

**SIAM UNIVERSITY**

BANGKOK, THAILAND



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**IS THERE A BUBBLE IN THE GERMAN REAL ESTATE MARKET?**

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THE INDEPENDENT STUDY SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR  
THE DEGREE OF MASTER IN BUSINESS ADMINISTRATION

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**Title: Is there a bubble in the German real estate market?**

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Vijit Sriniv  
June 8, 2017

## Abstract

As history has shown, bubbles in the real estate market can have a devastating impact, not only on the domestic economy but on the whole world. The current events and developments on the German housing market have shown strong, yet excessive growth in both purchase prices and rent rates and brought it to the attention of public debate. However, the indicators of speculation driven price bubbles are very individual, vary from market to market and are difficult to identify at a national level, since the aggregation of data is covering diverging developments on submarkets.

This independent study deals with the question whether there is a bubble in the German residential real estate market by application of different ratio analysis (Price-to-Rent ratio, Price-to-Income ratio, Debt ratio) and economic indicators. Firstly, these different key ratios will be applied on past bubbles as a back-test to verify its effectiveness. The property market bubbles of the USA in 2008/09 and of Spain in 1997 and 2008 will be analyzed. After verification of the key ratios they will be applied on the German real estate market.

It turns out that, by applying the presented ratios and including economic indicators and the gained insights from the American and Spanish markets, there is no clear answer to the question. Prices have grown drastically in many major cities, often much stronger than the rent rates have increased. But unlike the back-tested bubbles in the USA and Spain, private debt has not increased but even decreased and various economic indicators provided suitable explanations for fundamental changes in the market. But nonetheless, the emergence of a bubble could not be fully ruled out.

## **Index of abbreviation**

ca.	Circa
etc.	Et cetera
FED	Federal Reserve System
GDP	Gross domestic product
IREBS	International Real Estate Business School
OECD	Organization for Economic Cooperation and Development
US / USA	United States of America
UK	United Kingdom of Great Britain and Northern Ireland
Vol.	Volume
NINJA	No income, no job, no assets
CEO	Chief executive officer
REL	Remaining economic life
FFIEC	Federal Financial Institutions Examination Council
ZIA	Zentraler Immobilien Ausschuss e.V.

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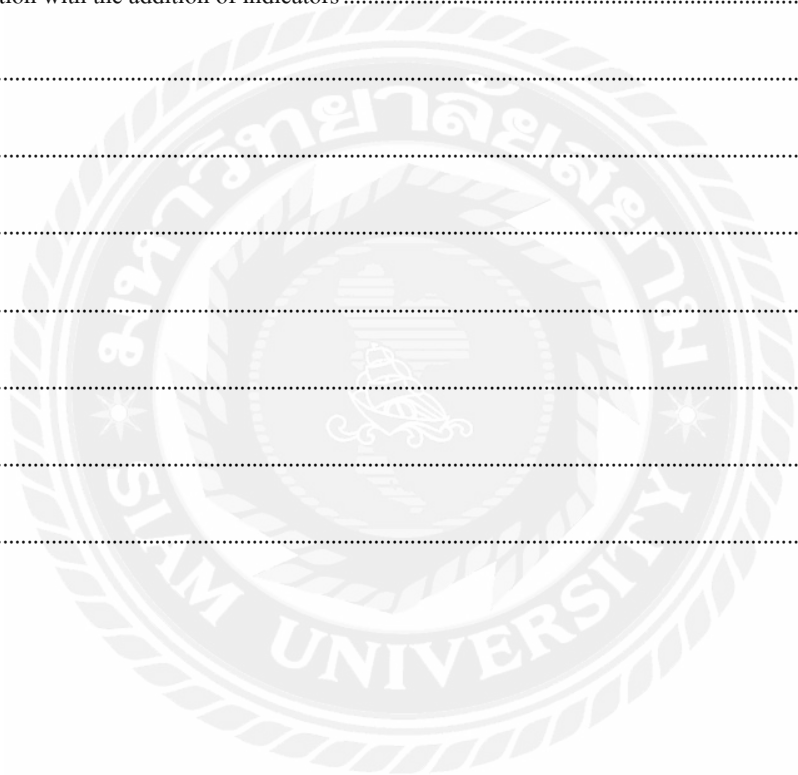
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## 1. Introduction

### 1.1 Prelude

Speculation bubbles in economies are almost as old as humankind itself. The probably most famous bubble of modern times, of which the world economy has hardly recovered from today, is the US-American housing bubble. Nourished by ever growing real estate market prices the banks were giving out so-called NINJA loans<sup>1</sup> thereby caused the bubble to grow and grow over the years. It reached its peak in spring 2007. Then the real estate prices began to crumble, credit defaults amassed, the bubble busted.

The so-called subprime crisis reached its climax when on September 15, 2008 the investment bank Lehman Brothers had to file for bankruptcy and the disruption began to spread to other economies in mid-2007. The bubble's burst made clear how heavily interconnected the world economies were and that the subprime crisis was merely the highlight of speculation bubbles on residential real estate markets worldwide. In Spain and Ireland similar phenomena were observed.

What influence the residential property market had on the economic growth and the employment of a country was shown by the busting of the Irish (2008) and the Spanish bubble (2007). According to the well-respected US-national economist Nouriel Roubini (2013) “[...] frothiness, if not outright bubbles, are reappearing in housing markets in Switzerland, Sweden, Norway, Finland, France, Germany, Canada, Australia, New Zealand, and, back for an encore, the UK (well, London). In emerging markets, bubbles are appearing in Hong Kong, Singapore, China, and Israel, and in major urban centers in Turkey, India, Indonesia, and Brazil”.

In Germany, during the last 5 years, house price increases of up to 40% have been observed (Statista 2015a) which brought up the topic of a real estate market bubble. In fact, a study (Just, Moebert, Heinrich, Orszulok 2015) carried out by the International Real Estate Business School (IREBS) / University of Regensburg on behalf of the Deutsche Bank Research concluded a “boom, but no bubble” (Deutsche Bank 2014) with regard to the current market price dynamic on the residential property market. But the voices among specialists grow pointing to the current price rise as the first warning signal of a speculative over-pricing. The Council of Real Estate also denies a price bubble covering the entire country and reiterates that the immense price increases are attributable to a disproportionately high demand as well as to an insufficient supply which focuses exclusively on large cities. However, a view at the regional markets shows that the fear of overheating does not seem to be unfounded.

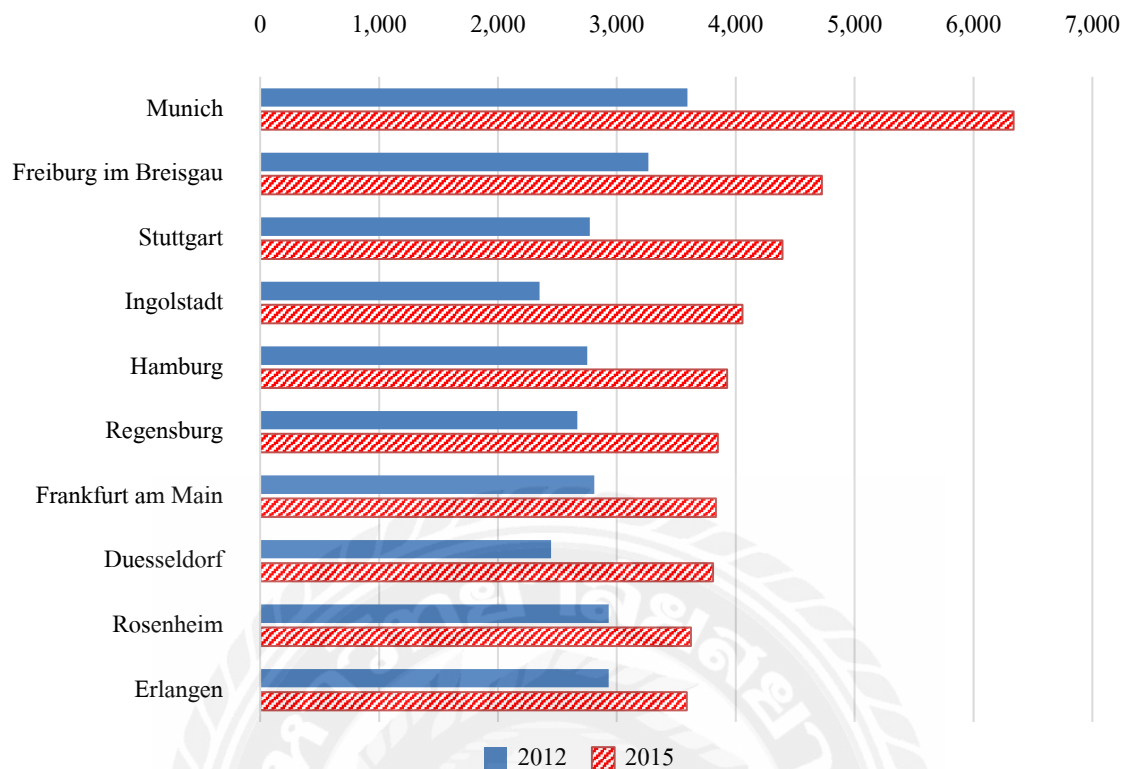
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Figure 1:

Cities with the highest price per square meter for condominiums compared for the years 2012 and 2015, in euro

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<sup>1</sup> The term “NINJA” means “No Income, No Job, no Assets” and refers to creditors of low creditworthiness



Source: Statista 2017a

Figure 1 compares the cities in Germany with the highest purchase prices for condominiums in 2012 and 2016. With EUR 6.338 per square meter, Munich is leading the statistics and has recorded a jump in the purchase price of 76% within just three years.

Among other metropolises and cities like Stuttgart, Hamburg and Frankfurt am Main, there are also some B-, C- and D-cities, whose housing prices exploded in recent years. According to Harald Simons, CEO of Empirica and real estate expert, special attention should be given to so-called “swarm towns”<sup>2</sup> such as Freiburg, Erlangen or Regensburg. In his recent study, which he presented at the Quo vadis real estate congress in February 2015, he stressed the dangers posed by a “flocking together of young people [...] who try to create a certain milieu around them in a city or a city district” (Simons 2015). If one compares the relative change in the purchase price development for owner-occupied apartments in figure 1, it is striking that Ingolstadt experienced a large jump upwards with a relative price increase of around 72%, even against Munich. A strong influx into these regions is welcomed by residential investors and encourages further investment. However, a shrinking of the housing markets, as expected by Harald Simons for the next ten to fifteen years, could have devastating consequences. “From the point of view of today's swarm towns<sup>2</sup>,

<sup>2</sup> a German term for towns which young people in particular find especially attractive, so that there is a high rate of influx

this would mean that the swarm would move forward, and investments in these "not-real" or "no-longer-real" swarm towns would then be lost" (Simons 2015).

In the face of such developments, one quickly remembers the turbulent events on the US real estate market. There were also explosive price increases in cities such as San Diego and New York City before the bubble finally burst.

Against the backdrop of the blown bubble in the US, some questions arise: How does a bubble develop? Are there any general characteristics that can be used for the early detection of future price bubbles? Are the current price developments on the European residential property markets still appropriate?

## **1.2 Occasion, objective, and delineation of the topic**

The search for the existence of price bubbles on residential property markets is the occasion and the aim of the following analysis. The real estate markets of the USA, Spain and Germany are used for this purpose as an example. In the beginning, however, the aim is to capture and define the price bubble phenomenon in its complexity.

By looking at it from different angles, a suitable definition of the term can be made. Chapter 3 then focuses on the determination of characteristic numbers, with the aid of which it should be possible to detect or anticipate the development of price bubbles at real estate markets. In addition to the key figure analysis, the primary aim is to establish a ratio of current market prices to fundamental values, the importance of indicators is underlined in the assessment of macroeconomic results.

The knowledge gained will be taken up and applied in Chapter 4. In a first step, the US real estate bubble burst in 2007 serves as a test basis for the reliability and validity of the key figures defined in Chapter 3. As an additional test object, the bursting of the real estate bubble in Spain 2008 will be investigated in a further step and the key figures will be tested for their expressiveness. Finally, the key figures should be used to adequately answer the question of a current price bubble on the German real estate market. Finally, Chapter 5 completes this work and summarizes the most important results in a conclusion. In this context, a critical examination of the weaknesses and gaps of the previous analysis takes place.

It is necessary to note that due to the fixed scope of the present work, not all indicators can be taken into account. Furthermore, this work is limited to the market for residential properties. It can therefore not be ruled out that the final results do not coincide with developments on commercial real estate markets.

## 2. Theory and literary reviews

### 2.1 Definitions and criteria for price bubbles

To adequately answer the question of the existence of a price bubble, it is first and foremost to clarify the conditions under which a bubble can be assumed. The popular bubbles of the recent past have made the term price bubble nearly “mundane” in order to describe the phenomenon of rapid price rises and decay of various asset classes in the financial markets.

Neither the dotcom nor the real estate bubble in the US were recognized as such, despite their explosion-like growth, and were only fully identified after they burst. The question of a suitable definition therefore seems by no means trivial. Even among economists, disagreement prevails over which criteria must be the essential for a scientifically based definition of the concept: "The term ‘bubble’ is widely used but rarely clearly defined" (Case, Shiller 2004).

The subject literature leads to a variety of different explanatory approaches, which can be classified according to three views: The so-called chart-based analysis is based on a specific course pattern or a cyclical course. Typical for such a view is the usage of the terms "boom", "crash" and similar descriptions of such different phases (Rombach 2011). This analogy follows the classical idea behind the expression bubble. Like a soap bubble, it continues to expand until it is so unstable that it bursts (Francke, Rehkugler 2011).

The comparison of the purchase prices for condominiums in Germany at the beginning of this paper has shown, however, that strong price movements are by no means sufficient to automatically conclude the existence of a bubble.

For this reason, another point of view makes a relationship with the market mood and the behavior of the market participants responsible for the emergence of price bubbles: „We think of a housing bubble as being driven by homebuyers who are willing to pay inflating prices for houses today because they expect unrealistically high housing appreciation in the future” (Himmelberg, Mayer, Sinai 2005). This behavior-based view, backed up by Joseph Stiglitz, is linked to the expectation of rising prices in the future and increasing demand, but neglects the possible presence of a current overheating. In addition, the potential for falling housing prices are neglected.

Finally, a price bubble can also be described as the deviation of the market price from the fundamentally justified value (Rehkugler, Rombach 2011).

