The effect of foreign real estate investments on Berlin's house prices

Masterthesis Real Estate Studies

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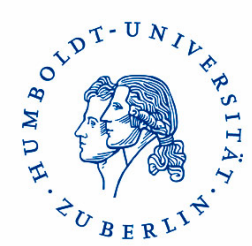
Faculty of Spatial Sciences



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Management Summary

Foreign capital inflows in German real estate markets increased over the last years impressively due to enhanced consumer confidence, increasing levels of transparency and low interest rates (Bundesbank, 2014). At the same time the property prices were overvalued (Bundesbank, 2013) and according to Ross (2014) international investors created this overvaluation of house prices. Several studies have shown that increasing capital inflows, including foreign real estate investments, have gone with rising house prices (Gholipour, 2013), or at least that house price appreciations are stimulated by increased amounts of foreign investments (Cordero & Paus, 2008; Mihaljek, 2005; Ben-Yehoshua, 2008), backing up this report of Ross (2014).

The objective of this research is to give insight in the effect of foreign real estate investments on Berlin's house prices. To achieve this objective the following central question is formulated: *"To which extent do foreign real estate investments influence house prices in Berlin's real estate market?"*

The challenge throughout this research was the limited availability of data. The dependent variable, a residential house price index (RPI), is composed of seven indicators according to the 'Bulwiengesa Property Market Index'. Data on the independent variable, foreign real estate investments (FREI[1]), is compiled from 2007 till 2013 over a cross-section of Germany's seven largest cities in terms of their functionality, real size and influence on international, national and local levels. Therefore, a time series cross-section (TSCS) dataset with gross domestic product, long-term interest rates, rents, construction costs, population and domestic real estate investments (DREI) as control variables, is put together based on prior literature. Subsequently an OLS regression with fixed effects and first differences is estimated on this TSCS dataset. To filter out the effect for Berlin a dummy variable is entered. The peculiarity of the time series, which includes the financial and Eurozone crisis and the start of recovery, and the short time span are limitations throughout this research.

The regression results show that FREI is a determinant for house price developments, although its effect on house price developments is relative small. A one per cent change in FREI, ceteris paribus, will result in a 0,051 per cent change in RPI, which gives answer to the central question. Also, DREI fluctuations have the same positive effect on house prices, but with a smaller impact i.e. 0,017 per cent change in RPI. These results underpin Gholipour's (2013) findings and support Barras' (1994) model of credit expansion leading to increasing house prices in the short run. Looking further into Barras' (1994) model and into Brixiova's (2010) findings for Estonia, they find that increased capital inflows result in a building boom in the long run. Taking the research restrictions in consideration, regressionmodels 6 and 7 find that increasing amounts of FREI lead to an increase in building activity, supporting Barras (1994) and Brixiova et al. (2010). Building activity is measured through the indicators planning permissions and completions.

Knowing the effects of FREI fluctuations to house prices and building activity indicators policymakers can decide to attract, restrict or avert FREI into their markets and in this case into Berlin's real estate market.

[1] FREI is a price index with 2007 as index year, according to RPI.

Preface

This thesis has been written for the completion of my Master degree Real Estate Studies at the University of Groningen. This Master is of added value to my previous education Real Estate Management at the Hanze University.

Before I started with my Master thesis I wanted to do something more than just write my thesis in Groningen like almost everybody else. I also wanted to complement my curriculum vitae with an international experience. Therefore, I chose to write my Master thesis abroad, expand my horizon and further shape my interests. I came up with this subject and the opportunity arose to write it in Berlin in cooperation with BPD that agreed to provide me with data.

I really enjoyed my stay in Berlin in combination with writing my thesis. It was an excellent experience to improve my German language as well as my English. I now have a better understanding of Germany's real estate economics, which is actually the largest real estate market in Europe and therefore important to have knowledge of for a real estate professional.

I want to thank Drs. H. Joosten and Mr. B. Reuther from BPD and Bouwfonds Investment Management Berlin for their valuable input and their cooperation in providing me the necessary data. I also want to thank Mr. J. Finke from Bulwiengesa AG with his cooperation in providing me specific data on real estate indicators required for the statistical analysis.

I would like to express my sincere appreciation to my research supervisor, prof. dr. E.F. Nozeman, for his insightful advice, constructive feedback and patience during my graduation. I also want to express my thanks for dr. V.A. Venhorst for his help in finding the right form of research approach and the statistical analysis.

Groningen, 23 April 2015

Niek Drent

Table of contents

1. Introduction

The purpose of this first chapter is to provide an introduction with background information and a justification of the research topic. It reveals the research problem and states research questions that will be answered later on. Further it outlines the approach of the study to answer its central question and includes a conceptual model. Lastly, the relevance of this study will be discussed and a tassel finalizes this chapter.

