Joebges, Heike; Dullien, Sebastian; Márquez-Velázquez, Alejandro

Research Report

What causes housing bubbles? A theoretical and empirical inquiry

IMK Study, No. 43

Provided in Cooperation with:
Macroeconomic Policy Institute (IMK) at the Hans Boeckler Foundation

Suggested Citation: Joebges, Heike; Dullien, Sebastian; Márquez-Velázquez, Alejandro (2015) : What causes housing bubbles? A theoretical and empirical inquiry, IMK Study, No. 43

This Version is available at:
http://hdl.handle.net/10419/148241

IMK
Institut für Makroökonomie
und Konjunkturforschung
Macroeconomic Policy Institute

Dezember 2015 43

Study

Heike Joebges[1], Sebastian Dullien[2],
Alejandro Márquez-Velázquez[3]

What causes housing bubbles? A theoretical and empirical inquiry[4]

The paper investigates in how far lax monetary policy (defined as deviations from prescriptive monetary policy rules or past trends) and/or financial innovation can be seen as a cause for housing price bubbles in industrialized countries. From a theoretical perspective, it is found that there are hardly any clearly formulated economic models which assign a role to lax monetary policy in bubble formation while there are a number of models which assign a role to financial innovation or liberalization. In the empirical part, the paper first presents cross-country-time-series SUR regressions for a sample of 16 industrialized countries. According to the results, there is no robust significant role for the relevance of loose monetary policy, measured by deviations from the Taylor rule. Instead, deviations from the past trend of the real policy rate affect housing prices, but the size of the effect depends on the regulation and development of the financial sector. In a third step, three case studies of the United States, Austria and the United Kingdom are presented, representing countries which have experienced a) lax monetary policy and a bubble b) lax monetary policy without a bubble and c) no deviation from the Taylor rule and a bubble. The case studies hint that specific changes in regulations played a role for the emergence or absence of bubbles, yet these regulations might not be appropriately covered by standard quantitative indicators for financial market (de-)regulation.

[1] HTW Berlin, Heike.Joebges@htw-berlin.de
[2] HTW Berlin, Sebastian.Dullien@htw-berlin.de
[3] HTW Berlin, AlejandroMarino.MarquezVelazquez@HTW-Berlin.de
[4] This research project is funded by the Macroeconomic Policy Institute of the Hans-Böckler-Foundation. We are grateful for the financial support.

What causes housing bubbles? A theoretical and empirical inquiry[1]

Heike Joebges,[2] Sebastian Dullien,[3] Alejandro Márquez-Velázquez[4]

November 2015

Study for the Macroeconomic Policy Institute, Hans-Böckler-Foundation, Düsseldorf

[1] This research project is funded by the Macroeconomic Policy Institute of the Hans-Böckler-Foundation. We are grateful for the financial support.

[2] HTW Berlin, Heike.Joebges@htw-berlin.de

[3] HTW Berlin, Sebastian.Dullien@htw-berlin.de

[4] HTW Berlin, AlejandroMarino.MarquezVelazquez@HTW-Berlin.de

Table of Contents

List of Abbreviations

BBVA	Banco Bilbao Vizcaya Argentaria
BIS	Bank for International Settlement
BoE	Bank of England
CDO	Collateralized Debt Oblication
CDS	credit-default-swaps
CFMA	Commodity Futures Modernization Act
CPI	Consumer Price Index
DSTI	debt-service-to-income
ECB	European Central Bank
EGLS	equations by generalized least squares
EU	European Union
EU-28	European Union Member Countries as of 1st July 2013
Fannie Mae	Federal National Mortgage Association
Fed	United States Federal Reserve System
GDP	Gross Domestic Product
GE Capital	General Electric Capital
GLBA	Glass-Leach-Bliley Act
GLS	Generalized Least Squares
GMAC-RFC	General Motors Acceptance Corporation – Residential Funding of Canada
HP	Hodrick-Prescott
IMF	International Monetary Fund
LTV	loan-to-value
OeNB	Oestererichische Nationalbank
OECD	Organisation for Economic Co-operation and Development
ONS	Office of National Statistics
RMBS	residential mortgage-backed-securities
SUR	Seemingly Unrelated Regressions
UK	United Kingdom
US	United States
VAR	Vector Autoregression

List of Tables

List of Figures

1 Introduction

The recent house price booms and busts in advanced economies have revived the debate about the causes of asset price bubbles. Taylor (2007) is the most prominent scholar blaming “too loose” monetary policy. He argues that the housing bubble seen in the US during the mid-2000s was mainly the consequence of the Fed’s excessively accommodating monetary policy According to him, the Fed’s policy interest rate was too low when compared to the rate suggested by a Taylor rule and this has led to exuberance in the residential real estate market. In a similar line of arguments, authors from the Bank of International Settlement (Borio and Lowe, 2004, 2002; White, 2006) have proposed that asset price inflation and not just output and consumer price inflation should be taken into account when setting policy rates, implicitly also supporting the argument that lax monetary policy can cause bubbles. In a similar vein, the IMF (2008) suggests that monetary policy should consider the developments of house prices in countries where the mortgage market is highly developed.

The ‘saving glut’ hypothesis is also linked to the argument of low interest rates causing bubbles, but the blame is not on the national central bank. According to Bernanke (2010, 2005), high saving rates in emerging markets have led to a global excess of savings which has poured into the United States in the form of capital imports and depressed the level of (long-term) interest rates, which the Fed could not counteract. The idea of capital inflows causing housing bubbles is also found in the literature on house price bubbles in emerging markets (Favilukis et al., 2013).

An alternative explanation is that financial innovation has caused the bubble. Originally pioneered by Minsky (1986) who argued that new financial products and procedures have repeatedly been important for the United States’ economy’s transition from “hedge finance” to “speculative finance” and hence “Ponzi finance”, Bernanke (2010) as well as the IMF (2008) and Dokko et al. (2011) have made out financial innovation at least as a contributing factor to the recent house price bubble in the United States and other advanced economies.

Our aim is to relate this policy debate to more recent academic research on housing bubbles and complement the existing empirical studies. The focus is on housing bubbles only, and not on asset price bubbles in general, as the empirical literature points to differences in duration and varying explanatory variables for housing versus stock price bubbles that call for separate estimation approaches (see e.g. IMF 2009; Bordo and Landon-Lane 2013a,b).

Before presenting the empirical literature on the causes of housing bubbles, we will briefly summarize the theoretical models that aim to explain such bubbles. As will be discussed in more detail in section two, bubbles occur once an asset price exceeds the asset's fundamental value (Brunnermeier 2008), yet there is no consensus on how to model the fundamental value – a fact that hinders theory-based empirical investigations. Interestingly, the theoretical literature does neither provide a detailed analysis for the causes of housing bubbles (Brunnermeier 2008). Price bubbles are attributed either to information asymmetries, to heterogeneous beliefs among agents, or to the interactions of two different groups of traders, of which only one acts rationally, however based on distorted price signals due to the actions of the other group (Black 1986, Brunnermeier 2008, Shleifer and Vishny 1997). Yet, "... most of these models do not address the question of whether monetary policy easing can start a bubble" (Dokko et al. 2011: 264).

Interestingly, only few empirical cross-country studies for housing bubbles, presented in section three, try to explain the role of economic policy in bubble formation, even though this discussion is at the center of the policy debate. The few that explicitly control for the stance of monetary policy provide diverging results: While Bordo and Landon-Lane (2013a,b) conclude that deviations from Taylor-rule recommendations contribute to bubble formation in housing prices, albeit not in all cases, Dokko et al. (2011) instead stress the role of financial innovation and deregulation. While both studies use OECD house price data starting in the 1970s, econometric approaches and explanatory variables used differ. For instance, the latter group of authors does not use deviations from the Taylor rule as an explanatory variable, but controls for monetary policy by using a broad set of relevant indicators.

Therefore, our aim is to complement the existing empirical studies. In order to be able to compare our results with existing ones, we try to use similar explanatory variables that e.g. include the deviation of a Taylor rule as a measure for the stance of monetary policy. We also follow the predominant approach in identifying housing bubbles by strong increases in real housing prices that are followed by busts. Yet, we deviate from the prevailing use of the OECD housing data series as they are not well documented. Our detailed and well documented BIS data series nevertheless have the drawback to provide time series with rather limited length. But as we anyway doubt regression results based on time series starting in the 1970s without controlling for structural breaks, we prefer to rely on our later starting data.

With the detailed BIS series, we cover the period 1990 to 2012 for a sample of 16 countries (sample 1). As a robustness check, we control our results with the long series that the BIS has recently started to offer. Sample 2 based on the long series runs from 1985 to 2012. Due to our nevertheless shorter time series compared to data based on OECD series,

the often used VAR approach for housing data is not an option. Instead, we rely on cross-country-time-series SUR regressions for a binary bubble indicator that takes the value one during a housing price boom and zero otherwise. We run several robustness checks, e.g. using a ternary boom indicator, different versions of exogenous variables, and a probit regression as an alternative estimation approach. Interestingly, we cannot find a significant role for the relevance of loose monetary policy measured by deviations from the Taylor rule. Instead, our results indicate that deviations from the past trend of the real policy rate affect housing prices, but the size of the effect depends on the regulation and development of the financial sector. Yet, as other studies, we have problems to quantify the interaction and to identify precise indicators for the financial sector.

As our regression results point to the importance of country specific determinants regarding the role of the financial sector, we additionally provide three case studies of selected countries: Austria and the US have been selected as two countries that are characterized by a loose stance of monetary policy if judged by standard Taylor rule settings. Yet, while the US has suffered from a housing bubble, Austria has not. The third case study presents the UK for a period when monetary policy followed Taylor rule prescription, but did not prevent a bubble. These case studies are supposed to illustrate the important role of institutional settings for housing bubble formation. The case studies are therefore a necessary and insightful complement of the regression approach, as they also explain, why single indicators for housing regulation or financial market developments used in our regression cannot capture the combined influence of different institutional settings.

The next section will provide the theoretical literature review, section three will cover empirical studies for housing bubbles, concentrating on those regression approaches that focus on cross-country studies and control for monetary policy influence. Section four will present our empirical approach, section five discusses the case studies, and section six concludes.

2 Theoretical Literature Review

When looking at the bubble literature and their treatment of potential causes for bubbles, one needs to distinguish between more policy-oriented approaches and more technical models for the emergence of bubbles. In general, the policy-oriented models do not include fully-fledged economic models for bubbles while most of the theoretical models leave open the question which factors actually trigger the bubble. In this section, we will give an overview over theoretical bubble models. Yet, before moving towards theory, we first need to define

what a house price bubble actually is. To this end, this section starts with a review of the definition of a housing bubble. In a second step, we will provide an overview of theoretical bubble models. Before concluding, the third subsection of this section will attempt to summarize which triggers proclaimed in the policy debate can be found within the theoretical bubble literature.

2.1 Defining a Housing Bubble: Deviation from the "fundamental" value

While there is no firm consensus about what actually constitutes a housing price bubble in the literature (Barlevy, 2012; Mayer, 2011), the most common understanding is that house price bubbles are situations in which the price for houses exceeds their fundamental value (Brunnermeier, 2008). Such a deviation is possible as houses are assets and hence some buyers might be willing to pay a higher price for houses than is fundamentally justified as they believe in further price increases. In the words of Stiglitz (1990, p. 13), 'if the reason that the [asset] price is high today is *only* because investors believe that the selling price will be high tomorrow – when "fundamental" factors do not seem to justify such a price – then a bubble exists'.

While this theoretical definition is rather straightforward, its empirical application is rather complicated, as will be discussed in detail in section 3. Interestingly, most of the empirical literature does not try to really define a "fundamental" value for houses in order to detect bubbles. Instead, most contributions look either at rapid price increases in nominal or real house prices (Mayer, 2011) or in deviations from certain ratios such as house-price-to-rent or house-price-to-income ratios to determine whether a bubble is present, e.g. as in McCarthy and Peach (2004). Often, in a second step, it is then tested whether certain variables such as interest rates can empirically help to explain such price movements. Here again, the variables included are not always derived from theoretical considerations. Instead, often a number of just plausible variables are included. For example, Case and Shiller (2003) run econometric regressions to explain the housing price level and its changes in different US states with proxies for a series of variables considered as fundamentals, such as: personal income, employment and unemployment, construction costs, population, residential investment and mortgage rates, in their attempt to assess whether there were housing bubbles in the US during the 1985–2002 period.

Yet, a closer look at the theoretical determination of house price bubbles shows that this research approach needs to be treated with care. One of the problems here is that this approach does not allow to distinguish between price changes due to changes in the fundamental value of a house and the beginning of a bubble. While in the end, it might not be

possible to detect a bubble with certainty and using arbitrarily defined thresholds as proxies might be the only viable approach, one needs to be aware of the limitations of this approach, when interpreting the results.

To understand this proposition, it is useful to take a look at the possible determinants of the fundamental value of a house. For the case of a house, in line with valuation approaches for other assets, a valuation can be done by discounting future returns (including a final resale price). The fact that a house is at the same time a durable consumption good from which households get utility by using it does not contradict this approach. As rental houses are (at least to a certain extent) substitutes for houses owned outright by the household, the monetary value of the utility derived from living in a house should be roughly the same as the rent. If we further assume that a house well maintained has an almost indefinite life-span, and that future buyers are again valuing a house by future payment flows, the value of a house should be equal to the discounted rents minus the discounted costs of maintaining and renting out the house.[5]

Mathematically, we can summarize this argument as follows and write the value of a house in period 0 as a function of net rents:[6]

$$V = \sum_{t=1}^{\infty} \frac{1}{(1+r)^t} NR_t \tag{1}$$

with V denoting the present value of a unit of housing, r denoting the nominal discount rate, NR_t denoting the net rent in period t (after deduction of capital depreciation, maintenance and service costs) in period t.[7] It is important to note that r here is not the short-term interest rate, but the expected discount rate over a long period of time and can hence be expected to be much more stable than the short-term interbank rate. Moreover, as houses are less liquid than bank deposits or government bonds and arguably carry a higher idiosyncratic risk, the discount rate to be used here can be expected to carry a risk-premium above the risk-free return on government bonds.

The question is now how rents behave over time. If supply is completely elastic and rental markets competitive, rents should not deviate much from costs (including capital costs)

[5] For physical investments, instead of financial cash flows, usually net operating income is used. For houses, net operating incomes equals net operating rents.

[6] See e.g. Scherbina (2013) or more fundamentally Brealy et al. (2007).

[7] In order to keep the exposition in line with the literature on the valuation of perpetual cash flows, it has been assumed here that the initial investment has been made in t=0, but payments only start in t=1.

to supply new housing. This leads us to the question how costs for providing rental dwellings develop over time. Shiller (2008) makes the compelling argument that construction costs should increase with the general price level, at least when the supply of building land is elastic. According to Shiller, a house is a structure built from reproducible materials such as bricks, wood, pipes and electrical lines and the cost of putting this structure together should roughly develop with costs of producing other goods and services in the economy.

If we follow this idea, we can write net rents in period t as a function of rents in period t-1 and the rate of inflation:

$$NR_t = (1+\pi)NR_{t-1} \tag{2}$$

Consequently, we can write rents in period t also as a function of rent in period 1 and the average rate of inflation in the future:

$$NR_t = (1+\pi)^{t-1}NR_1 \tag{3}$$

substituting (3) into the valuation formula (1) gives us

$$V = \sum_{t=1}^{\infty} \frac{(1+\pi)^{t-1}}{(1+r)^t} NR_1 \tag{4}$$

Pulling $(1+\pi)$ out of the sum and using (3) leads us to

$$V = \frac{1}{(1+\pi)} \sum_{t=1}^{\infty} \frac{(1+\pi)^t}{(1+r)^t} (1+\pi)NR_0 \tag{5}$$

Simplyfing and letting the sum start at t=0 (which implies substracting NR_0 again) gives us

$$V = \left[\sum_{t=0}^{\infty} \frac{(1+\pi)^t}{(1+r)^t} NR_0\right] - NR_0 \tag{6}$$

which allows us to apply the rule for geometric series which yields:

$$V = \frac{1+r}{r-\pi} NR_0 - NR_0$$

(7)

Again, it is important to note that inflation in this equation is not the rate of price changes in one given year, but the average (and assumed constant) expected rate of inflation over the life-time of the house. An important result deriving for (4) is that the value of a house (V) decreases when the long-term discount rate (r) increases, under normal economic circumstances.

Of course, completely elastic supply for housing is probably an excessive simplification. While Shiller (2008) argues that in the United States, space for potential construction is unlimited and over the long term, even new cities can be built, this certainly does not hold for large parts of Europe. Here, construction space is more limited, be it because of actual physical scarcity or building restrictions. Moreover, even if new cities can be built and land formerly used for other purposes such as agriculture or commerce may be turned into building plots for residential real estate, a completely elastic supply can only be assumed if returns on the other uses remain constant. Yet, with growing incomes and hence growing demand on land for other uses, the assumption of completely elastic housing demand seems less plausible.

If the supply for houses is inelastic, however, rents might increase more strongly than overall prices. In this case, the increase in demand for housing is the important factor determining the price increase and, as is known from microeconomic theory, this in turn depends on the functional form of the households' utility function and the development of disposable income.

If a Cobb-Douglas utility function is assumed, for example, the income share spent on a single good remains constant. Hence, the price elasticity of demand for each single good is minus 1 and the income elasticity for each good is also 1. With inelastic supply, this would imply that rents should be expected to increase with the same rate as overall incomes. Using g to denote the growth rate of real disposable incomes, this would give us for rents:

$$NR_t = (1 + \pi + g)^t NR_0 \tag{8}$$

and hence for the valuation of a house:

$$V = \frac{1 + r}{r - \pi - g} NR_0 - NR_0 \tag{9}$$

To gauge the impact of changes in the long-term equilibrium rate of inflation and discount rate on the value of a house, we can form the first derivatives, which for the case of elastic housing supply (7) are:

$$\frac{\partial V}{\partial r} = -\frac{1+\pi}{(r-\pi)^2} NR_0 \tag{10}$$

$$\frac{\partial V}{\partial \pi} = \frac{1+r}{(r-\pi)^2} NR_0 \tag{11}$$

The partial derivative (10) is negative under normal economic circumstances,[8] which means that the value of a house (V) decreases when the long-term discount rate (r) increases, ceteris paribus. Moreover, (11) is positive under normal economic conditions[9] and, therefore, means that the value of a house increases with inflation, ceteris paribus.

Furthermore, under the special case of perfectly inelastic housing supply, price elasticity of demand for housing of minus 1 and an income elasticity of housing demand of 1, the long-term rate of change of disposable income also influences the impact of changes in the discount rate and the inflation rate on house prices:

$$\frac{\partial V}{\partial r} = -\frac{1+\pi+g}{(r-\pi-g)^2} NR_0 \tag{12}$$

$$\frac{\partial V}{\partial \pi} = \frac{1+r}{(r-\pi-g)^2} NR_0 \tag{13}$$

Here, (12) is negative and (13) positive under normal economic conditions.[10]

An interesting question is now how the discount rate is to be interpreted. Girouard et al. (2006) interpret such a discount rate as the mortgage rate plus some kind of risk premium (because a household borrowing in order to buy a house takes on some of the risk of real estate ownership). If we follow this reasoning and assume that this risk premium is constant, the discount rate would be roughly proportional to the long-term average of the nominal mortgage rate in a country.

[8] For $\pi > -1$ and $r \neq \pi$.

[9] For $r > -1$ and $r \neq \pi$.

[10] (9) is negative as long as $\pi + g > -1$ and (10) is positive as long as $r > -1$. Moreover, both equations need to satisfy $r \neq \pi + g$.

Unfortunately, even with these considerations, it is not straightforward to calculate fundamental house prices. First, two measures crucial for the valuation of housing according to the above formula are not easily available. The expected long term rate of inflation is not directly measurable, but can only be inferred from other variables and this deduction carries a number of difficulties. Also, the long-term equilibrium mortgage rate is not something observable. In many countries, long-term mortgages (beyond 10 years) are not routinely offered. Especially if nominal interest rates are low (and hence discounting beyond the horizon of 10 years might have a significant impact on present values), this is a potentially serious problem. Finally, "net rents" might be a simple theoretical concept, but to apply it can easily get very messy as a number of factors including national tax provisions, rent controls and legal rulings on the balance of rights between landlords and tenants enter this variable, which differ widely in international comparison.

Nevertheless, even without being able to compute the exact fundamental value for houses, we can draw a number of interesting insights from this result:

1. The value of a house depends strongly on the equilibrium long-term real interest rate in a country. Lower long-term equilibrium interest rates mean a permanently higher level of house prices (this is not a bubble).

2. A stable price-to-rent-ratio (as is sometimes used in the literature to look at potential bubbles) is something one only can expect when the expected nominal long-term interest rate, the expected long-term rate of inflation and – for cases in which supply of housing is inelastic – the expected long-term growth rate of the economy remain unchanged.[11]

3. A stable price-to-income ratio (as is also sometimes used in the literature) also cannot necessarily be expected. Again, this ratio can only be expected to remain stable when interest rates and inflation expectations remain unchanged.[12]

4. The lower long-term real interest rates ($r - \pi$), the more sensitive equilibrium house prices become to changes in the interest rate. A percentage point change in the equilibrium real interest rate from 10 to 9 percent for example increases the fundamental value of housing by roughly 10 percent while a fall from 2 to 1 percent would roughly double the fundamental value of housing.

Thus, some of the indicators occasionally found in the literature cannot be reliably used to spot a bubble. Changes in price-to-rent or price-to-income ratios (both in absolute terms or relative to an historical average) can only serve as an indicator in times when one can be reasonably sure that neither the expectations about the long-term natural rate of interest nor about the long-term rate of inflation change – something that is difficult to argue at least for

[11] Alternatively, when changes in these variables occur as long the ratios in (4) and (6) remain constant.

[12] Refer to previous footnote.

the time since the late 1980s for which there is ample evidence discussing fundamental macroeconomic changes in at least some, if not in all, industrialized countries (financial liberalization, the “Great Moderation”, the introduction of the euro and the emergence of China as a factor reining in inflation).

More importantly, these results demonstrate that there are deeper conceptual challenges for some of the existing empirical research on house price bubbles: Some of the potential culprits for house price bubbles such as the short-term interest rate set by the central bank can clearly be argued to show a strong correlation with some of the determinants of house prices fundamentals. If, for some reason, the long-term profitability of capital (and hence the so-called natural rate of interest) falls (as has been argued lately for the post-2009-period), one would expect that the central bank also cuts its interest rate and will keep it low for an extended period of time. Rational investors would realize this development and hence would also adjust their own discount rates downwards. In this case, house prices could be expected to go up because the fundamental value has increased. Yet, this would not be a bubble as the house price development would be a result of a change in underlying fundamentals and no fall should be expected unless the fall in long-term capital profitability reverses. Any econometric research trying to identify triggers for bubbles by simply looking at the determinants for house price increases in such a situation would wrongly conclude that loose monetary policy causes house price bubbles.

A similar argument holds for other factors which permanently alter the long-term interest rate. For example, if macroeconomic volatility is brought down (as has arguably happened in the time of the “Great Moderation”), one would expect risk premia and hence the long-term interest rate to fall. Here again, one should expect a fundamental increase in house prices and certain research designs might be prone to interpret this development erroneously as a bubble.

Thus, it is important not only to look at house price *increases*, but at episodes which are clearly *bubbles*. As will be discussed in section 4, our solution to this problem has been to identify bubbles by strong price increases, followed by strong price corrections. While this measure might not be perfect in all cases (it would be perceivable that there are two following shocks to the fundamentals which cancel out each other), it seems to be the best available approach and it is not as open to erroneously identifying bubbles as defining bubble episodes as any periods with strong price increases.

2.2 Theoretical Bubble Models

The literature concerned with developing analytical models to explain the rise, existence and burst of asset price bubbles can be divided into an early and later strand of rational bubble models, and a series of more recent behavioral models (Scherbina, 2013), or alternatively into rational and behavioral models, distinguishing these further by separating the rational expectation models into those with symmetric and asymmetric information and the behavioral models in those in which only some or all agents deviate from the rational-expectation assumption (Brunnermeier, 2009). In the following, we follow Scherbina's (2013) classification.

2.2.1 First Generation Rational Expectations Models

The first generation rational expectations models on bubbles link to the early contribution on bubbles such as Blanchard (1979) and Blanchard and Watson (1982) which derived their conclusions about bubbles from the explosive solution path of rational expectation models. These models were mostly concerned with proving or disproving whether bubbles were in general possible for different asset classes under the assumption of rational expectations. As Scherbina (2013, p. 8) points out, this literature mainly managed to show that under a wide range of assumptions, asset price bubbles were impossible.

An exception is the model by Allen, Morris and Postlewaite (1993). The authors notice that if all agents are rational and are trading finitely-lived assets, agents have to be aware that the assets' present value has to be equal to the facial value discounted by the discount rate, otherwise there would be arbitraging opportunities. However, if agents are not sure whether all the other agents are rational, there is asymmetric information. When this asymmetry is combined with a situation of an overpriced asset, i.e. a bubble, such overvaluation will be sustained by the belief that some non-rational agent might buy the asset. Furthermore, the bubble will continue to exist if there are short-selling limitations in the market.

2.2.2 Second Generation Rational Expectations Models

Newer rational expectations models generally keep the assumptions that all agents have rational expectations, but they add institutional features or deviations from the standard utility function to derive models in which bubbles can exist. The authors within this literature developed models that attempted to explain bubbles by showing that rational agents could follow a herd behavior or under certain institutional settings of the banking sector can cause bubbles. A prominent model representative of the later strand of the rational bubbles

literature, which still does not depart from the assumption that all agents are rational, is the one developed by Scharfstein and Stein (1990). In this model rational professional investment managers are worried about their labor market prospects and, therefore, adopt a herd behavior with respect to the investment decisions made by their colleagues, without paying attention to fundamentals. By behaving as the rest of the 'herd', managers investing under uncertainty can protect their labor market prospects when bubbles burst because they can share the blame with the majority of managers that contributed to inflate the bubble.

Another model within this later strand of rational bubbles is the one presented in Allen and Gale (2000). The authors' model aims to explain how bubbles can arise in a bank-based economy because of the agency problem generated by the limited liability of borrowers in combination with a fixed supply of risky assets. If rational investors only have limited liability, but can borrow from banks, they have an incentive to continue investing even in overpriced assets as long as there is uncertainty about the duration of prices remaining above the fundamental. The logic behind this behavior is that in the case of a bursting bubble, the bank has to bear the losses, yet as long as the bubble continues, the investor can pocket the profits. The authors list as potential sources of uncertainty shocks to the rate of return of real investments, uncertainty about the duration of a credit expansion (either because of uncertainty about the future path of monetary policy or about the impact of financial deregulation) or uncertainty about financial fragility.