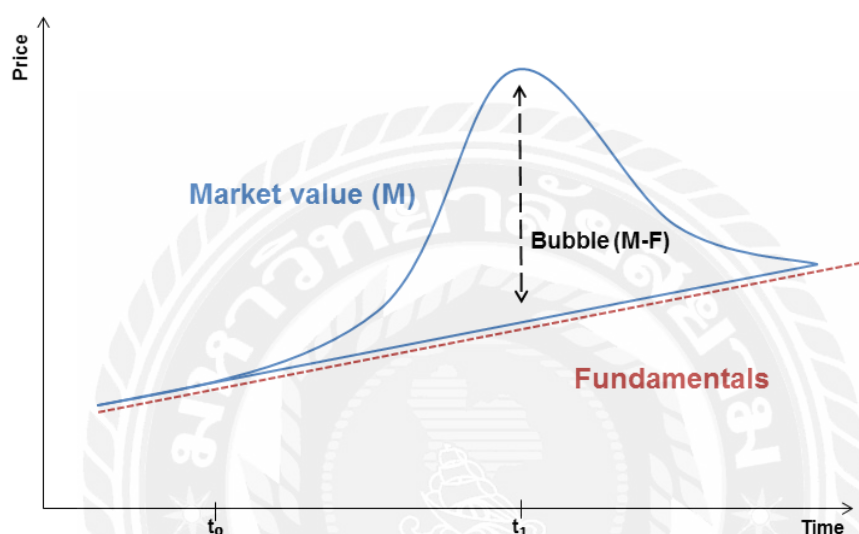
Due to their high complexity, a definition of the term "bubble" must be able to differentiate precisely between an actual price or speculative bubble and a purely cyclical development.

In science, the fundamental point of view for the categorization of a bubble is generally accepted. The fundamental value is equal to the price that a rational investor would pay for an asset, considering all market-relevant information. It is, therefore, a composite value of all the factors driving the value. In the case of real estate, for example, this value would be calculated as the present value of the sum of all future rental income.

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Figure 2:

Deviation of the market value from the fundamentals



Source: Rombach 2011

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Figure 2 shows the classical lifecycle of a price bubble from a fundamental point of view. Up to the time  $t_0$ , the market price determined by supply and demand, is the same as the fundamental value. From now on, the market price begins to move farther and farther away from the fundamental value. This is due to the growth expectations of the market participants. A bubble develops.

At this point it is easy to see that a pure dispute between the two values does not have a negative impact on the stability of the financial markets, as the chart-like viewpoint assumes. Only the bursting of the bubble in  $t_1$  leads to instability on the financial markets. The market participants realized that their expectations were too optimistic. Excessive sales of assets lead to a correction of prices to a fundamentally justified level.

Overpriced optimism has also been a driving factor in the sub-prime crisis. Increasing media reports about payment default in mortgage loans eventually caused the bubble to burst and rang a downward spiral of housing prices (Geradi, Sherlund, Lehnert, Will 2009).

After explaining the phenomenon of price bubbles in this section from different perspectives, the central point is that the fundamental view is superior to both the behavioral and the chart-based perspective. Since its center

is the empirical analysis of key figures, it is particularly suitable as the basis for the investigations carried out in this work. Real estate prices are placed in relation to fundamental influencing factors such as rents, inflation, income, and population. Although the determination of the fundamental value can lead to difficulties due to the multiplicity and inaccuracy of the economic variables, the following assumptions are made in the upcoming chapters: The existence of a price bubble can be assumed if the market value deviates significantly from the fundamental value without recognition of a structural break on the respective market (Quantum Real Estate 2012).



### **3. Instruments for the detection of price bubbles on residential property markets**

The following chapter deals with the key figures and indicators which are the foundation for the analysis. The key figures include the following ratios: Price-to-Rent ratio, Price-to-Income ratio, and debt ratio. If these key figures deviate from their long-term values this can be taken as a “red flag” and leads to closer examination.

The closer examination is carried out by the attempt to justify the deviation through indicators. These are fundamental circumstances, such as interest rates or population changes, which may have caused the key figures to react the way they did.

#### **3.1 Key figures**

##### **3.1.1 Price-to-Rent ratio**

A common indicator for the determination of potential bubbles in the residential real estate segment is the ratio of purchase and rental price development, the so-called Price-to-rent ratio. According to this relation, the price of a property corresponds to the net rental income discounted over its remaining economic life (REL). As long as the rent remains constant, purchase and rental prices are constant and there is a market balance. However, if the purchase prices rise faster than the rents over a longer period, this could be an indication of an overvaluation and a coming price correction downwards (Pomogajko, Henger, Voigtländer 2012).

However, it is not clear when the difference between the purchase price and the rental price is too great and can be considered as “red flag”. For this reason, current data is frequently set in relation to the long-term average and used as an indicator. The prerequisite for the functionality of this practice is a constant price-to-rent ratio.

This approach becomes problematic when the assumed constant situation no longer exists. An example would be the government's decision to permanently reduce the taxation of real estate. Due to a permanently increased demand for property and an imbalance in purchase and rental prices from the former values, there would be a change in the fundamental environment. The resulting increase in the price-to-rent ratio could be erroneously interpreted as a price bubble (Krainer, Wie 2004).

Although the price-to-rent ratio is not the only indicator for the identification of price bubbles, it has a decisive advantage over other multipliers: It is immune to measurement problems, which exist due to the heterogeneity of residential real estate. This can be exemplified by modernization acts, affecting the price of a property, but having also an influence on the amount of the rent (Rombach 2011).

### 3.1.2 Price-to-income ratio

The so-called price-to-income ratio serves as a further aid to investigating residential property markets for overheating. The current market price is set in relation to the average per capita income. If the latter deviates from the long-term average, an overheating on the respective residential property market cannot be ruled out. For the purchase of a property, potential buyers would now have to spend a larger share of their disposable income. As a result, fewer people would be able to acquire a home. Under the assumption of a constant supply there would finally be a decrease in house prices, induced by a decrease in demand.

Nevertheless, this ratio also has weaknesses. The price-to-income ratio reflects an average of the total population. However, prices for real estate are mainly determined by market participants whose income is above average. As a result, this indicator tends to over- than underestimate. At the same time, the house purchase is typically not a decision by individuals, but by households, so the key figure is the long-term change in the size of the personal and therefore the household income (Rombach 2011).

By completely ignoring debt financing, the price-to-income ratio reveals a different weakness. In the rarest cases the purchase of a property is financed entirely from equity. For most potential homebuyers, therefore, the monthly burden of borrowing is of more importance than the purchase price itself. This burden is closely linked to the development of current interest rates on the money market. If an economy is in a low-interest phase, individuals are more likely to opt for the purchase of property and thus to accept a mortgage loan than during a high-interest phase. "The downward trend in nominal mortgage interest rates - a major feature of the housing market over the past decade - thus has significant implications for home ownership affordability (the home price-to-income ratio) [...]" (McCarthy, Peach 2004).

### 3.1.3 Debt ratio

The debt ratio is one of the most important indicators for making statements about the sustainability of economic growth. The ratio indicates the extent to which the amount of the debt of the non-financial private sector is still sustainable compared to the economic performance of a state. The basis for the calculation of the debt ratio is the absolute debt burden of the private sector, which is placed in relation to the gross domestic product. The GDP is a measure of the economic performance of a national economy and serves as a measure for economic growth. In a cyclical recession, the gross domestic product is declining, which is partly the result of an increase in unemployment.



As a result, economic performers are increasingly unable to minimize their debt burden and the debt ratio increases. The same applies to a stable GDP, which is counterbalanced by a high degree of new debt - for example due to an interest rate cut by the central banks. A sharp deviation of the indicator, which is above the long-term average value, can therefore indicate a rising private sector debt, deviations downwards to a declining debt.

Debt plays a decisive role in the context of real estate bubbles, as the acquisition of real estate is typically carried out by a substantial part of borrowed capital. When the market is overheating, the market participants try to leverage their overdue yield expectations, similar to a hedge fund, through increased debt financing. The increased demand for real estate is causing a price increase. If the economic performance of the society cannot be linked to the market price developments, this is to be interpreted as an indication of a possible bubble formation (McCarthy, Peach 2004).

The analysis of the presented ratios provides an intuitive and trivial way of investigating price exaggerations on residential property markets. A deviation of one of the above-mentioned ratios from their long-term average value can indicate the existence of a price bubble. It should be noted, however, that the risk of misinterpretation cannot be ruled out in all three ratios - the price-to-rent ratio, the price-to-income ratio, and the debt ratio. Fundamental value changes are not considered in the course of time and are to be viewed critically just like the general use of average values.

For this reason, it is expressly mentioned that they should not be used as an exclusive instrument for market assessment and identification of bubbles, although they may serve as a guide. Rather, it is necessary to define fundamental explanatory factors and to include them in the analysis.

### **3.2 Indicators**

In addition to the key figure analysis, indicators are a classic instrument for verifying the valuation level on residential property markets. Although they are not directly related to real estate prices, they can have an impact on the recognition of fundamental changes in value. In the following key figure analysis, indicators are supplemented by their explanatory effect, since "bubble tests do not a good job of differentiating between miss-specified fundamentals and bubbles" (Gürkaynak 2005).

Viewed individually, indicators have no meaningfulness about the presence of a price bubble. Nevertheless, they can be important indicators in the context of the results of the key figure analysis. Basically, indicators display whether the considered market is in the "normal state" or is moving outside the borders because of disturbing factors. It should be borne in mind that indicators reflect only a momentary picture of the current market situation

and do not suffice for analysis. As descriptive instruments, they can act as a support or as a relativity to the results of the key figure analysis.

Possible indicators are, for example, a high number of unemployed, extremely low interest rates as well as strong political or economic distortions. Indicators can occur in a variety of ways and have an infinite number of expression variations that need to be redefined for each bubble.



## **4. Analysis of real estate markets**

### **4.1 USA**

The real estate bubble on the US market, which burst in the year 2007, had a whole bundle of causes, which together resulted in an enormous overpricing of residential real estate. After the bursting of the dotcom bubble in spring 2000, many investors withdrew from the equity business. The steady rise in prices since the 1990s has made the property market increasingly attractive.

Because of a sustained, substantial rise in the value of residential real estate, there was a growing demand for residential property. The already very high quota of home owners rose from 65.7% in 1997 to 68.9% in 2005. US government's subsidy programs strongly drove this to promote home ownership in financially vulnerable populations.

Thus, a large proportion of the sudden home owners came from a group with lower than average income. Due to the sustained increases in value, the multiple collateralization of the property did not pose a problem, neither for the borrowers nor the creditors. The continued upward trend of prices for residential properties served as sufficient security for new financing. The reason for this mainly was the fact that the financing banks began to securitize many of these so-called subprime or NINJA loans and to outsource the risk to third parties.

Finally, when the voices in the media were increasing in 2007 and the massive overvaluation of the loaned properties became apparent, numerous banks were in a state of emergency due to an immense number of credit defaults. The fluctuating creditworthiness of the banks led to refinancing problems and high revaluation losses on investment instruments that were subject to credit risk.

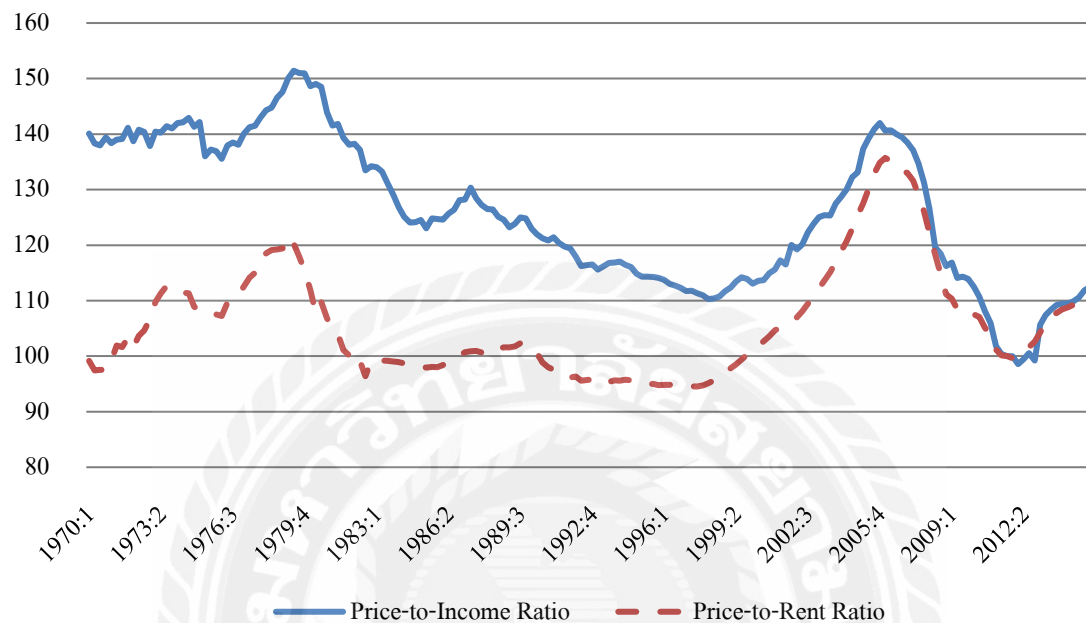
The slump in the real estate bubble in the USA led to a global financial and economic crisis, which from 2008/09 onwards also extended to the European economic area as a European crisis.

#### **4.1.1 Price-to-rent ratio & price-to-income ratio**

While the change in the real house price index is used to determine whether prices have risen or fallen compared to the previous year, the two ratios presented in Chapter 3 are used to assess this price change. The price-to-rent ratio serves as a measure of the profitability of home ownership, while the price-to-income ratio is a measure of affordability. The following analysis assumes that the purchase prices have to develop in the long term in the same proportion as the rents or the incomes. If this is not the case, this can be interpreted as an indication of the existence of a real estate bubble.

Figure 3:

Key figures, US-American market, index 100=2011:3



Source: own research

data: OECD 2017

Figure 3 shows that the ratio of purchase prices to both rental prices and incomes in the 1990s has been at an almost identical level, while the growth of rental rates until 1997 was still below the income's growth. Beginning in 1997, the purchase prices began to lose their long-term average and rose. Until the last quarter of 2001, a moderate increase in the purchase price of 12.05% over the past four years was recorded. During the downturn of the New Economy, real estate as a low-risk investment project became increasingly attractive for many investors. As a result, the growth picked up again, so that the price-to-rent ratio peaked in the third quarter of 2006 at an index value of 141.92 points, reaching an all-time high since the beginning of the review period in 1970. In the US, a price boom has occurred, which has led to a rise in real estate market prices in just nine years to more than 40% above the rental price level.

By contracts, the price-to-income ratio deviated from the long-term average with a lag. From 1997 to 2000, the ratio remained at an average value of 113 points and only began to clear significantly in 2001. In essence, the price-to-rent curve is linked to the trend of the price-to-income ratio, but remains below the price-to-income curve until the bubble busted. Again, the bursting of the dotcom-bubble can be considered as a decisive factor. The climax of the drift of purchase prices and income was already achieved in the fourth quarter of 2005, with a relative price

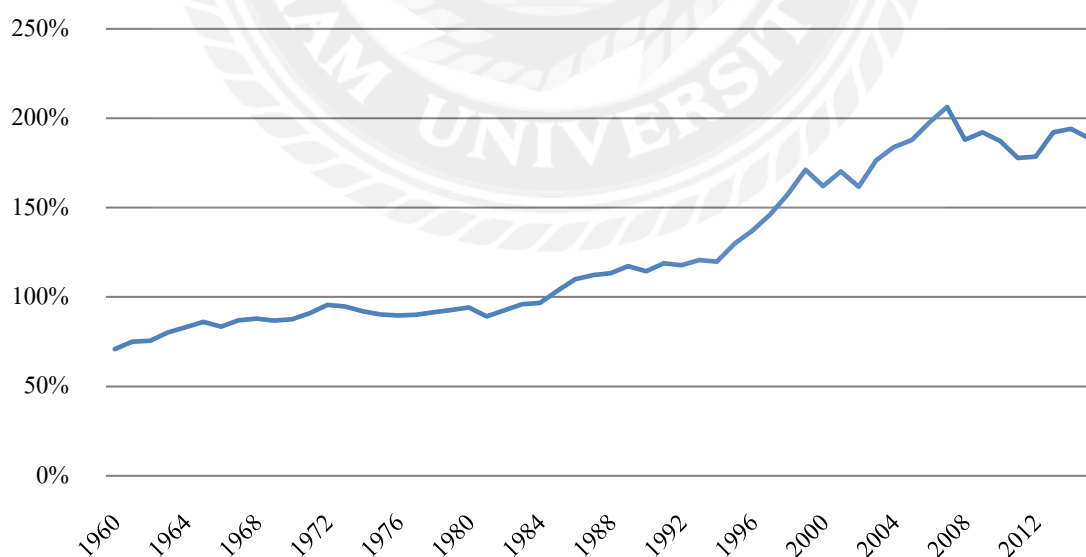
increase of ca. 25 % since 1997. From this point onwards, prices for real estate had almost reached its peak and a burst of the price bubble was already apparent.