1.1 Background information

Foreign capital inflows in German real estate markets increased over the last years impressively due to enhanced consumer confidence, increasing levels of transparency and low interest rates (Bundesbank, 2014). Inflows of capital have been recognized as an important component of economic upturns. According to Barras (1994) economic upturns start with expanding capital flows, credit expansion and increased investments, leading to a property development boom. In Berlin's case these capital inflows increased significantly due to its favourable investment environment. Berlin's strengths are environmental quality, infrastructure and proximity to science and R&D (Dupuis, 2014). Berlin is ranked nineteenth on the A.T. Kearney Global Cities Index 2014 and it is ranked seventh for European cities on the same index. According to that index Berlin is Germany's most global city.

Ross (2014) reported that house prices in Germany's largest cities are overvalued by 25 per cent and that international investors had created this 'property bubble' in Europe's largest economy. In October 2013 the Bundesbank reported that property prices were overvalued by 20 per cent, which suggests that the overvaluation is getting worse. Several institutes came up with figures that showed that German house prices in its largest cities climbed at record rates. According to JLL (2013) the house prices of Berlin rose rapidly from 2010 to the first half of 2014 with almost 65 per cent, as can be seen in figure 1.1.

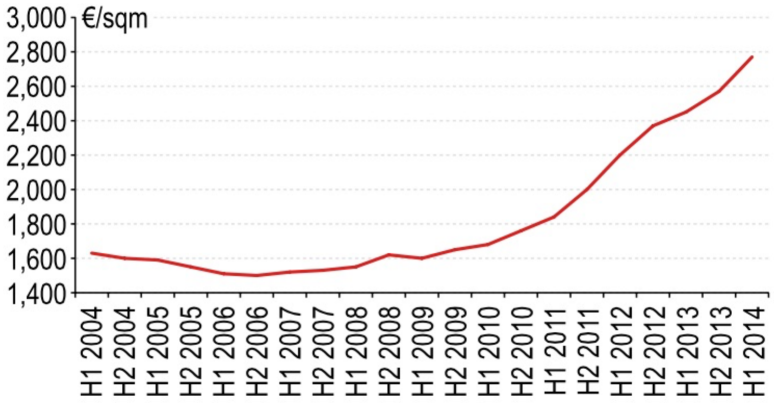


Figure 1.1 Development of residential purchase prices in Berlin (Median in €/m²)(for condominiums)
Sources: IDN ImmoDaten GmbH & JLL GmbH (2014)

Several studies have shown that increasing capital inflows, including foreign real estate investments (FREI), have gone with rising house prices, or at least that house price appreciations are stimulated by increased amounts of foreign investments (Cordero & Paus, 2008; Mihaljek, 2005; Ben-Yehoshua, 2008). Capital inflows can influence real estate prices in three ways: a change in direct demand for assets, a change in liquidity and capital inflows can result in economic booms (Gholipour, 2013). A higher demand for real estate will result in the short run in higher house prices due to the long real estate cycle (Demary, 2010). The

second way in which capital inflows can influence real estate prices is through increased money supplies in the real estate sector resulting in a higher liquidity level in the local market, which in turn boost asset prices (Kim & Yang, 2009). The third way is that capital inflows tend to create economic booms, which lead to increases in real estate prices (Barras, 1994). There is no satisfactory evidence up till now, underpinning the correctness of one of these theories in relation to FREI. Therefore this research tries to find empirical evidence underpinning (one of) these theories.

1.2 Research outline

This paragraph outlines this research by stating the research problem, the objective, the central question and the research questions.

Problem definition

There is no sufficient insight in the effect of foreign real estate investments on Berlin's house prices.

Objective

The objective of this research is to give insight in the effect of foreign real estate investments on Berlin's house prices.

To achieve this objective the following central question is formulated.

"To which extent do foreign real estate investments influence house prices in Berlin's real estate market?"

To gain more insight in the theoretical background of the central question the following sub-questions will be answered throughout Chapter 2.

1. *How can the development, current situation and future prospects on Berlin's economy and more specific its real estate market be characterized?*
2. *How is the development of FREI in Berlin from 2000 onwards?*
3. *Do FREI have impact on house prices in specific markets according to literature and if so to what extent?*
4. *Which method is favourable to measure the impact of FREI on Berlin's house prices and which data should be appropriate?*
5. *Do empirical data show impact of FREI on house prices?*
6. *Is there a difference between the effect of FREI fluctuations on house prices compared to DREI fluctuations on house prices and if so to what extent?*

1.3 Research method

The background information implies that there are theories and statistical findings about the impact of FREI fluctuations on house prices. Therefore, a theory testing research will be conducted to answer the central question. A theory testing research aims to test and possibly adjust these existing insights. To do so, hypotheses will be formulated based on these theories that later on will be tested on correctness. These hypotheses together will form the perspective of the researcher from which the research will be conducted. A theory testing research is characterized by its quantitative form, high degree of generalizability for the results and it finds its roots in theory (Verschuren & Doorewaard, 2007).