One last recent rational expectations model worth presenting is that of DeMarzo, Kaniel and Kremer (2008), which also features a finite horizon in the vein of the models presented in Allen et al. (1993) and Allen and Gale (2000). However, while short-sale restrictions, asymmetric information and agency problems are key features in the latter models, the model of DeMarzo et al. (2008, p. 24) does not rely on these characteristics. Although bubbles arise in this model because of herding behavior, its trigger differs from the reputation concern of managers modeled in Scharfstein and Stein (1990). In DeMarzo et al. (2008) the driver of the herding behavior is the concern about relative wealth that agents have, which leads them to follow the so-called 'keeping up with the Joneses' behavior pattern. The herding behavior arises in an overlapping generations model, with a limited supply of assets and within which prices are driven by the wealth of agents, so that an agent's possibility to get hold of an asset will depend on its relative wealth. This constellation creates the incentives for herd behavior from young agents that want to be able to maintain their relative wealth in future periods as asset prices increase, even if they are aware that they are feeding a bubble that might burst.

2.2.3 Behavioral Bubble Models

In behavioral bubble models, the assumption of rational expectations is relaxed. Instead, all or at least some of the agents in the model form their expectations about the future in a way which deviates from rational expectations. Within this literature authors develop models that explain bubbles ensuing from difference of opinions between bounded-rational agents or from the behavior rules, such as feedback-trading, that some non-rational agents might follow. Bubbles in many of these models are conceived as under- or over-reactions to shocks. For example, the model of Scheinkman and Xiong (2003) predicts bubbles because of the combined effects of finitely supplied assets being traded by agents that are bounded rational in a market with short-selling restrictions.

The authors represent bounded rationality as the agents being overconfident about the models they use for interpreting information that is available to all agents. Moreover, agents are aware that their peers might interpret the same information differently. In other words, agents trade assets because they 'agree to disagree' (Scheinkman and Xiong, 2003, p. 1185), and this behavior makes the price of finitely supplied assets differ from their fundamentals. A more recent model presented in Hong, Scheinkman and Xiong (2006), which attempts to explain the bust of the US dotcom bubble in the early 2000s, also exploits similar features as bounded rationality of agents combined with short-selling restrictions.

Continuing within the behavioral bubbles literature, Hong and Stein (1999) build a model with two types of agents that are bounded rational, with one group of agents (the 'newswatchers') basing their investment decisions on private information about the fundamentals, and another group of traders (the 'momentum traders') that base their investment decisions only on simple past price growth rules. The authors assume that private information about the fundamentals gradually reaches the newswatchers population and, therefore, asset prices fail to completely reflect short-term changes in fundamentals. However, if the activity of newswatchers increases an asset price, then momentum traders start investing and will eventually feed an asset price bubble. At the end, the bubble will burst once the private information has diffused to all newswatchers.

Analyzing US stock data during the 1980–2004 period and Japanese data for the 1992–2001 period, Yalcin (2008) and Nguyen (2005) respectively find evidence supporting Hong and Stein's (1999) model, which predicts better the price evolution of stocks of smaller firms, for which information circulates more slowly than in the case of larger firms. A related model is the one developed by De Long, Shleifer, Summers and Waldmann (1990), in which rational investors exploit their knowledge of the existence of momentum traders by increasing an asset's price beyond its fundamental value after receiving good news about it.

Therefore, contrary to the general assumption in many models under which investors with bounded rationality are responsible for the emergence of the bubble, in the De Long et al. (1990) framework, rational agents are responsible for creating bubbles.

Brunnermeier and Julliard (2008) introduce money illusion into a model in which investors discount future rents and buy housing according to their valuation. Under money illusion, home buyers mistake a fall in inflation (which leads to a fall in the nominal interest rate via the Fisher equation) as a fall in the real interest rate, which in turn pushes the perceived value of houses up. As short-selling houses is not generally possible, professional investors are not able to bid the price back to equilibrium and a bubble emerges.

A related model is that of Piazzesi and Schneider (2008), which is developed to attempt to explain why house price bubbles can take place in a context of high inflation, such as occurred in many countries in the 1970s, as well as in a period of low inflation, as the bubbles seen in the 2000s. For this purpose, the authors develop a general equilibrium model with illusionary investors, who suffer from money illusion, and smart investors, who do not. Housing bubbles occur in this model when the inflation expectations of illusionary investors are either unrealistically high or unrealistically low, which is when illusionary and smart investors disagree about real interest rates (Piazzesi and Schneider, 2008, p. 148). The mechanism that allows the formation of the bubble is that when smart investors expect high inflation, they sense low real interest rates and borrow funds to buy houses from the illusionary investors, who are willing to lend funds since they confuse a high nominal interest rate with a high real rate. Alternatively, whenever smart investors expect low inflation, they will sense high real interest rates and will be willing to lend to illusionary investors, who sense low real rates and are ready to borrow to buy houses (Piazzesi and Schneider, 2008, p. 149). Bubbles thus can emerge whenever inflation deviates strongly from its long term average.

To conclude this section, despite the clear division within the theoretical bubble models into the rational and behavioral literature, these models tend to share some features that allow the triggers to actually generate a bubble. The most common of these features is limited asset supply elasticity. For the sake of simplicity, models that take into consideration supply elasticity generally consider it to be equal to zero, i.e. the supply of assets does not change with prices. This allows the bubble to form due to a demand shock that cannot be counteracted by an increasing supply. When comparing different asset types, such an assumption seems more plausible for the case of houses, at least in comparison to stocks, not only because of natural limitations imposed by land, yet also because of the existence of zoning regulations and the fact that a certain amount of time is needed to build houses.

Another common feature of models of different strains is the fact that short-selling is not allowed, which again seems close to reality for the case of houses.

When it comes to the main points of contrast of the models, the trigger of bubbles in settings where all agents are rational is seldom explained and a common reason given for their existence is asymmetric information. Whereas within the behavioral literature, bubbles arise as the consequence of at least one group of agents being bounded rational. Bounded rationality is modelled differently, but the setup of models tends to include two types of agents, and one of them can be rational, but not always. Bounded rationality can be modelled in different forms such as agents making investment decisions influenced by money illusion or based on news, on past asset price growth rules, as well as in models where they fail to adapt to price shocks. The next section will analyze to what extent the theoretical literature allows to assess the influence of the variables mostly discussed in the policy debate as potential causes for the formation of bubbles.

2.3 The Role of Monetary Policy, the Saving Glut and Financial Regulation within the Bubble Models

The interesting element about rational expectation models for bubbles is, however, that even if some of them are able to explain the existence of a bubble, they are generally very weak in explaining the emergence of a bubble, and if they do, this is very seldom linked to the potential culprits discussed in policy-oriented papers. For example, in the early rational bubbles literature, such as in Blanchard (1979) or in Allen et al. (1993), it is discussed whether asset prices can be on a bubble path, yet at the same time, in order for this to be the case, a bubble already needs to exist. As monetary policy, capital inflows or financial regulation is neither explicitly nor implicitly modelled, there is no role for these factors in bubble generation.

When it comes to the more recent rational bubbles literature, the model presented in Allen and Gale (2000) is one of the few considering some of the potential culprits of house price bubbles discussed in the policy-oriented literature, namely monetary policy and financial regulation. The authors' model is specified in such a way that bubbles occur within bank-based economies whenever there is uncertainty about the future credit expansion. Such an uncertainty clearly exists when there has been a change in financial regulation which allows banks to expand their lending; yet, it is unclear by how much. As explained in section 2.2.2, however, the driver of bubbles within this model is the agency problem generated by the borrowers' limited liability.

Moving on to the behavioral models reviewed in the previous subsection, all of which belong to the core of the literature of behavioral models explaining bubbles, most of them also do not consider the role of policy variables, since they tend to have a microeconomic focus, and the policy-oriented literature analyzes variables that have macroeconomic relevance. Nevertheless, as was the case with the rational bubbles literature, there are some models that can be more directly related to the policy debate.

A case in point are the models developed by Brunnermeier and Julliard (2008) and Piazzesi and Schneider (2000), which can be related to the saving glut hypothesis as well as central bank behavior. Both models share the trait that bubbles can be triggered if inflation deviates from the long-term average of inflation. While the Brunnermeier and Julliard model is asymmetric in the way that bubbles might occur if the actual rate of inflation falls below what (some) investors have been used to, the Piazzesi and Schneider model is symmetric in as far bubbles can be triggered by upward and downward deviations of the actual rate of inflation from its long-term average.

Both models would hence give some credit to the savings glut hypothesis. The excess savings in China in this framework would have led to a lack of global aggregate demand, at the same time keeping down inflation and leading to capital inflows into the US. The interaction of this fall of inflation and money illusion could then have been a trigger for bubbles.

Although Brunnermeier and Julliard (2008, p. 173) argue that their model and evidence support the argument in favor of price stability, in fact it really argues for not allowing inflation to fall unexpectedly or quickly, and would thus support authors which call for more active monetary policy action when there is a danger of undershooting the inflation target in line with Krugman's (2014) demands. The Pazzesi and Schneider model, in contrast, would call for a symmetric limitation of inflation deviations from its target and against quick shifts in inflation targets.

The interesting thing about the reviewed models is, however, that the possible central bank actions which can trigger bubbles are not those which are generally discussed in the policy related literature. None of the models really sees a central bank setting the interest rate below its natural rate (as argued implicitly by Taylor and the BIS) can be seen as a trigger for bubbles, while the failure to counteract falling rates of inflation can cause bubbles through the money illusion channel.

It is also important to note that while financial liberalization is seldom modelled as a direct trigger for bubbles, certain features of the financial sector or banking sector which could be related to financial liberalization are necessary conditions for the emergence of a

bubble or determine the size of a potential bubble. The ability to borrow in order to invest is key for the bubble formation both in the Allen and Gale (2000) paper as well as the Piazzesi and Schneider (2008) model; in the Piazzesi and Schneider model, the maximum loan-to-value ratio in addition explains the potential deviation of actual house prices from equilibrium prices.

Table 1 below presents in a summarized manner the main triggers of asset price bubbles, as long as one is provided, within the rational and behavioral models reviewed in the previous subsection.

Literature	Model	Main Bubble Trigger
Early Rational Bubbles	Allen et al. (1993)	Not modelled.
	Blanchard (1979)	Not modelled.
	Blanchard and Watson (1982)	Not modelled.
Newer Rational Bubbles	Allen and Gale (2000)	Uncertainty about real return, about credit expansion or about financial fragility.
	DeMarzo et al. (2008)	Herding behavior of young agents due 'keeping up with the Joneses' concerns.
	Scharfstein and Stein (1990)	Herding behavior of professional investment managers due to concerns about their job perspectives.
Behavioral Bubbles	Brunnermeier and Julliard (2008)	Flawed housing market valuations because of money illusion.
	De Long et al. (1990)	Rational investors driving up asset prices above their fundamental value to take advantage of momemtum traders.
	Hong and Stein (1999)	Slow spread of information among newswatcher investors and their interaction with momentum traders.
	Hong et al. (2006)	Expansion of a company's publicly tradable shares and bounded rational agents agreeing to disagree.
	Piazzesi and Schneider (2008)	Low and high inflation episodes and interaction between (money) illusionary and smart investors.
	Scheinkman and Xiong (2003)	Bounded rational agents that are overconfident about their models to interpret information and that agree to disagree.

Source: own elaboration.

Table 1: Main Triggers within Selected Theoretical Bubble Models

2.4 Conclusion

In this section a general definition of housing bubbles was presented, in the sense of a price that does not reflect a house's fundamental value, which is a definition analogous to the one used for asset price bubbles in general. Although such a definition allows for price increases to account for changes in house price fundamentals, it is not straightforward in practice to clearly identify when price increases are beyond changes justified by them. As will be further explained in section 4, our solution to this problem will be to identify house price bubbles as very strong real price hikes, followed by equally strong price corrections, which is in line with approaches found in the empirical literature of cross-country studies. While there is a degree of arbitrariness related to this measure, it seems to be the best available approach and it avoids identifying any period with strong price increases as a bubble.

Subsequently a brief overview of the most prominent models that explain the rise, existence and burst of asset price bubbles was provided, stressing the difference between the rational and behavioral strands of the literature. Despite the unambiguous division within the theoretical bubble models literature, the review allowed to portray some common settings of the models, such as a fixed asset supply and short-selling restrictions, which allow the different bubble triggers within each model to generate them. It was argued within the section that these model features are probably closer related to the conditions of actual housing markets than those of other asset markets. Moreover, when it comes to the bubble triggers, the rational literature surveyed did either not explain how bubbles formed or based its explanations on rational herding behavior or credit expansions interacted with the agency problem of the banking sector. Within behavioral models, bounded rationality has often been modeled as the main precondition of bubbles, and has been modelled in different forms, such as agents being influenced by money illusion, being overconfident on their own models to interpret new information, relying on news or on past asset price growth rules to invest, etc.

When analyzing the relationship between the theoretical bubble models reviewed and the policy debate that we briefly mentioned in the introduction, we realized that the theoretical literature seldom addresses the triggers discussed in the policy debate. Developed financial markets are a precondition in some models, and financial liberalization which leads to more developed financial markets can be a trigger for a bubble in single models. When it comes to central banks, interestingly, from the theoretically model, deviations in inflation from the inflation target and quick shifts in the inflation target seem to be more of a danger than deviations in the policy rate from anything which could be perceived as the “correct rate”. Now that the theoretical literature has been reviewed, the next section will assess the relevant empirical cross-country studies concerned with housing bubbles.

3 Empirical Literature Review of Cross-Country Studies

This section attempts to provide an overview on the cross-country empirical literature related to housing bubbles. A particular focus will be given to studies interested in the relationship between monetary policy, financial regulation and housing bubbles. Two crucial issues that all empirical analyses of housing bubbles face is that there is no consensus in the literature concerning the definition of a housing bubble (Brunnermeier 2008; Mayer 2011), as explained in the previous section, and that housing bubbles are rare events. The first subsection examines cross-country studies that analyze housing prices, considering

economic policy as one driver for price changes. The second section reviews how housing bubbles are usually been measured. The third section discusses studies with housing bubbles as their variable of interest. The final subsection provides a conclusion of the entire section.

3.1 Studies focusing on house price levels

This section reviews cross-country studies that try to explain the evolution of house prices in developed countries and consider monetary policy or financial market developments as relevant explanatory variables. Empirical cross-country studies often employ a (panel) VAR approach over a long time span, e.g. starting in the 1970s. As will be shown below, studies tend to report that decreasing short-term interest rates have a positive effect on house price levels, as would be expected according to the theoretical inverse relationship between house prices and interest rates discussed in section 2. However, the effect seems to depend on the degree of development of the mortgage market. This seems to be in line with findings for single-country VAR approaches, yet the effect seems to run both ways: "Countries where mortgage markets are more developed experience a higher volatility of house prices and a greater role for housing in the transmission of monetary policy" (Carstensen et al. 2009: 4). In the following, we neither cover single-country studies nor those that are more interested in the question in how far the housing market is propagating monetary policy shocks (see e.g. Carstensen et al. 2009). Yet, the cited article provides an overview on both topics.

One example for a cross-country study pointing to links between house prices and monetary policy is a fixed-effects panel VAR for 17 OECD countries by Goodhart and Hofmann (2008). The authors indirectly provide some evidence for the relevance of the development of the mortgage market, as they find higher effects of monetary policy on housing prices (and vice versa) for the more recent period since 1985 than for the entire period from 1970 to 2006. Yet, to quantify the effect seems to be difficult, as the difference is not statistically significant.

In a similar panel VAR approach for the same OECD countries, Assenmacher-Wesche and Gerlach (2010) directly focus on the more recent period from 1986 to 2006. The authors confirm the result that monetary policy affects housing prices, yet stress that the effect is rather small compared to its effects on GDP. Like Goodhart and Hofmann (2008), the authors detect some relevance of the financial system for the propagation of monetary policy shocks, but they fail to find a quantitatively relevant impact, even though they use several

indicators for differences in the financial system of countries and use those for splitting the sample.

A different approach for a comparable period stems from the IMF (2008): The Fund forecasts house prices in three countries since the end of the 1990s until the mid-2000s, comparing two different assumptions in a cross-country VAR with data for a sample of 18 OECD countries since the 1980s. In one scenario, interest rates remain unchanged, while in the other forecasting scenario, interest rates are assumed to be 100 basis points higher. The IMF performs this exercise as an effort to assess whether tighter monetary policy would have prevented strong hikes in house prices. The result is that lower interest rates generally have a positive effect on the house price level, yet that the degree depends on the development of the mortgage market. The latter is measured by an index based on a battery of indicators from the early- and mid-2000s controlling for the size of the loan-to-value ratio, the common length of the mortgage payment period, the level of development of the secondary market of mortgage loans, and whether mortgage equity withdrawal is prevalent and if mortgage refinancing is mainly free of fees. The Fund presents the case of Ireland as an example of a country with a low mortgage market index and argues that tighter monetary policy in this country would not have made much of a difference in the evolution of house prices. On the other hand, the IMF includes Netherlands in its analysis as a case of a country with a high mortgage market index and concludes that higher interest rates would have dampened price increases observed in this country since 2003 (IMF, 2008, p. 122).

Even though most studies show that monetary policy affects housing prices, this is not explaining the recent housing price hikes, as Dokko et al. (2011) show. The authors run VAR models with quarterly data from 14 developed countries from the beginning of the 1970s to the beginning of the 2000s with the main interest of analyzing the impact of a set of monetary policy indicators. To control for the stance of monetary policy, they use indicators closely related to those used by central banks: the short-term interest rates, the employment rate, real GDP gap, and core inflation. They analyze the effect of these indicators on real house prices as well as related housing sector variables such as residential investment over GDP, or real personal consumption (Dokko et al., 2011, p. 254). They show that the out-of-sample forecast cannot explain the increase in housing prices during the 2000s. The authors conclude that financial market developments are responsible for the gap and underline this argument by anecdotal evidence (Dokko et al. 2011). In addition, they show that this more elaborate measure for monetary policy hardly signals a “loose” stance of monetary policy – in

contrast to authors like Taylor (2007, 2008) that judge the stance of monetary policy by Taylor-rule approaches.[13]

Even though this study stresses the role of financial market developments as the main culprit for the recent housing price bubbles, the authors do not directly control for financial market developments. Kuttner and Shim (2013) control for the level of regulation of the financial system, but conclude that financial regulation alone can neither explain the recent price developments: The authors assess the impact of financial regulation in general and non-interest rate policy issues regarding the housing market on the growth of credit and evolution of housing prices. Running ARIMA regressions with GDP growth and the short term interest rate as controls, Kuttner and Shim (2013, p. 39) do not obtain significant impacts on changes in house prices for any of their policy variables of interest which are: limitations to general credit, loan-to-value ratio, and debt-service-to-income ratio; limits to bank exposure to housing credit, especial risk weighting for housing credit, provisioning regulations and housing taxes.

Yet, financial market developments do not only seem to be relevant for monetary policy implications, but also for the transmission of capital inflow shocks: Sá et al. (2014) reveal that the impact of capital inflows on house prices is higher in developed countries with more advanced mortgage markets and where complete securitization of mortgages is allowed. The authors arrive at this conclusion after running panel VAR specifications for 18 OECD countries with quarterly data from 1984 to 2006 (Sá et al. 2014, p. 524). The development of the mortgage market is assessed with the help of the mortgage market index designed by the IMF (2008 p. 106), explained above.

To sum up, several studies focusing on house price developments conclude that monetary policy has a statistically relevant impact. Lower interest rates seem to increase house price levels, as expected by theory. The degree of policy transmission to the housing market seems to depend on the level of development and regulation of the financial system, even though the relevance of this effect seems to be difficult to quantify. In addition, the financial system may be similarly relevant for the effects of capital inflow shocks. Nonetheless, the fact that lower interest rates have been reported to have a positive impact on house prices does not automatically mean that it can be held as the main culprit for the formation of housing bubbles, as some studies demonstrate for the recent increases in

[13] For the case of the US, the authors find that the federal funds rate was only below what could be considered normal starting in 2008, when the country was in recession as a consequence of the global financial crisis, based on data from the period 1972–2002 (Dokko et al., 2011, p. 256).

house price levels. The next section will therefore first present methods to detect bubbles before we turn to studies that try to explain housing bubbles.

3.2 Measuring Housing Bubbles

Given the lack of consensus within the theoretical literature surrounding the definition of housing bubbles, it is not surprising that within the empirical literature, approaches for measuring house price bubbles differ. Yet, most studies try to avoid this problem by directly focusing on the evolution of house prices without identifying bubbles. For instance, both in Dokko et al. (2011) and the IMF (2008) the main variables of interest are real house prices and residential investment, whereas in Sá, Towbin and Wieladek (2014), a measure of credit to the private sector is added to the previously mentioned variables of interest. If these papers refer to bubbles at all, then the deviation of actual house prices from forecasted values is seen as an indicator for bubble formation. A case in point is Dokko et al. (2011), where bubbles are identified when house prices are above out-of-sample forecasts of the models used to predict them. Similarly, IMF (2008) identifies as a 'house price gap' this part of the price growth that is not explainable by a series of fundamentals (lagged ratio of house prices to disposable incomes, change in disposable income per capita, etc.). The 'house price gap' may therefore be interpreted as an indicator for housing bubble formation.

Studies that directly try to identify bubbles do not always base their measures on theoretical considerations. The few studies that follow theoretical approaches and try to identify bubbles by deviations from the fundamental value mainly concentrate on a single or few countries. Examples are the already mentioned study by Case and Shiller (2003) in section 2, with its focus on the US housing market, as well as Brunnermeier and Julliard (2008), a study in which the authors collect US and UK data to calculate house price-rent ratios that they decompose into a part that can be explained by fundamentals and another that cannot.

Cross-country studies that try to identify bubbles mainly rely on a pragmatic approach that defines bubbles ex post by the occurrence of a price hike in (nominal or real) house prices that is later followed by a sharp price correction. The calculation of price up- and downturns can be more or less refined. One less refined form is used by Bordo and Landon-Lane (2013a, p. 19, 2013b, p. 19): The authors first identify peaks (troughs) in the real house price series as price points that are higher (lower) than the two nearest observations. The studies then differentiate 'normal' price expansions from booms by defining the latter as annual price expansions equal or above five per cent that last at least two years. Additionally, the authors only classify a price expansion as a boom if the price correction after the peak is

greater than 25 percent of the expansion in price before the peak. The *ad hoc* part of their method is that the authors visually inspect the candidates for booms to see if the starting date of the boom needs to be adjusted to a point in time in which house prices grow fast. The authors then create a dummy variable equal to one during the thus identified booms and zero otherwise (Bordo and Landon-Lane, 2013a, p. 25, 2013b, p. 34).

In contrast, Agnello and Schuknecht (2011, p. 174) use a rather refined approach to identify housing bubbles. They distinguish as boom and bust phases of bubbles only the strongest upswings and downturns of a de-trended housing price cycle.[14] With the help of the booms and busts identified, the authors generate a binary variable equal to one when there is a price boom (bust) and zero otherwise. They also create a ternary variable equal to one during booms, minus one during busts and zero in 'normal' times.

As these examples illustrate, studies are not always interested in explaining bubbles in general, but may instead focus on a particular phase of bubble formation like e.g. only the boom or only the bust of a bubble. IMF (2009), for example, relies on an indicator that only identifies house price busts, since the interest of the study is detecting early warning signals against busts. House price busts are defined as periods when the four-quarter moving average of the annual growth rate of real house prices falls below minus five percent (IMF 2009, p. 94). Gerdesmeier, Reimers and Roffia (2010) also develop a bust indicator for their study, however, their study focuses on both stock and house prices. The authors generate a composite index of the growth of stock and house prices, which is used to define asset price busts (Gerdesmeier et al., 2010, p. 385).[15]

One important implication of the apparent detachment in bubble identification between theory and empirics in cross-country studies is that the empirical evidence can hardly be used to falsify the propositions developed in the theoretical literature. In other words, it is hard to translate the results of studies defining housing bubbles as strong price expansions followed by strong price corrections to a theoretical setting in which such bubbles are defined as price levels above levels warranted by fundamentals, whatever such fundamentals might

[14] They identify boom and bust phases of the house price cycle in three steps, following the triangular approach of Harding and Pagan (2002). First, they de-trend the time series of annual house prices with a Hodrick-Prescott (HP) filter. Second, they arrange in ascending order house price upswings (downturns) according to their severity. They define severity as the hypotenuse of a triangle whose base is equal to the distance between the time elapsed amid troughs and peaks and whose height is equal to the change in prices between troughs and peaks. Lastly, they identify as boom (bust) phases of a bubble only the cases with the highest severity, i.e. those above (below) the third (first) quartile of the distribution of de-trended housing price upswings (downturns).

[15] The study defines as busts three year periods in which the composite index has a growth rate lower than the average growth rate of the index, calculated from the first period in the dataset until the current period, minus 1.5 times the index's standard deviation within the same time span. A similar approach to identify asset price booms and busts is employed in Bordo and Jeanne (2002).

be. Furthermore, given the diversity of measures used in the empirical literature, the degree to which the evidence is comparable is hard to assess. Results of the studies are presented in the next section.

3.3 Bubbles and Monetary Policy

This section reviews a selection of empirical cross-country studies that investigate the link between monetary policy and the formation of house price bubbles. Studies concentrating on the bursting of bubbles are also covered, but only at the end, as they are not central for our research.

As already mentioned in section 2, Brunnermeier and Julliard (2008) disaggregate house price-rent ratios into two components: one that can be explained by fundamentals and another that cannot. The authors call the latter the mispricing component. The sample covers the US and the UK during the mid-1960s until the mid-2000s. The authors' empirical evidence supports the view that nominal variables such as interest rates and inflation are main drivers of the mispricing component of house prices in the two countries within their sample. Brunnermeier and Julliard (2008, p. 145) argue that this result can be explained by money illusion (see section 2) and support this proposition by showing that only nominal interest rates, and not real, have predictive power over the house price-rent ratio, in the case of the UK (Brunnermeier and Julliard, 2008, p. 147).

Another study modeling house price booms, however, with a larger country sample comprised of 18 developed countries, is Agnello and Schuknecht (2011). As mentioned in section 3.2, the authors develop binary and ternary housing boom variables, which they use to run binomial and multinomial probit panel regressions. These regressions allow the authors to assess how a series of variables affect the probability of a housing price boom (bust) taking place, with data for the 1980–2007 period. The authors present empirical evidence in favor of the hypothesis that the growth of domestic credit to the private sector, nominal short-term interest rates and the growth of global liquidity all have significant impacts on housing booms and busts. Other control variables included in their regressions are GDP per capita growth and growth of the working age population. Furthermore, by including mortgage market deregulation and banking crises dummies interacted with their variables of interest, the authors show that their impact on housing booms increases in periods with higher deregulation and that their impact on busts are amplified by banking crises.

A pair of studies that cover more countries is written by Bordo and Landon-Lane (2013a, 2013b). Although both papers employ a pooled VAR model for real house prices, the focus is not in explaining house price levels, but the effect of monetary policy, inflation and bank

credit on house prices during house price booms episodes in contrast to normal periods. This is done by comparing the effects of monetary shocks while controlling for booms by a binary dummy. The stance of monetary policy is measured by deviations from a Taylor rule. In Bordo and Landon-Lane (2013a) the authors employ pooled panel VAR regressions for a sample of 11 developed countries with yearly data for 1920–2010. The authors' main finding is that during booms, all of the previously mentioned factors have a higher impact on house prices than in normal periods, especially bank credit. Bordo and Landon-Lane (2013b) arrive at similar conclusions with a larger sample of developed countries (18), a broader set of asset prices (house prices, stocks and commodities) as dependent variables, as well as with alternative econometric methods.