Based on the analysis of the two ratios, a bubble formation in the US real estate market can be concluded. The purchase price for real estate can also be identified as a driving element. Since both curves developed approximately at the same time and are subject to the purchase price as a common thread, it is to be assumed that said purchase price is decisive for the change in the ratio characteristics.

The index in figure 3 was set to 2011:3 with a value of 100 points. Based on this assumption, the development of the ratios from the previous years (1970 to 1982) could also be interpreted that they are subject to bubbling. However, it is noticeable that both curves - especially the price-to-income curve - have been at a fundamentally higher level in earlier periods, so it can be assumed that the fundamental framework conditions of this period are different than in the analysis carried out. For this reason, a more intensive investigation of this period would not be an important factor in this work.

#### 4.1.2 Debt ratio

Figure 4:  
Domestic credit to private sector (% of GDP), US-American market



Source: own research

data: World Bank 2017, OECD 2017b

The debt of the private sector in the US was over many decades characterized by a continuous growth. As can be seen in figure 4, the extend of private debt was already at around 100% of GDP in 1984. While the growth rate of debt in the period from 1984 to 1994, with an increase of around 25 points to 125.23% of GDP, could still be considered as moderate, the following acceleration in debt growth is considered exorbitant. When the bursting of the real estate bubble began in 2007, the private sector debt in the USA amounted to 213.92% of the gross domestic product. Over a period of 13 years, the new borrowing rose by almost 90%, suggesting an overheating of the market. Since real estate financing is usually carried out via non-recourse loans in the USA, the sudden decline in debt after the price bubble is broken is due to numerous insolvencies because of credit defaults.

#### **4.1.3 Interpretation with the addition of indicators**

In the preceding key figure analysis, a clear indication for the existence of a price bubble could be identified. All three ratios have delivered a measuring instrument for the existence of a bubble in the US real estate market.

At the very least, it can be said that there are other indicators which point to an unusual market situation and in this case, support the key figures as indicators.

If one looks at the political situation during the observation period, it becomes clear that the US government's particularly financial policy interventions in the real estate market were significant for the following overheating. The funding programs adopted by the US government, which were designed to provide low-income citizens with a home, triggered a sudden surge in new debt through mortgage loans in the private sector. In 2002/03, the rate of refusal of applications for mortgage loans was only 14%, five years earlier it was twice as high (FFIEC 2004).

To counter the recession of the early 2000s, the FED lowered the US dollar interest rate from 6.5% in 2000 to a low 1.0% in 2003. The consequence was a further tightening of the debt situation in the private sector. Furthermore, in the same period, the decoupling of the purchase prices from the income began after the development of the purchase prices had ditched the development of rent rates since the late 1990s. The whole market seemed convinced that the values of the residential property were fundamentally justified and a decline was impossible.

During the state subsidy programs, Fannie Mae and Freddie Mac, the state-owned mortgage banks, bought securitized subprime loans of \$ 81 billion worth in 2003 and again over \$ 434 billion in the period from 2004 to 2006. Other private banks were also encouraged to grant credits and drop limits or rules on collateral policy to allow loans that were classified as highly risky. At the same time, American banking supervision failed to monitor the outsourcing of risks over the sale of securitized loans by banks.

## 4.2 Spain

The Spanish real estate crisis shows some parallels to the real estate crisis in the USA. In their entirety, the development of the bubble in Spain can be classified in the years 1985 until its bursting in 2007, whereby this period can be divided into two phases of inflation. After the end of the dictatorship and with the accession to the European community of values in the 1980s, Spain experienced an economic upturn, which also had a positive effect on the real estate markets. In the first phase, from 1986 to 1991, prices for home ownership rose significantly, but rebounded, suggesting that the market economy was recovering. This short-term stagnation of prices is likely to be attributed to the domestic political turmoil, which has also had an impact on the investment activities of the market participants.

A worsening increase in housing costs prompted the Spanish government to motivate the population to invest in home ownership by means of tax reliefs. As a result, property prices began to rise once again in 1998 and soon exceeded the development of the first phase. The ownership rate increased to more than 80%. Banks offered mortgage loans with maturities of 40, sometimes even 50 years. Like in the United States, the extend of debt rose immensely and tripled within ten years. From the late 1960s to the year 2007, residential real estate values grew continuously. Especially in the period from 2000 to 2007, annual growth rates of 4% were common.

Due to the global networking of the international markets, the bursting of the US real estate bubble caused a shock in the euro zone, which also collapsed the over-rated residential property market in Spain. As in the USA, Spain's excessive indebtedness led to credit losses and foreclosures.

### 4.2.1 Price-to-rent ratio & price-to-income ratio

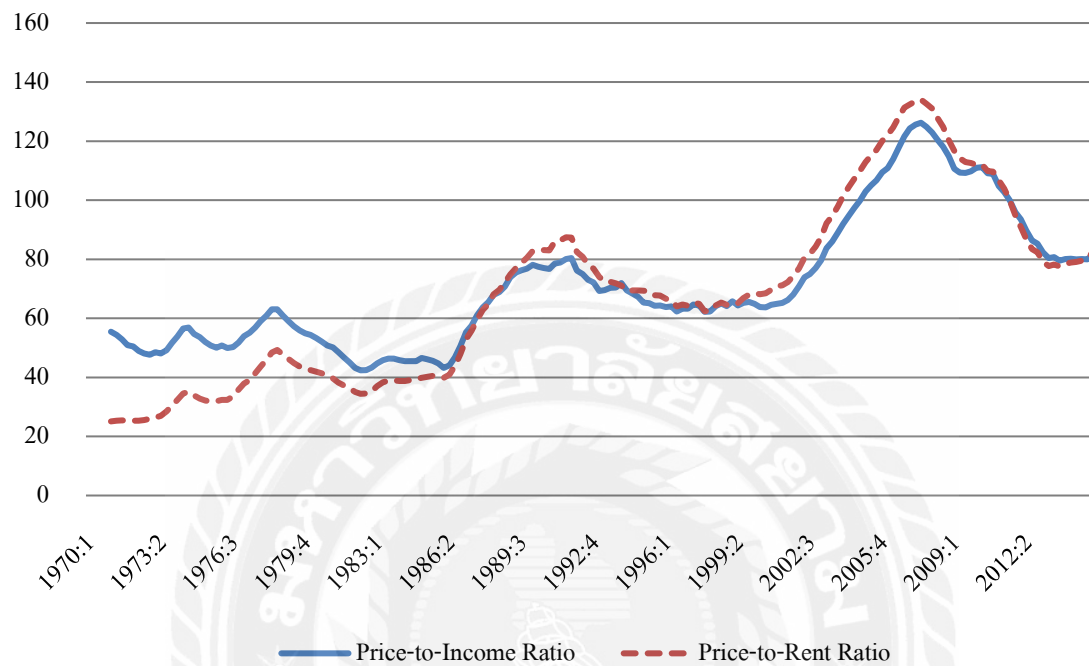
A look at the ratios of Spain shows even more obvious the possible presence of a price bubble than it was in the USA. In figure 5 (Index: 100 = 2011:3), with the start of the first price overrunning phase 1985, the Price-to-Rent ratio gradually deviated further and further away from the long-term average and reached its peak of 176.4% of the normal value in the third quarter of 1991. The ratio of purchase prices to rental prices has consequently drifted apart by just under 116% in just six years, or the purchase prices have more than doubled in this period relative to rents.

By the beginning of 1998, a short phase of cooling down followed by a drop of the price-to-rent ratio by 39.77% (24.85 points). By the turn of the century, the real estate market began to bloom again and with increased intensity. Based on a value of around 63 in 1997, the multiplier rose to just over 130 points in 2006/07. The additional plus of over 100% property price increases against rents finally culminated in 2007/08 - simultaneously with the events on the US real estate market - in the bursting of the bubble.

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Figure 5:

Key figures, Spanish market, index 100=2011:3



Source: own research

data: OECD 2017

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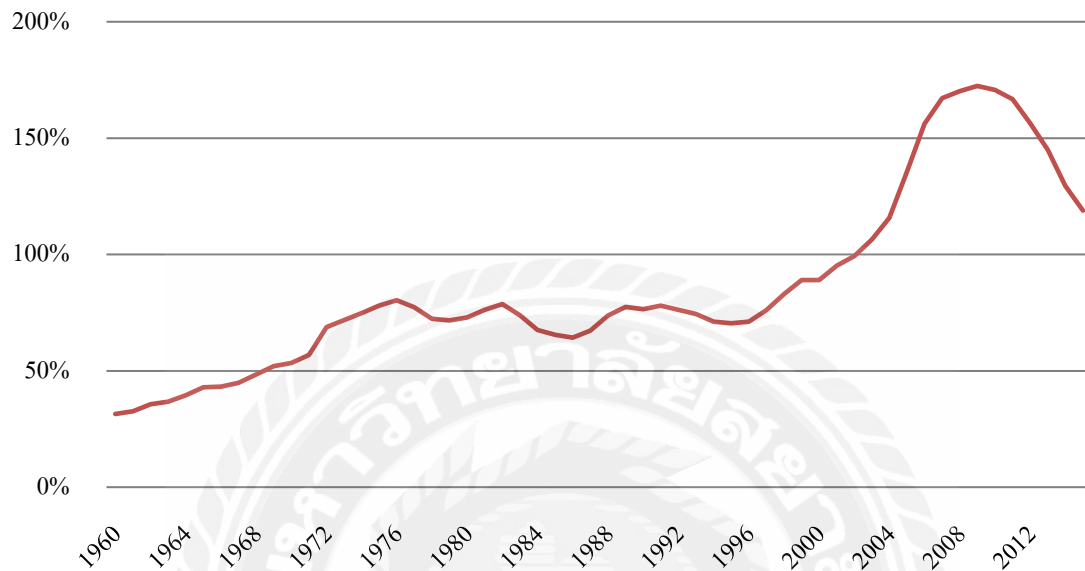
At the peak of the first phase, the price-to-income curve was roughly 2 points below the price-to-rent curve. Shortly before the total crash, the gap widened to about 10 points. Although the curves shown in figure 5 are not identical, a strong correlation is evident. For the example of Spain, an approximately equal curve of the two ratios can also be observed. It therefore can be assumed that rents and income have developed nearly identical. From this it can be concluded that, again, the price was the main driver for deviations of the two ratios.



#### 4.2.1 Debt ratio

Figure 6:

Domestic credit to private sector (% of GDP), Spanish market



Source: own research

data: World Bank 2017, OECD 2017b

A glance at private sector debt in relation to GDP shows a relatively constant level for Spain up to around the end of the millennium. Although slight fluctuations in the degree of debt are visible in figure 6, these are due to normal economic fluctuations and remain constant between 60% and 80%. Consequently, the first phase of bubble formation cannot be identified through the private indebtedness. How inconspicuous this first phase was, the more obvious was the following one. The ever-increasing course of the curve in figure 6 illustrates the subsequent significant debt growth in the following years. Spain had a debt ratio of 84.48% in 1999, in 2009 it was already 210.03%. In ten years, Spain's private sector recorded an increase in the debt of almost 126 percentage points. The annual growth rate was consistently double-digit from 2005 to 2008, with a peak of 16.04 points in 2006.

Figure 6 shows the importance of the debt ratio as a key figure. The rapid rise in the debt ratio shows that the Spanish private banking sector had been ignoring any risk, especially in the second phase of bubble formation, despite increased warnings by the Spanish central bank against the inflated bubble (de Barrón 2007).

### **4.2.3 Interpretation with the addition of indicators**

Also for Spain, the key figures have proved themselves to be valuable parameters for answering the question whether there is a bubble in the Spanish real estate market. The two ratios capture the two phases of bubble formation and, due to their significant change from the fundamentally justified long-term values to the existence of a real estate bubble. The debt ratio, on the other hand, did not reflect the first phase to an extent that it could act as an indicator of a price bubble. An explanation for this can be found in the catch-up and price-fixing processes of the Spanish economy. The history of Spain has been strongly influenced by political and economic changes during the period under consideration. It was not until 1982 that political change took place from a dictatorship to a parliamentary monarchy. In 1986, Spain finally joined the European Community. The first phase of the purchase price increase was the result of this strong opening of the market. As the private debt level did not change significantly at this time and there was no real boom in the real estate market, this first phase could be considered a catching-up phase.

In the second phase, which began at the end of the 1990s, the existence of bubble formation can be identified by means of indicators and with the support of the results from the analysis of the ratios.

A strong neo-liberalization of the economy in 1996 and the introduction of the euro in cash 2001 provided optimal conditions for international investors in the opening Spanish market. In addition to the already strong population growth of 2-3% p.a., immigrants accounted for 17% of the working population of the country in the years 1998 to 2008. There was an increase in the demand for living space, which gave the construction and real estate sector a real boost.

In order to mitigate the rising rents caused by the market's slowness, the government decided to reduce the cost of housing through tax reliefs. In addition, liberalization of the building regulations adopted in 2003 and the reduction of the euro interest rate led to excessive new construction, which resulted in an explosive increase in the housing supply. Many real estate investors took out loans to further leverage their returns from the booming market. The indebtedness of the private households also increased into exorbitant sums. As was the case in the US, a large part of the population lent on their houses and apartments for consumer loans. Shortly before the final burst of the bubble in 2006, the share of the construction and real estate sector in the GDP was 18%, which illustrates the immense extent of the real estate bubble.