This research will be conducted through application of two methods. Firstly, the theoretical framework in which the first three sub-questions will be answered by a review of relevant literature and previous studies. These sub-questions have the purpose to define the field of research and to recognise variables that have an impact on the development of house prices and the relationships between these variables. The literature study ends with hypotheses on the price development of Berlin's residential market.

Secondly, the formulated hypotheses will be tested via a quantitative approach to reject or accept the hypotheses. This quantitative approach allows the researcher to answer the central question at different significance levels by testing the influence of the independent variable on the dependent one and at the same time controlling for a set of other relevant variables.

Figure 1.2 shows a schematic overview of the variables to be used in the statistical analysis. The theoretical background and the relationship of these variables with asset prices will be discussed in Chapter 3.

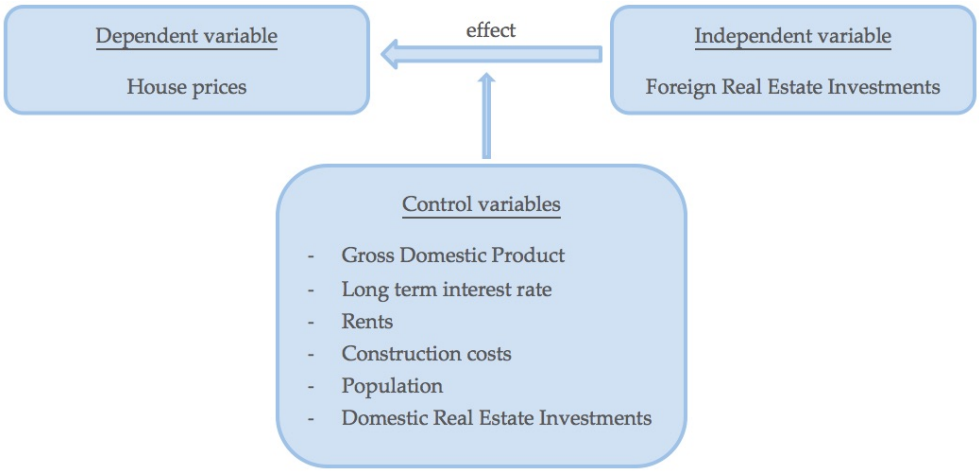


Figure 1.2 Conceptual model

1.4 Scientific and societal relevance

The aim of this research is to give insight in the effects of FREI in Berlin's real estate market and the effect of FREI on house prices in Berlin. Several studies have researched the effects of capital inflows on asset prices (Brixiova et al., 2010; Kim & Yang, 2011; Kim & Yang 2009; Bo & Bo, 2007; Guo & Huang, 2010), but to my knowledge none has done research into the impact of increasing and decreasing amounts of FREI on house prices, except for Gholipour (2013). Gholipour's research has been focused on the emerging real estate markets on a national level. This study will focus on Berlin's relatively modest, but exceptional real estate market. The reason that the impact of FREI on house prices has not been studied extensively is presumably the limited availability of data on FREI. This implies that there is a relative big information gap in the relation between FREI and house prices. This addresses the scientific relevance.

There is a reason to complement the existing studies of the effects of aggregated FDI on asset prices with FREI data. For example, FDI in other sectors do not have the same economic impacts as FREI do on house prices (Gholipour, 2013). Studying this effect helps

policymakers to decide to attract, restrict or avert FREI into their markets. This addresses the societal relevance.

1.5 Tassel

This Master thesis exists of five further chapters. Chapter 2 covers the history, current situation and prospects of Berlin's politics, economy and real estate market in perspective to Germany. The goal of this chapter is to provide a solid view of the contextual framework in which this research is conducted. Chapter 3 provides the theoretical framework with two underpinning models, namely Barras' (1994) model and DiPasquale & Wheaton's (1992) model. Subsequently it discusses the variables derived from previous studies and theories, which could influence the development of house prices. The literature study ends with hypotheses on the assumed impact of FREI on house price developments of Berlin's residential market and on building activity. Chapter 4 begins with a detailed description of the data that will be used and then looks at the methodology of the statistical analysis. Validity and reliability of the data will be discussed. The results of the empirical research will be discussed in Chapter 5. Finally, Chapter 6 present the conclusion, evaluation of this research and recommendations for further research.

2. Contextual framework: Berlin's economic and investment environment

This chapter contains an overview of the relevant literature and the contextual framework in which this research is conducted. Firstly, it will give insights in Berlin's political history and current situation. Secondly, it discusses Berlin's socioeconomic change over the years as far as relevant to the real estate market and its economic perspective. Lastly, the investment environment will be discussed. This background information is needed to understand Berlin's real estate market and its position within Germany's economy.