In contrast to the studies on bubble formation, some studies focus on the bust period, and try to find early warning indicators. Monetary policy is analyzed as one potential driver: Gerdesmeier et al. (2010) are interested in indicators that can forecast asset price busts, i.e. stock and house prices, in the medium-term. The authors use a pooled probit approach with a sample of 17 countries and quarterly data for the years 1969–2008. The authors present evidence for the importance of credit to the private sector and long-term interest rates,[16] as well as the share of investment over GDP and past nominal house prices and stock price growth, as predictors of asset price busts. This study is similar to one conducted by the IMF (2009), focusing on early warning signals to prevent housing price busts, which also employs probit regressions with data for the 1970–2008 period for a sample of 21 developed countries. However, the results differ: The IMF (2009) finds evidence in favor of current account balances and residential investment as predictors of house price busts, while for the 1985–2008 period output growth and inflation do not seem to have predictive power. As the IMF study fails to find a significant impact of short-term nominal interest rates for asset price busts, the IMF (2009, p. 116) suggests that macro-prudential policies may play a role in dealing with problems in the financial sector and thus limit the need of monetary policy tightening in the face of house price booms. Moreover, while Gerdesmeier et al. (2010, p. 404) seem confident about the successful prediction of asset price busts with early warning indicators, the IMF (2009, p. 116) warns against the fallibility of such indicators, which could mislead the policy stance of central banks. It therefore recommends leaving central bankers room for discretion.

[16] The yield of government bonds with a maturity of ten years (Gerdesmeier et al., 2010, p. 384).

3.4 Conclusions

The prevalent approach for measuring housing bubbles in cross-country studies is to define bubbles as strong price expansions (booms) and corrections (busts) within house price cycles. As this approach is in contrast to theoretical models defining bubbles as deviations from fundamental values, it is problematic to assess the lessons from the theoretical bubble literature with the results of empirical studies.

Generally, studies that focus on the causes of house prices seem to prefer employing a variant of the VAR approach, which allows estimating relationships that are not necessarily backed by theoretical models. Moreover, the presented studies focus on developed countries, for which data is collected for very long periods of time. They then test the impact of monetary policy on real house prices. The main result that stems from these studies is that lower interest rates have a positive effect on house prices; however, this is to be expected according to the theoretical inverse relationship between house prices and interest rates discussed in section 2. Furthermore, authors such as Dokko et al. (2011) underscore that the strong house price booms observed in the 2000s across the developed world cannot be explained by monetary policy alone. They instead point to the loosening of standards for mortgage credits, which they however do not directly control for within their empirical approach. Nevertheless, authors that attempt to empirically assess the impact of financial regulations in the housing sector fail to report statistically significant impacts on house prices (Kuttner and Shim, 2013). Yet, the presented studies seem to indicate that the development of the financial system and its regulation interact with the transmission of short-term interest rates and capital flows on house price levels.

Turning to studies that directly focus on the formation of house price bubbles, results are mixed. Findings for the case of the US and UK suggest that nominal interest rates and inflation drive the bubble component of house prices, pointing to money illusion. Similarly, deviations of the short-term interest rate from a Tayor rule seem to drive bubble formation according to Bordo/Landon-Lane (2013a,b). Yet, if monetary policy is measured in a way that more closely tries to match central bank behavior as in Dokko et al. (2011), monetary policy can no longer explain the recent housing price hikes. Therefore, the next section tries to complement the existing studies by investigating whether loose monetary policy drives house price bubbles in advanced economies, by explicitly controlling for developments in financial markets. The focus is on a more recent time period – in which no radical financial liberalization took place.

4 Time series cross section evidence

This section tries to answer the question if “too loose” monetary policy is the main culprit of housing price bubbles, using an empirical cross-country-time-series approach explained below. The empirical approach is motivated by the problem that the theoretical literature does not provide an answer for the causes of bubble formation (Brunnermeier 2008), as has been discussed in section 2.

Section 3 concluded that empirical studies do neither provide a clear answer, especially regarding the role of economic policy in bubble formation. Only few studies directly try to explain bubble formation and control for the stance of monetary policy in a cross-country approach. The few that do so provide diverging results: Agnello and Schuknecht (2011) find evidence for low short-term interest rates driving bubbles. Similarly, Bordo/Landon-Lane (2013a,b) conclude that deviations from Taylor-rule recommendations contribute to bubble formation in housing prices, albeit not in all cases. In contrast to these studies, Dokko et al. (2011) cannot explain recent price developments by monetary policy developments. They instead stress the role of financial innovation and deregulation for the gap between their house price forecast and actual developments. Even though Bordo/Landon-Lane (2013a,b) and Dokko et al. (2011) use similar house price data and a VAR regression for time series starting in the 1970s, the results are not directly comparable due to the different approaches used. In addition, empirical studies trying to explain house price levels point to the interaction between monetary policy and the development of the financial system (see section 3.1). Nevertheless, this factor is not explicitly controlled for in the mentioned VAR approaches.

This research therefore tries to complement the existing studies with an approach for advanced economies that focuses on more recent decades. As we want to relate our results to the existing studies, we control for the stance of monetary policy by including a measure for deviations from a Taylor rule (as in Bordo/Landon-Lane 2013a,b). In addition, we try to control for financial sector developments, in order to find some statistical evidence for this factor. The aim is to clarify if inadequate regulation of the financial sector contributes to the formation of house price bubbles.

Econometric cross-country approaches aiming at the explanation of house price bubbles face several general problems:

1. The lack of agreement on how to define a bubble empirically and hence how to identify it in the empirical data.

2. A general lack of internationally comparable high quality data on housing market features, including data on house prices, mortgage credits, and regulation that affects the housing market.

3. The fact that bubbles are a rather rare event makes it difficult to detect regularities in bubble formation with econometric techniques.

These problems also affect our approach. We follow the empirical literature in using a "pragmatic" approach that identifies bubbles ex post as a strong price increase in real housing prices (a "boom") that is followed by an equally severe decrease (a "bust", see details below). We use data on residential property prices from the Bank for International Settlements (BIS).[17] The BIS provides two different data sets: As one option, the BIS offers "detailed" series on nominal housing prices that are well documented (much better than the OECD data). Yet, it has the disadvantage that the time series provided vary over countries and are generally much shorter than the OECD series. As a second option, the BIS additionally has started to offer "long" series since November 2014. Even though these long series are less reliable, we use the data as a robustness check for our results.

As we need the time series dimension for our research focus and a balanced sample, i.e. data for all countries over a comparable period, we concentrate on the period 1990 to 2012 based on the detailed data plus the extended period 1985 to 2012 based on the long data. The short period for the detailed data aggravates the third problem by excluding bubbles that happened before. This is in contrast to the mentioned studies that rely on OECD data and can therefore use time series starting in 1970 (Bordo/Landon-Lane 2013a,b; Dokko et al. 2011).

Yet, besides data availability, there are good reasons to concentrate on the period after the mid-1980s:

- First, the global macroeconomic environment changed over time to such an extent that the analysis of housing bubbles based on long time series starting in the 1970s may be misleading. The IMF therefore separates the analysis on housing price bubbles into pre-1985 and post-1985. This breaking point is supposed to separate the period of oil price shocks from the start of the "great moderation" and higher financial liberalization in advanced economies (IMF 2008, 2009).

- Second, part of the change in the macroeconomic environment is the declining level of inflation in advanced economies and with it the change of the (explicit or implicit) inflation target of central banks. As we follow the literature in using a Taylor rule in order to judge the stance of monetary policy, we need an assumption about the inflation target. While the assumption that advanced economies target a 2 percent inflation rate is convincing for the post-1985 period, it is rather questionable for the previous period. The results in Bordo/Landon-Lane (2013a,b) that are based on time series starting in 1970 and assuming an inflation target of 2 percent since the 1970s may be affected by that assumption.

[17] See http://www.bis.org/statistics/pp.htm.

- Third, the decline in inflation rates in advanced economies has the convenient side effect that peaks and busts in real housing data, the focus of our analysis, more closely match those in nominal data. As most non-economists focus on nominal price developments (instead of calculating the real price level as economic theory would suggest), every day experience relates peaks and busts to nominal developments only. It is therefore helpful for policy advice that the post-1985 differences in nominal and real developments are negligible.

Nevertheless, there is a general disadvantage of the time period analyzed here, if one is interested in the effect of financial regulation on housing prices: All advanced countries in the sample started liberalizing their financial markets in the 1980s or even before, i.e. before the start of our period of analysis. As our sample is rather homogenous in this regard, an indicator for deregulation can at best capture additional (de-)regulation in mortgage markets, for which comparable high quality data is rarely available. This may explain the poor performance of our indicator for housing regulation in the regression (see below).

The structure of the reminder of this section is as follows: Subsection 4.1 describes the data, and subsection 4.2 explains the estimation approach. Subsection 4.3 presents our estimation results and interpretation. Lastly, subsection 4.4 summarizes the findings.

4.1 Data

We use an indicator for the formation of a housing bubble and run a cross-country-time-series regression based on annual data during the period 1990 to 2012 (detailed series) and 1985-2012 (long series). In contrast to standard panel approaches, we use subgroups of the countries in our sample and we do not restrict all coefficients to be the same across countries. Both samples consists of economically advanced countries for which BIS data on residential property prices are available and that fulfill the criteria of being an OECD member country before 1990 and a high income country since 1997, according to the World Bank. This leads to slightly more than 20 countries. As some explanatory variables are not available for the selected countries, especially indicators on financial regulation, the country sample shrinks to a maximum of 16 countries based on the detailed series and 15 countries based on the long series. Table 2 provides an overview on the countries in the two samples. Depending on the explanatory variables used in the regression, the sample is partly smaller.

4.1.1 Endogenous variable:

Housing bubbles are identified by a “boom” in real house prices that is later followed by a “bust”.

- "Boom" periods are defined as periods when the four-quarter moving average of the annual growth rate of the house price, in real terms, exceeds the threshold of five percent.
- "Bust" periods are (symmetrically) defined as periods, when the same four-quarter moving average of the annual growth rate of the house price, in real terms, falls below minus five percent, for at least two quarters in a row. The bust definition follows IMF (2009, p. 94).

As we are interested in the contributing factors for the formation of a bubble, we concentrate on a binary "boom" indicator: The indicator takes the value "one" for a boom, yet only, if the boom is later followed by a bust, and "zero" otherwise.[18]

The indicator is based on quarterly BIS data for the nominal house price that is deflated by OECD CPI. Yet, due to data availability of the exogenous variables, we use yearly data for the regression. We construct the endogenous variable based on the quarterly signals in a way that allows for extended boom phases: the endogenous takes the value one if in that year the indicator exhibited at least one boom signal (but no bust signal) and if the last boom signal is followed by a bust signal less than 12 quarters later. Boom periods can be interspersed by no signal periods or even a single bust signal in only one quarter, but only, if this one bust signal is surrounded by boom signals.[19] Periods of boom signals are not always interspersed by no-signal quarters, and if they are, then by less than eight quarters at most.[20]

Figure 1 gives an overview of the boom and bust signals for sample 1, based on the detailed series, Figure 2 does the same for sample 2, based on the long series. As can be seen, the formation of bubbles and especially their busts tend to cluster over time. In addition, bubble formation before the bust can take several years. Comparing the lengths of bubbles in our analysis with those in IMF (2009), we also find that average bubble duration after the mid-1980s exceeds the mean duration before that time. For the period 1985-2012, booms last on average four and a half years and thereby more than double the time of busts (two years), while the mean period between the last boom and first bust signals is only one year according to our data (see Table A 1 in appendix 1). All in all, the average bubble lasts about seven and a half years (calculation based on detailed BIS data).

[18] As a robustness check, we also use an indicator that does not only control for booms, but also for busts with the following three outcomes: "one" in a boom, "minus one" in a bust, and "zero" otherwise. This does not change our main results.

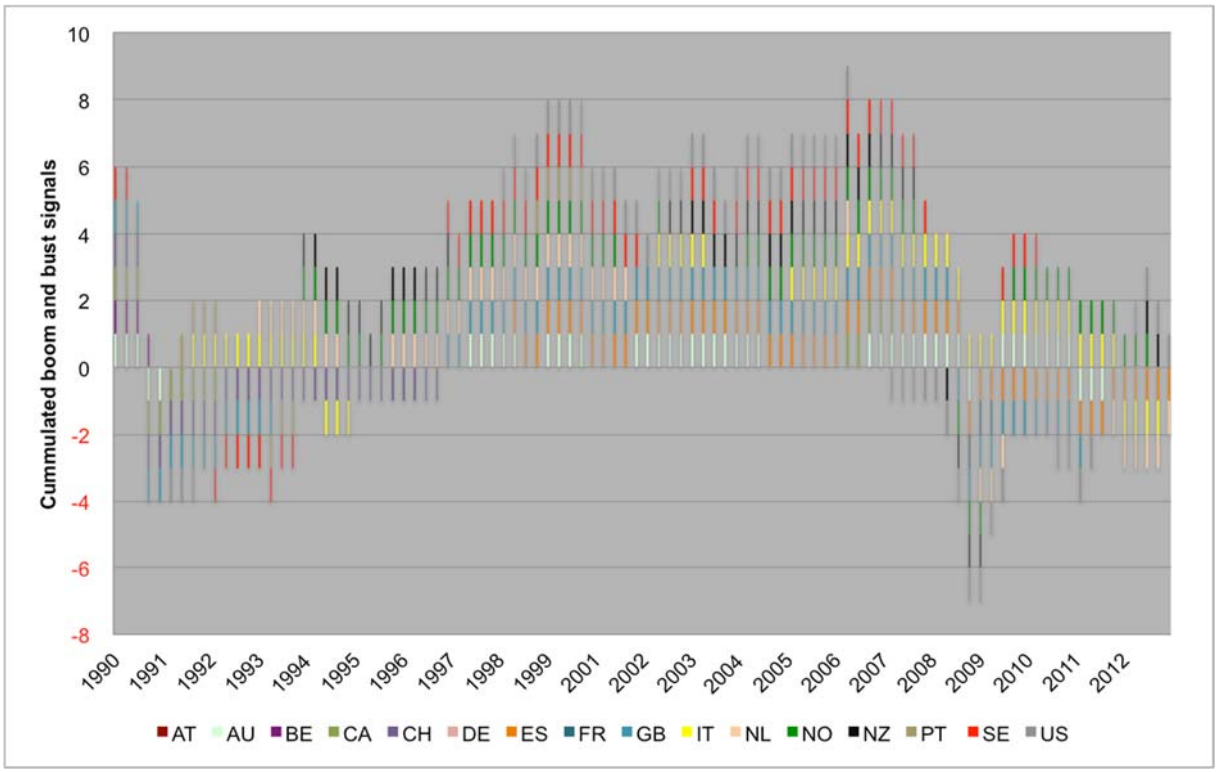
[19] The reason is to allow for temporary and short lived price corrections, see information on Netherland's bubble around 2007 and the Australian bubble in 2010 in Appendix 1.

[20] The only exception are the Netherlands, where the last boom signal follows after 19 quarters of no signals, before the first bust signals start. As the Netherlands are an outlier regarding our definition, we treated the price developments as a bubble in sample 1 and not as a bubble in sample 2.

Abbreviation	Country name	Sample 1	Sample 2
AT	Austria	X	-
AU	Australia	X	X
BE	Belgium	X	X
CA	Canada	X	X
CH	Switzerland	X	X
DE	Germany	X	X
ES	Spain	X	X
FI	Finland	X	-
FR	France	X	X
GB	UK	X	X
IT	Italy	X	X
JP	Japan	-	X
NL	Netherlands	X	X
NO	Norway	X	X
NZ	New Zealand	X	X
PT	Portugal	X	-
SE	Sweden	X	X
US	US	X	X
Total		16 countries	15 countries

Table 2: Overview over the country samples used in the regression

We purposefully constructed samples that comprise countries that did not experience a housing bubble during the time of analysis. In sample 1, three countries (Austria, Belgium, and Germany) did not experience a bubble during our regression period according to our indicator. 13 countries suffered from at least one bubble during 1990 and 2012, yet, the boom phase occurred before 1990 in five of them, and is therefore not covered by the regression. Australia, United Kingdom and the United States had two bubbles during that period, but for all three countries the boom phase of the first bubble happened before 1990 and is therefore not reflected in the regressions for sample 1. Table A 1 in appendix 1 contains more details on the selected BIS housing data for sample 1, and the resulting boom and bust signals.



Source: Author's calculations

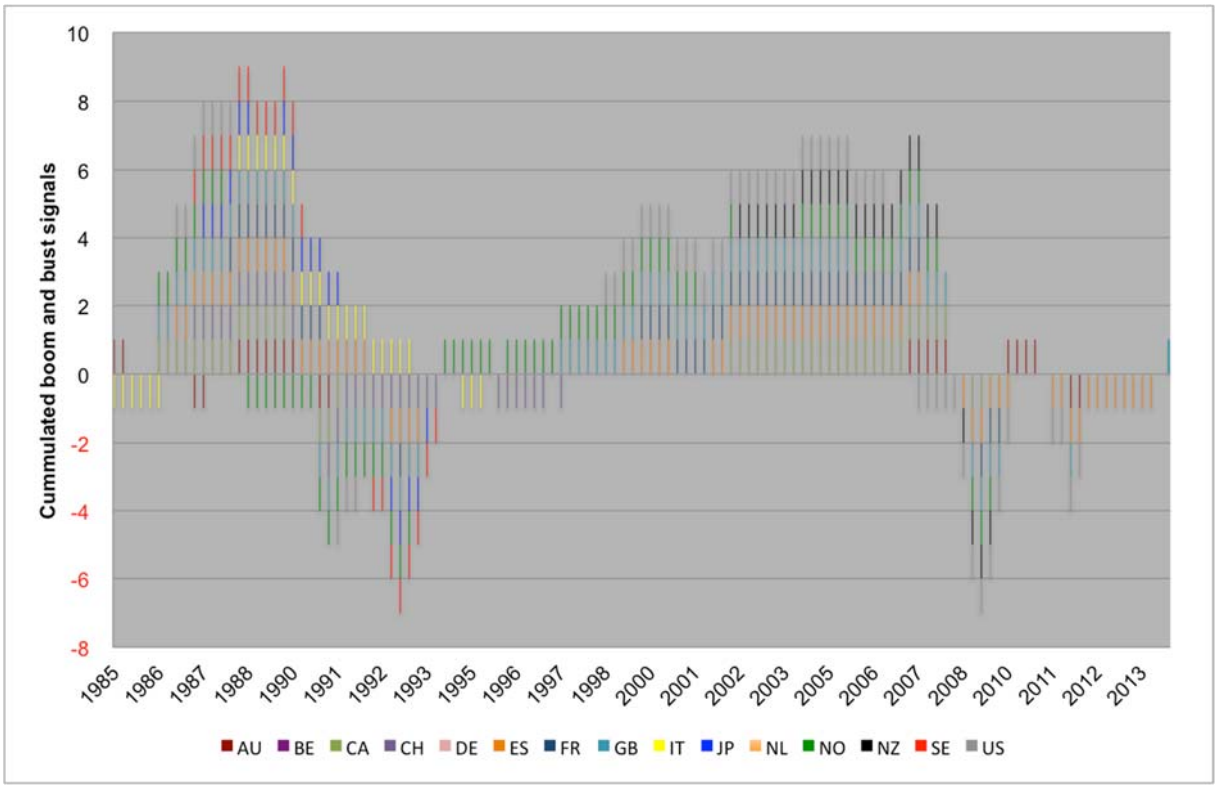
Figure 1: Boom and bust signals for sample 1 (detailed series, 1990-2012)

In sample 2, three countries did not experience any bubble over the period 1985 until 2012, Belgium, Germany, and the Netherlands[21]. Five countries experienced one bubble (Italy, Japan, New Zealand, Sweden, Switzerland), six countries two bubbles (Canada, France, Norway, Spain, UK, US) and Australia three bubbles during the regression period.

The reason for including countries that did not suffer from a housing bubble during the period under review is that we are interested in the question if a too "loose" stance of monetary policy will generally provoke a housing bubble or not. Austria is an example for a country that managed to avoid a bubble so far, although the stance of monetary policy was "too loose" judged by a standard Taylor rule (see the case study in section 5). If our sample only comprised bubble countries, all we could explain were the different contributions of monetary policy to bubble formation, given that a bubble is forming.[22]

[21] As already stated, the Netherlands show an extremely long building up of a bubble and a bust after stagnating prices. As our bubble indicator would not capture this, we included it as a bubble in sample 1, and as no bubble in sample 2. Regression results seem to be unaffected.

[22] Due to our research focus, we cannot follow the IMF (2009) approach that analyzes the behavior of relevant explanatory variables before the bust of a bubble (the research focus of that publication), and apply it to the formation of a bubble. This would imply running a cross-country regression at an artificially constructed point in time (e.g. the start or bubble formation) and only be able to explain differences in bubble formation, as the sample would only include bubble episodes. This approach is



Source: Authors calculations

Figure 2: Boom and bust signals for sample 2 (long series, 1985-2012)

Comparing our binary boom indicator with the one used by Bordo/Landon-Lane (2013a,b), there is one important difference: The cited papers take the trough of a housing bubble as the starting point of bubble formation. We deliberately chose not to follow their definition for the start of a bubble. The reason is that a trough marks the end of a former price decrease. As housing busts may go hand in hand with a general economic recession, one would expect expansionary policy to stimulate demand. The resulting house price increase may just correct a former too strong price decrease – without necessarily signalling the start of a bubble. The approach in Bordo/Landon-Lane (2013a,b) may therefore overstate the evidence for expansionary monetary policy as a cause of bubble formation by assuming that bubbles start to build up at the trough of housing price cycles. Yet, even though our method differs from the one in Bordo/Landon-Lane (2013a,b), we seem to get roughly similar boom and bust periods for the time periods where our data overlaps, apart from the fact that our boom phases start slightly later.

only helpful for finding common and diverging developments in bubble formation, but does not help analyzing whether too "loose" monetary policy necessarily increases the probability of a bubble.

4.1.2 Explanatory variables

A sample of 16 countries over 23 years for sample 1 (as well as 15 countries over 28 years for sample 2) limits the amount of explanatory variables that we can use in regressions. Our aim is to find robust statistical evidence for the following explanatory variables for which we use at least two different proxies for each one of them:

1. Indicator for economic activity
2. Indicator for foreign capital
3. Indicator for the stance of monetary policy
4. Indicator for the level of development and regulation of the financial sector

Most of the explanatory variables enter in our regressions as deviations from their "normal" behavior as they are non-stationary in levels. For economic activity and monetary policy, we use deviations from past trends, in order to control for "exceptional" developments, closely following other studies: For the calculation of trends we mainly follow IMF (2009 p. 95f.) by using an eight-year-trailing moving average. For the calculation of the Taylor rule, we follow the literature and use a HP filter (see below). To calculate deviations from trends does not only ease the problem of non-stationarity, but also makes sense, as we do not want to explain house price levels but "booms" in housing prices, i.e. exceptionally strong price increases.[23]

All right-hand side variables generally enter with their previous year values. The reason is to ease endogeneity concerns, since the direction of causality is highly questionable for several of our explanatory variables. This can be exemplified for foreign capital inflows that can be seen as either precursors or successors of housing bubbles. For instance, Aizenman/Jinjarak (2009) find a statistically significant negative correlation between real house prices and the current account. Yet, capital inflows can also follow asset price rises according to Fratzscher/Straub (2010). This motivated us to use past year's values only.

For changes in housing market regulation we construct an indicator based on a database provided by Shim et al. (2013), explained below. As this indicator seems to be too narrow in focus, we also control for the level of development and regulation of the financial system in a broader sense. Indicators like domestic credit to GDP are frequently used in

[23] In addition, we control for exceptionally strong price decreases in the case of the ternary boombust indicator that also controls for busts.

comparative studies on the development of the financial sector in different countries.[24] Yet, during our period of interest, this indicator increased enormously for all countries in the sample, leading to non-stationary series. We therefore tried to rely on national averages over the estimation period, deviations from past national developments, or deviations from OECD developments. Indirect indicators for changes in financial regulation like the gap between mortgage rates and a risk-free rate were impossible to include as comparable data on mortgage credit for all countries are not available. It is important to stress that we do not use credit supply (for housing) as an explanatory variable, as supply would follow demand according to theoretical concepts of endogenous money.

The following provides a brief overview on the variables used. For a detailed overview on variable names, construction, source and interpretation please see appendix 2.

1. **Indicator for economic activity**
   - Real GDP growth, deviations from an eight year trailing moving average.
   - Real personal consumption expenditure growth, deviations from an eight year trailing moving average.
2. **Indicator for foreign capital**
   - Current account balance of a country as percent of GDP.
     - Version 1: simple form.
     - Version 2: deviations from an eight year trailing moving average.
3. **Indicator for the stance of monetary policy**
   - Deviations of the nominal policy rate[25] from a standard Taylor rule.[26] The Taylor rule prescription was calculated following Taylor's (1993, p. 202) original formulation: r=p+0.5y+0.5(p-2)+2

     where r is the target nominal policy rate and p is the inflation rate, i.e. the y-o-y growth rate of the CPI. The target inflation rate is assumed to be 2 percent, which is subtracted from p, which also represents expected inflation. The percent deviation of real GDP from its trend is represented by y, which is equal to 100×((Y-Y^*))/Y^* , where Y is real GDP and Y* its trend based on a HP filter calculated by taking GDP data up to the respective year into account. Finally, this Taylor rule assumes equal weights (0.5) to GDP and inflation gaps, and a "natural" interest rate of 2 percent.
   - Deviation of the real policy rate[27] from an eight year trailing moving average.

[24] M2 to GDP constitutes an even more accepted control for the development of the financial system, yet was not available for all countries for the entire time period under study.

[25] We use the three months interbank rate for the policy rate to also account for changes in money provision by tender operations.

[26] The Taylor rule assumes equal weights for the inflation goal (2 percent) and the output goal. Output trend is measured by a HP filter, following the literature (see e.g. Bordo/Landon-Lane 2013a,b), yet taking GDP data up to the respective year into account.

[27] Nominal three months interbank rate deflated by OECD CPI.

4. Indicator for the level of development and regulation of the financial sector

- Domestic credit to the private sector, as percent of GDP.
  - Version 1: national average over the entire estimation period.
  - Version 2: national deviation from an eight-year trailing moving average.
  - Version 3: deviations from the same variable's OECD average, in percent, as a control for national deviations from OECD developments.
  - Version 4: the standard deviation of version 3 since the mid-1970s up to the actual year, in order to measure the stability of credit developments in comparison to OECD developments.
- Indicator of securitization: The "quantitative de jure mortgage backed securitization indicator" used by Sa et al. (2014), which builds on the one developed by Hoffmann and Nitschka (2009).[28] The higher the indicator, the more securitization is allowed in the respective country. This indicator almost acts like a country specific constant, as it hardly fluctuates over time.
- Indicator for changes in housing regulation based on the Shim et al. (2013)[29] database for policy actions on housing markets that we transformed to numerical values. The indicator has the following three outcomes: +1 indicates tightening regulation; -1 indicates lowering regulation standards, and 0 reflects no change in regulation.