## **4.3 Germany**

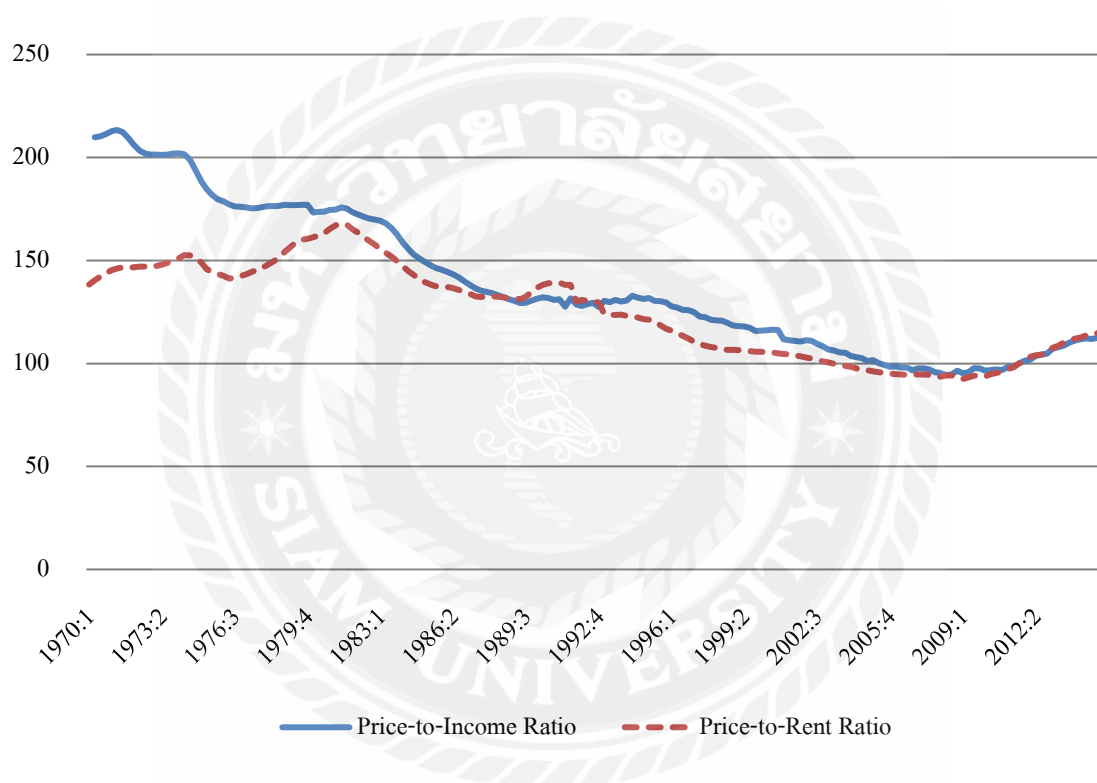
After explaining the significance of the previously defined key figures in the preceding paragraphs, the following will be about testing the German market for residential properties for the existence of a price bubble.

### 4.3.1 Price-to-rent ratio & price-to-income ratio

For the subsequent analysis of the German residential property market, the assumption remains that purchasing and rental prices are linked in the long-term and define the fundamental value. If property prices rise faster than rents over a longer period, this could indicate the existence of a real estate bubble.

Figure 7:

Key figures, German market, index 100=2011:3



Source: own research

data: OECD 2017

The ratios for Germany shown in Figure 7 reveal a clear downward trend for the price-to-rent ratio for residential property over almost the entire period. It is only in 2008 that an end to this trend can be seen. The price-to-rent ratio remains at a constant level for a short period of about three years and is only slightly fluctuating around the index of 94. As of 2011, a moderate upward trend of the ratio can be seen. In the last year, the ratio of purchase prices to rental prices with ca. 100 index points finally reached the level of the year 2002.

The price-to-income ratio moves similarly, but is characterized by a less severe cyclical fluctuation. Here, too, a weakening of the current trend from 2008 is depicted.

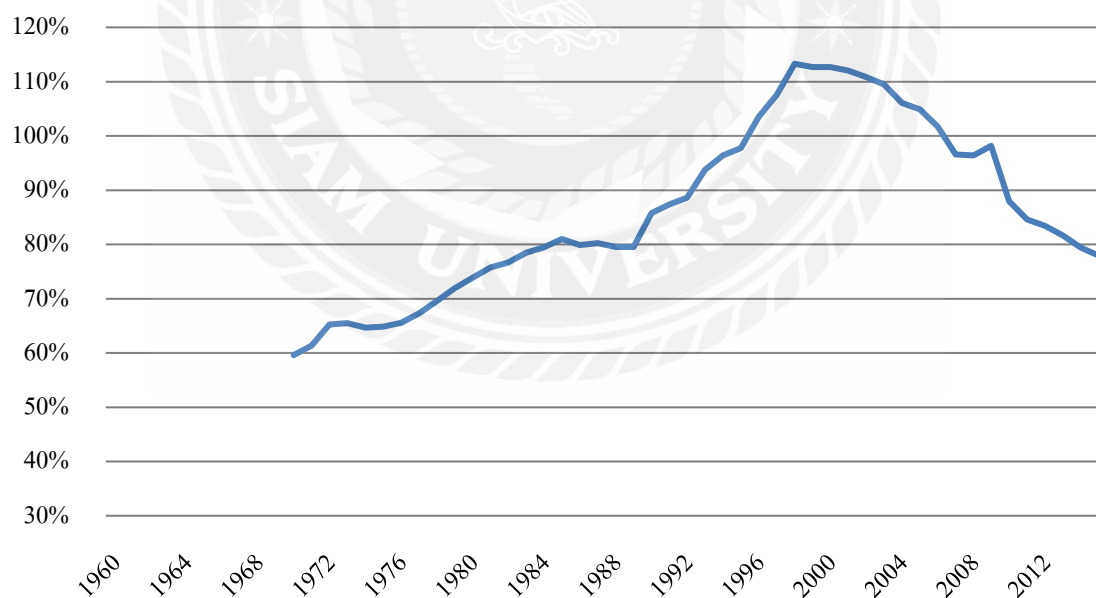
Based on the two ratios, no overheating of the German residential property market can be derived; On the contrary, there are current catch-up effects due to the long-lasting price stagnation. The ongoing price decline, which was followed by a rather modest price rise, left the purchase prices for residential properties only to rise to 1995 levels in 2009/2011. The current price rise can therefore be interpreted rather as a catch-up effect. (Deutsche Bank 2015).

### 4.3.2 Debt ratio

Looking at the debt ratio of the German private sector, no significant outbreak of the graph in figure 8 is to be seen. By 1990, the maximum degree of debt was no more than 80% of the GDP. Because of increased investment activity, private sector debt also intensified as a result of the rise in real estate prices after the reunification. Until the turn of the century, this trend continued and came to a halt at a debt level of 115.72% of the GDP. The debt ratio declined again from 2000 onwards and reached the 1986 level in 2015 (78% of GDP).

Figure 8:

Domestic credit to private sector (% of GDP), German market



Source: own research

data: World Bank 2017, OECD 2017b

The sustained relatively low degree of debt is due to the fact that Germany, as one of the few economies, has gone relatively stable through the global economic crisis and that the German GDP has only declined in a few years.

Although the debt ratio of the German private sector had already hit the benchmark of 100% of the GDP in 1996, six years before the Spanish private sector, there were no major, rapidly rising new borrowings or critically growth rates. Nor is there any danger in the consideration of the real estate lending volume. "The volume of real estate loans that are granted in Germany should soothe critics," says Michael Voigtlaender, head of the competence group financial and property markets of IW Cologne. In the previous examples of USA and Spain, the credit volume has almost tripled before the crisis, "in Germany, the real estate loans have only increased by 9 percent since 2010" (Voigtlaender 2015).

#### **4.3.3 Interpretation with the addition of indicators**

The key figure analysis did not show significant deviations from the fundamentally justified criteria for the German residential real estate market as a whole. Following, a comparison with the property markets of Spain and the USA, having already been investigated, will discuss the price developments over the past few years.

The German residential real estate market has evolved almost identically over the past 25 years, compared to the markets of the USA and Spain. Beginning in the mid-1990s, purchase prices for properties in the USA and Spain began to pick up slowly. As a result of the low-interest rate policy of the central banks and the loose credit licensing guidelines in the private banking sector, speculative bubbles developed in the 2000s. For the German real estate market, however, stagnation in prices and a subsequent decline in real estate price developments can be seen during this period. Even as the bubbles burst in the USA and finally in Spain, the German market for residential properties continued to see a drop in purchase prices without any serious disruptions.

Since 2010, house prices on the German residential real estate market have risen significantly. Against the backdrop of the long time stagnating prices, however, they appear only little conspicuous regarding a bubble formation. Moreover, the current price rises are, on an international scale, quite moderate. Nevertheless, significant deviations in the price-to-rent ratios in metropolitan regions and the so-called swarm cities can be observed.

For example, the ratio of purchase price and rental rate in Frankfurt am Main grew from 20.6 in 2004 to 25.6 in 2016:3. Similar developments were also observed in the same period in Duesseldorf (22.4 → 30.6), Cologne (22.7 → 28.7), Munich (27.7 → 36.0), and Bremen (19.9 → 24.4). However, a general statement about metropolises cannot be derived due to their heterogeneity. In Dortmund (25.2 → 24.7) and Leipzig (31.9 → 23.8), the multipliers even sank (Empirica 2016b).

### **Low interest rates**

This dynamic development in the real estate market is due to several factors: As a result of increased inflows from Germany and abroad, many large cities are currently experiencing an increasing demand for housing. Due to the global uncertainties, the German real estate market, which is regarded as safe, will become increasingly attractive for foreign investors. In addition, the currently extremely low interest rates fueled the investment activities further and increased the already high demand. Although the results of this study show no signs of bubble formation at the national level, significant changes in price developments can be observed in the focus on individual metropolitan regions and swarm cities, which may have speculative motives as a background.

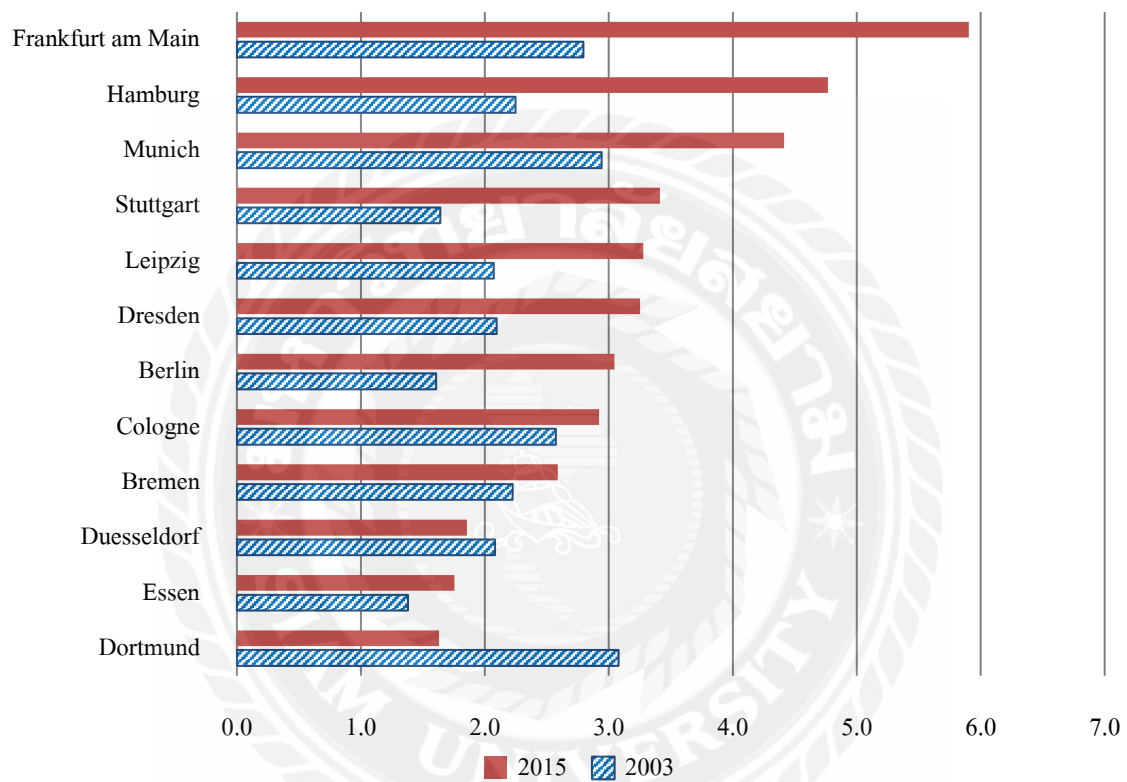
The low yields in the market are "justified by the mini interest rates" says empirica (2016c). Almost all the safe money investments bring less and less income. In this respect, it is normal that this also applies to real estate. If prices rise faster than rents, the return of real estate investors decreases. In the case of a sustained interest rate change, however, purchasing prices could drop sharply. Whether this happens depends on the rate of the interest rate reversal and the circumstances surrounding it. "External shocks" increased the likelihood of such a drop: "From devaluation through elections to customs, a large number of candidates are available". The short-term setback potential, i.e. the relative price gap between purchase prices for condominiums and rent, is now between 20% and 30% in the seven top cities, empirica has calculated. In Hamburg, Duesseldorf, Frankfurt or Berlin, the prices could drop by a quarter, in Cologne or Munich by a third. However, per empirica, larger vacancies did not threaten in the centers of the swarm towns either, such as around the year 2000. Too large is the "buffer potential" by involuntary moves to the hinterland. The expellees, driven by the high prices, returned when the rents and prices became affordable again.

### No oversupply

Also, there is no oversupply of property space, which was a common feature of the past bubbles.

Figure 9:

Completion rates, residential units competed per 1,000 residents



Source: own research

data: empirica 2016b

The opposite is true, the completion rate of real estate space is quite low, especially in the metropolises, due to the delay in real estate business response to rising demands.

### Change in household size

Another indicator reasoning the development on the market is the shrinking of household size over the past years, which leads to an increasing demand for units while the population stays constant or even decreases.

Table 1:

Change in household size in Germany, 2000 to 2014

Household size	2000	2005	2010	2014	2000 to 2014	2014		
	in 1,000's				in %	share of households	People in households in 1,000's	Share of people in %
1 Person	13,750	14,695	16,195	16,412	16.2	40.8	16,412	20.3
2 people	12,720	13,266	13,793	13,837	8.1	34.4	27,674	34.2
3 people	5,598	5,477	5,089	4,968	-12.7	12.4	14,905	18.4
4 people	4,391	4,213	3,846	3,672	-19.6	9.1	14,689	18.2
5 people or more	1,665	1,527	1,378	1,333	-24.9	3.3	7,121	8.8
Total	38,124	39,178	40,301	40,223	5.2	100.0	80,802	100.0

Source: own research

data: Federal Office of Statistics 2016

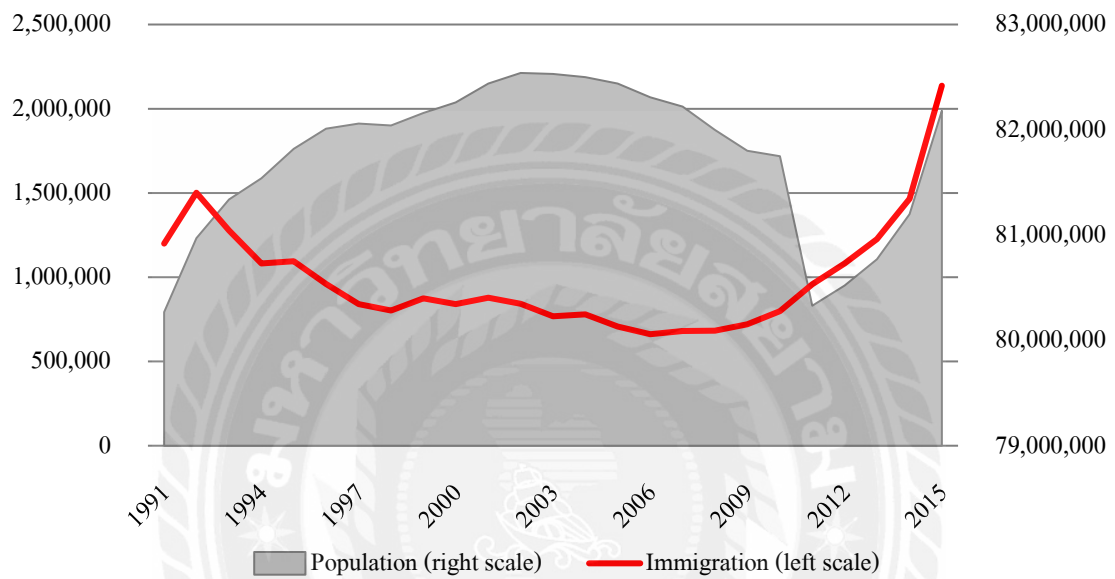


## Population Development

In the last few years, the initially decreasing German population, was absorbed by a large immigration wave, due to various international crises.

