the literature demonstrated that it is relevant to distinguish between ex post and real-time data (Orphanides, 2001). Since we use observed expected variables in our analysis, all variables are available to the central bank in real-time.

5. Since this issue is also not of a strong concern in the present paper, we refer to the related literature. See, for instance, Rudebusch (2006).

6. Gorter *et al.* (2008) use the Consensus Economics poll to estimate a Taylor-type rule for the ECB. Compared to this, Bernanke and Woodford (1997) show that strict inflation targeting based on private sector forecasts is inconsistent with the existence of rational expectations equilibrium, and that policies approximating strict inflation-forecast targeting are likely to have undesirable properties.

7. The participants are professional economists working for universities and financial institutions such as international economic research institutes, investment and commercial banks. Further information concerning the survey can be found in the website: *www.consensuseconomics.com.*

8. Furthermore, Dovern and Weisser (2011) show that forecasters in the Consensus Economic survey provide rational forecasts.

9. See Appendix for the concrete formula.

10. Since we use monthly data, we use a $\lambda = 129,600$ as suggested by Ravn and Uhlig (2002).

11. In our subsequent analysis we will we allow for an observable time-varying inflation target.

12. We use the inflation targets reported in Bernanke *et al.* (1999). For the time period the *Banco de España* announced a target range, we take the average value of this range in order to obtain a point target.

13. The generation of a hypothetical interest path based on the parameter values of an estimated Taylor-type rule – which is indeed a strong ceteris paribus assumption – is also standard in the literature of Taylor rule based analysis (see Bean, 2010; Bernanke, 2010; Taylor, 2007).

14. As an alternative we also used our estimate for the constant shown in the first column of Table 2. This would imply $\alpha = .00$, since the reported value is not significantly different from zero. However, we do not decide for this option, because $\alpha = -1.02$ can be interpreted as the more defensive estimate as will become clearer in the subsequent analysis.

15. Note that we do not need any output gap forecasts, since the output gap coefficient is set to zero.

16. Note that the original Taylor rule implies values of $\pi^* = 2.00$, $\alpha_\pi = 1.50$, $\alpha_{\tilde{y}} \leq .50$, and $\rho = .00$. Moreover, we replaced the expected inflation rate and the expected output gap by the actual inflation rate and the actual output gap. We also calibrated Taylor's original rule with our expectational data and found a slightly different interest path. However, it never falls below the interest rate path based on a Taylor-type rule with constant implicit target given by the solid line in Figure 5. Hence, the main massage remains unchanged.

17. The potential endogeneity of expectations is indeed a valid argument against our analysis. One way to deal with it and suggested by a referee is to go along the way towards estimated DSGE models. However, incorporating an explicit expectation formation process is not an easy task to do and, moreover, not the objective of our paper since the expectations we use is observed forecast data taken from the Consensus Economics forecasting poll. The estimation of Taylor-type rules with such data is commonly applied in the literature and potential endogeneity issues are taken into account by applying the General Methods of Moments (GMM) as an estimation technique (Gorter *et al.*, 2008). Furthermore, the generation of a hypothetical interest path based on the parameter values of an estimated Taylor-type rule is also standard in the literature of Taylor rule based analysis (Bean, 2010; Bernanke, 2010; Taylor, 2007).

18. Regression results are not reported here, but are available upon request.

19. We remind the reader of the ceteris paribus assumption concerning the interdependence of different variables (see Section 5) and therefore caution against misinterpreting the hypothetical mortgage real interest rate.

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