Table 3 summarizes the expected signs for the coefficient estimates of the exogenous variables. While positive deviations from economic activity in the past should further housing price bubbles, higher current account positions reflect lower net capital inflows and should therefore have a dampening effect on bubble formation. Similarly, positive deviations from past monetary policy signal a more restrictive policy stance by construction and should decrease the probability of bubbles. For indicators on the level of development of the financial sector, the direction is not always clear. A more developed financial system, being reflected in a higher level of domestic credit to GDP and/or higher levels of securitization could dampen or further bubble formation. Yet, stricter financial regulation should dampen the probability of bubbles, while higher credit growth should further it.

4.2 Estimation approach

Our sample has the disadvantage that 16 (15) countries are a small number of cross-sections for a standard panel approach. As we do not have data on all OECD countries, we cannot claim that this was a representative sample – a justification that is often used in cross-country studies with a limited amount of countries and time series features (see e.g.

[28] Even though the data ends 2008Q1, the dataset has been expanded until the end of 2012 by replicating the value of the last available data point. Unfortunately, the indicator is not available for all 16 countries in sample 1.

[29] This database collects information published by central banks of 60 countries between 1990 and 2012 and codes it as measures tightening or loosening the housing market. As the indicator starts in 1990, it can only be used for sample 1.

Beck 2001). It is neither randomly selected, but determined by data availability. At the same time, 23 (28) observations over time are rather short for a time series analysis, especially regarding the non-stationarity issues of several of our explanatory variables that cannot be fully solved by our transformations.

Control for...	Interpretation	Coefficient's expected sign
Indicator for economic activity		
Deviations from real GDP growth	Positive (negative): GDP is above (below) trend	Positive
Deviations from real household consumption growth	Positive (negative): household consumption expenditure is above (below) trend	Positive
Indicator for foreign capital		
Current account balance, % of GDP	The more negative, the higher are capital inflows	Negative
Current account balance, deviations from past values	The more negative, the higher are capital inflows compared to the past	Negative
Indicator for the stance of monetary policy		
Deviation from the Taylor rule	Positive (negative): nominal policy rate is above (below) Taylor rule recommendations, monetary policy is rather restrictive (loose)	Negative (according to Taylor 2008)
Deviation from past real policy rate	Positive (negative): real policy rate is above (below) the past trend; i.e. monetary policy is rather restrictive (loose)	Negative
Indicator for the level of development and regulation of the financial sector		
Domestic credit, version 1	The higher (lower) the value, the more (less) important are bank credits for economic activity over the estimation period on average.	Ambiguous
Domestic credit, version 2	Positive (negative): credit expansion is above (below) trend	Positive
Domestic credit, version 3	Positive (negative): bank credits to GDP are higher (lower) than for the OECD average	Positive
Domestic credit, version 4	The more stable the domestic credit development is with regards to average OECD developments, the lower the value.	Negative (Less volatile credit developments should dampen the probability of bubbles)
Indicator on securitization	The higher (lower) the indicator, the more (less) securitization is allowed.	Ambiguous
Indicator for changes in housing market regulation	Positive (negative) values indicate the number of policy actions that tighten (lower) the regulation of the housing market.	Negative (The tighter regulation, the lower the probability for bubbles)

Table 3: Interpretation and expected signs of the explanatory variables' coefficients

With a larger country sample, our binary endogenous variable would call for a standard panel probit or logit model (or even a multinomial model for the ternary boombust indicator).

This would help in interpreting the estimated coefficients as probabilities, as the (in-sample) forecast of the endogenous would be restricted to outcomes between zero and one. Fixed or random effects should not play a relevant role, as countries should not be "prone" to bubbles in a country-specific way. We would need a dynamic panel probit or logit model, as our results indicate that bubbles depend on past developments in housing prices. Yet, this approach assumes common coefficients for the exogenous variables. As will be demonstrated later, this restriction is not adequate for several of our exogenous variables. Especially the coefficients for monetary policy and financial regulation cannot be restricted to be the same for all countries in the sample. We therefore do not use a dynamic panel probit or logit model.

Our main approach is a system of seemingly unrelated time series regressions that allows for cross-country shocks (cross-country SUR).[30] We estimate a system of country-specific time series equations by generalized least squares (EGLS) and allow for same-period connections of their error terms. To allow for cross-country shocks improves the fit of the regressions and implies that a shock in one country (as well as a global shock) affects other countries.

While the cross-country SUR approach is very robust due to the GLS estimation, it has the negative side effect that the forecast for our endogenous variable is not restricted to outcomes between zero and one. This inhibits a direct interpretation of the estimated coefficients regarding the size of the influence, however not their sign. We therefore mainly concentrate our presentation of results on the question if variables influence the probability of a boom in a statistically significant negative or positive way. We control for the robustness of these results by changing the country sample, the time period under study, by including other exogenous variables as well as a by modifying the construction of the endogenous variable.

If we had enough data points, we would follow the common estimation procedures. For estimating the cross-country SUR, this would imply:

- We would start by using all explanatory variables and then eliminate those that are not significant.
- We would start with country-specific coefficients for all explanatory variables, then test if we can restrict them to be the same across countries, and only do this if we cannot reject the hypothesis of common coefficients.

[30] SUR stands for seemingly unrelated regression. Due to the limited amount of data, we cannot allow for cross-time shocks. Residuals of the SUR regression as well as in country specific equations are free from autocorrelation.

Due to data limitations, we start instead with small models, and check which estimation set-up proves to be robust to changes in the country-sample, time-period, as well as to adding additional explanatory variables. We mostly start with common coefficients and test the adequateness afterwards, for one explanatory variable at a time. We may therefore run into problems of path dependence of our results.

4.3 Estimation results

The estimation set-up that proved to be the most robust regarding changes in the country composition, the time period considered, and the inclusion of additional variables is the following: It is a cross-country SUR approach with a constant, a lagged endogenous and a lagged indicator for economic activity. We call this estimation set-up the **"baseline equation"**. The restriction to common coefficients of the lagged endogenous and, separately conducted, the lagged indicator for economic activity cannot be rejected. The results are in line with theoretical models that stress herding behavior on the side of investors (Scharfstein/Stein 1990, DeMarzo et al. 2008):

1. The **lagged endogenous** is highly significant with a positive sign, indicating, that past bubble developments increase the probability of actual bubbles.

2. Cross-country and/or global shocks seem to play a relevant role: to allow for **cross-country SUR** improves the fit of the regression enormously. The null hypothesis of no cross-country shocks has to be rejected.

3. An above-the-trend increase in **economic activity** in the past year increases the probability of a bubble, be it measured by deviations from past real GDP growth or by deviations from real private household consumption growth.

Besides this very robust baseline equation, we find the following:

4. **Monetary policy** is only statistically significant in a robust way if **measured as deviations of the real policy rate from past trends**, not if measured as deviations of the nominal policy rate from a Taylor rule.

5. In order to get robust results for monetary policy, the sample has to be divided in two subsamples according to the level of credit to GDP (the threshold being more than 120 percent for "high" credit to GDP countries) or according to the indicator for securitization.

6. The effect of monetary policy shocks seems to depend on the level of development and regulation of the **financial system**. For countries with a higher credit to GDP level and for those with higher securitization levels, the estimated coefficient for monetary policy shocks is higher in absolute terms. In addition, the effects of past bubbles on current developments seem to be depend on the financial system.

7. Indicators for the development and the regulation of the financial system seem to be important, yet the versions we use are not optimally capturing the differences between the countries.

8. Interestingly, deviations of **foreign capital inflows** from past developments are **not relevant** for housing price developments in the two samples.

As can be seen in the regression output tables 4 and 5 below and in appendix 3, the coefficient estimates for the lagged endogenous are stable around 0.69 to 0.75 for both samples (with few exceptions). This estimation range is independent of the country sample and the period considered in the estimation.[31] It reflects that most of bubble formation is explained by past bubble developments. This result is less satisfying for explaining bubble formation, but in line with other empirical studies (e.g. Bordo/Landon-Lane 2013b). Similarly, deviations from the trend in economic activity seem to be highly significant for the boom explanation, even though their effect is smaller than the one of past bubbles developments.

More interestingly for the focus of our study, the past stance of monetary policy seems to be highly significant in explaining bubble formation, at least if measured by deviations of the real policy rate from its former trend. Yet, the full sample results are not trustworthy as they hide a high variety over the countries in the sample. This becomes obvious once we allow for country specific coefficient estimates for monetary policy. As appendix 4 documents, country-specific coefficient even differ in signs in a statistically significant way: in some countries, monetary tightening seems to further bubbles in a significant way. This counter-intuitive result seems to be driven by the problem that we do not control adequately for the level of development and regulation of the financial system. Yet, it is not enough to control for it by including one of the financial sector variables presented.[32] Monetary policy continues to be country specific, even if we control for interaction between monetary policy and the financial system in a country by including the product of the indicator for monetary policy and a selected financial sector indicator.[33]

---

[31] Yet, it is even above 0.8 for the high credit to GDP countries in sample 1, see Table 4.

[32] Interestingly, not all control variables for the financial system improve the fit of the regression, if their coefficients are restricted to be the same across countries: The indicator for housing market regulation is not statistically significant, if added to the baseline equation plus a control for the stance of monetary policy. This may be due to the before mentioned problem that the indicator only captures additional (de-) regulation during the estimation time, which might not be relevant, as all countries in the sample already liberalized their financial system before the start of the analysis. Consequently, the interactive term (housing market regulation times the indicator for monetary policy) does not change the country specific effects. The same significant swings in coefficient signs show up as in appendix 4.

In contrast to the regulation indicator, the indicator for securitization increases the probability of bubbles in a statistically significant way. This result is in line with other econometric studies (see Sa et al. 2014). Yet, while the interactive term improves the fit of the regression if the stance of monetary policy is measured by deviations of the real policy rate from the past, this is not the case for the indicator based on the Taylor rule (Appendix 4). Consequently, the interactive term has an influence on country specific signs for the effect of monetary policy only in the former case (Appendix 4). Unfortunately, the indicator is only available for a group of 14 countries (excluding Austria and Portugal), and the values after 2008 are not fully trustworthy (see construction in Appendix 2).

Domestic credit to GDP in version 1 (national average over the estimation period) is neither significant (and an interactive term leads to a nearly singular matrix). All other versions for the domestic credit developments are statistically significant, yet with unexpected signs: Versions 2 and 3 enter with a negative sign, version 4 with a positive sign. Interactive terms with monetary policy yield unstable results, not in line with expectations.

[33] The latter was not possible for all versions of the financial indicator (problem of a nearly singular matrix).

Once we subdivide the country samples according to an indicator controlling for the development of the financial system and its regulation, we find that monetary policy shocks have the expected sign, even if we allow for country specific coefficients. Yet, the deviations from the Taylor rule cease to be significant in explaining bubbles.

To group the countries into two subsamples, we mainly use the level of domestic credit to GDP over the regression period (version 1 of the indicator for credit developments). All countries with an average level of more than 120 percent are considered as having a high level of domestic credit: Canada, Netherlands, Portugal, Spain, Switzerland, and the US (with Portugal being only part of sample1). All other countries have lower credit levels: Austria, Australia, Belgien, France, Germany, Italy, Japan, Norway, New Zealand, Sweden (with Austria only being part of sample1; and Japan only of sample 2). Alternatively, we also groupe countries by the indicator of de jure securitization, which leads to similar results.

Sample 1 (16 countries, 1990-2012), cross-section SUR

Endogenous variable: Binary Boom-Indicator

	full sample		**subsample "high" credit to GDP**		**subsample "low" credit to GDP**	
	Coefficient	**Significance**	**Coefficient**	**Significance**	**Coefficient**	**Significance**
Regression with Taylor rule						
Constant	0.05	***	0.03	**	0.02	**
binary boom-indicator (lag)	0.73	***	0.82	***	0.70	***
deviation from GDP trend (lag)	0.02	***	0.01	**	0.01	***
dev. from Taylor rule (lag)	-0.00	***	0.00		0.00	
Weighted R-Squared	*0.89*		*0.70*		*0.63*	
Unweighted R-Squared	*0.58*		*0.59*		*0.55*	
Regression with policy rate						
Constant	0.03	***	0.02		0.01	
binary boom-indicator (lag)	0.74	***	0.81	***	0.68	***
deviation from GDP trend (lag)	0.02	***	0.02	***	0.00	**
dev. from past policy rate (lag)	-0.00	***	-0.01	*	-0.00	*
Weighted R-Squared	*0.90*		*0.71*		*0.63*	
Unweighted R-Squared	*0.58*		*0.60*		*0.55*	
Regression with policy rate and an additional control for credit developments						
Constant	0.05	***	0.02		0.02	
binary boom-indicator (lag)	0.75	***	0.82	***	0.70	***
deviation from GDP trend (lag)	0.01	***	0.01	***	0.00	
dev. from past policy rate (lag)	-0.01	***	-0.01	*	-0.01	**
dev. from past credit trend (lag)	-0.00	***	0.00		-0.00	*
Weighted R-Squared	*0.86*		*0.73*		*0.64*	
Unweighted R-Squared	*0.58*		*0.59*		*0.56*	

Table 4: Regression results for Sample 1

An important finding is that the effects of monetary policy seems to be higher (in absolute terms) in countries with a higher level of domestic credit to GDP than for those with a lower level of credit to GDP. Deviations of the policy rate from past trends have a high explanatory power (see tables 4 and 5). We get similar results once we group the countries according to the securitization indicator. These findings are in line with Assenmacher-Wesche and Gerlach (2008). We interpret these findings as an indicator that more "developed" financial markets show a stronger reaction of housing prices to monetary policy shocks.

While the grouping is helpful, the indicator does not seem to capture the entire effect of the financial system, as the equations can partly be improved by using additional controls for financial developments. As an example, we add deviations from past credit growth to the baseline regression plus the monetary policy control, even for the subsamples. As can be seen, this partly improves the fit, albeit that depending on the sample and the respective subgroup, different versions of financial developments would be called for. Yet, it seems as if none of our indicators for the development and the regulation of the financial sector captures the entire regulatory framework in a satisfying way. This is partly due to the scarce availability of high quality data for international comparisons that lead to quite unspecific controls for the financial sector.

Sample 2 (15 countries, 1985-2012), cross-section SUR						
Endogenous variable: Binary Boom-Indicator						
	full sample		subsample "high" credit to GDP		subsample "low" credit to GDP	
	Coefficient	Significance	Coefficient	Significance	Coefficient	Significance
Regression with Taylor rule						
Constant	0.05	***	0.04	**	0.03	*
binary boom-indicator (lag)	0.70	***	0.72	***	0.75	***
deviation from GDP trend (lag)	0.02	***	0.01		0.01	**
dev. from Taylor rule (lag)	-0.000		0.000		-0.003	
Weighted R-Squared	*0.56*		*0.54*		*0.58*	
Unweighted R-Squared	*0.54*		*0.55*		*0.51*	
Regression with policy rate						
Constant	0.02	**	-0.00		0.01	
binary boom-indicator (lag)	0.69	***	0.73	***	0.74	***
deviation from GDP trend (lag)	0.02	***	0.01		0.01	**
dev. from past policy rate (lag)	-0.013	***	-0.02	***	-0.01	***
Weighted R-Squared	*0.72*		*0.64*		*0.63*	
Unweighted R-Squared	*0.57*		*0.60*		*0.53*	
Regression with policy rate and an additional control for credit developments						
Constant	0.01		-0.03		0.01	
binary boom-indicator (lag)	0.70	***	0.68	***	0.74	***
deviation from GDP trend (lag)	0.02	***	0.02	**	0.01	**
dev. from past policy rate (lag)	-0.01	***	-0.02	***	-0.01	***
dev. from past credit trend (lag)	0.00	***	0.00	***	0.00	
Weighted R-Squared	*0.73*		*0.64*		*0.63*	
Unweighted R-Squared	*0.57*		*0.61*		*0.53*	

Table 5: Regression results for Sample 2

4.4 Conclusion

We focus on the boom period of housing prices in order to explain the driving factors for the formation of housing bubbles. In two samples, one of 16 advanced economies during the period 1990 to 2012 and one of 15 advanced economies during the years 1985 to 2012, we show in a cross-country-time-series approach that the following variables seems to drive booms in housing prices in an econometrically robust way:

1. Past booms increase the probability of actual booms, especially in countries with a high credit to GDP ratio and/or high levels of securitization.
2. Economic activity above the former trend increases the probability of actual booms.
3. Global shocks or shocks stemming from other developed economies contribute to house price booms.

4. Regarding the effect of monetary policy, exceptionally low real policy rates (compared to past trends) further housing booms, yet not exceptionally low nominal rates (compared to Taylor rule prescriptions).
5. In addition, the effect of monetary policy shocks seems to interact with the financial system: It is more relevant in countries with a high credit to GDP ratio and/or high levels of securitization.
6. Deviations of capital inflows from their past developments are not significant in a robust way for the countries in the sample, even though Bernanke (2010, 2005) stresses their role.

The first three findings are in line with theoretical approaches that stress the importance of herding behavior among investors and bounded rationality (Black 1986, Scharfstein/Stein 1990, DeMarzo et al. 2008). That the influence of monetary policy on the formation of housing bubbles seems to depend on the level of development and regulation of the financial sector is in line with Dokko et al. (2011) and Assenmacher-Wesche (2008) as well as single-country approaches cited in Carstensen et al. (2009, see section 3.1).

Even though we find a statistically significant impact of monetary policy shocks, this is not the case for deviations of the nominal policy rate from the Taylor rule, which turn out to have little if any explanatory power. Insofar we cannot confirm the arguments raised in Taylor (2008) or Bordo/Landon-Lane (2013a,b). Nevertheless, we can relate our results to their paper, as our approach may indicate an underlying problem for the mentioned results: Even in our approach, the effect seems to be significant with the expected sign at a first glance. Yet, the full sample results camouflage huge country specific differences, to the extent of statistically significant differences in the signs. Once we group the countries according to their credit to GDP levels (or another control for the level of development of the financial system), deviations from the Taylor rule cease to be significant.

Our alternative indicator, based on deviations of the real policy rate from its past trend, performs significantly better. According to the latter, “too loose” monetary policy in the sense that the real short-term policy rate is below past levels, may contribute to bubble formation. Yet, the effects are especially relevant for those countries that exhibit high credit to GDP levels and/or high securitization levels. If changes in nominal rates or changes in the price level are the main driver, remains for future research.

Regarding our regression setup, it is surprising that we do not find more support for the hypothesis that too “loose” monetary policy measured by the Taylor rule drives housing bubbles. Central banks had several reasons to deviate from their past policy stance around the 2000s, e.g. to stabilize stock market developments. As we do not control for these reasons in our regression, the role of monetary policy for housing bubbles might even be overstated in our approach.

Even though we find indications for the relevance of the development and regulation of the financial sector, we have to admit that the indicators used are not optimal. Unfortunately, high quality data for international comparisons is hardly available for the period under study. We therefore cannot precisely determine the influence of the financial sector, a problem that is in line with empirical studies for the level of house prices. In order to shed more light on the role of the financial sector, the next section will provide case studies on Austria, UK, and the US. The case studies are supposed to explore the interaction between monetary policy and the financial system as well the general regulatory framework.

5 Housing Markets, Monetary Policy and Financial Developments: Three Case Studies

The results from the empirical part of this study are not completely satisfactory from a policy perspective as they did not give a clear answer on what might trigger housing bubbles. According to the results, the effect of real policy rate shocks on housing prices seem to depend on the development and regulation of the financial system, yet, our variables controlling for it (credit to GDP levels or the indicator for securitization) are not very precise and therefore of little help for policy recommendations. Even if we directly control for financial regulation indicators, none of the numerical indicators checked turned out to have high explanatory power for the forming of housing bubbles. All they indicate is an underlying interaction of the financial system with the effects of real interest rate changes.

Such inconclusive regressions actually call for an approach usually dubbed as „mixed methods“: When looking at aggregate cross-country data does not yield a satisfactory result to a given research question, in a second step, selected case studies can shed more light on the issues. The rationale behind such an approach is that very often, institutional settings play a role for certain economic phenomena which cannot be well captured in a single-dimensional, cross-country index, as institutional realities are too complex (Lieberman 2005).

This approach has been chosen for this section. The aim is twofold: On the one hand, we want to show that the interaction between monetary policy and the financial system is important for the formation of real estate bubbles. On the other hand, we want to illustrate that deviations of the nominal policy rate from the Taylor rule are not necessarily leading to bubbles. We therefore present three country cases for three different situations: The first case presents a country where a lax monetary policy (defined as a sustained downward deviation of the monetary policy rate from the Taylor rate) has been followed by a house price bubble. For this, the house price bubble in the US in the 2000s has been selected. The

second case portrays a country in which a bubble emerged without monetary policy having been overly lax to start with. Here, the UK in the 2000s has been selected. The third case illustrates a country in which a very lax monetary policy has not been followed by a housing price bubble. Here, Austria in the 2000s has been chosen.

5.1 A bubble under lax monetary policy: The House price bubble in the United States in the 2000s

The United States has been selected as one of the case studies because it is often at the centre of the discussion on housing price bubbles thanks to the fact that the bursting of its housing price bubble from 2007 onwards and the ensuing subprime-mortgage crisis has brought the global economy to the brink of a new depression. Moreover, the United States of America is an interesting case in which a rather lose monetary policy relative to the recommendations of the Taylor rule has coincided with a period of very strong house price increases.

The case study focuses on the recent house price boom from around 2000 onwards. However, as far as knowledge of former developments is needed to understand the recent house price bubble, these developments are also covered.

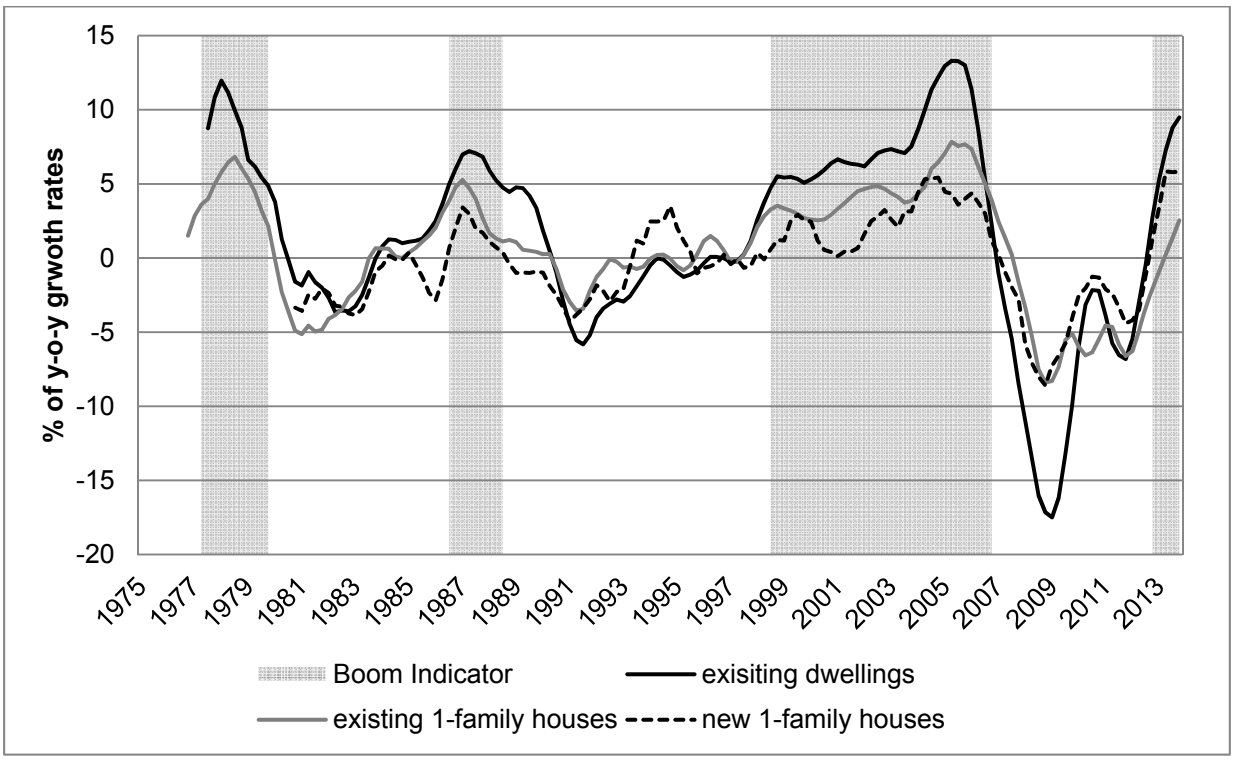
5.1.1 Description of house price developments

As described above, for this study, we have defined a house price bubble as a house price boom followed by a bust. According to this measurement, the house price boom for the bubble period of the early 2000s started in 1998 Q4 and lasted until 2006 Q3. Similarly to other countries during that time, the bust period is comparatively short contrasted with the long boom period (see e.g. the UK and section 4.1): Bust signals start in 2007 Q3 and end in 2012 Q1, with an intermediate no-signal period of even increasing prices from 2010 Q2 to 2011 Q1. Since the start of the year 2013, prices have recovered so strongly that they meet again the boom criteria.

As price changes in existing dwellings are most of the time more pronounced in absolute terms than for single-family houses, the latter do not seem to be the main driver of price changes (Figure 3).

Looking into regional data, it becomes clear that the boom in the United States has been far from uniform across the country. According to Anundsen/Heebøll (2013), cumulative residential real estate price increases in the 248 US metropolitan statistical areas have ranged between slightly less than 10 percent and more than 160 percent for the time period

2000 to 2006, with the largest increases seen in coastal areas in California and Florida and the smallest increases in some remote regions in the Midwest.[34]



Data source: BIS data on residential property prices, OECD CPI deflated, four-quarter moving averages of y-o-y growth rates based on quarterly data, own calculations. Prices per dwelling.

Figure 3: Real residential property prices in the US, y-o-y, four-quarter moving averages

5.1.2 Structure of the housing market and relevance of mortgage loans

It is plausible that a significant share of the house price increase has been driven by owners who have purchased houses for their individual use. In the United States, home ownership rates have traditionally been rather high in OECD comparison, yet not above the EU28-average.[35] The run-up of a bubble coincided with an increase in the home ownership which peaked in 2004 at 69 percent (US Bureau of Census 2014), but then dropped with the bust of the bubble, reaching 64.7 percent in the first quarter of 2014, the lowest rate since the mid-1990s.

[34] The Metropolitan area with the highest price increase reported in the paper has been Naples-Marco Island (FL), the area with the lowest increase Lafayette (IN).

[35] The EU28 average itself conceals vast differences between the member states. In some post-Communist countries, the specific procedures taken to privatise dwellings have led to very high rates of homeownership of more than 90 percent, while some large Western European countries such Germany have low homeownership ratios.