Figure 10:

Population and Immigration in Germany



Source: own research

data: Statista 2016b, Statista 2016c

As has been shown, this follows the market forces of supply and demand. The typical over-supplies of past bubbles are not to be observed.

## 5. Conclusion

In the context of this work it has been confirmed that the recognition of price bubbles is a complex process, since price bubbles are generally not only favored by one cause alone. Rather, the formation of a bubble is based on a combination of different variables. This thesis aimed to select and apply macroeconomic ratios that enable early detection of bubble formation on the real estate market. The price-to-rent ratio, the price-to-income ratio, and the debt ratio have proven to be reliable tools. On their own, they could only partially reflect the existence of a price bubble in the markets under investigation, but in combination they provided a satisfactory result. They were thus able to point out the existence of the price bubbles when examining the real estate markets of the USA and Spain.

On the other hand, the existence of a bubble on the German market for residential real estate could not be sufficiently confirmed. Rather, property prices follow the fundamentals, so that a future price correction does not appear necessary. Moreover, the decline in real house prices in the past may have led to a repercussion on market prices over the past years, thus contributing to a "normalization" of the previously undervalued market. This is the conclusion reached by the German Institute for Economic Research in its investigation of the German real estate market in 2014 (DIW 2014).

However, each bubble is characterized by its individual development history, which is why the reliability of the key figures used can only be confirmed to a limited extent for the prediction of future price bubbles. It is necessary, to expand the scope of the economic variables to include indicators, as well as behavioral patterns of the market participants, and to interpret them in a common context. Although they are not directly related to the price developments on the property market, indicators can contribute to the recognition of fundamental value changes due to their descriptive properties. It is equally important to be able to anticipate market participants' reactions to changes in the market in order to allow conclusions to be drawn on future trends.

The busted bubbles in the US and Spain have drawn attention to two phenomena which can be indicative of a bubble formation on the real estate market. Above all, a sudden expansion of the real estate lending volume as well as a rapid increase in construction activity can be observed in phases of exorbitant purchase price increases and could be interpreted as speculative investment motifs. Furthermore, the events of the past have shown that real estate market crises have always limited themselves to regional housing markets and have only expanded later at the national level.

Looking at the regional markets in Germany, extraordinary price developments are noticeable in the major German states. Especially metropolises such as Munich, Berlin, and Cologne, but also swarm cities like Regensburg, which have demonstrated enormous price growth potential in recent years, are the focus of attention. However, clear signs of a speculative price bubbles can only be seen if the real estate prices, but not the rents increase strongly.

The declining rental yields therefore made the boom in the real estate market more susceptible to a sudden end. But so far, there has been no trigger. This may have changed. In September 2016, the interest rates have slightly turned, they started a cautious climb. Whether this is really a sustainable interest rate turn has not yet been fixed. Nevertheless, the development of the property market and the sharp rise in prices in many cities are kinds of stress test. Now even industry representatives are worried. In the current spring report, the Central Real Estate Committee (ZIA 2017) points out that the development in some cities is no longer sustainable. Real estate investors apparently assumed that rental income could be boosted sharply. Otherwise, the purchase prices paid could no longer be explained.

However, rapid price cuts are unlikely to threaten even in cities with a strongly overheated property market. Demand is still very high in many places; The supply is scarce. According to a study by the German Institute of German Economy (IW), 385,000 apartments per year would have to be completed by 2020. In 2015, however, the number was only around 250,000 and 2016 in about 300,000 apartments. This figure covers large regional differences. Harald Simons, CEO of the market research company empirica, recently warned against the newspaper *WirtschaftsWoche*: “Berlin’s growth is not a natural law.” Immigration from other parts of the country is already decreasing. So far this has been covered by the inflow from South and South-Eastern Europe. If suddenly only 5,000 instead of 40,000 new inhabitants came to Berlin, the prices could break in. “Of course, the market is overheated, what else?” (Simons 2017).

Finally, neither the existence of a bubble in the German residential real estate market nor the negation of it can be proclaimed with full conviction. The market is overheated, especially in metropolises such as Munich and Berlin. Typical traits of purchase price exaggerations can be perceived while, unusual for a bubble situation, all market participants are fully aware of it. The current situation can be described as tipping point between further walking into a probable bubble with eyes wide open, and a slow correction into fundamentally justified purchase prices and rent rates.

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Year: Quarter	Price-Income-Ratio			Price-Rent-Ratio		
	data sets		constructed index 100=2011:3	data sets		constructed index 100=2011:3
	data set 2017 100=2010	data set 2015 100=2011:3		data set 2017 100=2010	data set 2015 100=2011:3	
1970:1	128.158		140.116	93.670		99.180
1970:2	126.528	101.890	138.334	92.001	74.982	97.413
1970:3	126.186	101.833	137.959	92.132	75.089	97.551
1970:4	127.491	102.944	139.386	92.094	75.057	97.511
1971:1	126.577	102.222	138.387	93.686	76.357	99.197
1971:2	127.156	102.656	139.021	96.286	78.475	101.949
1971:3	127.264	102.842	139.138	95.978	78.225	101.624
1971:4	129.095	104.432	141.140	97.591	79.539	103.331
1972:1	126.849	102.431	138.684	95.996	78.237	101.643
1972:2	128.779	104.064	140.794	97.899	79.788	103.658
1972:3	128.392	103.636	140.371	98.819	80.537	104.631
1972:4	126.082	101.760	137.846	100.799	82.152	106.729
1973:1	128.475	103.257	140.462	103.663	84.486	109.760
1973:2	128.300	102.915	140.271	105.136	85.687	111.320
1973:3	129.361	103.715	141.430	106.382	86.702	112.639
1973:4	128.989	103.288	141.024	105.800	86.228	112.023
1974:1	129.872	103.860	141.990	105.465	85.947	111.669
1974:2	130.001	103.871	142.131	105.246	85.768	111.436
1974:3	130.749	104.242	142.948	105.145	85.686	111.330
1974:4	129.241	103.385	141.299	102.829	83.799	108.878
1975:1	130.047	104.272	142.181	102.255	83.331	108.270
1975:2	124.404	99.522	136.011	101.703	82.727	107.685
1975:3	125.488	100.248	137.196	101.346	82.391	107.307
1975:4	125.236	99.832	136.920	101.523	82.561	107.494
1976:1	123.967	98.754	135.533	101.286	82.560	107.244
1976:2	126.173	99.955	137.946	103.573	84.212	109.666
1976:3	126.685	100.268	138.506	104.107	84.710	110.231
1976:4	126.321	99.878	138.107	104.876	85.355	111.045
1977:1	128.106	101.145	140.059	106.282	86.463	112.534
1977:2	129.220	102.038	141.276	107.818	87.637	114.160
1977:3	129.421	102.168	141.496	108.617	88.229	115.005
1977:4	130.792	103.118	142.996	111.050	90.172	117.582
1978:1	132.011	104.265	144.328	111.945	90.980	118.530
1978:2	132.437	104.430	144.794	112.472	91.400	119.087
1978:3	134.031	105.519	146.537	112.608	91.444	119.232
1978:4	134.994	106.241	147.589	112.785	91.549	119.419
1979:1	137.251	108.056	150.057	114.809	93.265	121.562
1979:2	138.491	108.916	151.412	113.578	92.308	120.259
1979:3	138.081	108.414	150.965	111.421	90.502	117.975
1979:4	138.062	108.106	150.944	109.027	88.642	115.440
1980:1	135.937	106.423	148.620	105.697	85.864	111.915
1980:2	136.340	106.731	149.061	101.793	82.737	107.780
1980:3	135.820	106.487	148.493	103.680	84.235	109.779
1980:4	131.598	103.038	143.877	100.914	81.949	106.850
1981:1	129.467	101.447	141.546	99.106	80.583	104.936
1981:2	129.710	101.525	141.813	98.209	79.792	103.986
1981:3	127.456	99.587	139.349	95.492	77.589	101.108
1981:4	126.305	98.670	138.089	94.591	76.848	100.155
1982:1	126.433	98.674	138.229	95.362	77.401	100.971
1982:2	125.459	98.102	137.165	93.609	76.215	99.115
1982:3	122.075	95.523	133.465	91.016	74.079	96.370
1982:4	122.747	96.133	134.200	93.691	76.236	99.202
1983:1	122.627	96.149	134.068	93.917	76.465	99.441
1983:2	121.849	95.499	133.218	93.701	76.274	99.213
1983:3	119.869	93.928	131.054	93.627	76.192	99.135
1983:4	118.094	92.637	129.113	93.533	76.131	99.035
1984:1	116.000	90.852	126.823	93.410	76.018	98.904
1984:2	114.441	89.584	125.119	93.204	75.849	98.686
1984:3	113.498	88.681	124.088	92.941	75.632	98.408
1984:4	113.556	88.621	124.151	92.966	75.651	98.434
1985:1	113.876	88.974	124.501	92.692	75.417	98.145

Year: Quarter	Price-Income-Ratio			Price-Rent-Ratio		
	data sets		constructed index 100=2011:3	data sets		constructed index 100=2011:3
	data set 2017 100=2010	data set 2015 100=2011:3		data set 2017 100=2010	data set 2015 100=2011:3	
1985:2	112.515	87.933	123.013	92.494	75.247	97.934
1985:3	114.178	89.648	124.832	92.620	75.369	98.069
1985:4	114.037	89.544	124.677	92.576	75.336	98.021
1986:1	113.932	89.498	124.563	92.919	75.607	98.384
1986:2	114.967	90.311	125.694	93.291	75.902	98.779
1986:3	115.604	90.783	126.391	93.876	76.380	99.398
1986:4	117.172	91.987	128.104	94.542	76.915	100.103
1987:1	117.286	92.042	128.230	95.137	77.409	100.733
1987:2	119.203	93.719	130.325	95.287	77.529	100.892
1987:3	117.505	92.308	128.468	95.340	77.557	100.948
1987:4	116.374	91.345	127.232	95.048	77.313	100.639
1988:1	115.695	90.913	126.490	95.096	77.342	100.689
1988:2	115.638	90.968	126.427	95.937	78.036	101.580
1988:3	114.431	90.199	125.108	95.703	77.852	101.332
1988:4	113.940	89.898	124.570	95.945	78.047	101.588
1989:1	112.712	88.940	123.228	95.933	78.041	101.576
1989:2	113.293	89.510	123.863	96.093	78.166	101.745
1989:3	114.336	90.392	125.004	96.670	78.640	102.356
1989:4	114.149	90.254	124.799	96.577	78.555	102.258
1990:1	112.467	88.937	122.960	95.935	78.041	101.578
1990:2	111.541	87.989	121.948	94.936	77.221	100.520
1990:3	110.893	87.423	121.240	93.375	75.948	98.867
1990:4	110.552	87.047	120.867	92.550	75.282	97.994
1991:1	111.079	87.253	121.443	92.152	74.955	97.573
1991:2	110.120	86.918	120.394	91.479	74.874	96.860
1991:3	109.551	86.345	119.773	90.828	74.185	96.171
1991:4	109.188	86.797	119.375	90.805	74.709	96.146
1992:1	107.894	85.837	117.961	90.994	74.580	96.347
1992:2	106.325	84.830	116.246	90.295	74.032	95.606
1992:3	106.454	84.949	116.387	90.398	74.198	95.716
1992:4	106.550	84.097	116.492	90.476	74.173	95.798
1993:1	105.724	85.295	115.588	89.778	73.637	95.059
1993:2	106.236	84.528	116.148	89.945	73.684	95.235
1993:3	106.832	84.888	116.799	90.082	73.747	95.380
1993:4	106.865	84.265	116.836	90.334	73.956	95.647
1994:1	107.057	85.112	117.046	90.298	73.757	95.610
1994:2	106.545	83.940	116.486	90.449	73.659	95.769
1994:3	106.151	83.143	116.056	90.341	73.322	95.655
1994:4	105.052	81.912	114.854	90.066	72.727	95.363
1995:1	104.544	81.504	114.298	90.043	72.524	95.339
1995:2	104.585	82.639	114.343	89.657	73.047	94.931
1995:3	104.494	83.101	114.243	89.744	73.497	95.023
1995:4	104.354	83.255	114.090	89.506	73.543	94.771
1996:1	104.016	83.077	113.721	89.589	73.790	94.859
1996:2	103.346	82.007	112.989	89.587	73.391	94.857
1996:3	103.069	81.403	112.685	89.426	72.975	94.686
1996:4	102.731	81.392	112.316	89.356	73.174	94.612
1997:1	102.213	81.119	111.750	89.232	73.172	94.481
1997:2	102.263	81.279	111.805	89.317	73.293	94.570
1997:3	101.852	81.430	111.355	89.286	73.687	94.538
1997:4	101.484	81.386	110.953	89.464	74.071	94.727
1998:1	100.891	80.907	110.305	89.849	74.530	95.134
1998:2	101.006	80.625	110.430	90.351	74.662	95.665
1998:3	101.294	80.786	110.745	90.797	75.012	96.137
1998:4	102.142	81.212	111.673	91.391	75.247	96.766
1999:1	102.766	81.387	112.355	92.374	75.637	97.807
1999:2	103.792	82.124	113.476	93.041	76.130	98.513
1999:3	104.461	82.401	114.207	93.881	76.572	99.403
1999:4	104.221	81.798	113.945	94.685	76.881	100.255
2000:1	103.421	81.074	113.070	95.442	77.548	101.056
2000:2	103.905	81.485	113.599	96.291	78.242	101.955