The relatively high rate of home ownership is generally explained with government policies after World War II which helped provide affordable finance for dwellings of middle-class families. Here, the creation of the Federal Housing Administration as well as the Veterans Administration which would guarantee mortgages to lower-income household as well as the inception of the Federal National Mortgage Association (Fannie Mae) which would purchase and resell these loans is often seen as crucial (Gramlich 2007). In fact, the homeownership rates increased from below 50 percent before World War II to more than 60 percent from the mid-1950s onwards, after these "agencies" and "government-sponsored enterprises" were created.

It is undisputed that the house price boom of the 2000s was mainly financed by an expansion of mortgage loans. During our boom period, annual increases of outstanding mortgages were regularly above 10 percent, and the amount of mortgages outstanding relative to GDP increased from less than 60 percent in 1997 to about 90 percent in 2008 (Figure 7 below). In 2011, about two thirds of the home owners had a mortgage on their home and the median value of this mortgage was about 70 percent of the dwellings' current value (US Department of Housing and Urban Development 2013). Less than 10 percent of home owners occupying their own house reported that they purchased their house outright without a mortgage.

Historically, the most predominant type of mortgages has been a thirty-year fixed interest rate mortgage with full amortization over this period (Moench et al. 2010). While there have been some fluctuations in the share of adjustable-rate mortgages, they have never gained the importance they have achieved in other countries.

A special case has been the subprime segment of the mortgage market, which played an increasing relevance in the boom of the 2000s. In this segment, mortgages often were of a "short-term hybrid" variety, meaning that interest rates were fixed for an initial period of up to three years, but became adjustable afterwards. According to Mayer et al. 2008, up to 75 percent of the subprime mortgages which originated between 2003 and 2007 were of this variety, while according to some studies, more than 60 percent of conventional mortgages are of the fixed-rate variety (Krainer 2010).

A specific feature of the US housing markets since the 1980s has been the heavy reliance on securitization of mortgages. As Green et al. (2007, p. 43) show, agency- and government-sponsored enterprises backed mortgage pools replaced savings institutions as the main holders of mortgages over the 1990s. Moreover, from 2000 onwards, the share of mortgages financed by privately issued asset-backed securities more than doubled while the share of mortgages financed through agency- and government-sponsored enterprises fell.

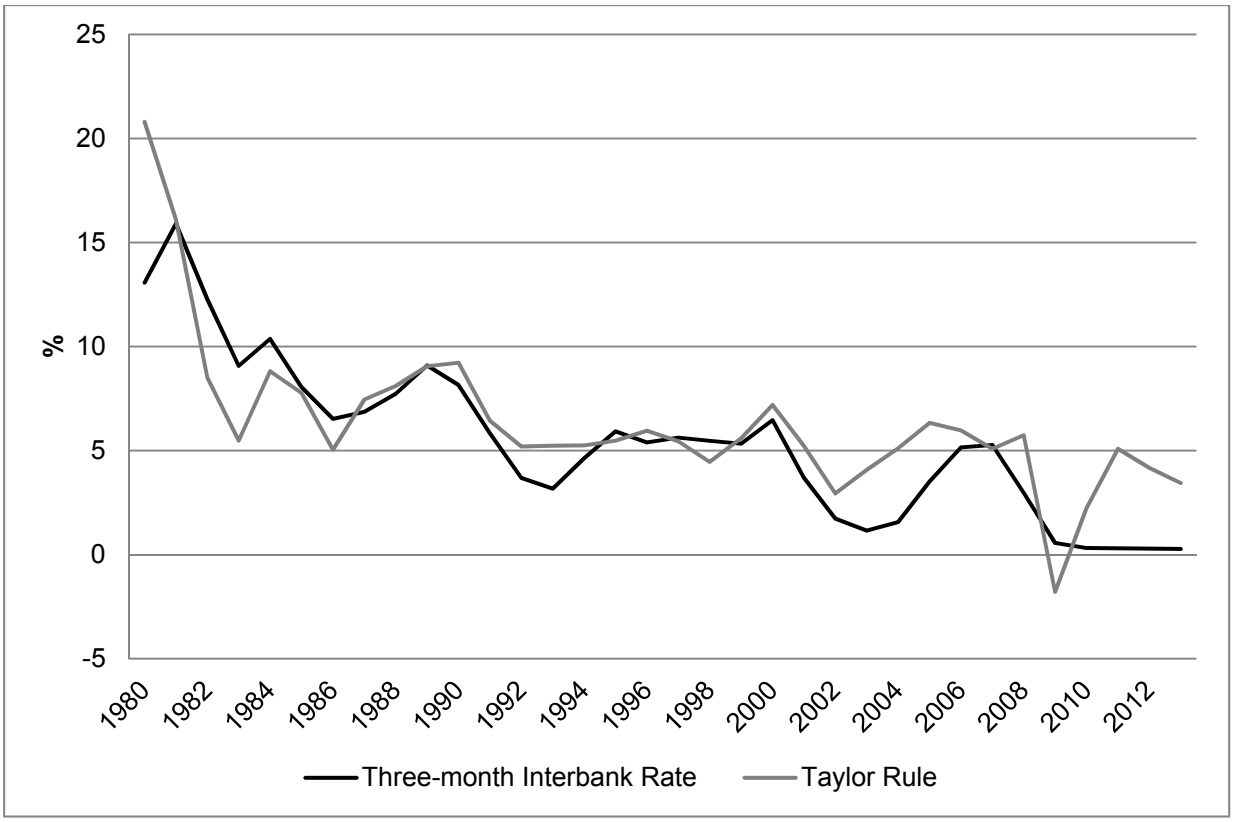
In total, the amounts of mortgages securitized until the mid-2000s grew tremendously, with the largest growth in privately issued mortgage-backed-securities. According to Deloitte (2013), the value of newly issued residential mortgage-backed-securities (RMBS) increased from $532 bn in 2000 (about 5 percent of US GDP) to $2481 bn in 2003 (more than 20 percent of US GDP) and remained elevated at around $1700 bn until the outbreak of the subprime crisis in 2007. In these years, the issuance of RMBS explains most of the increase of outstanding mortgage loans in the United States. Moreover, from 2003 onwards, the share of RMBS issued by agencies and government-sponsored enterprises dropped from around 85 percent to about 55 percent, reflecting the strong growth of private-sector issuance of RMBS.

There is hardly any dispute in the literature that this increase in mortgage securitization and the growing involvement of private-sector issuances of RMBS has been a major factor to explain the strong demand for houses during the 2000s boom in house prices.[36]

5.1.3 Description of monetary policy

The interesting questing is now: What has caused this increase in credit supply and securitization? Some authors such as Taylor (2007) argue that according to the behavior of macroeconomic data in the US since the 1980s, the Fed adopted an overly loose monetary policy stance in the 2000s. Taylor especially claims that the US Federal Reserve has deviated strongly from the Taylor-rule, an empirical rule well describing US monetary policy as a function of inflation and the output gap over the late 1980s (Taylor 1993).

[36] For a good survey on securitization, its role in the financial crisis and recent regulation, see Segoviano et al. (2013).



Data Source: OECD's Main Economic Indicators. Taylor rule prescription calculated by the authors following Taylor (1993, p. 202), based on most recent data.

Figure 4: The United States' Three-Month Interbank Rate and Taylor Rule Prescriptions between 1980 and 2013 (%)

As can be easily seen in Figure 4, the US' three-month interbank interest rate, an indicator of the Federal Reserve's monetary policy stance, in general has followed the prescribed Taylor rule rate between 1980 and 2013. However, the Fed followed a rather tight monetary policy path until the end of the 1980s and thereafter a more relaxed one. During six out of the ten years of the 1980s decade the interbank rate was slightly above the rate prescribed by the Taylor rule. Moreover, during the entire decade, the interbank rate was on average 18 bps above the Taylor rate.

In contrast, during the period starting in 1990 the interbank rate was only above the Taylor rule prescription during five years, three in the mid- to late-1990s and two in the late-2000s. During the house price boom period under investigation (1998 to 2006), the three-month-interbank rate was always (and sometimes significantly) below the Taylor rule.

Thus, at first sight, this data seems to support the claim that the Federal Reserve's monetary policy has been too lax during this time. However, there are a number of authors who caution against an overly simplistic application of the Taylor rule to gauge the appropriateness of monetary policy. For example, Dokko et al. (2011, p. 246) point to the fact that during the 2000s, inflation was expected to remain low, i.e. close to 2 percent, as well as

unemployment, slightly above 5 percent. Therefore, a rise in the policy rate seemed unjustified. These authors point out that even though simple monetary policy indicators such as the Taylor rule are useful, they have their limitations and, therefore, the guidance that they provide needs to be complemented with forward looking tools, assessments of the effectiveness of policies given the current information that central bankers might have access to.

5.1.4 Changes in regulatory environment

When trying to check alternative explanations of the US housing price bubbles, one also needs to look into the regulation of housing finance and the financial market at large. While the US housing price bubble in the 1980s had been preceded by strong deregulations in the US financial sector and especially concerning institutions heavily involved in the mortgage market, the same cannot easily be claimed of the bubble in the 2000s. In fact, the regulations concerning mortgages and even securitisation remained basically unchanged in the late 1990s.

However, there are some other, seemingly unrelated changes in regulation which could have had an impact on mortgage loan growth and mortgage securitizations. Some authors list the repeal of (parts of) the Glass-Steagall act (which prohibits banks from investment banking activities) by the Gramm-Leach-Bliley Act (GLBA) of 1999 as a possible trigger of the growth in mortgages and mortgage securitisation,[37] but this claim does not stand up to closer scrutiny. As Wallison (2011) points out, both before and after the partial repeal of the Glass-Steagall act, regular banks were prohibited to securitize their loans themselves, but were allowed to sell their loans to other financial institutions for securitization as well as buy securitized loans for investment purposes. As Markham (2010) describes, mortgage-backed securities appeared long before the passage of the GLBA.

Another, more likely culprit is the 2000 Commodity Futures Modernization Act (CFMA). As described in Roe (2008) and Stout (2011), this legislation exempted over-the-counter derivatives from strict regulation and strengthened the legal enforcement of derivative contracts. In combination with the US bankruptcy code which gave “quasi priority” to derivative contracts in bankruptcy proceedings, these legal changes allowed the growth among others in the market for credit-default-swaps (CDS). With these contracts which promise a payment in case of default of a debt security (including collateralized debt obligations), securitized mortgages could be insured against default.

[37] See for this line of argument for example Popken (2008).

Arguably, the ample supply of CDS for all kinds of securities made investors more willing to buy asset-backed-securities, which together with a correspondent CDS was considered as a risk-free investment by many institutional investors. The increased willingness of investors to hold CDOs during this time then could explain the extraordinary boom in private securitisation which then led to the well-known moral hazard problems in the process of originating and securitizing mortgages. As is widely discussed in the literature, the possibility by mortgage lenders to securitize their loans and hence get the risk off their own balance sheet creates an incentive for lowering credit standards. As Dell'Ariccia et al. (2008) document, this is not only a theoretical possibility, but in regional data from the United States it can be shown that in regions where a larger share of mortgages were securities, credit standards were relaxed more strongly than in other regions.

Duca et al. (2012) show empirically that falling lending standards (as proxied by loan-to-value ratios of first-time home buyers) explain most of the US house price boom in the 2000s. Moreover, they show that the amount of outstanding CDS is strongly linked to the issuance of residential-mortgage-backed securities in the United States, another indicator for the impact of financial deregulation and financial innovation, especially in the derivative market.

As a separate factor, Levitin et al. (2009, p. 11) propose that the shift towards performance-based bonuses in Wall Street firms (non-bank financial institutions) might have contributed towards the boom in securitization: As investment banks were earning fees for successful securitization and their employees were paid according to the profits they generated, there was an inherent incentive to securitize as many mortgages as possible without regard for the riskiness of the securities created.

5.1.5 Conclusions from the case study of the 2000s US house price bubble

Summarizing the experience of the United States during the house price bubble in the 2000s, we have to admit that we cannot conclude from this case with absolute certainty what has caused the bubble. Monetary policy has been loose relative to the Taylor rule during the run-up of the bubble. However, the immense importance of mortgage securitization during this boom and the changes in the regulation which have turned residential-mortgage backed securities from a risky and exotic financial product into a standard investment product which in turn could be transformed into a (seemingly) safe asset by the combination with CDSs hint that financial innovations and changes in the regulatory environment have played a significant, if not decisive, role in the emergence of the bubble.

Another important lesson from this case study is that financial innovation and changes in the regulatory environment can impact the credit supply strongly even if these changes are

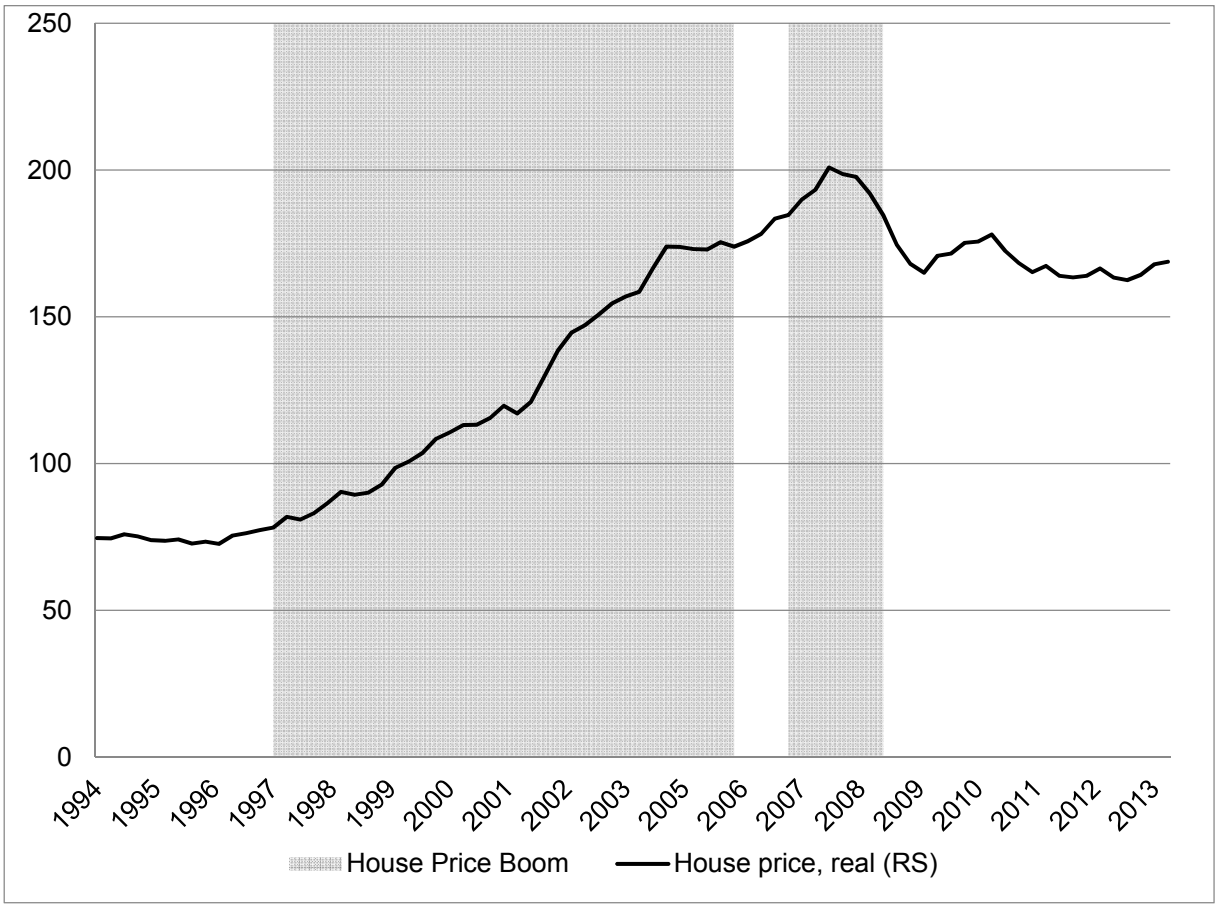
not covered in the standard (rather narrow) indexes for financial sector depth and mortgage market regulation. This might be an explanation why indicators for financial regulation have not shown up in a statistically significant way in our econometric estimations.

5.2 A bubble without lax monetary policy: The house price bubble in the United Kingdom in the late 1990s/early 2000s

The UK presents an interesting case in which it can be argued that recent house price bubbles cannot be explained by loose monetary policy since the Bank of England (BoE) followed a rather tight monetary policy from the end of the 1990s until onset of the global financial crisis at the end of the 2000s. Notwithstanding, during this period, a bubble developed and burst in Great Britain. In this section, house price developments will be depicted and then the structure of the UK's housing market will be presented. Afterwards, the monetary policy stance of the BoE will be described. The section ends with a discussion of changes in the UK's regulatory financial environment and of financial innovations that could have had an impact on house price developments.

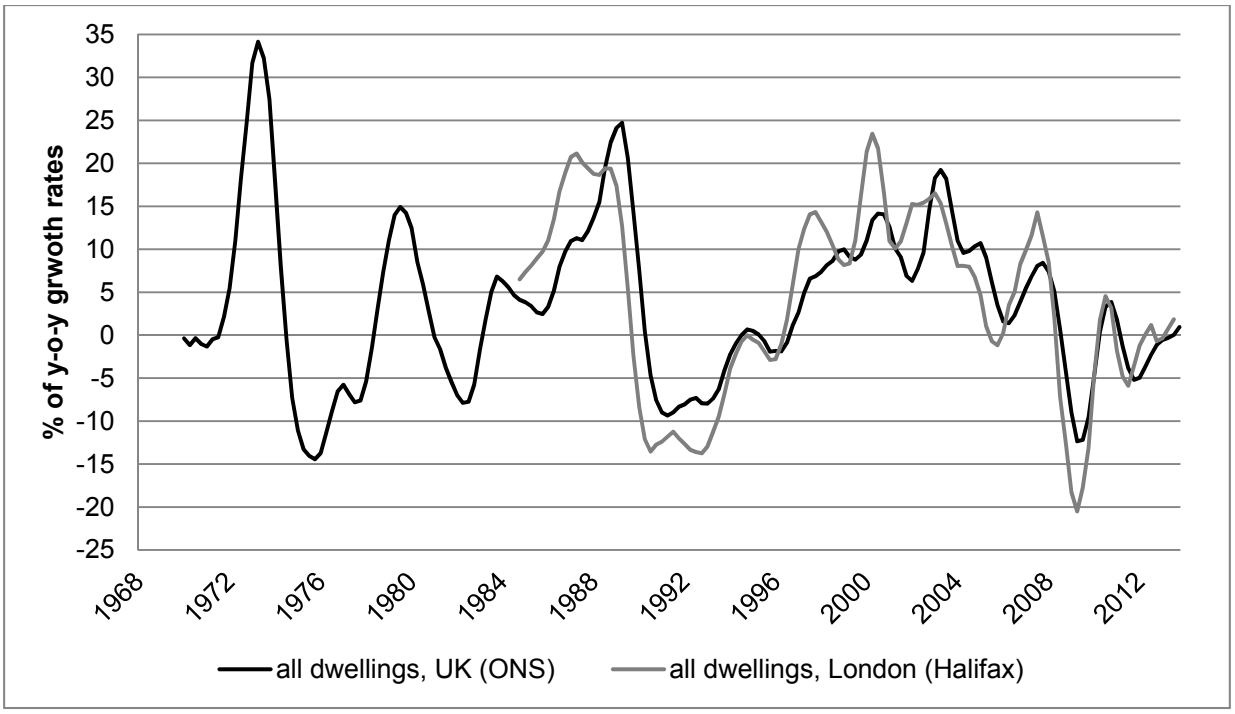
5.2.1 Description of house price developments

The period analyzed in this case study starts with the rise of the most recent house price bubble in the UK, which started to form during the third quarter of 1997 and burst during 2009. As can be seen in figures 5 and 6, this bubble is characterized by a long boom period running from 1997 until 2005. Interestingly, figure 6 seems to indicate that price developments in London lead those at the national level by one to three quarters, even though the real residential property price for London from Halifax, a mortgage provider, may not be fully comparable to the one for the national level from the ONS. Moreover, price changes in London can exceed and undershoot those at the national level—in contrast to Austria, where prices in Vienna only show higher increases, but always undercut the price decreases, as is discussed in section 5.3.



Source: BIS data, own calculations.

Figure 5: Evolution of real house prices in the UK and house price booms 1994–2013.



Source: BIS data on residential property prices, pure prices OECD CPI deflated, four-quarter moving averages of y-o-y growth rates based on quarterly data, own calculations. ONS: Office for National Statistics.

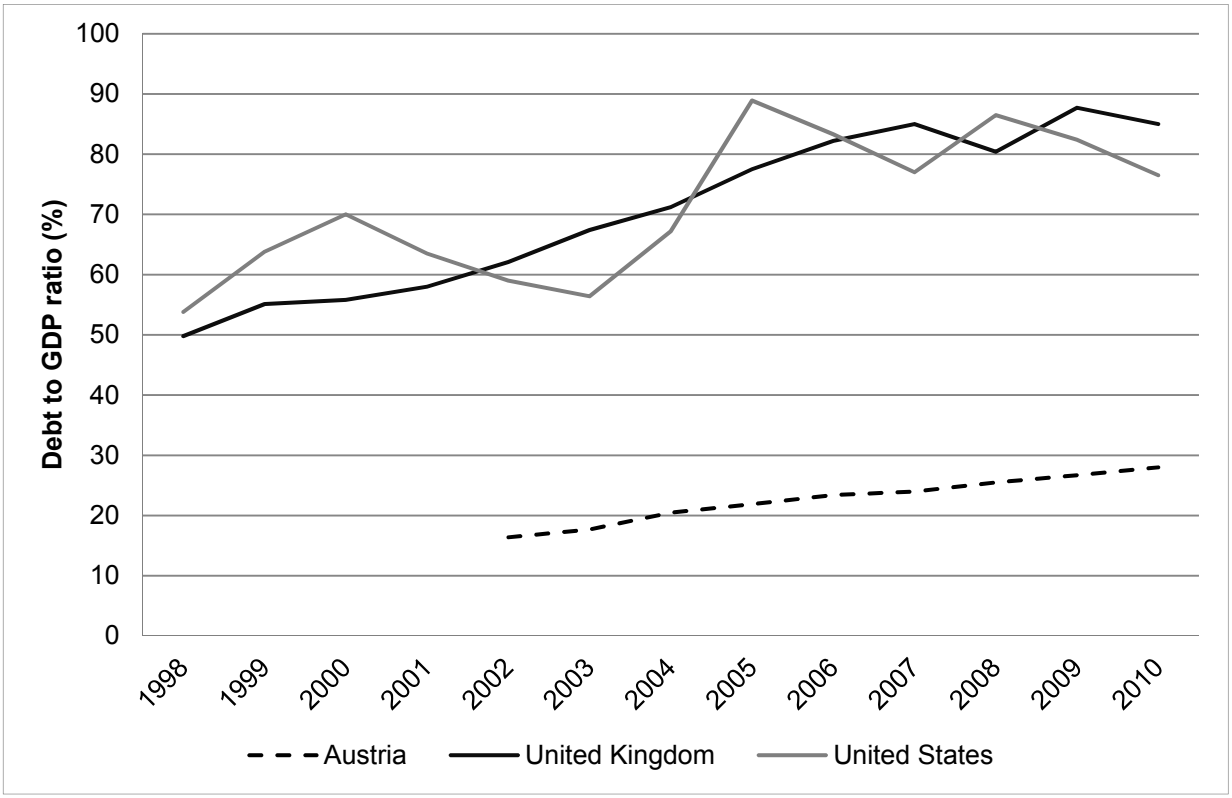
Figure 6: Real residential property prices in the United Kingdom, y-o-y, four-quarter moving averages.

The bubble that is the focus of this case study has boom signals going from 1997 Q3 to 2008 Q2, interspersed by a no-signal period between 2005 Q4 and 2006 Q4. Compared to the nine years of boom signals, the bust period is very short, consisting of one year of bust signals during all quarters of the year 2009 plus another bust signal for the last quarter in 2011, yet quite drastic with downward corrections of up to 20 percent. The magnitude of the price hike is remarkable since real house prices increased more than 150 percent between the start of the price increase and the peak of the bubble. Despite the strong real price corrections observed in 2009 and 2011, the average real house price in the UK remained at a level two times higher than at the beginning of the bubble during the late 1990s.

5.2.2 Structure of the housing market

The latest price booms in the UK housing market had little impact on the share of households owning their houses, despite their long duration. According to data from the Department for Communities and Local Government (2014), the share of owner occupier households was 69 percent in 1997 and had an equal value in 2007–2008 when real house prices peaked. However, the subsequent strong price corrections seen afterwards did have an impact, albeit limited, on the share of owner occupied households, which decreased 3 percentage points reaching 66 percent. Moreover, during the 1997–2008 period the share of owner occupiers that owned outright their houses, i.e., that were not using a mortgage to

finance their housing investment, slightly increased from 39 percent in 1997 to 45 percent in 2008, a contrasting trend with respect to the case of the US, as seen in section 5.1. Finally, during the bust phase of the bubble this share continued to increase to 49 percent in 2011. However, the fact that the share of homeowners that outright own their homes continuously increased to almost reach half of the homeowners population might give a wrong impression about the evolution of the economic weight of mortgages in the British economy during its last house price bubble.



Source: Source: own calculations based on the DICE Database (2012).

Figure 7: Ratio of mortgage debt to GDP in Austria, the United Kingdom and the United States

In fact, the UK's ratio of mortgage debt to GDP constantly grew between 1998 and 2007, from almost 50 percent of GDP to 85 percent, as can be seen in Figure 7, when house prices reached their peak. Together with the fact that an increasing share of home-owners owned their house outright, this means that the size of the average individual outstanding mortgage loan has been increasing.

Different from most other industrialized countries, in Britain, a large share of mortgages is of the adjustable-rate variety while in other European countries as well as the United States of America, the fixed-rate type is more common. BBVA (2013) classifies roughly half of the outstanding mortgages in Britain as "variable-rate" loans, while only about 10 percent of the US loans are classified in the same way.

When it comes to the question of amortization, academic literature states that during the 2001–2008 period, 79 percent of the mortgages issued were of the fully amortizing type, whereas just 21 percent were interest-only (Cocco, 2013, p. 1671). However, the share of interest-only mortgages has continuously increased over this period: According to Lea (2010, p. 25), the share of interest-only mortgages already reached 24 percent for the years 2005-6 and reached 43 percent in the years 2009-2010.

During the 2000s endowment loans, a type of interest-only loan in which borrowers not only pay the bank the loan's interest but also the prime of a life insurance that matures at the end of the mortgage (Hendershott et al., 2003, p. 56), had all but disappeared (Cocco, 2013, p. 1671). The main reason for this decrease in popularity could be attributed to the negative impact of the stock market crash in 2000 on the life insurances' return, which implied that by the end of the loan borrowers would need to cover the gap between initially forecasted high returns and realized low returns (Cocco, 2013, p. 1668).

Another factor that characterizes the structure of the housing market is that since 1947 the UK has a national urban containment law, the Town and Country Planning Act, mainly as a means of curbing urban sprawl to protect rural areas adjacent to towns (Dawkins and Nelson, 2002, p. 4). Several studies show that this policy exercises great influence on the supply of land for housing projects and, therefore, on house prices (Dawkins and Nelson, 2002, p. 6). Moreover, such a policy has been held responsible for low levels of residential investment in the UK. For instance, Marqués et al. (2010, p. 113) point towards the severity of zoning restrictions as a main determinant of the rather low price elasticity of supply.

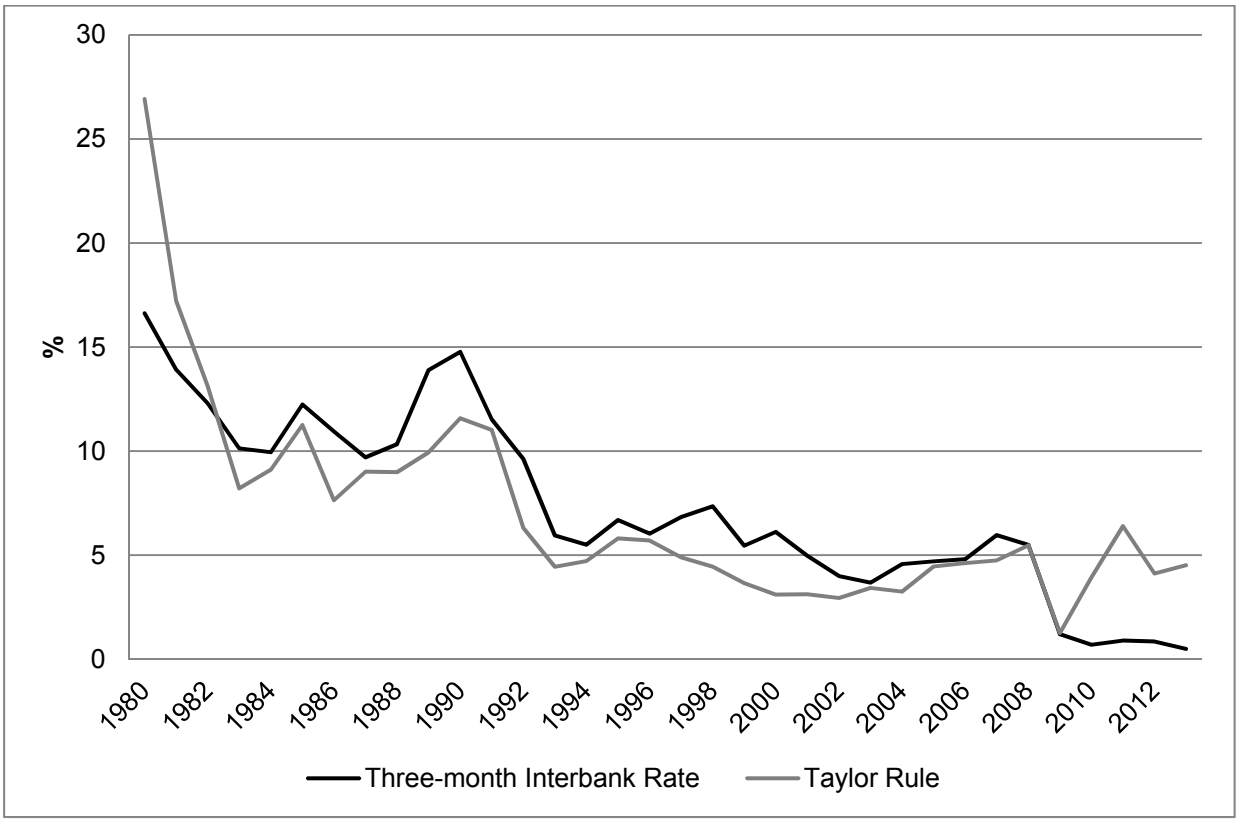
A further relevant characteristic of the UK's mortgage market is the increasing importance of securitization in the housing market: The share of securitization rose from just 3 percent of the stock of mortgage debt in 2000 to 22 percent in 2007 (Cocco, 2013, p. 1669). According to Ahlswede (2013, p. 4), this ratio continued to rise further until the onset of the crisis, and at the end of 2008, residential mortgage backed securities in the UK accounted for about 60 percent of outstanding mortgages. Within less than a decade, the UK thus moved from a mortgage market funded mainly through the traditional channels of deposit-taking institutions lending out to home-owners to a system with a strong reliance on financial market funding of mortgages (see also below).

5.2.3 Description of monetary policy

Figure 8 presents the UK's three month interbank rate and the Taylor rule prescriptions for this country for the period 1980–2013. The UK's three-month interbank interest rate, an indicator of the BoE's monetary policy stance, in general seems to follow the prescribed Taylor rule rate between 1980 and 2013, as can be seen in Figure 8. However, the bank

followed a rather tight monetary policy path during most of the period, since between 1983–2008 the interbank rate was above the Taylor rule rate by 152 basis points (bps) in average. Judged by the Taylor rule, the BoE only followed a loose monetary policy between 1980–1982 and 2009–2013, according to Figure 8. Thus, especially in the run-up of the housing bubble in the 2000s, the BoE kept its interest mostly above the Taylor rule and hence cannot easily be argued to having been "loose".

The loosening of the policy stance of the BoE since 2009, in contrast, is not of large interest for our study: This deviation must be seen as a reaction to the global financial and economic crisis and post-dates the housing price bubbles under investigation in this study.



Source: OECD's Main Economic Indicators. Taylor rule prescription calculated by the authors following Taylor (1993, p. 202), based on most recent data.

Figure 8: The United Kingdom's Three-Month Interbank Rate and Taylor Rule Prescriptions between 1980 and 2013 (%).

5.2.4 Regulatory financial environment and financial innovations

During the period under investigation, the mortgage market in the UK has undergone important changes. First, the importance of traditional building societies has declined. Traditional building societies in the UK were not-for-profit companies, but owned by their members who could deposit interest-bearing funds, but could also borrow from their building

society. These building societies were restricted in how they were allowed to fund themselves. As late as 1980s, building societies held 80 percent of outstanding mortgage loans (Whitehead 2008, p. 7).

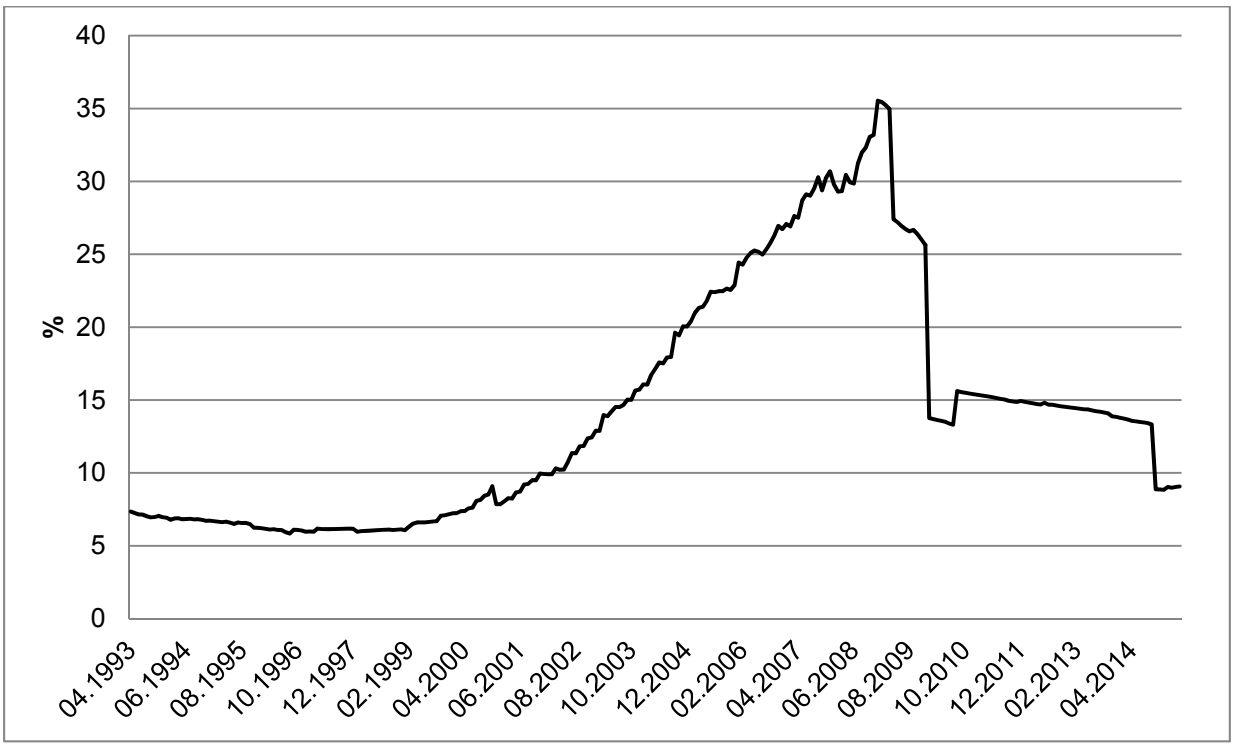
The Building Societies Act of 1986 was one element to deregulate financial markets in the UK. It relaxed some of the restrictions of the building societies' assets and liabilities and – importantly – allowed the building societies to de-mutualize, meaning that they would transform into publicly traded corporations. However, it took another decade before a larger number of building societies took this step, and the late 1990s/early 2000s saw a wave of demutualizations. Among the building societies demutualized in the late 1990s/early 2000s, there are a number which played an important role in the housing boom and which needed to be rescued or taken over by other institutions such as Northern Rock, Bradford & Bingley or Halifax.[38] These building societies played an important role in the credit boom in Britain as can be seen by the example of Northern Rock. The institute increased its total assets from GBP 17.4 billion in 1998 to GDP 113.5 billion in 2007, having become the fifth largest British bank by mortgage assets on the eve of the crisis (Shin 2009).

Second, there has been a boom in non-traditional funding of lending institutions. First, an increasing number of institutions relied on short-term wholesale financing of their long-term loan business. In addition, as was mentioned in section 5.2.2., the UK's housing market witnessed a steep rise in securitization during the 2000s. Again, Northern Rock here is an instructive example: In 1998, 60 percent of its fund came from retail funding. By 2007, this share had dropped to 23 percent and securitized notes and short-term loans from the wholesale market made up most of the funding (Shin 2009).

Third, there has been a boom in the lending from so-called "other specialist lenders" (figure 9). This term denotes financial institutions which hand out loans secured on dwellings, but which do not have their own deposit-taking business. These institutions fund mortgages by either borrowing from the wholesale market or by putting these loans into the securitization process. During the emergence of the housing price bubbles, these institutions increased their share in lending in the UK market to more than 35 percent. As evident in figure 10, these lenders were a crucial factor in the exponential loan growth prior to the bursting of the house price bubble in the UK. A number of these specialized lenders such as GMAC-RFC and GE Capital were among the top 20 lenders in the UK prior to the crisis. However, with the break-down of the demand for residential mortgage-backed-securities and

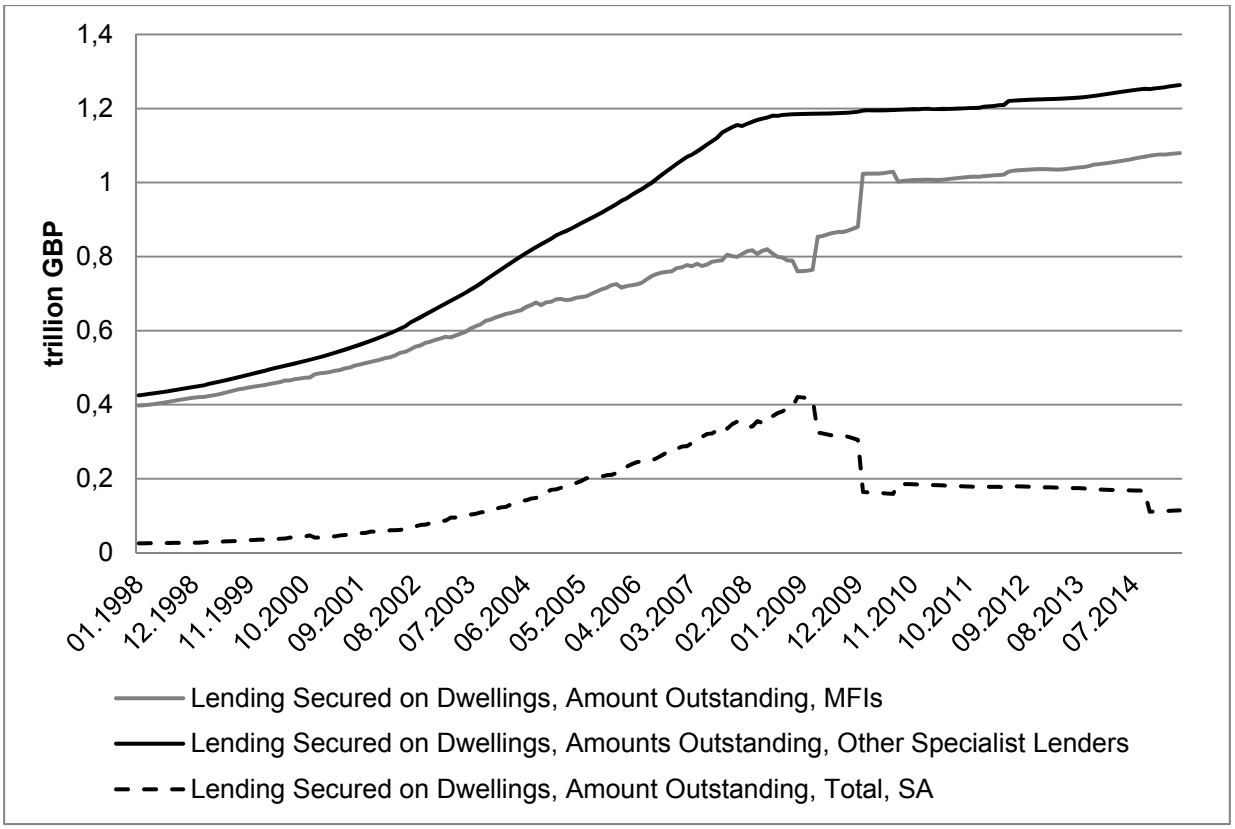
[38] For more details, see Whitehead (2008).

the emerging problems of obtaining other types of wholesale financing after the bursting of the bubble, they were quickly reduced to niche suppliers after the crisis (Stoclet 2012).



Source: Macrobond.

Figure 9: Outstanding UK mortgages from "Other specialised lenders" as a share of total mortgages outstanding



Source: Macrobond.

Figure 10: UK mortgages outstanding, in trillion GBP, by type of lender

In parallel with these structural changes, the 2000s witnessed the appearance of new mortgage products and a heavier reliance on mortgage-backed securities (Cocco, 2013, p. 1669; Scanlon and Whitehead, 2011, p. 281). As mentioned above, also the share of interest-only mortgages increased while the average loan size also rose.

5.2.5 Conclusions from the UK case study

This case study on the developments of the housing market and monetary policy in the UK since the end of the 1990s has shown that it is problematic to assign the blame of the house price bubble seen in this period to monetary policy. As mentioned before, the UK's three-month interbank interest rate in general closely followed the prescribed Taylor rule rate between 1982 and 2009. Yet, a bubble of similar magnitude as in the US developed.

Since this development has been accompanied by a strong rise of mortgage-backed securities, one can make the case that financial innovation within the mortgage market seemed to have played a more important role as a culprit of the bubble. Together with the emergence of other types of wholesale finance and of new lenders, this increase might well explain the recent bubble formation.

5.3 Lax monetary policy without a housing bubble: The Austrian real estate market in the 2000s

Austria has been selected as one case study because it provides the interesting example of a country that has violated Taylor rule prescriptions since the introduction of the euro, being "too loose" in its monetary policy stance, yet so far has not shown signs of a housing bubble.[39] In addition, housing prices developed in striking contrast to other euro area countries. The case study therefore focuses on the period since the introduction of the euro. As will be shown below, Austria is a good example for the importance of the institutional setting, as many authors attribute stable house price developments in Austria to public support for low-rent housing, housing assistance schemes that subsidies construction and renovation of housing and a regulatory setting that dampens the incentive to buy a house for investment purposes. In addition – and in contrast to the previously presented case studies – securitization of mortgage credits beyond the traditional covered bonds ("Pfandbriefe") is still at comparatively low levels. The Austrian case might also explain why the empirical approach presented in section 4 failed to provide precise results for the effect of housing regulation, as the chosen indicators are not capable of capturing the effect of the entire regulatory setting.

5.3.1 House price developments

Since the introduction of the euro, the behavior of residential property prices in Austria has differed strikingly to developments in other countries of the European Monetary Union, where house prices on average increased from the mid-1990s up to the middle of 2008 and slightly decreased thereafter.[40] In Austria in contrast, they had stagnated in nominal terms until the middle of the 2000s and have started to move up more strongly since 2007. For the period since 2007 up to the mid-2013, the growth rate in Austrian housing prices of 39 percent is the highest in the euro area (OeNB 2014, Schneider 2013: 30) and the price hike is especially pronounced in the capital Vienna.

The BIS housing data that have been used for the econometric analysis presented in section 4 show similar developments. BIS data on residential property prices in Austria are only available from the year 2000 onwards. Figure 11 depicts the annual growth rates in real residential property prices since the year 2001, for Austria as well as for Vienna. Growth

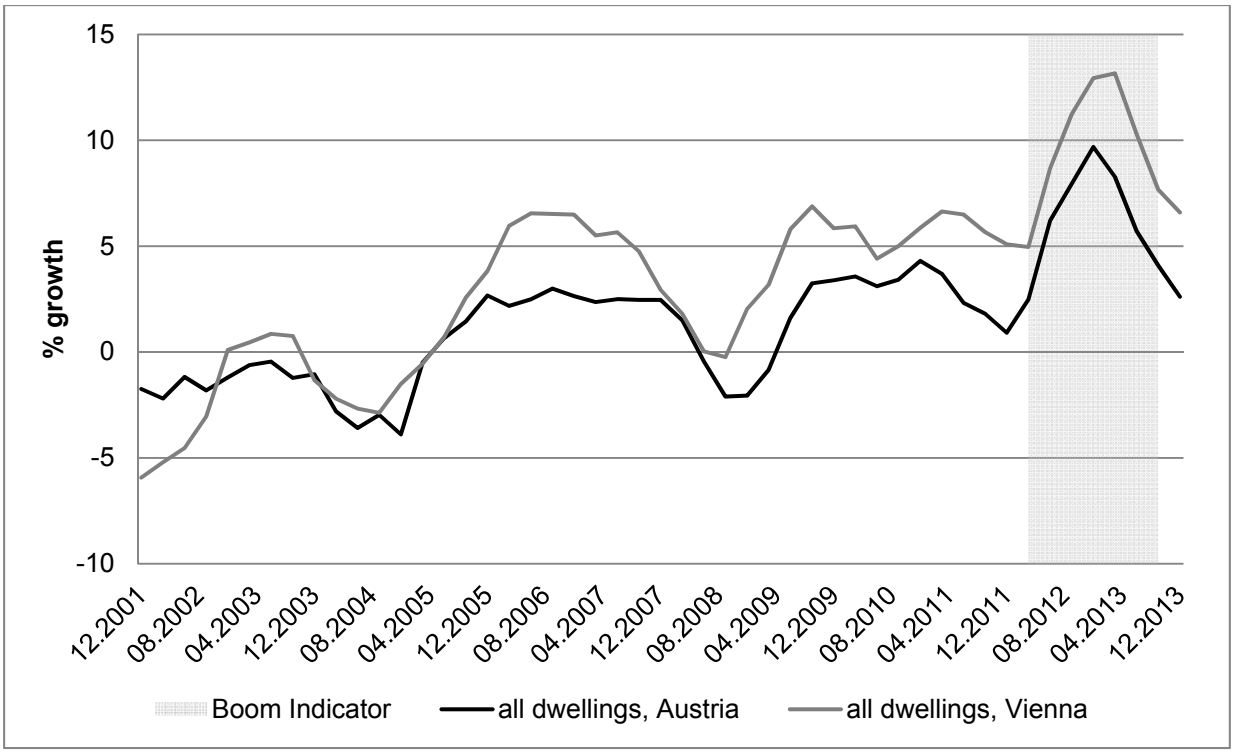
[39] The only exception is a strong price increase in 2012.

[40] Eurostat 2014a: House price indices, http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/ File: House_Price_Indices_euro_area_and_EU_aggregates_Index_levels_2010_100_2014Q1.PNG

rates for Vienna and Austria generally move in line, yet price increases have always been more pronounced in Vienna than in the rest of the country. Interestingly, flat price developments seem to drive residential property prices not only for Vienna, but also for the rest of the country (see BIS data on housing prices).

As can be seen in Figure 11, residential property prices even decreased in Vienna and in Austria in real terms until the mid-2000s. Since then, real property prices have increased by about two percent annually in Austria, not signaling a housing bubble. Only the very recent price developments since 2012 for Austria (and since 2006 in Vienna, with a temporary damper in 2008 and distinctly higher growth rates in 2012) meet the boom criteria of our indicator. Nevertheless, neither Austria nor Vienna have experienced a price correction so far that would count as a bust, such that the boom signals in housing prices cannot be counted as a formation of a bubble. Yet, it remains to be seen if the latest house price developments are sustainable.

According to the Austrian central bank, the latest price developments do not signal problematic developments, as the price level for Austria is even 8 percent below the level given by long-run relations to rental prices, consumer prices and construction costs (considering the price developments up to the last quarter of 2013, OeNB 2014). And even the high price level in Vienna, 21 percent above the fundamentally justified level, is not necessarily signaling a bubble (see Schneider 2013 for the statements and information on the methodology of identifying bubbles).



Data source: BIS data on residential property prices, OECD CPI deflated, own calculations. Pure prices for Austria, prices per square meter for Vienna.

Annotations: The boom-bust-indicator for Austrian house price developments takes the value of "1" for a boom and "-1" for a bust. Growth rates are shown as four-quarter moving averages of y-o-y growth rates based on quarterly data.

Figure 11: Annual growth rates in real residential property prices in Austria and Vienna

5.3.2 Housing finance

How is home ownership financed? An evaluation of the micro census on private household property conducted by the Austrian central bank in 2008 shows that two thirds of homeowners needed external financing for the purchase of their private property (Albacete/Wagner 2009). Half of these households had to finance the property entirely by (bank) credits, the other half also used additional sources (e.g. family and friend support, inheritances). External financing mainly refers to bank credits (77 percent) that predominantly (by 61 percent) yield a variable interest rate, compared to an average of only 43 percent variable interest rates credits in the euro area (Albacete/Wagner 2009: 81, see also ECB 2009).[41] Mortgage and housing loan financing leads to a share of 22 percent of all households in 2007 being indebted due to the acquisition of property, a share that is lower than the EU average. Regarding the debt level, the average debt stemming from mortgage

[41] Yet, the IMF classifies Austria as a country where fixed interest rates predominate (IMF 2011: 117).

and housing loans amounts to 77,500 euro per household in 2007; the median is only 43,000 euro. Hence, the mortgage debt to GDP ratio is rather low in Austria compared to the US and UK, where it is more than 40 percentage points higher (see figure 7).

In a comparative study for the access to mortgage credits published in 2008, the IMF judged the accessibility in the Austrian market as rather low: The value for Austria was 0.31 in 2008 for an index that could vary between 0 (low access) and 1 (easy access; IMF 2008: table 3.1, p. 107). One element of the index consisted in loan to value ratios for mortgage credits that typically fluctuate around 60 percent in Austria (IMF 2008: table 3.1, p. 107), indicating a rather high level of self-financing requirements for borrowers. Long-term financing (20-30 years) predominates and credit duration has been increasing since the introduction of the euro.

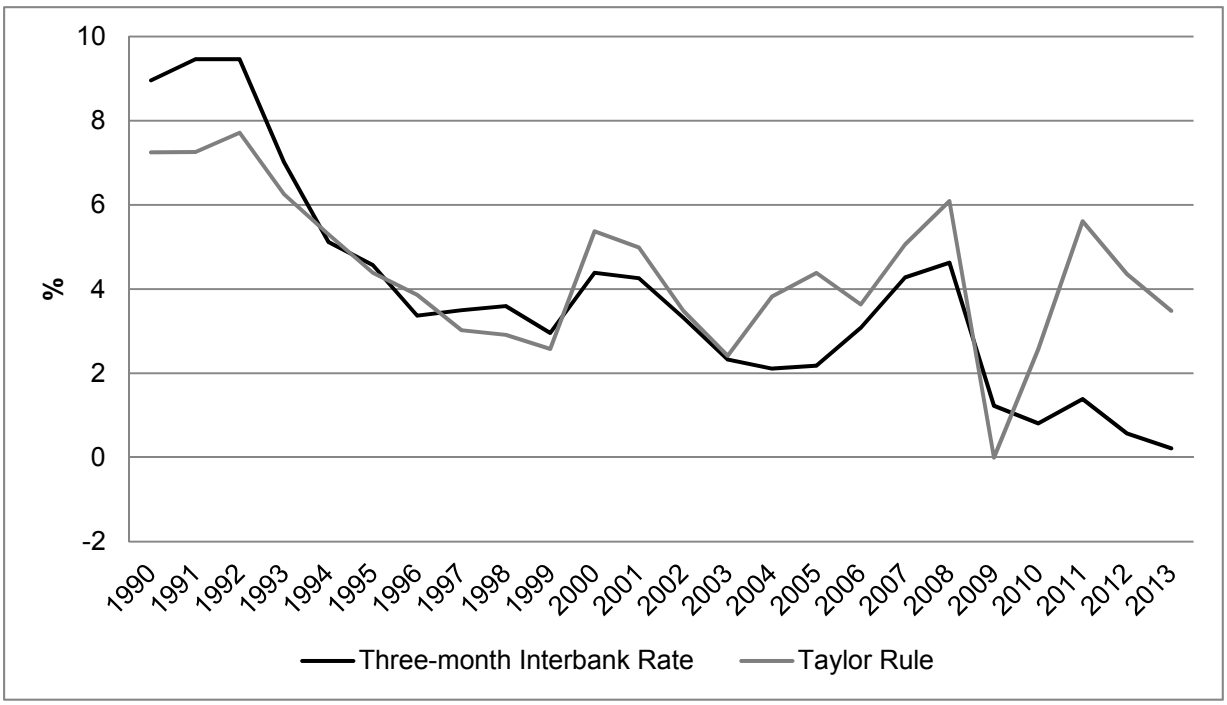
According to the IMF study, mortgage equity withdrawal did not exist in the early 2000s (IMF 2008: table 3.1, p. 107). This is no longer the case, as 24 percent of homeowners use it according to the micro census results (Albacete/Wagner 2009, p. 78). Modern forms of securitization like residential mortgage backed securities (RMBS) of credits (besides the traditionally used covered bonds) only became possible with legal changes in 2005 (Hahn 2006). RMBS rose to 7 percent of residential loans (IMF 2011, p. 117), still being on an extremely low level compared to the other industrialized countries surveyed in this study. The low Austrian level is in striking contrast to the levels in the other two case studies, UK and US, even after controlling for the size of the countries (see also Erber 2011, p. 6). Nevertheless, the latest developments together with the implementation of Basel III (and the thereby higher incentive for variable rates mortgage credits) may implicate a higher interest sensitivity of the Austrian housing market,[42] and more business cycle dependent financing conditions for household in the future.