Year: Quarter	Price-Income-Ratio			Price-Rent-Ratio		
	data sets		constructed index 100=2011:3	data sets		constructed index 100=2011:3
	data set 2017 100=2010	data set 2015 100=2011:3		data set 2017 100=2010	data set 2015 100=2011:3	
2000:3	103.972	81.763	113.673	96.999	78.913	102.704
2000:4	105.123	82.742	114.931	97.845	79.514	103.600
2001:1	105.720	83.816	115.584	98.823	80.831	104.636
2001:2	107.259	85.334	117.267	99.340	81.381	105.183
2001:3	106.583	84.590	116.528	99.882	81.723	105.757
2001:4	109.783	86.884	120.026	100.430	81.988	106.337
2002:1	109.048	85.831	119.223	101.043	82.285	106.986
2002:2	109.905	86.343	120.160	102.076	83.008	108.080
2002:3	111.850	88.078	122.286	103.340	84.052	109.419
2002:4	113.266	88.898	123.834	104.684	84.668	110.842
2003:1	114.371	89.278	125.043	105.990	85.340	112.224
2003:2	114.715	89.171	125.418	107.298	86.082	113.610
2003:3	114.666	88.801	125.364	108.724	86.729	115.120
2003:4	116.595	90.451	127.473	110.432	88.445	116.928
2004:1	117.720	91.080	128.703	112.263	89.465	118.866
2004:2	118.934	91.921	130.031	113.974	90.766	120.678
2004:3	120.964	94.331	132.250	116.153	93.501	122.985
2004:4	121.744	94.369	133.103	118.425	94.914	125.391
2005:1	125.607	97.442	137.327	120.444	96.432	127.529
2005:2	127.345	99.484	139.226	122.917	98.973	130.147
2005:3	128.898	101.074	140.924	125.580	101.616	132.967
2005:4	129.891	101.965	142.011	127.348	102.978	134.839
2006:1	128.631	101.533	140.633	128.179	103.759	135.719
2006:2	128.689	101.319	140.696	127.598	103.757	135.103
2006:3	128.025	101.535	139.970	126.522	103.850	133.964
2006:4	127.575	101.205	139.478	125.980	103.582	133.390
2007:1	126.647	100.342	138.464	125.617	102.953	133.006
2007:2	125.420	99.752	137.122	124.305	102.277	131.617
2007:3	123.191	98.432	134.685	121.861	100.858	129.029
2007:4	120.086	96.555	131.290	119.076	99.661	126.081
2008:1	115.724	93.882	126.522	115.420	98.254	122.209
2008:2	109.344	89.406	119.547	111.756	95.863	118.330
2008:3	108.391	88.384	118.504	108.433	92.855	114.811
2008:4	106.291	88.906	116.209	104.985	91.585	111.161
2009:1	106.897	91.071	116.871	104.212	92.006	110.342
2009:2	104.371	89.007	114.109	102.422	89.988	108.446
2009:3	104.583	87.657	114.341	101.947	87.923	107.944
2009:4	104.203	86.485	113.925	102.173	87.225	108.183
2010:1	102.905	84.171	112.507	101.562	86.489	107.536
2010:2	101.220	82.989	110.664	101.137	86.406	107.086
2010:3	98.938	83.270	108.169	99.323	87.158	105.166
2010:4	96.936	81.831	105.981	97.977	85.810	103.740
2011:1	93.133	78.850	101.822	95.536	83.148	101.156
2011:2	91.828	77.617	100.396	94.556	81.907	100.118
2011:3	91.466	78.421	100.000	94.445	82.086	100.000
2011:4	91.426		99.957	94.082		99.616
2012:1	90.158		98.570	94.176		99.716
2012:2	90.971		99.459	95.383		100.993
2012:3	91.945		100.524	95.980		101.625
2012:4	90.760		99.228	96.939		102.641
2013:1	96.673		105.692	98.476		104.269
2013:2	98.218		107.382	100.093		105.980
2013:3	99.202		108.458	101.326		107.286
2013:4	99.943		109.268	101.844		107.835
2014:1	100.108		109.448	102.424		108.448
2014:2	100.128		109.471	102.747		108.791
2014:3	100.509		109.886	103.174		109.243
2014:4	101.143		110.580	103.941		110.055
2015:1	102.307		111.853	104.689		110.846
2015:2	102.878		112.477	105.164		111.350

Year: Quarter	Price-Income-Ratio			Price-Rent-Ratio		
	data sets		constructed index 100=2011:3	data sets		constructed index 100=2011:3
	data set 2017 100=2010	data set 2015 100=2011:3		data set 2017 100=2010	data set 2015 100=2011:3	
1970:1						
1970:2						
1970:3						
1970:4						
1971:1	50.418	52.448	55.479	22.635	21.590	25.097
1971:2	49.415	51.692	54.375	22.876	21.806	25.364
1971:3	48.046	50.524	52.869	22.974	21.902	25.473
1971:4	46.312	48.972	50.961	22.864	21.802	25.351
1972:1	45.855	47.708	50.457	22.854	21.790	25.340
1972:2	44.547	46.618	49.018	22.862	21.795	25.349
1972:3	43.739	46.025	48.129	23.031	21.960	25.537
1972:4	43.320	45.880	47.668	23.410	22.322	25.957
1973:1	44.132	45.850	48.562	23.860	22.746	26.455
1973:2	43.753	45.869	48.145	24.326	23.191	26.972
1973:3	44.721	47.195	49.210	25.656	24.460	28.446
1973:4	46.919	49.558	51.628	27.442	26.162	30.427
1974:1	48.914	51.623	53.824	29.220	27.860	32.399
1974:2	51.413	53.990	56.574	31.193	29.739	34.586
1974:3	51.707	54.162	56.897	31.661	30.186	35.106
1974:4	49.728	52.176	54.719	30.572	29.148	33.898
1975:1	48.779	50.818	53.675	29.632	28.251	32.855
1975:2	47.258	49.535	52.002	29.014	27.659	32.170
1975:3	46.167	48.652	50.801	28.683	27.343	31.803
1975:4	45.439	48.240	50.000	28.772	27.429	31.902
1976:1	46.216	47.988	50.855	29.160	27.802	32.332
1976:2	45.405	47.626	49.963	29.219	27.855	32.398
1976:3	45.727	48.354	50.317	30.320	28.905	33.618
1976:4	47.062	50.026	51.785	32.327	30.819	35.844
1977:1	49.026	51.442	53.947	34.193	32.602	37.913
1977:2	50.106	52.749	55.135	35.233	33.589	39.065
1977:3	51.651	54.520	56.835	37.290	35.551	41.346
1977:4	53.647	56.607	59.032	39.366	37.530	43.648
1978:1	55.311	58.510	60.862	41.418	39.492	45.924
1978:2	57.301	60.416	63.053	43.694	41.658	48.447
1978:3	57.290	60.271	63.040	44.417	42.348	49.249
1978:4	55.350	58.173	60.906	42.986	40.984	47.662
1979:1	53.635	56.498	59.018	41.721	39.782	46.259
1979:2	52.045	54.825	57.269	40.463	38.581	44.865
1979:3	50.803	53.526	55.902	39.340	37.510	43.619
1979:4	49.888	52.651	54.895	38.705	36.906	42.916
1980:1	49.442	52.394	54.404	38.284	36.506	42.448
1980:2	48.476	50.937	53.342	37.840	36.083	41.957
1980:3	47.385	49.906	52.141	37.319	35.586	41.379
1980:4	46.173	48.506	50.807	36.606	34.906	40.589
1981:1	45.538	47.631	50.109	35.746	34.087	39.635
1981:2	44.109	46.298	48.536	34.532	32.929	38.288
1981:3	42.577	44.808	46.851	33.645	32.084	37.305
1981:4	40.961	43.425	45.073	32.690	31.173	36.246
1982:1	39.289	41.458	43.233	31.641	30.171	35.083
1982:2	38.527	40.408	42.394	31.085	29.641	34.467
1982:3	38.596	40.543	42.470	31.145	29.697	34.533
1982:4	39.425	41.447	43.382	31.886	30.405	35.355
1983:1	40.648	43.375	44.728	33.432	31.882	37.069
1983:2	41.665	43.922	45.847	34.541	32.940	38.299
1983:3	42.163	44.244	46.395	35.093	33.466	38.911
1983:4	42.125	43.753	46.353	35.145	33.516	38.968
1984:1	41.679	43.640	45.862	34.974	33.354	38.778
1984:2	41.390	43.434	45.545	35.017	33.395	38.826
1984:3	41.326	43.691	45.474	35.247	33.615	39.081
1984:4	41.329	43.436	45.477	35.576	33.929	39.446
1985:1	42.353	43.842	46.604	35.987	34.326	39.902

Year: Quarter	Price-Income-Ratio			Price-Rent-Ratio		
	data sets		constructed index 100=2011:3	data sets		constructed index 100=2011:3
	data set 2017 100=2010	data set 2015 100=2011:3		data set 2017 100=2010	data set 2015 100=2011:3	
1985:2	41.975	44.082	46.188	36.246	34.573	40.189
1985:3	41.436	43.745	45.595	36.498	34.814	40.468
1985:4	40.657	43.112	44.737	36.569	34.882	40.547
1986:1	39.295	41.377	43.239	35.935	34.286	39.845
1986:2	40.093	42.202	44.117	36.959	35.263	40.980
1986:3	42.482	44.441	46.746	39.592	37.774	43.899
1986:4	46.023	48.387	50.643	43.226	41.241	47.928
1987:1	50.315	52.909	55.365	47.737	45.549	52.930
1987:2	52.294	54.858	57.543	50.314	47.999	55.787
1987:3	55.401	58.095	60.961	53.664	51.200	59.502
1987:4	57.878	60.845	63.687	56.689	54.076	62.856
1988:1	59.432	62.384	65.398	58.400	55.681	64.753
1988:2	61.787	64.719	67.988	61.452	58.605	68.136
1988:3	62.599	65.260	68.882	62.854	59.935	69.692
1988:4	64.330	68.220	70.787	65.053	62.039	72.129
1989:1	67.153	69.905	73.894	67.511	64.351	74.855
1989:2	68.629	71.981	75.518	69.516	66.264	77.079
1989:3	69.290	72.975	76.245	71.088	67.754	78.821
1989:4	69.788	73.757	76.793	72.576	69.183	80.472
1990:1	71.038	74.815	78.168	74.699	71.183	82.825
1990:2	70.409	73.923	77.476	74.835	71.292	82.975
1990:3	70.063	73.992	77.095	74.916	71.381	83.065
1990:4	69.759	72.908	76.761	74.903	71.360	83.051
1991:1	71.376	75.594	78.540	77.546	73.887	85.982
1991:2	71.688	75.494	78.883	77.862	74.186	86.332
1991:3	72.820	76.434	80.129	78.857	75.134	87.436
1991:4	73.093	76.356	80.430	78.753	75.021	87.320
1992:1	69.190	72.022	76.134	74.352	70.849	82.441
1992:2	68.106	71.334	74.942	72.879	69.431	80.807
1992:3	66.354	69.970	73.014	70.606	67.272	78.287
1992:4	65.596	69.300	72.180	69.289	66.013	76.827
1993:1	62.899	66.461	69.212	66.786	63.645	74.051
1993:2	63.201	66.335	69.545	65.349	62.278	72.458
1993:3	63.897	66.376	70.310	65.264	62.198	72.364
1993:4	63.983	66.935	70.405	64.790	61.736	71.838
1994:1	65.387	67.930	71.950	64.118	61.131	71.093
1994:2	63.133	66.541	69.469	62.586	59.666	69.394
1994:3	62.140	65.567	68.378	62.632	59.705	69.445
1994:4	61.176	63.444	67.316	62.648	59.724	69.463
1995:1	59.418	61.898	65.382	62.516	59.615	69.316
1995:2	59.220	60.472	65.164	62.396	59.496	69.183
1995:3	58.347	59.324	64.204	61.186	58.347	67.843
1995:4	58.525	59.245	64.399	61.092	58.254	67.738
1996:1	57.951	59.329	63.767	60.077	57.313	66.612
1996:2	58.172	59.635	64.011	59.708	56.949	66.203
1996:3	56.574	57.650	62.253	57.757	55.100	64.040
1996:4	57.477	58.577	63.246	58.327	55.642	64.672
1997:1	57.531	58.693	63.305	57.903	55.213	64.202
1997:2	58.765	59.917	64.664	58.945	56.212	65.357
1997:3	58.493	59.786	64.365	58.493	55.785	64.856
1997:4	56.478	57.707	62.147	56.319	53.716	62.445
1998:1	56.600	57.851	62.281	56.346	53.751	62.475
1998:2	58.269	59.455	64.118	58.046	55.370	64.361
1998:3	59.114	60.356	65.047	58.926	56.203	65.336
1998:4	58.245	59.527	64.091	58.235	55.545	64.570
1999:1	59.769	60.197	65.768	58.882	56.179	65.287
1999:2	58.475	59.689	64.344	58.689	55.993	65.073
1999:3	59.248	61.136	65.195	60.278	57.516	66.835
1999:4	59.616	61.738	65.600	61.415	58.600	68.096
2000:1	59.000	61.847	64.922	61.865	59.012	68.595
2000:2	58.021	61.123	63.844	61.433	58.598	68.116

Year: Quarter	Price-Income-Ratio			Price-Rent-Ratio		
	data sets		constructed index 100=2011:3	data sets		constructed index 100=2011:3
	data set 2017 100=2010	data set 2015 100=2011:3		data set 2017 100=2010	data set 2015 100=2011:3	
2000:3	57.937	61.103	63.753	61.763	58.911	68.482
2000:4	58.648	62.018	64.534	62.858	59.956	69.696
2001:1	58.995	62.812	64.916	63.950	60.991	70.907
2001:2	59.298	63.228	65.250	64.234	61.267	71.222
2001:3	60.156	63.782	66.194	65.174	62.159	72.264
2001:4	61.878	65.632	68.089	67.023	63.926	74.314
2002:1	64.386	68.234	70.849	69.390	66.154	76.939
2002:2	67.180	71.161	73.923	72.579	69.200	80.475
2002:3	68.113	72.296	74.949	73.781	70.374	81.808
2002:4	69.992	74.308	77.017	76.009	72.480	84.277
2003:1	72.388	76.762	79.654	78.849	75.140	87.426
2003:2	76.158	80.841	83.802	83.142	79.250	92.186
2003:3	78.157	82.939	86.001	85.445	81.517	94.740
2003:4	80.847	85.660	88.962	88.253	84.160	97.854
2004:1	83.572	88.448	91.961	91.451	87.060	101.399
2004:2	86.214	91.357	94.868	94.339	89.891	104.602
2004:3	88.501	93.440	97.384	96.772	92.378	107.299
2004:4	90.719	95.600	99.825	99.081	94.470	109.859
2005:1	93.576	97.777	102.968	101.844	96.847	112.923
2005:2	95.395	98.889	104.970	103.789	98.879	115.079
2005:3	96.965	100.506	106.698	105.571	100.892	117.056
2005:4	99.475	102.628	109.460	108.264	103.195	120.041
2006:1	100.731	103.304	110.842	110.128	103.953	122.108
2006:2	103.561	104.268	113.956	112.451	104.906	124.684
2006:3	107.171	104.921	117.929	115.586	105.701	128.160
2006:4	110.473	106.107	121.562	118.434	107.002	131.317
2007:1	112.972	105.497	124.311	119.480	106.593	132.477
2007:2	114.190	105.642	125.651	120.465	106.452	133.570
2007:3	114.717	105.484	126.231	120.913	106.443	134.066
2007:4	113.462	105.500	124.851	119.669	106.554	132.688
2008:1	111.713	102.743	122.926	118.199	105.760	131.057
2008:2	109.443	102.082	120.428	115.288	104.097	127.830
2008:3	107.404	100.267	118.184	112.564	101.748	124.809
2008:4	104.364	97.956	114.839	108.506	98.145	120.310
2009:1	100.580	94.680	110.675	105.301	94.636	116.756
2009:2	99.422	92.733	109.402	103.031	92.114	114.239
2009:3	99.306	91.875	109.274	101.870	90.690	112.952
2009:4	99.789	91.853	109.805	101.524	89.926	112.568
2010:1	100.816	92.856	110.935	100.945	88.968	111.926
2010:2	101.073	92.565	111.218	101.055	88.294	112.048
2010:3	99.133	91.848	109.084	99.087	86.751	109.866
2010:4	98.978	91.640	108.913	98.913	86.108	109.674
2011:1	95.239	87.917	104.799	96.259	83.289	106.730
2011:2	93.411	85.315	102.787	93.715	81.902	103.909
2011:3	90.878	84.569	100.000	90.189	80.774	100.000
2011:4	87.118		95.862	85.489		94.789
2012:1	85.036		93.571	82.037		90.961
2012:2	81.568		89.756	78.293		86.810
2012:3	78.531		86.413	75.283		83.472
2012:4	77.484		85.261	74.289		82.371
2013:1	74.853		82.366	71.479		79.254
2013:2	73.091		80.428	70.067		77.689
2013:3	73.329		80.689	70.607		78.288
2013:4	72.330		79.590	69.965		77.576
2014:1	72.801		80.109	70.783		78.483
2014:2	72.836		80.146	71.169		78.911
2014:3	72.636		79.927	71.311		79.068
2014:4	72.735		80.035	71.706		79.506
2015:1	72.691		79.987	72.313		80.179
2015:2	74.252		81.705	74.427		82.523

Year: Quarter	Price-Income-Ratio			Price-Rent-Ratio		
	data sets		constructed index 100=2011:3	data sets		constructed index 100=2011:3
	data set 2017 100=2010	data set 2015 100=2011:3		data set 2017 100=2010	data set 2015 100=2011:3	
1970:1				145.699		138.335
1970:2		198.766	209.785	147.815	141.918	140.344
1970:3		199.244	210.290	149.724	143.660	142.157
1970:4		200.250	211.352	151.460	145.087	143.806
1971:1		201.609	212.786	153.065	146.964	145.329
1971:2		202.177	213.386	153.848	147.674	146.073
1971:3		201.149	212.301	154.584	148.299	146.772
1971:4		198.491	209.496	154.285	147.880	146.488
1972:1		195.209	206.031	154.507	148.313	146.698
1972:2		192.734	203.420	154.812	148.561	146.988
1972:3		191.343	201.951	154.806	148.510	146.982
1972:4		190.867	201.449	154.856	148.488	147.030
1973:1		190.907	201.491	155.138	148.893	147.298
1973:2		190.724	201.298	155.764	149.453	147.891
1973:3		190.803	201.382	156.808	150.437	148.883
1973:4		191.278	201.883	158.164	151.698	150.171
1974:1		191.477	202.093	159.073	152.657	151.033
1974:2		191.024	201.614	160.701	154.181	152.579
1974:3		188.500	198.951	160.609	154.086	152.492
1974:4		183.762	193.950	159.396	152.909	151.340
1975:1		178.603	188.504	156.979	150.633	149.046
1975:2		174.936	184.635	153.539	147.354	145.779
1975:3		172.192	181.738	152.059	145.971	144.374
1975:4		170.286	179.727	151.091	144.818	143.455
1976:1		169.305	178.691	150.142	143.978	142.554
1976:2		167.907	177.216	148.816	142.735	141.295
1976:3		167.050	176.311	149.020	142.925	141.489
1976:4		166.893	176.146	149.883	143.736	142.308
1977:1		166.518	175.750	150.871	144.658	143.246
1977:2		166.172	175.385	152.006	145.689	144.324
1977:3		166.199	175.414	153.165	146.792	145.424
1977:4		166.621	175.859	154.427	148.045	146.622
1978:1		167.099	176.363	155.968	149.540	148.085
1978:2		167.122	176.387	157.610	151.108	149.644
1978:3		167.310	176.586	159.635	153.090	151.567
1978:4		167.666	176.961	162.528	155.720	154.314
1979:1		167.534	176.822	165.024	158.171	156.684
1979:2		167.633	176.927	167.464	160.553	159.000
1979:3		167.739	177.038	168.608	161.677	160.087
1979:4		167.739	177.038	169.120	162.143	160.573
1980:1	178.995	165.668	173.238	169.874	162.825	161.289
1980:2	179.299	167.826	173.532	170.654	163.518	162.029
1980:3	179.609	169.487	173.832	172.035	164.908	163.340
1980:4	180.331	170.291	174.530	174.108	166.866	165.309
1981:1	180.560	169.805	174.751	175.902	168.744	167.012
1981:2	181.582	170.130	175.741	176.855	169.574	167.917
1981:3	181.038	169.673	175.215	176.327	169.145	167.415
1981:4	179.259	168.083	173.492	174.082	166.886	165.284
1982:1	178.059	167.028	172.331	172.131	164.915	163.432
1982:2	176.958	165.866	171.265	170.150	162.914	161.551
1982:3	175.999	164.831	170.338	167.889	160.862	159.404
1982:4	175.456	164.170	169.812	166.083	159.057	157.690
1983:1	174.949	163.651	169.321	163.693	156.692	155.420
1983:2	173.605	162.698	168.021	161.957	155.153	153.772
1983:3	171.227	160.587	165.718	159.990	153.308	151.904
1983:4	167.925	157.313	162.523	157.661	150.987	149.692
1984:1	163.976	153.723	158.701	155.032	148.585	147.197
1984:2	160.721	150.575	155.551	152.600	146.179	144.888
1984:3	157.929	148.012	152.849	150.479	144.211	142.874
1984:4	155.856	146.150	150.843	148.312	142.163	140.817
1985:1	154.199	144.683	149.239	146.858	140.801	139.436

Year: Quarter	Price-Income-Ratio			Price-Rent-Ratio		
	data sets		constructed index 100=2011:3	data sets		constructed index 100=2011:3
	data set 2017 100=2010	data set 2015 100=2011:3		data set 2017 100=2010	data set 2015 100=2011:3	
1985:2	152.540	143.170	147.633	145.606	139.634	138.247
1985:3	151.116	141.838	146.255	144.736	138.908	137.421
1985:4	150.234	140.702	145.401	144.470	138.484	137.168
1986:1	149.216	139.540	144.416	144.306	138.157	137.013
1986:2	147.982	138.480	143.222	143.890	137.773	136.618
1986:3	146.373	137.189	141.665	142.961	136.923	135.735
1986:4	144.458	135.586	139.811	141.979	136.025	134.804
1987:1	142.718	134.044	138.127	140.860	134.997	133.741
1987:2	140.948	132.215	136.414	139.648	133.887	132.590
1987:3	139.903	131.012	135.403	139.368	133.521	132.324
1987:4	139.300	130.315	134.819	139.611	133.729	132.555
1988:1	138.532	129.576	134.076	139.685	133.765	132.625
1988:2	137.606	128.793	133.179	139.542	133.598	132.490
1988:3	136.579	128.026	132.186	139.105	133.227	132.074
1988:4	135.517	127.270	131.157	138.582	132.853	131.578
1989:1	134.662	126.463	130.330	138.622	132.828	131.616
1989:2	133.587	125.449	129.290	138.215	132.552	131.230
1989:3	133.818	125.316	129.513	139.432	133.575	132.386
1989:4	134.895	126.176	130.556	141.730	135.784	134.567
1990:1	135.857	126.814	131.487	143.972	137.739	136.696
1990:2	136.480	127.449	132.090	145.593	139.258	138.235
1990:3	136.176	127.759	131.795	146.274	140.160	138.881
1990:4	135.136	127.586	130.789	146.505	140.850	139.100
1991:1	135.495	128.466	131.136	146.690	141.647	139.277
1991:2	131.816	125.346	127.575	145.602	141.186	138.243
1991:3	135.939	128.465	131.566	145.459	141.392	138.107
1991:4	132.882	125.799	128.608	136.953	133.530	130.031
1992:1	132.132	125.744	127.882	137.769	134.759	130.806
1992:2	133.191	128.038	128.907	137.273	134.793	130.335
1992:3	133.791	129.144	129.487	137.051	134.807	130.124
1992:4	131.656	126.121	127.421	136.531	134.397	129.630
1993:1	134.771	130.159	130.436	130.618	128.709	124.016
1993:2	134.095	129.745	129.781	130.331	128.503	123.744
1993:3	135.131	129.747	130.784	130.183	128.473	123.604
1993:4	134.365	130.032	130.043	130.259	128.710	123.675
1994:1	134.921	130.156	130.580	129.559	128.218	123.012
1994:2	137.343	133.065	132.925	129.282	128.081	122.748
1994:3	136.341	132.872	131.955	128.780	127.667	122.272
1994:4	135.681	130.223	131.316	128.045	126.827	121.574
1995:1	136.160	131.342	131.780	127.717	126.184	121.263
1995:2	134.725	130.145	130.391	126.817	125.128	120.408
1995:3	134.557	129.877	130.228	124.876	123.305	118.565
1995:4	133.929	129.444	129.621	123.083	121.604	116.863
1996:1	131.984	127.647	127.739	122.058	120.710	115.889
1996:2	131.363	127.237	127.137	120.596	119.447	114.501
1996:3	130.291	125.830	126.100	119.461	118.187	113.423
1996:4	130.150	125.428	125.963	117.983	116.822	112.021
1997:1	129.026	124.818	124.876	116.563	115.524	110.672
1997:2	126.895	122.811	122.813	115.397	114.363	109.565
1997:3	126.534	122.266	122.463	114.489	113.418	108.703
1997:4	125.237	120.657	121.209	113.777	112.812	108.026
1998:1	124.974	120.550	120.954	113.291	112.315	107.565
1998:2	124.787	120.413	120.773	112.716	111.679	107.019
1998:3	123.711	119.132	119.732	112.340	111.321	106.662
1998:4	122.403	117.948	118.465	112.206	111.241	106.535
1999:1	121.992	118.081	118.068	112.175	111.126	106.506
1999:2	121.853	118.088	117.933	111.785	110.881	106.136
1999:3	121.256	117.464	117.355	111.561	110.694	105.923
1999:4	119.569	115.033	115.723	111.370	110.459	105.742
2000:1	119.802	115.888	115.948	111.287	110.306	105.663
2000:2	119.958	115.884	116.099	111.042	110.084	105.430

Year: Quarter	Price-Income-Ratio			Price-Rent-Ratio		
	data sets		constructed index 100=2011:3	data sets		constructed index 100=2011:3
	data set 2017 100=2010	data set 2015 100=2011:3		data set 2017 100=2010	data set 2015 100=2011:3	
2000:3	120.228	115.734	116.361	111.002	109.922	105.392
2000:4	120.116	115.709	116.252	110.513	109.622	104.927
2001:1	115.505	112.416	111.789	110.230	109.384	104.659
2001:2	114.995	111.825	111.296	109.980	109.160	104.422
2001:3	114.715	111.822	111.025	109.406	108.645	103.877
2001:4	114.285	111.615	110.609	108.961	108.172	103.454
2002:1	115.023	111.475	111.323	108.296	107.469	102.823
2002:2	114.689	110.976	111.000	107.873	107.021	102.421
2002:3	113.250	109.792	109.607	107.229	106.453	101.810
2002:4	111.903	108.384	108.303	106.460	105.772	101.079
2003:1	110.373	106.780	106.823	105.851	105.110	100.501
2003:2	109.774	106.686	106.242	105.083	104.409	99.772
2003:3	108.938	106.320	105.433	104.467	103.842	99.187
2003:4	108.758	105.323	105.260	104.044	103.313	98.786
2004:1	107.146	104.121	103.699	103.547	102.734	98.314
2004:2	106.521	103.612	103.094	102.870	102.137	97.671
2004:3	106.045	102.857	102.634	102.264	101.563	97.095
2004:4	104.527	101.457	101.164	101.811	101.090	96.666
2005:1	105.077	101.812	101.697	101.280	100.642	96.161
2005:2	103.388	99.882	100.062	100.826	100.127	95.730
2005:3	102.652	99.126	99.349	100.476	99.755	95.398
2005:4	101.702	99.221	98.431	100.184	99.481	95.121
2006:1	101.782	98.527	98.508	99.904	99.201	94.855
2006:2	101.313	97.746	98.054	99.728	98.958	94.688
2006:3	101.284	97.880	98.025	99.597	98.824	94.564
2006:4	99.806	97.035	96.595	99.629	98.734	94.594
2007:1	100.801	98.229	97.559	99.706	99.004	94.667
2007:2	100.789	97.828	97.546	99.760	98.983	94.718
2007:3	100.414	97.276	97.184	99.498	98.656	94.469
2007:4	98.900	96.012	95.719	99.117	98.163	94.108
2008:1	98.631	95.420	95.458	98.570	97.469	93.589
2008:2	97.536	95.442	94.398	99.234	98.736	94.218
2008:3	97.775	95.575	94.630	99.158	98.867	94.147
2008:4	99.773	94.408	96.564	98.584	96.551	93.601
2009:1	98.387	95.295	95.222	97.367	95.990	92.446
2009:2	98.956	96.730	95.773	98.247	98.016	93.281
2009:3	100.959	96.128	97.711	99.015	97.118	94.010
2009:4	100.858	96.719	97.613	99.169	97.890	94.157
2010:1	99.656	95.749	96.450	98.660	97.763	93.674
2010:2	100.055	96.070	96.837	99.868	98.598	94.821
2010:3	100.319	95.509	97.092	100.507	98.775	95.427
2010:4	99.970	94.531	96.754	100.964	98.474	95.862
2011:1	101.427	93.964	98.165	102.536	98.339	97.354
2011:2	101.605	93.291	98.336	103.253	97.635	98.034
2011:3	103.324	94.747	100.000	105.323	99.159	100.000
2011:4	104.658		101.291	106.886	99.348	101.484
2012:1	105.139		101.757	108.754	99.723	103.258
2012:2	107.150		103.704	109.482	100.485	103.949
2012:3	107.782		104.315	109.898	103.134	104.344
2012:4	108.268		104.785	110.718	103.424	105.122
2013:1	110.708		107.147	113.200	104.777	107.479
2013:2	111.382		107.799	114.245	104.561	108.471
2013:3	112.183		108.574	115.952	105.810	110.092
2013:4	113.748		110.089	116.711	106.224	110.812
2014:1	114.890		111.194	117.978	107.553	112.015
2014:2	115.394		111.682	118.519	108.438	112.529
2014:3	115.925		112.196	119.711	108.861	113.661
2014:4	115.590		111.872	120.299	109.525	114.219
2015:1	116.056		112.323	120.796		114.691