Up to now, the current developments do not indicate overinvestment: Investment into dwellings decreased during the first half of the 2000s and has started to increase since 2004, besides another transient decline during 2007 and 2008 (Eurostat 2014b: gross investment by asset type: dwellings). The rate of expansion in 2013 was higher than in the four preceding years, reaching 3.2 percent on an annual basis. Yet, the GDP share of investment in dwellings is still well below the levels of the 1990s, when the ratio was about 6 percent of GDP. It has reached 4.7 percent of GDP in 2013, indicating that the gap to the long-run share of dwellings to GDP is closing.

[42] See Kunnert/Baumgartner (2012) for country case studies that indicate higher interest-elasticity of securitization.

5.3.3 Description of monetary policy

Figure 12 presents Austria's three-month interbank rate and the Taylor rule prescriptions (see section 4 for details on the calculation) for this country for the period 1990–2013. Similarly to the case in the US and UK, the interbank rate in Austria generally follows the Taylor rule prescriptions, as can be seen in Figure 12. An important difference with the cases of the US and UK is that during the period analyzed, the responsibility to undertake monetary policy was ceded from Austria's central bank (OeNB, its German acronym) to the European Central Bank (ECB) in 1999. This delegation of monetary policy coincides with a change in relative tightness towards a more loose policy stance.



Data Source: OECD's Main Economic Indicators. Taylor rule prescription calculated by the authors following Taylor (1993, p. 202), based on most recent data.

Figure 12: Austria's Three-Month Interbank Rate and Taylor Rule Prescriptions between 1990 and 2013 (%)

Between 1990–1998 Austria's interbank rate was most of the time above the Taylor rate. In fact the interbank rate was on average 79 bps above the Taylor rate during the tenure of the OeNB. However, despite the relative tightness of monetary policy, the OeNB managed to decrease the interbank rate from a high of 9.46 percentage points in 1991–1992, to a low of 3.6 percentage points in 1998. During the first decade of the euro, however, the ECB's monetary policy was rather loose for the needs of Austria, as can be judged by Figure 12, where the interbank rate is seen below the Taylor rate for every year between 2000–2008.

During 1999–2008 the average gap between the interbank and the Taylor rates was 83 basis points. Since the period starting in 2009, which witnessed the peaks of the global recession and the euro crisis, the average gap between the rates has widened to a yearly average of 236 basis points. The widening of spreads since 2009 has also been reported for the cases of the US and UK, with average spreads larger than the one observed in Austria. As has been argued in the case studies of the Anglo-Saxon countries, such a spread between rates rather reveals the limitation of the Taylor rule in times of economic distress than a loose monetary policy stance from the part of the ECB.

Nevertheless, Austria has not experienced housing bubbles like the Anglo-Saxon countries. Monetary policy may have contributed to increasing real house price levels by its more expansionary stance, as theory would suggest (see section 2). But the question is why problematic price bubbles could be avoided for such a long time, even though the policy rate has been below the Taylor rule recommendations for nine years in a row from 2000 onwards.

5.3.4 Public Sector Involvement and Housing Regulation

Compared to the EU-28 average of 70.6 percent, homeownership of private households is low in Austria, amounting to only 56.4 percent in 2012. This constitutes the lowest value for an EU country besides Germany (Eurostat 2014a: Housing statistics[43] and Statistik Austria 2013, p. 27). Home ownership rates in rural areas are higher (up to 82.4 percent in Burgenland), while the capital Vienna exhibits the lowest percentage (20.4 percent, Statistik Austria 2013, p. 27).

According to Schneider (2013, p. 31) and Albacete and Wagner (2009, p. 79), public support for low-rent flats explains the low home ownership rate in Austria. More than 50 percent of apartments in the rental market are being provided by cooperative associations (*Genossenschaftswohnungen*) or municipalities (*Gemeindewohnungen*) that offer lower rents (for details see Albacete/Wagner 2009: 87-88).[44] These are part of the Austrian system of public sector involvement in housing.

Supporting the supply for low-rent flats provides an attractive alternative to the ownership of houses and thereby indirectly stabilizes house prices (Albacete/Wagner 2009).45 It is one important factor to explain the moderate house price developments in

[43] http://ec.europa.eu/eurostat/statistics-explained/index.php/Housing_statistics

[44] This is combined with individual subsidies for low income households. According to the survey results, 12 percent of tenants received rent subsidies in 2007 (Albacete/Wagner 2009, p. 86).

[45] The effect of rent regulation can also be seen for the housing boom in Vienna that lasted until the early 1990s. This price increase had been mainly driven by an abolishment of rent regulation for apartments in old dwellings in 1986 (Wieser 2009).

Austria. Another factor is the housing assistance scheme that subsidizes the construction of new and renovation of existing dwellings. According to Kunnert and Baumgartner (2012), these subsidies play an important role in stabilizing the supply of houses. Subsidies come mainly in the form of subsidized interest rates for credits (see OeNB 203, p. 129). According to micro census results, 42 percent of homeowners received construction subsidies in 2007. They amount on average to 72 percent (the median is 29 percent) of the purchasing price of the dwelling (Albacete/Wagner 2009, p. 87).

The third factor contributing to rather moderate house price developments are the low incentives for renting out a privately owned house, reflected in the following figures: If private households own property, they are most likely to live in it, only 5 percent rent their property. Renting out is not attractive due a regulation that favors the protection of tenants (Albacete/Wagner 2009, p. 79) plus low tax incentives, as property owners cannot deduct mortgage interest payments from taxable income to the extent allowed in countries like the Netherlands and Spain (Albacete and Wagner 2009, p. 72). Albacete and Wagner stress that this makes the Austrian system less bubble prone: "... the Austrian housing assistance schemes – which are less vulnerable to cyclical developments than tax-based systems are – seem to be one of the reasons for the moderate development of real estate and rent prices." (Albacete and Wagner 2009, p. 82, English version).

To sum up, important factors for the surprisingly moderate developments of housing prices in Austria are the combination of regulatory settings and public sector support for the housing sector:

1. Public support for low-rent housing by government subsidized housing.
2. Public subsidies for construction and renovation of dwellings.
3. Low incentives to buy a house for investment purposes.

Yet, the decreasing public support for the construction of housing since 2009 (Kunnert/Baumgartner 2012, p. 103-104)[46] may contribute to rising house prices via higher rents due to a lower supply of low-rent housing in the future.

5.3.5 Conclusions from the Austrian case study

Since the introduction of the euro, the stance of monetary policy in Austria has to be judged as "too loose" according to the standard Taylor rule for the entire period. Nevertheless, Austria has not experienced a price bubble like the presented case studies of Anglo-Saxon countries. In addition, house prices developed quite differently to the rest of the

[46] Aufhebung der Zweckbindung der Wohnbaufördermittel seit 2009.

euro area: They stagnated until the mid-2000s, yet showed the highest increase in the euro area during the period 2007 until mid-2013. The recent price hike provoked boom signals in 2012 according to our indicator and could signal the building up of a bubble. Nevertheless, the Austrian central bank only judges house prices in Vienna to be above the fundamentally given price level, while those in Austria are still below this level. And up to now, investment into dwellings does not signal overinvestment.

How to explain the surprisingly moderate developments of Austrian housing prices, despite monetary "looseness" for such a long time? The answer lies in public sector support of housing and a regulatory setting that seems to be very successful in stabilizing house prices. Important elements are public support for low-rent housing that also stabilizes house price levels of owner occupied houses. In addition, housing assistance schemes support construction and renovation of dwellings, mainly via subsidized credits. At the same time, tenant protection and low taxation incentives make it less attractive to buy a house as an investment good. Last, an additional factor for moderate price developments may be due to a rather "traditional" way of housing finance: Even though legally possible since the mid-2000s, the use of complex securitization products (unlike the traditional covered bonds, *Pfandbriefe*) is still strikingly low compared to the UK and the US – countries that experienced a bubble.

5.4 Lessons from the Case Studies

Summing up these three case studies, we can say that the most clearly distinguishable element of the bubble countries relative to the non-bubble country Austria is the strong increase in the use of securitization in the process of residential mortgage lending. Both the US and the UK (which experienced a rather similar housing price bubble from the late 1990s onwards) have seen a strong increase in securitization while Austria has not. Also, home ownership ratios are rather high in the two bubble countries, at least when compared to the non-bubble case. Third, there are stark differences in public activity in the three housing market. In Austria, large parts of rental apartments are publicly owned and contribute together with tenant protection to a low-rent housing supply while state involvement in the provision of public housing is rather low, both in the UK and the US.

Beyond these features, there seem to be more differences than similarities between the bubble cases. Most prominently, the US has seen a rather loose monetary policy in the run-up of the housing price bubble while the UK has seen a rather tight monetary policy. Moreover, while in the US, most mortgages are of the fixed-rate variety, in both the UK and Austria, a variable interest rate is more widely used. Finally, while the UK has a rather inelastic housing supply, the housing supply in the US has been rather elastic.

6 Conclusions, Policy Implications and Questions for Further Research

In conclusion, one can say that the position widely held in the policy debate that a lax monetary policy causes housing bubbles has extremely weak scientific foundation, both theoretically and empirically. Among the theoretical literature on bubble formation (which has grown substantially over the past decade), no detailed model with either standard neo-classical or alternative behavioral micro-foundations sees monetary policy mistakes in the form of an excessively low policy rate as a possible trigger for housing price bubbles.

The empirical literature does not lend more credibility to the hypothesis of lax monetary policy as a cause for residential real estate price bubbles either: While some econometric studies seem to point at lax monetary policy as a good explanatory variable for house price increases, they have significant methodological problems. First, house price increases do not necessarily imply a bubble formation as rising house prices can also reflect changes in fundamentals which many studies do not control for. Second, many studies do not really examine causes of the emergence of bubbles, but rather causes of house price increases or causes of the bursting of house price bubbles that cannot necessarily be transferred to the question of the emergence of bubbles.

Our own empirical research also casts doubts over the assumption of lax monetary policy as an important trigger for housing price bubbles, at least if measured by deviations of the nominal policy rate from a Taylor rule. While we do find an influence of monetary policy shocks measured by deviations of the real policy rate from past developments, the shock transformation to the housing sector seems to depend on the development and regulation of the financial sector. This result is in line with other empirical approaches. As our case studies revealed, there have been cases of bubbles in countries with lax and in countries with tight monetary policy; there also have been countries in which lax monetary policy coincided with bubbles and countries in which a loose monetary policy stance was observed, yet no bubbles formed. This combination of cases logically must lead to the conclusion that lax monetary policy can neither be necessary nor a sufficient condition for bubble formation.

When it comes to the hypothesis that financial market deregulation caused bubbles, at least the theoretical foundation is slightly better. In a number of models, the market entrance of certain speculative actors or changes in financial fragility can explain the emergence of a real estate bubble.

However, unfortunately, none of the widely used indicators for financial (de-)regulation have shown a satisfactory significance in explaining the formation of housing bubbles. Here, the case studies have given an indication why this might be the case: The indicators for

financial (de-)regulation usually only cover a narrow set of financial sector regulations and mostly those which are codified in specific legislations. Using these indicators misses other parts of regulation of the business sector which might have an impact on the financial sector as well as financial innovation which might lead to a de facto deregulation if regulators do not react with tightening measures. The change for the treatment of derivatives in the US insolvency rules and the financial sector's innovation of subprime mortgages are a case in point here. More research would be needed to analyze whether housing bubbles in other countries or during other time periods can equally well be explained by changes in regulation or the financial institutions' behavior.

From a policy perspective, these results mean that financial regulators should watch out for bubbles very carefully during times of large changes in the behavior of financial institutions and during the emergence of new financing instruments. While the question how best to address bubbles and whether to use higher interest rates or more direct prudential instruments (such as variations of maximum loan-to-value ratios or additional provisions by commercial banks) has not directly been within the scope of this study, some of our results indirectly question the efficiency of higher interest rates for bubble fighting: The US has experienced a similar residential housing bubble as the UK; yet the former had much lower interest rates than the latter. While of course a number of other factors might explain the difference between the countries, this raises the question by how much the US Fed would have had to increase its interest rate to really stop the bubble from further developing. Here, also more research is necessary as to how regulators and central banks should fight bubbles.

One conclusion for monetary policy comes out of the theoretical models and is in line with our empirical findings that only identify a role for real policy rate changes, not nominal ones: Central banks should prevent large unexpected changes in inflation as these might cause bubbles under certain behavioral assumptions for at least some investors. As one feature of the housing market is the existence of several unexperienced investors (most of the owners of owner-occupied houses), it is highly plausible that deviations from rational behavior or misperceptions about the underlying macroeconomic developments might play a significant role in this market. Again, however, more research is needed to assess the hypothesis of whether a shift in inflation can indeed be seen as a robust trigger for housing bubbles.

Appendix 1: Details on the construction of the bubble indicator

We use an indicator for bubble formation. Housing bubbles are identified by a "boom" in real house prices that is followed by a "bust" in less than three years. "Boom" periods are defined as periods when the four-quarter moving average of the annual growth rate of the house price, in real terms, exceeds the threshold of five percent. "Bust" periods are (symmetrically) defined as periods, when the same four-quarter moving average of the annual growth rate of the house price, in real terms, falls below minus five percent, for at least two quarters in a row. The bust definition follows IMF (2009, p. 94) and is symmetrically applied to the boom definition. The binary "boom" indicator takes the value "one" for a boom, yet only, if the boom is later followed by a bust, and "zero" otherwise. An alternative "boombust" indicator differentiates between three outcomes, "one" in a boom, "minus one" in a bust, and "zero" otherwise.

Sample: Housing data has been selected for countries that fulfill the following criteria: OECD country since before 1990 and, high income country according to the World Bank since 1997. Sample 1 is based on the detailed series (explained below), sample 2 on the long series.

Data source: The indicator is based on quarterly BIS data for the nominal house price that is deflated by OECD CPI. The following quarterly BIS series have been used for the detailed series (or have been constructed out of monthly series for Portugal), if available:

- Covered Area: whole country, with the exceptions Australia (eight cities) and Austria (Vienna only for the period before 2000)
- Property type: all, exceptions: Australia, Switzerland, Canada (houses, new structures), France (existing dwellings),
- Vintage: all, exceptions: Canada (new), Netherlands, US (existing)
- Priced unit: pure price or price per dwelling, exceptions: Canada, Spain, Portugal (price per square meters)
- Adjustments: no seasonal adjustments, besides the seasonally adjusted US data.

As the regression is based on yearly data, we construct the endogenous variable in a way that allows for extended boom phases: the endogenous takes the value one if in that year the indicator exhibits at least one boom signal but no bust signal and if the last boom signal is followed by a bust signal less than 12 quarters later. Boom periods can be interspersed by no signal periods or even a single bust signal in only one quarter in order to allow for temporary and short lived price corrections like in the case of the Netherland's bubble around 2007 and the Australian bubble around 2010. Periods of boom signals are not

always interspersed by no-signal quarters, and if they are, then by less than eight quarters at most. The only exception are the Netherlands, were the last boom signal follows after 19 quarters of no signals (see Table A 1)

Results: For the period after 1985, based on the detailed series for sample 1, booms last on average more than four years and thereby at least double the time of busts (two years), while the period between the last boom and first bust signals is only one year. A bubble lasts on average 7.5 years (see Table A 1 below).

	data available since	Quarterly data: Booms after 1985	Quarterly: Peak	Quarterly data: Busts	Annual data: Boom signals for analysis	Annual data: Bust signals for analysis	Quarters of boom signals	Quarters between boom signals	Quarters between boom and bust	Quarters between bust signals	Quarters of bust signals
AT	2000 (1986)[1]	/ (88q3-93q1)*	/	/ (98q4-99q1; 01q4-02q1)*	**none**	**none**	(19)	0	(22 - too long)	(10)	(2+2)
AU	1986	88q3-90q1	89q1	90q4-91q1	**none**[3]	**1990-91**	7	0	2	0	2
…		08q2	10q2	11q4-12q2	**1998-2004; 2007-08; 2010**	**2011-12**	4	0	3	0	3
BE	1973	/	/	/	**none**	**none**	/	/	/	/	/
CA	1981	86q4-88q2; 89q1-89q2	89q1	90q4-92q2	**none**[3]	**1990-92**	7+2	2	5	0	7
CH	1970	86q4;87q2-90q1	89q4	90q4-94q2; 95q4-97q2	**none**[3]	**1990-97**	1+12	1	2	5	15+7
DE	2000 (1990)[2]	/	/	/	**none**	**none**	/	/	/	/	/
ES	1995	99q1-00q3; 01q4-07q2	07q1	09q2-13q4	**1999-2007**	**2009-12**	7+23	4	7	0	19
FR	1996	99q4-07q4	07q3	09q2-10q1	**1999-2007**	**2009-10**	33	0	5	0	4
GB	1968	83q3-84q2; 86q2-90q1	89q3	90q4-93q3	**none**[3]	**1990-93**	4+16	7	2	0	12
…		97q3-05q3;07q1-08q2	07q3	09q1-09q4; 11q4	**1997-2005; 2007-08**	**2009; 2011**	33+6	5	2	7	4+1
IT	1990	91q4-93q2	92q3	94q4-95q2	**1991-93**	**1994-95**	7	0	5	0	3
…		02q2-03q2;05q2-05q4	no clear peak	12q4-13q3	**none**	**none**	(5+3)	(7)	(27 - too long)	0	(4)
NL	1976	93q2-95q1;96q2-01q3; 06q3	07q3	09q3-10q1;12q3-13q4	**1993-2001; 2006**	**2009-10; 2012**	8+22+1	4+19	11	9	3+6
NO	1992	94q2-95q3;96q1-01q2;02q2;04q2-08q1	07q2	09q3-10q1	**1994-2002; 2004-08**	**2009-10**	6+22+1+16	1+3+7	3	0	3
NZ	1979	[94q2-97q3] 02q3-08q1	07q2	08q4-09q3	**2002-2007**	**2008-09**	[13+] 23	[19 - too long] 0	2	0	4
PT	1988	91q3-92q2	92q1	93q1-94q1	**1991-92**	**1993-94**	4	0	4	0	3
SE	1986	87q4-90q2	90q1	92q2-94q1	**1990**	**1992-94**	114	0	7	0	8
US	1975	86q4-88q2	89q4	91q2-91q4	**none**[3]	**1991**	7	0	11	0	3
…		98q4-06q3	06q1	07q3-10q1;11q2-12q1	**1998-2006**	**2007-12**	32	0	3	4	11+4
						averages (quarters):	**18.5**		**4.4**		**8.3**
						averages (years):	**4.5**		**1**		**2**

1) Data before 2000 only for Vienna, see case study; 2) Data extended by OECD real house price data;

3) Booms before 1990 cannot be analysed as regression starts in 1990; 4) Missing data at the start.

AT = Austria, AU = Australia, BE = Belgium, CA = Canada, CH = Switzerland, DE = Germany, ES = Spain, FR = France, GB = United Kingdom, IS = Iceland, KR = South Korea, NL = Netherlands, NO = Norway, NZ = New Zealand, PT = Portugal, SE = Sweden, US = United States.

*Periods in brackets indicate that signals during these times have not been counted as booms/busts of a bubble.

Table A 1: Overview on boom and bust signals for the standard bubble indicator for sample 1, 1990-2012

Appendix 2: Data source, construction, and interpretation of explanatory variables

Control for...	Abbreviation	Data source	Construction	Interpretation
Indicator for Economic Activity				
Deviation from real GDP growth	DevGDP00	AMECO GDP at 2005 market prices	National deviation from the national eight year trailing moving average of year-on-year real growth rates	Positive (negative): GDP is above (below) trend
Deviation from real household consumption growth	DevC00	AMECO final consumption expenditure of households and NPISH, extended** by IMF IFS* data, OECD CPI deflated	National deviation from the national eight year trailing moving average of year-on-year real growth rates	Positive (negative): household consumption expenditure is above (below) trend
Indicator for foreign capital				
Current account balance, % GDP	CAGDP	IMF WEO current account balance, percent of GDP	-	The more negative, the higher are capital inflows
Current account balance, deviation from trend	CAGDP	IMF WEO current account balance, percent of GDP	National deviation from the national average of the past eight years (including the current year)	The more negative, the higher capital inflows have been for the last four years
Indicator for the stance of monetary policy				
Deviation from the Taylor rule	DevTaylor	OECD* three month interbank rates	Deviation of the nominal policy rate from a Taylor rule (r) following Taylor (1993), calculated as: r=p+0.5y+0.5(p-2)+2 with p=actual inflation rate in %, y=output gap (GDP deviation in % from a trend calculated by HP filter), inflation target assumed as 2 % and long-term real interest rate as 2 %.	Positive (negative): Nominal policy rate is above (below) Taylor rule recommendations; i.e. monetary policy is rather strict (lax)
Deviation from past real policy rate	Devinter00	OECD* three month interbank rates, OECD* CPI deflated ***	Deviation of the real policy rate from the trailing eight year moving average (in percentage points)	Positive (negative): real policy rate is above (below) trend, monetary policy rather strict (lax)
Indicator for the level of development and regulation of the financial sector				
Domestic credit, version 1	CredGDPav	World Bank*: domestic credit to GDP in %	National average over the period 1990-2012	The higher (lower) the value, the more (less) important are bank credits for economic activity during the estimation period.

Domestic credit, version 2	Dev8ycredGDP	World Bank*: domestic credit to GDP in %	National deviation from the national eight year trailing moving average	Positive (negative): credit expansion is above (below) trend
Domestic credit, version 3	DevOECDcredGDP	World Bank*: domestic credit to GDP in %	National deviation from the same year OECD average in % of OECD average	Positive (negative): bank credits to GDP are higher (lower) than OECD average
Domestic credit, version 4	StabOECDcred	World Bank*: domestic credit to GDP in %	Standard deviation of version 3 since the mid-1970s up to the respective year	The closer domestic credit developments are to OECD developments, the lower the value.
Indicator on securitization	FI_Sa2014	Qualitative de jure mortgage-backed securitization indicator extracted from Sa et al. 2014, values by construction between 0 and 1.	Extension of the original dataset by replicating the last data point (original series end in Q1 2008) for the period 2009-2012.	The higher, the more securitization is allowed in the country
Indicator on housing market regulation	FI	Shim et al. (2013) database for policy actions on housing markets, based on central banks information. Data coded as measures tightening or loosening the housing market.	Transformation to numerical values: +1 = tightening, -1 = lowering regulation standards; 0 = no regulatory change. Indicator sums up actions taken in one year.	Positive (negative) values indicate the number of policy actions that tighten (loosen) the regulation of the housing market.

*via Macrobond; ** Extension with IMF IFS data for AU, CA, IS, KR, NZ, partly: AT, BE, CH, DE, ES, GB, PT, *** Extension for AT with the World Bank WDI yearly changes of the deposit interest rate for the period before 1990.

Table A 2: Explanatory variables – data sources and construction

Appendix 3: Detailed regression results for cross-section SUR, Sample 1, 1990-2012

Endogenous	Binary Boom-Indicator									
Exogenous variables plus constant		**Coefficient estimates and significance level**									
Past Booms	**binary boom-indicator (lag)**	0.73***	0.73**	0.73***	0.73***	0.74***	0.72***	0.72***	0.73***	0.73***	0.72***
Activity	**deviation from GDP growth (lag)**	0.02***	0.02***	0.02***	0.02***	0.01***	0.02***	0.02***	0.01***	0.02***	0.02***
Mon. Policy	dev. past policy rate (lag)		-0.01***								
	dev. from Taylor rule (lag)			-0.00***							
Financial system	Change in housing market regulation (lag)				-0.00						
	dev. of credit to GDP from OECD average					-0.00***					
	credit to GDP average over period						-0.00				
	standarddev. of dev. from OECD av.							0.00***			
	Securitization indicator (lag)								0.03***		
Foreign Capital	Current account to GDP (lag)									-0.00***	
	dev. From current account to GDP (lag)										0.00***
	weighted adjusted R-square	0.87	**0.90**	0.89	0.84	0.84	0.86	0.87	0.80	0.87	0.86

Regression: Cross-section SUR regression for a sample of 16 countries with constant. Exception: Securitization indicator is only available for 14 countries (not for AT, PT).
*Significant at the 10 % level, **... at the 5 % level, ***... at the 1 % level.
Regressions for the alternative activity variable, private consumption expenditures of households, lead to similar results.

Table A 3a: Regression results for baseline regression plus one additional variable, Sample 1, 1990-2012

Endogenous	**Binary Boom-Indicator**												
Exogenous variables plus constant		**Coefficient estimates and significance level**											
Past Booms	binary boom-indicator (lag)	0,73***	0,72***	0,74***	0,74***	0,72***	0,73***	0,75***	0,75***	0,75***	0,74***	0,74***	0,74***
Activity	deviation from GDP growth (lag)	0,02***	0,01***	0,01***	0,01***	0,02***	0,02***	0,02***	0,01***	0,01***	0,01***	0,02***	0,02***
Mon. Policy	**dev. from Taylor rule (lag)**	**0,00*** **	**0,00**	**0,00*** **	**-0,01*** **	**0,00*** **	**0,00*** **						
	dev. past policy rate (lag)							**0,00*** **	**-0,01*** **	**-0,01*** **	**0,00****	**0,00*** **	**0,00*** **
Financial system	Change in housing market regulation (lag)	0,00						0,00					
	Securitization indicator (lag)		0,03***						0,02***				
	dev of credit to GDP from past trend (lag)			0,00***						0,00***			
	dev. of credit to GDP from OECD average (lag)				0,00***						0,00***		
	standarddev. of dev. from OECD av. (lag)					0,00***						0,00***	
	credit to GDP over period average (lag)						0,00						0,00**
Foreign Capital	dev. from current account to GDP (lag)	0,00***	0,00*	0,00***	0,00***	0,00***	0,00***	0,00***	0,00	0,00	0,00***	0,00***	0,00***
	weighted adjusted R-square	0,88	0,79	0,84	0,86	0,90	0,90	0,87	0,78	0,86	0,83	0,89	0,90

Table A 3b: Regression results for baseline regression plus monetary policy indicator and financial system indicator and foreign capital inflows, sample 1, 1990-2012

Appendix 4: Detailed regression results for monetary policy, Sample 1, 1990-2012

	1991-2012		1994-2012	
	Significant coefficients	Expected sign?	Significant coefficients	Expected sign?
AT	-	-	Positive***	NO
AU	-	-	-	-
BE	-	-	Positive***	NO
CA	-	-	-	-
CH	Positive***	NO	Positive***	NO
DE	-	-	Positive***	NO
ES	Negative**	YES	Negative***	YES
FR	Negative*	YES	Negative**	YES
GB	Positive*	NO	Positive*	NO
IT	-	-	Negative***	YES
NL	Positive*	NO	-	-
NO	-	-	-	-
NZ	-	-	Negative***	YES
PT	Negative**	YES	Positive***	NO
SE	-	-	-	-
US	-	-	-	-

*Significant at a 10 % level, ** 5 % level, *** 1 % level.