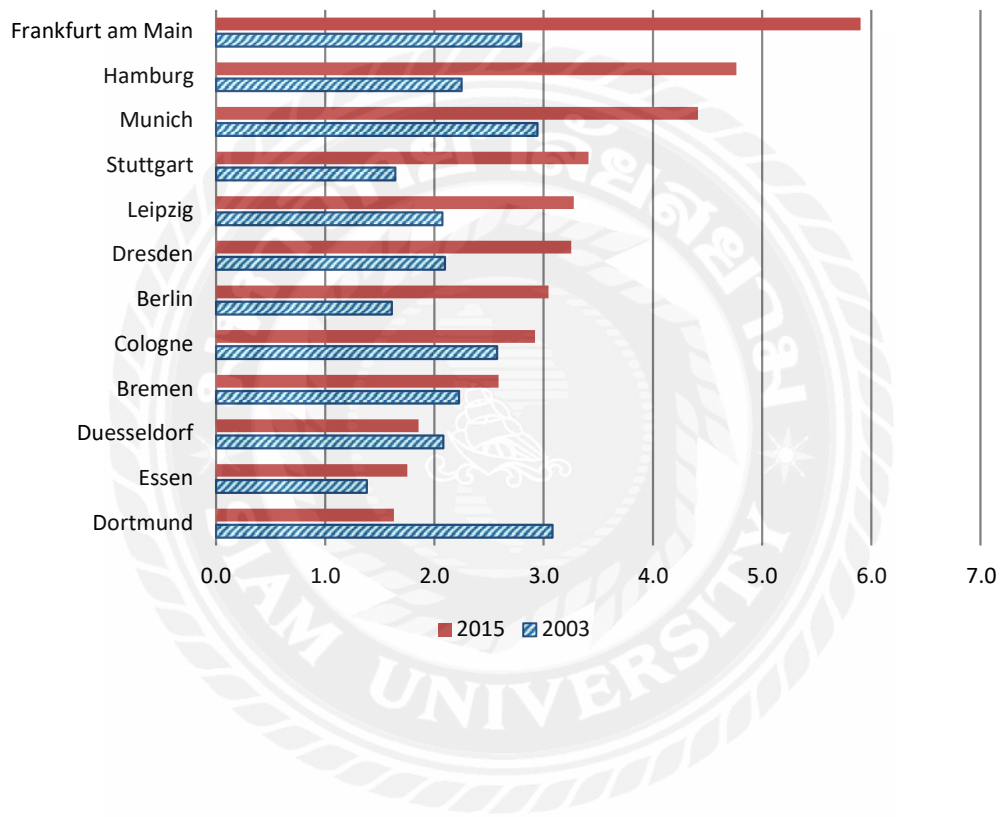
Appendix IV: Domestic credit to private sector (% of GDP)

Year	USA		Spain		Germany	
	year value	Change y/y	year value	Change y/y	year value	Change y/y
1960	70.87 %		31.45 %			
1961	75.08 %	5.93 %	32.62 %	3.74 %		
1962	75.55 %	0.63 %	35.65 %	9.28 %		
1963	80.29 %	6.28 %	36.77 %	3.15 %		
1964	83.14 %	3.55 %	39.49 %	7.40 %		
1965	86.14 %	3.60 %	42.96 %	8.77 %		
1966	83.51 %	-3.05 %	43.22 %	0.61 %		
1967	87.02 %	4.21 %	44.85 %	3.78 %		
1968	87.85 %	0.96 %	48.43 %	7.98 %		
1969	86.76 %	-1.24 %	52.00 %	7.37 %		
1970	87.47 %	0.81 %	53.33 %	2.56 %	59.60 %	
1971	90.89 %	3.91 %	56.82 %	6.53 %	61.35 %	2.95 %
1972	95.54 %	5.12 %	68.77 %	21.04 %	65.28 %	6.40 %
1973	94.63 %	-0.96 %	71.85 %	4.47 %	65.51 %	0.34 %
1974	92.07 %	-2.70 %	74.80 %	4.11 %	64.64 %	-1.32 %
1975	90.26 %	-1.97 %	78.00 %	4.28 %	64.87 %	0.35 %
1976	89.68 %	-0.64 %	80.28 %	2.92 %	65.52 %	1.01 %
1977	90.00 %	0.35 %	77.32 %	-3.69 %	67.24 %	2.63 %
1978	91.44 %	1.60 %	72.35 %	-6.42 %	69.59 %	3.49 %
1979	92.78 %	1.46 %	71.65 %	-0.97 %	71.92 %	3.36 %
1980	94.18 %	1.52 %	72.90 %	1.75 %	73.85 %	2.68 %
1981	89.13 %	-5.37 %	76.22 %	4.55 %	75.77 %	2.60 %
1982	92.58 %	3.87 %	78.72 %	3.28 %	76.68 %	1.19 %
1983	96.00 %	3.70 %	73.84 %	-6.20 %	78.49 %	2.36 %
1984	96.72 %	0.75 %	67.61 %	-8.44 %	79.48 %	1.27 %
1985	103.50 %	7.01 %	65.50 %	-3.11 %	81.01 %	1.92 %
1986	109.91 %	6.19 %	64.25 %	-1.91 %	79.91 %	-1.36 %
1987	112.27 %	2.15 %	67.28 %	4.72 %	80.25 %	0.43 %
1988	113.34 %	0.95 %	73.70 %	9.54 %	79.55 %	-0.88 %
1989	117.21 %	3.41 %	77.43 %	5.06 %	79.52 %	-0.04 %
1990	114.48 %	-2.33 %	76.46 %	-1.25 %	85.78 %	7.87 %
1991	118.87 %	3.84 %	77.94 %	1.93 %	87.37 %	1.86 %
1992	117.90 %	-0.82 %	76.22 %	-2.21 %	88.64 %	1.45 %
1993	120.64 %	2.32 %	74.46 %	-2.31 %	93.76 %	5.78 %
1994	119.83 %	-0.67 %	71.06 %	-4.57 %	96.41 %	2.83 %
1995	129.76 %	8.28 %	70.37 %	-0.96 %	97.76 %	1.40 %
1996	137.21 %	5.74 %	71.07 %	0.99 %	103.52 %	5.89 %
1997	146.05 %	6.45 %	76.12 %	7.11 %	107.55 %	3.89 %
1998	157.35 %	7.73 %	82.92 %	8.93 %	113.29 %	5.34 %
1999	171.09 %	8.73 %	89.03 %	7.37 %	112.66 %	-0.55 %
2000	162.09 %	-5.26 %	89.03 %	0.00 %	112.66 %	0.00 %
2001	170.21 %	5.01 %	95.13 %	6.86 %	112.04 %	-0.55 %
2002	161.69 %	-5.01 %	99.35 %	4.44 %	110.87 %	-1.05 %
2003	176.56 %	9.20 %	106.44 %	7.13 %	109.52 %	-1.22 %
2004	183.94 %	4.18 %	115.75 %	8.74 %	106.06 %	-3.16 %
2005	187.85 %	2.13 %	135.51 %	17.08 %	104.87 %	-1.12 %
2006	197.71 %	5.25 %	156.11 %	15.20 %	101.72 %	-3.01 %
2007	206.30 %	4.35 %	167.13 %	7.06 %	96.60 %	-5.04 %
2008	188.02 %	-8.86 %	170.17 %	1.82 %	96.43 %	-0.18 %
2009	192.13 %	2.19 %	172.41 %	1.32 %	98.19 %	1.82 %
2010	187.35 %	-2.49 %	170.73 %	-0.98 %	87.95 %	-10.42 %
2011	177.87 %	-5.06 %	166.76 %	-2.33 %	84.60 %	-3.82 %
2012	178.49 %	0.35 %	156.39 %	-6.22 %	83.41 %	-1.40 %
2013	192.21 %	7.69 %	144.97 %	-7.31 %	81.67 %	-2.10 %
2014	194.12 %	1.00 %	129.49 %	-10.68 %	79.41 %	-2.76 %
2015	188.83 %	-2.72 %	118.86 %		77.95 %	-1.84 %



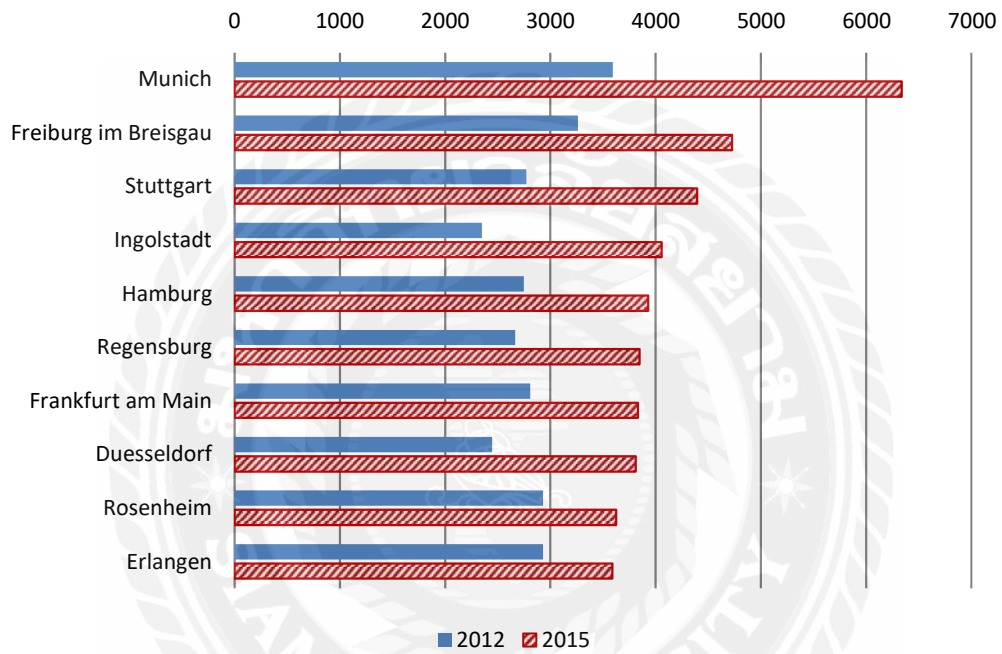
**Appendix V: Completion of residential units, per 1000 residents**

Town	Germany	
	2003	2015
Dortmund	3.08	1.63
Essen	1.38	1.75
Duesseldorf	2.08	1.86
Bremen	2.22	2.59
Cologne	2.57	2.92
Berlin	1.61	3.05
Dresden	2.09	3.25
Leipzig	2.07	3.28
Stuttgart	1.64	3.41
Munich	2.94	4.41
Hamburg	2.25	4.77
Frankfurt am Main	2.79	5.90



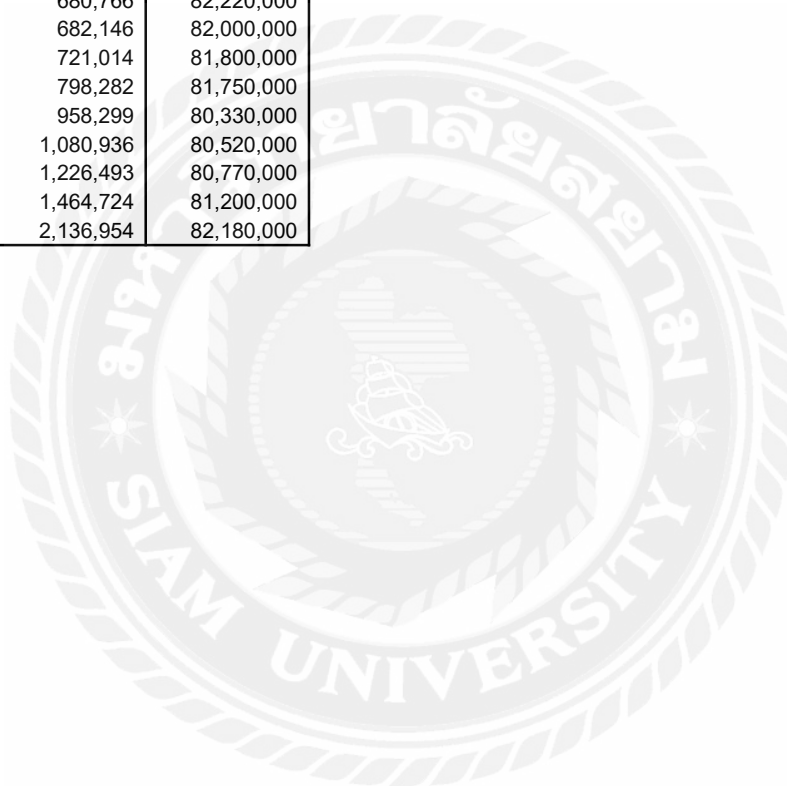
**Appendix VI: Cities with the highest price per square meter for condominiums compared for the years 2012 and 2015, in Euro**

Town	Germany	
	2012	2015
<b>Munich</b>	3595.00	6338.00
<b>Freiburg im Breisgau</b>	3265.00	4726.00
<b>Stuttgart</b>	2773.00	4394.00
<b>Ingolstadt</b>	2351.00	4057.00
<b>Hamburg</b>	2751.00	3929.00
<b>Regensburg</b>	2667.00	3849.00
<b>Frankfurt am Main</b>	2811.00	3833.00
<b>Duesseldorf</b>	2447.00	3810.00
<b>Rosenheim</b>	2933.00	3624.00
<b>Erlangen</b>	2933.00	3590.00



**Appendix VII: Immigration and Population in Germany**

<b>Year</b>	<b>Immigration</b>	<b>Population</b>
<b>1991</b>	1,198,978	80,270,000
<b>1992</b>	1,502,198	80,970,000
<b>1993</b>	1,277,408	81,340,000
<b>1994</b>	1,082,553	81,540,000
<b>1995</b>	1,096,048	81,820,000
<b>1996</b>	959,691	82,010,000
<b>1997</b>	840,633	82,060,000
<b>1998</b>	802,456	82,040,000
<b>1999</b>	874,023	82,160,000
<b>2000</b>	841,158	82,260,000
<b>2001</b>	879,217	82,440,000
<b>2002</b>	842,543	82,540,000
<b>2003</b>	768,975	82,530,000
<b>2004</b>	780,175	82,500,000
<b>2005</b>	707,352	82,440,000
<b>2006</b>	661,855	82,310,000
<b>2007</b>	680,766	82,220,000
<b>2008</b>	682,146	82,000,000
<b>2009</b>	721,014	81,800,000
<b>2010</b>	798,282	81,750,000
<b>2011</b>	958,299	80,330,000
<b>2012</b>	1,080,936	80,520,000
<b>2013</b>	1,226,493	80,770,000
<b>2014</b>	1,464,724	81,200,000
<b>2015</b>	2,136,954	82,180,000



**Appendix VIII: Change in Household size**

Household size	2000	2005	2010	2014	2000 to 2014	2014		
	in 1,000's				in %	share of households	People in households in 1,000's	Share of people in %
<b>1 Person</b>	13,750	14,695	16,195	16,412	16.22	40.80	16,412	20.30
<b>2 people</b>	12,720	13,266	13,793	13,837	8.07	34.40	27,674	34.20
<b>3 people</b>	5,598	5,477	5,089	4,968	-12.68	12.40	14,905	18.40
<b>4 people</b>	4,391	4,213	3,846	3,672	-19.58	9.10	14,689	18.20
<b>5 people or more</b>	1,665	1,527	1,378	1,333	-24.91	3.30	7,121	8.80
<b>Total</b>	38,124	39,178	40,301	40,223	5.22	100.00	80,802	100.00