Binary boom indicator, 16 countries, estimated by cross-section SUR with common coefficients for the constant, the lagged endogenous and economic activity, but country-specific coefficients for the stance of monetary policy, measured by deviations from the nominal policy rate from a Taylor-rule. For details see Appendix 4.

Table A 4a: Statistically significant signs of the country-specific coefficients for the stance of monetary policy measured by Taylor rule deviations for two different time periods, sample 1

The following two tables document the country specific coefficient estimates of monetary policy on bubble formation, if the development and regulation of the financial sector is not appropriately controlled for. The table below presents the coefficient estimates for the stance of monetary policy **measured by Taylor rule deviations** for sample 1, based on the detailed BIS series. It shows that the coefficient is indeed negative in a statistically significant way for the countries Spain, France, and Portugal. Yet, this is not the case for all countries, and three other countries, Switzerland, United Kingdom, and the Netherlands, even exhibit a statistically significant positive effect that is in contrast to theoretical consideration.

The amount of results that are not in line with positions blaming loose monetary policy for housing booms increases, once the period is restricted to the years 1994 to 2012: While Spain, and France keep a statistically significant negative coefficient, and Italy as well as New Zealand join this club, the number of countries with a statistically positive sign increases: Next to Switzerland and the United Kingdom, also Austria, Belgium, Germany plus Portugal form that group. Portugal is especially interesting, as it has the opposite sign for an

estimation period that is only three years shorter (and thereby excludes the bubble formation in Portugal right at the start of the sample).

That the stance of monetary policy can further and dampen bubble formation in the housing market does not depend on the Taylor-rule indicator. If we use the alternative indicator to judge the stance of monetary policy, **deviations of the real policy rate from past developments**, we get similarly conflicting results (see the table below): While "loose" monetary policy seems to drive bubbles in Spain, France, UK, Netherlands, and Norway in a statistically significant way, it dampens bubble formation in Austria and Belgium. If the sample period is restricted to 1994 to 2012, the amount of countries that exhibit the "wrong" sign increases. Yet, even though the country-specific results for monetary policy overlap for the two indicators, there are some differences: If the stance of monetary policy is statistically significant in a country measured by Taylor rule deviations, this is not necessarily the case if measured by policy rate deviations from past developments (see the highlighted entries in red in red). For the United Kingdom, even the sign differs: Measured by nominal policy rate deviations from a Taylor rule, "loose" monetary policy dampens bubble formation. Measured by real policy rate deviations from past trends, monetary policy furthers housing bubbles. The detailed regression results are presented below.

	1991-2012		1994-2012	
	Significant coefficients	Expected sign?	Significant coefficients	Expected sign?
AT	Positive*	NO	Positive***	NO
AU	-	-	-	-
BE	Positive***	NO	Positive***	NO
CA	-	-	Positive***	NO
CH	-	-	Positive***	NO
DE	-	-	Positive***	NO
ES	Negative*	YES	Negative**	YES
FR	Negative*	YES	Negative**	YES
GB	Negative**	YES	-	-
IT	-	-	Positive***	NO
NL	Negative*	YES	Negative***	YES
NO	Negative***	YES	Negative***	YES
NZ	-	-	-	-
PT	-	-	Positive**	NO
SE	-	-	-	-
US	-	-	Negative**	YES

*Significant at a 10 % level, ** 5 % level, *** 1 % level.

Binary boom indicator, 16 countries, estimated by cross-section SUR with common coefficients for the constant, the lagged endogenous and economic activity, but country-specific coefficients for the stance of monetary policy, measured by deviations of the real policy rate from the past trend. Differences to the previous table are highlighted in red.

Table A 4b: Statistically significant signs of the country-specific coefficients for the stance of monetary policy measured by deviations from past real policy rates for two different periods, sample 1

System of equations for 16 countries, cross-section SUR, with common coefficients for all variables but monetary policy, **1991-2012**		
Endogenous variable: Binary Boom-Indicator		
Exogenous variables (in lags)	**Coefficient**	**Significance**
Constant	0.04	***
Past Booms: binary boom-indicator (lag)	0.70	***
Activity: deviation from GDP trend (lag)	0.02	***
Mon. Policy: dev. from Taylor rule (lag) - country specific coefficients		
AT	0.00	
AU	-0.01	
BE	0.00	
CA	0.00	
CH	0.01	***
DE	0.00	
ES	-0.01	**
FR	-0.01	*
GB	0.05	*
IT	0.00	
NL	0.05	*
NO	0.00	
NZ	-0.02	
PT	-0.03	**
SE	0.00	
US	-0.01	
Weighted R-Squared	0.84	
Unweighted R-Squared	0.59	

Table A 4c: Sample1, period 1990-2012, Taylor rule indicator

System of equations for 16 countries, cross-section SUR, with common coefficients for all variables but monetary policy, **1994-2012**		
Endogenous Variable: Binary Boom-Indicator		
Exogenous variables (in lags)	**Coefficient**	**Significance**
Constant	0.04	***
Past Booms: binary boom-indicator (lag)	0.70	***
Activity: deviation from GDP trend (lag)	0.02	***
Mon. Policy: dev. from Taylor rule (lag) - country specific coefficients		
AT	0.02	***
AU	0.01	
BE	0.01	***
CA	0.00	
CH	0.01	***
DE	0.01	***
ES	-0.02	***
FR	-0.01	**
GB	0.05	*
IT	-0.05	***
NL	-0.02	
NO	-0.05	
NZ	-0.04	***
PT	0.01	***
SE	0.00	
US	-0.03	
Weighted R-Squared	0.76	
Unweighted R-Squared	0.61	

*Significant at 10 % level, **...at 5 % level,***...at 1 % level.

Table A 4d: Sample1, period 1994-2012, Taylor rule indicator

System of equations for 16 countries, cross-section SUR, with common coefficients for all variables but monetary policy, **1991-2012**		
Endogenous Variable: Binary Boom-Indicator		
Exogenous variables (in lags)	**Coefficient**	**Significance**
Constant	0,02	***
Past Booms: binary boom-indicator (lag)	0,70	***
Activity: deviation from GDP trend (lag)	0,01	***
Mon. Policy: dev. real policy rate (lag) - country specific coefficients		
AT	0,00	*
AU	-0,02	
BE	0,01	***
CA	0,00	
CH	0,00	
DE	0,00	
ES	0,00	*
FR	-0,01	*
GB	-0,04	**
IT	0,00	
NL	-0,04	*
NO	-0,05	***
NZ	0,00	
PT	0,00	
SE	0,01	
US	-0,02	
Weighted R-Squared	0,82	
Unweighted R-Squared	0,59	

Table A 4e: Sample1, period 1990-2012, Real rate indicator

System of equations for 16 countries, cross-section SUR, with common coefficients for all variables but monetary policy, **1994-2012**		
Endogenous Variable: Binary Boom-Indicator		
Exogenous variables (in lags)	**Coefficient**	**Significance**
Constant	0,03	***
Past Booms: binary boom-indicator (lag)	0,67	***
Activity: deviation from GDP trend (lag)	0,01	***
Mon. Policy: dev. real policy rate (lag) - country specific coefficients		
AT	0,01	***
AU	-0,02	
BE	0,01	***
CA	0,01	***
CH	0,01	***
DE	0,01	***
ES	-0,01	**
FR	-0,02	**
GB	-0,03	
IT	0,02	***
NL	-0,07	***
NO	-0,06	***
NZ	-0,01	
PT	0,00	**
SE	0,01	***
US	-0,04	**
Weighted R-Squared	0,83	
Unweighted R-Squared	0,64	

Table A 4f: Sample1, period 1994-2012, real rate indicator

System of equations for 16 countries, cross-section SUR, with common coefficients for all variables but monetary policy, **1991-2012**		
Endogenous Variable: Ternary Boom-Indicator		
Exogenous variables (in lags)	**Coefficient**	**Significance**
Constant	0,04	***
Past Booms: ternary boom-indicator (lag)	0,66	***
Activity: deviation from GDP trend (lag)	0,04	***
Mon. Policy: dev. Taylor rate (lag) - country specific coefficients		
AT	0,02	***
AU	0,07	**
BE	0,01	**
CA	0,01	*
CH	0,00	
DE	0,02	***
ES	-0,01	
FR	-0,01	
GB	0,01	
IT	-0,02	
NL	0,08	***
NO	-0,03	
NZ	-0,02	
PT	-0,02	*
SE	0,02	**
US	-0,03	
Weighted R-Squared	0,82	
Unweighted R-Squared	0,53	

Table A 4g: Sample 1, ternary boombust indicator, Taylor indicator

System of equations for 16 countries, cross-section SUR, with common coefficients for all variables but monetary policy, **1991-2012**		
Endogenous Variable: Ternary Boom-Indicator		
Exogenous variables (in lags)	**Coefficient**	**Significance**
Constant	0,00	
Past Booms: ternary boom-indicator (lag)	0,66	***
Activity: deviation from GDP trend (lag)	0,04	***
Mon. Policy: dev. real policy rate (lag) - country specific coefficients		
AT	0,00	*
AU	-0,03	**
BE	0,00	
CA	-0,01	**
CH	0,01	
DE	-0,01	***
ES	-0,02	***
FR	-0,06	***
GB	-0,05	**
IT	0,00	
NL	-0,09	***
NO	-0,05	***
NZ	-0,01	*
PT	0,01	
SE	0,03	**
US	-0,06	**
Weighted R-Squared	0,90	
Unweighted R-Squared	0,54	

Table A 4h: Sample 1, ternary boombust indicator, real rate indicator

Bibliography

Agnello, L., Schuknecht, L., (2011): Booms and busts in housing markets: Determinants and implications. Journal of Housing Economics 20, 171–190. doi:10.1016/j.jhe.2011.04.001

Ahlswede, S. (2013): Bank funding of residential mortgages in the EU, Deutsche Bank Research, Financial Market Special EU-Monitor 86, August 12, 2011, Frankfurt am Main. Aizenman, J., Jinjarak, Y. (2009): Current Account Patterns and National Real Estate Markets, *Journal of Urban Economics,* 66, 75-89.

Albacete, N. und K. Wagner (2009): Wie finanzieren private Haushalte in Österreich ihr Immobilienvermögen? In: Geldpolitik und Wirtschaft, Q3/09, Österreichische Nationalbank,pp. 68-102; English version: Housing Finance of Austrian Households, in: Monetary policy & the economy Q3/09, S. 62-92.

Allen, F., Gale, D., 2000. Bubbles and crises. The economic journal 110, 236–255.

Allen, F., Morris, S., Postlewaite, A., 1993. Finite bubbles with short sale constraints and asymmetric information. Journal of Economic Theory 61, 206–229.

Anundsen, A. K. and C. Heebøll (2013), Supply Restrictions, Subprime Lending and Regional US Housing Prices, University of Oslo Department of Economics Memorandum 04/2013, Oslo.

Assenmacher-Wesche, K., Gerlach, S. (2010): Financial Structure and the Impact of Monetary Policy on Property Prices, Working Paper, University of Frankfurt.

Barlevy, G., 2012. Rethinking theoretical models of bubbles. Reflections inspired by the financial crisis and Allen and Gorton's Paper "Churning Bubbles," in: Evanoff, D.D., Kaufman, G.G., Malliaris, A.G. (Eds.), New Perspectives on Asset Price Bubbles: Theory, Evidence, and Policy. Oxford University Press, Oxford, pp. 41–61.

Basco, S. (2014): Globalization and financial development: A model of the Dot-Com and the Housing Bubbles. *Journal of International Economics*, *92*(1), 78–94. doi:10.1016/j.jinteco.2013.10.008

Beck, N., 2001. Time-series-cross-section data, *Statistica Neerlandica,* Vol. 55, nr. 2, pp. 111-133.

Bernanke, B., 2005. The global saving glut and the US current account deficit. Remarks at the Sandridge Lecture, Virginia Association of Economists. The Federal Reserve Board, Richmond, Virginia.

Bernanke, B., 2010. Monetary policy and the housing bubble. Speech at the Annual Meeting of the American Economic Association.

Black, F. (1986): Noise, *The Journal of Finance*, 41, 529-543.

Blanchard, O.J., 1979. Speculative bubbles, crashes and rational expectations. Economics letters 3, 387–389.

Blanchard, O.J., Watson, M.W., 1982. Bubbles, Rational Expectations and Financial Markets, in: Wachtel, P. (Ed.), Crises in the Economic and Financial Structure. D.C. Heathand Company, Lexington, MA, pp. 295–316.

Bordo, M.D., Jeanne, O., 2002. Monetary Policy and Asset Prices: Does "Benign Neglect" Make Sense? International Finance 5, 139–164. doi:10.1111/1468-2362.00092

Bordo, M.D., Landon-Lane, J., 2013a. What Explains House Price Booms?: History and Empirical Evidence. NBER Working Papers Series. Working paper 19584.

Bordo, M.D., Landon-Lane, J., 2013b. Does Expansionary Monetary Policy Cause Asset Price Booms; Some Historical and Empirical Evidence. NBER Working Paper Series. Working paper 19585.

Borio, C., Lowe, P., 2002. Assessing the risk of banking crises. BIS Quarterly Review, December, 43–54.

Borio, C., Lowe, P., 2004. Securing Sustainable Price Stability: Should Credit Come Back from the Wilderness? BIS Working Paper 157.

Brunnermeier, M. K.(2008): Bubbles, The New Palgrave Dictionary of Economics 2.

Brunnermeier, M.K., Julliard, C., 2008. Money Illusion and Housing Frenzies. Review of Financial Studies 21, 135–180.

Caballero, R. J., Farhi, E., Gourinchas, P.-O., (2008): An Equilibrium Model of 'Global Imbalances' and Low Interest Rates, *American Economic Review,* 98, 358-393.

Calza, A., Monacelli, T., Stracca, L. (2013): Housing Finance and Monetary Policy, *Journal of the European Economic Association,* 11 (S1), 101-122.

Carstensen, K., Hülsewig, O., Wollmershäuser, T. (2009): Monetary Policy Transmission and House Prices: European Cross-Country Evidence, CESifo Working Paper No. 2750.

Case, K.E., Shiller, R.J., 2003. Is there a bubble in the housing market? Brookings Papers on Economic Activity 2003, 299–362.

Cocco, J.F., 2013. Evidence on the benefits of alternative mortgage products. The Journal of Finance 68, 1663–1690.

Dawkins, C.J., Nelson, A.C., 2002. Urban containment policies and housing prices: an international comparison with implications for future research. Land Use Policy 19, 1–12.

Deloitte (2013), U.S. Residential Mortgage Market Update Industry metrics and analysis, April 2013.

Dell'Ariccia, G., D. Igan and L. Laeven (2012), Credit Booms and Lending Standards: Evidence from the Subprime Mortgage Market, Journal of Money, Credit and Banking, Vol. 44 (3), pp. 367-384.

De Long, J.B., Shleifer, A., Summers, L.H., Waldmann, R.J., 1990. Positive Feedback Investment Strategies and Destabilizing Rational Speculation. The Journal of Finance 45, 379–395.

DeMarzo, P.M., Kaniel, R., Kremer, I., 2008. Relative wealth concerns and financial bubbles. Review of Financial Studies 21, 19–50.

Department for Communities and Local Government, 2014. Tenure trends and cross tenure analysis - Statistical data sets [WWW Document]. GOV.UK. URL https://www.gov.uk/government/statistical-data-sets/tenure-trends-and-cross-tenure-analysis (accessed 7.29.14).

Dokko, J., Doyle, B.M., Kiley, M.T., Kim, J., Sherland, S., Sim, J., Van Den Heuvel, S., 2011. Monetary policy and the global housing bubble. Economic Policy 237–287.

Duca, J. V., J. Muellbauer and A. Murphy (2011), Shifting credit standards and the boom and bust in U.S. house prices, Federal Reserve Bank of Dallas Working Papers 1104.

Erber, Georg (2011): Verbriefungen: Aus der Krise nichts gelernt? in: DIW Wochenbericht Nr. 35, S. 3-11.

European Central Bank (ECB 2009): Housing Finance in the Euro Area, Structural Issues Report, March, http://www.ecb.europa.eu/pub/pdf/other/housingfinanceeuroarea0309en.pdf.

Eurostat (2014a): Housing Statistics, released December 2014, http://ec.europa.eu/eurostat/statistics-explained/index.php/Main_Page.

Eurostat (2014b): National accounts data, gross fixed capital formation by 6 asset types: dwellings, released December 2014, http://ec.europa.eu/eurostat/web/national-accounts/data/database.

Favilukis, J., Kohn, D., Ludvigson, S.C., Van Nieuwerburgh, S., 2013. International Capital Flows and House Prices: Theory and Evidence, in: Glaeser, E.L., Sinai, T. (Eds.), Housing and the Financial Crisis. University of Chicago Press, pp. 235–299.

Fratzscher, M., Straub, R. (2010): Asset Prices, News Shocks and the Current Account, CEPR Discussion Paper No. 8080.

Gerdesmeier, D., Reimers, H.-E., Roffia, B., 2010. Asset Price Misalignments and the Role of Money and Credit. International Finance 13, 377–407. doi:10.1111/j.1468-2362.2010.01272.x

Goodhart, C., Hofmann, B. (2008): House Prices, Money, Credit, and the Macroeconomy, *Oxford Review of Economic Policy,* 24, 180-205.

Gramlich, E. M. (2007), Subprime Mortgages: America's Latest Boom and Bust, Washingtion, D.C.

Green, R.K. and S. M. Wachter (2005), The American Mortgage in Historical and International Context, Journal of Economic Perspectives, 19 (4), pp. 93-114.

Green, R.K. and S. M. Wachter (2007), The Housing Finance Revolution, University of Pennsylvania, Institute for Law & Econ Research Paper No. 09-37.

Hahn, F.R. (2006): Der Einfluss der Finanz- und Kapitalmarktsysteme, Teilstudie 5 des WIFO-Weißbuchs: Mehr Beschäftigung durch Wachstum auf Basis von Innovation und Qualifikation, Wien, http://www.wifo.ac.at/jart/prj3/wifo/resources/person_dokument/person_dokument.jart?publikationsid=27444&mime_type=application/pdf.

Harding, D., Pagan, A., 2002. Dissecting the cycle: a methodological investigation. Journal of monetary economics 49, 365–381.

Hendershott, P.H., Pryce, G., White, M., 2003. Household Leverage and the Deductibility of Home Mortgage Interest: Evidence from UK House Purchasers. Journal of Housing Research 14, 49.

Hoffmann, M., Nitschka, T., 2009. Securitization of Mortgage Debt, Asset Prices and International Risk Sharing, CESifo Working Paper No. 2527.

Hong, H., Scheinkman, J., Xiong, W., 2006. Asset Float and Speculative Bubbles. The Journal of Finance 61, 1073–1117.

Hong, H., Stein, J.C., 1999. A unified theory of underreaction, momentum trading, and overreaction in asset markets. The Journal of Finance 54, 2143–2184.

Hume, M., Sentence, A., 2009. The Global Credit Boom: Challenges for Macroeconomics and Policy, *Journal of International Money and Finance, 28, 1426-1461.*

International Monetary Fund (IMF), 2008. The changing housing cycle and the implications for monetary policy, in: World Economic Outlook: Housing and the Business Cycle.

International Monetary Fund (IMF), 2009. Lessons for monetary policy from asset price fluctuations, in: World Economic Outlook. Internatinal Monetary Fund, Washington, D.C., pp. 93–120.

International Monetary Fund (IMF 2011): Housing finance and financial stability, in: Global financial stability report 2011, ch.3, pp. 111-113, http://www.imf.org/external/pubs/ft/gfsr/2011/01/pdf/chap3.pdf.

Krainer, J. (2010), Mortgage Choice and the Pricing of Fixed-Rate and Adjustable-Rate Mortgages, FRBSF Economic Letter No. 2010-03, San Francisco.

Krugman, P., 2002. Dubya's Double Dip? The New York Times.

Krugman, P., 2014. Inflation Targets Reconsidered. Draft paper for ECB SINTRA conference.

Kunnert, A., Baumgartner, J. (2012): Instrumente und Wirkungen der österreichischen Wohnungspolitik, Österreichisches Institut für Wirtschaftsforschung WIFO, Wien, November.

Kuttner, K., Shim, I., 2013. Can Non-Interest Rate Policies Stabilize Housing Markets? Evidence from a Panel of 57 Economies (NBER Working Paper No. 19723).

Lieberman, Evan, S. (2005), Nested Analysis as a Mixed-Method Strategy for Comparative Research. *American Political Science Review*, Vol. 99 (3), 435-452.

Markham, J. W. (2010), The Subprime Crisis--A Test Match For the Bankers: Glass-Steagall vs. Gramm-Leach-Bliley, University of Pennsylvania Journal of Business Law, 12 (4), 1081-1134.

Marqués, J.M., Maza, L.Á., Rubio, M., 2010. Una Comparación de los ciclos inmobiliarios recientes en España, Estados Unidos y Reino Unido. Boletín Económico 107–120.

Mayer, C., 2011. Housing Bubbles: A Survey. Annual Review of Economics 3, 559–577.

McCarthy, J., Peach, R.W., 2004. Are home prices the next bubble? FRBNY Economic Policy Review 10, 1–17.

Minsky, H.P., 1986. Stabilizing an unstable economy. Yale University Press.

Nguyen, P., 2005. Market underreaction and predictability in the cross-section of Japanese stock returns. Journal of Multinational Financial Management 15, 193–210.

Österreichische Nationalbank (OeNB 2014): Fundamentalpreisindikator für Wien und Österreich, Pressedienst, Wien, 20. Januar. http://www.oenb.at/dms/oenb/Presse/Pressearchiv/2014/_20140120/Fundamentalpreisindikator%20f%C3%BCr%20Wohnimmobilien%20in%20Wien%20und%20%C3%96sterreich.pdf

Piazzesi, M., Schneider, M., 2008. Inflation illusion, credit, and asset prices, in: Asset Prices and Monetary Policy. University of Chicago Press, pp. 147–189.

Popken, B. (2008), Blame The Subprime Meltdown On The Repeal Of Glass-Steagall, The Consumerist, April 17, 2008, http://consumerist.com/2008/04/17/blame-the-subprime-meltdown-on-the-repeal-of-glass-steagall/, last accessed on September 22, 2014.

Roe, M. J. (2011): The Derivatives Market's Payment Priorities as Financial Crisis Accelerator, *Stanford Law Review*, 63, 539-90.

Sá, F., Towbin, P., Wieladek, T., 2014. Capital Inflows, Financial Structure and Housing Booms. Journal of the European Economic Association 12, 522–546.

Scanlon, K., Whitehead, C., 2011. The UK mortgage market: responding to volatility. Journal of housing and the built environment 26, 277–293.

Scharfstein, D.S., Stein, J.C., 1990. Herd behavior and investment. The American Economic Review 80, 465–479.

Scheinkman, J.A., Xiong, W., 2003. Overconfidence and speculative bubbles. Journal of political Economy 111, 1183–1220.

Scherbina, A., 2013. Asset Price Bubbles: A Selective Survey. IMF Working Paper WP/13/45.

Schneider, M. (2013): Are Recent Increases of Residential Property Prices in Vienna and Austria Justified by Fundamentals? *Monetary Policy and the Economy*, Q4/13, Österreichische Nationalbank, 29-46 (deutsch: Ein Fundamentalpreisindikator für Wohnimmobilien für Wien und Gesamtösterreich, Österreichische Nationalbank).

Segoviano, M. A., Jones, B., Lindner, P., Blankenheim, J. (2013), Securitization: Lessons Learned and the Road Ahead, IMF Working Paper No. 13/255, Washington, DC.

Shiller, R.J., 2008. The subprime solution: How today's global financial crisis happened, and what to do about it. Princeton University Press, Princeton, NJ and Oxfordshire.

Shim, I., Bogdanova, B., Shek, J., Subelyte, A., 2013. Database for policy actions on housing markets. *BIS Quarterly Review*, (September), 83–95.

Shin, H. S., 2009. Reflections on Northern Rock: The Bank Run that Heralded the Global Financial Crisis, Journal of Economic Perspectives 23 (1), pp. 101–119.

Shleifer, A., Vishny, R. W. (1997): The Limits of Arbitrage, *The Journal of Finance*, 52, 35-55.

Statistik Austria (2013): Wohnen 2012. Ergebnisse der Wohnungserhebung im Mikrozensus, Jahresdurchschnitt 2012, http://www.statistik.at/web_de/Redirect/index.htm?dDocName=071868

Stiglitz, J.E., 1990. Symposium on bubbles. The Journal of Economic Perspectives 4, 13–18.

Stoclet, E. 2012. Where have all the specialist mortgage lenders gone?, Mortgage Strategy July 23, http://www.mortgagestrategy.co.uk/blogs/product-blogs/where-have-all-the-specialist-mortgage-lenders-gone/1054956.article (accessde June 5, 2015).

Stout, L. A. (2008). Derivatives and the Legal Origin of the 2008 Credit Crisis, *Harvard Business Law Review*, 1, 1-38

Taylor, J.B., 1993. Discretion versus policy rules in practice. Carnegie-Rochester Conference Series on Public Policy 39, 195–214.

Taylor, J.B., 2007. Housing and Monetary Policy, in: Proceedings - Economic Policy Symposium - Jackson Hole. Federal Reserve Bank of Kansas City, pp. 463–476.

Taylor, J.B., 2008. The Financial Crisis and the Policy Response: An Empirical Analysis of What Went Wrong, keynote lecture at the Bank of Canada, Ottawa, November.

U.S. Bureau of Census (2014), Housing Vacancies and Homeownership, Online at: http://www.census.gov/housing/hvs/, last accessed on September 22, 2014.

U.S. Department of Housing and Urban Development (2013), American Housing Survey for the United States: 2011

Wallison, P. J. (2011), Did the "Repeal" of Glass-Steagall Have Any Role in the Financial Crisis? Not Guilty. Not Even Close, in: J. A. Tatom (ed.), Financial Market Regulation, New York et al., pp. 19-29.

Warnock, F. E., Warnock, V. (2009): International Capital Flows and U.S. Interest Rates, *Journal of International Money and Finance,* 28, 903-919.

White, W.R., 2006. Procyclicality in the financial system: do we need a new macrofinancial stabilisation framework? BIS Working Paper 193, Basel.

Whitehead, C. M. E. 2008. The Nature and Role of Building Societies in the UK, Swedish National Board of Housing, Building and Planing, Karlskrona.

Wieser, R. (2009): Determinanten der Mietwohnhauspreise in Wien, ifip TU Wien Working Paper Nr. 4/2008, http://www.ifip.tuwien.ac.at/publ/wp/PDF/IFIP_WP_4_2008.pdf

Yalçın, A., 2008. Gradual information diffusion and contrarian strategies. The Quarterly Review of Economics and Finance 48, 579–604.

Publisher: Hans-Böckler-Stiftung, Hans-Böckler-Str. 39, 40476 Düsseldorf, Germany
Phone: +49-211-7778-331, IMK@boeckler.de, http://www.imk-boeckler.de

IMK Study is an online publication series available at:
http://www.boeckler.de/imk_5023.htm

ISSN: 1861-2180

Hans Böckler Stiftung

Fakten für eine faire Arbeitswelt.