2.1 Geopolitical context

Owing to allied air bombings, Soviet artillery and street fighting during the Second World War a third of Berlin was destroyed. The so-called "Zero Hour" in 1945 with the capitalization of the Nazi's high command marked a new beginning for the city. The United States, The United Kingdom and France occupied the West part of Berlin and the Soviet Union occupied Berlin's East part (see figure 2.1). The separation in West and East made a unique situation of Berlin as a half-controlled city, which had many future implications for the development of its economy. From 1945 onwards that division influenced Berlin's development heavily. It was due to these particular political-territorial relations that made it a natural focal point in the Cold War after 1947. While the city was initially governed by a 'Four Power Allied Control Council' with a monthly rotating leadership the practice showed that West and East governed independently, due to deteriorating relations. West Germany had Bonn as their 'de facto' capital and East Germany chose (East) Berlin as its capital. When the Wall fell in 1989, which marked the end of the Cold War, political events followed each other in rapid succession. In 1990 the city-state of Berlin became the federal capital of Germany as one of the stipulations of the Unification Treaty. In 1991 a 'capital decision' as a result of the German reunification resulted in the move of the West German government's headquarters from Bonn to Berlin. Since then most of the federal ministries and government offices moved back and today Berlin houses most of the German government offices and associated institutions, including many embassies.

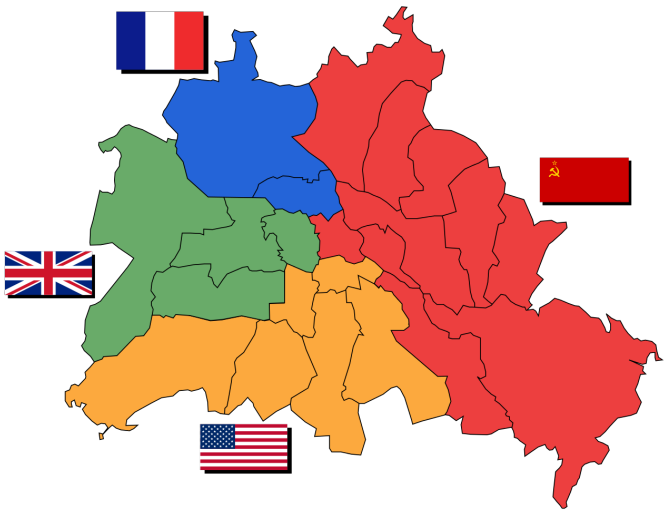


Figure 2.1 Occupied sectors of Berlin
Source: Occupied Berlin, 2015

Due to these historical events Berlin today is an independent city-state and can be compared on a political administrative level to the other fifteen States of Germany (Bundesländer).

Besides Berlin, Hamburg and Bremen are also city-states. These three city-states differ slightly from the other geographical states, which are parliamentary republics. The parliament of Berlin, also known as the House of Representatives, appoints the Governing Mayor. The executive branch of Berlin's Government is the Senate, led by the Governing Mayor together with eight appointed senators. Due to this political structure Berlin can make its own regulations and laws that can affect Berlin's unique real estate market.

When looking at a larger geopolitical framework, the joining of in particular Poland and Czech Republic and to a lesser extent, Slovakia and Hungary to the European Union in 2004, affected Berlin in several ways. Before the EU expanded Berlin was in a peripheral location, economy-wise, due to the closed borders of Poland and the Czech Republic. The Polish border is only 60 kilometres away from Berlin. After the joining of these countries to the EU Berlin shifted to a more central position. Therefore Berlin gained in market area and the economic hinterland. This shift increased the city's attractiveness and was accompanied by a substantial population growth after 2004.[2]

2.2 Socioeconomic environment

Besides Berlin's federal importance, its socioeconomic importance in perspective to Germany as well as internationally has also been growing. While Germany's economy as a whole continues to strengthen with a 0,4 per cent rise in 2013 and a 0,8 per cent rise in the first quarter of 2014, Berlin's economy even experienced a stronger growth, showing the second highest growth of all sixteen states in 2012 and the highest in 2013 (JLL, 2014). Looking at a longer timeline, other sources report the same trend. According to DIW Berlin[3], Berlin's gross domestic product (GDP) increased between 2004 and 2009 by 1,75 per cent on average, compared to the 0,5 per cent annual growth of Germany as a whole. In 2012 the GDP increased by 17,4 per cent compared to 2005, while over the same period Germany's gain as a whole was only 10,9% (Statistics Offices of the Federal and State Governments). The prospects for Berlin's economy are also looking attractive. Berlin's economy is expected to show the strongest economic growth in the coming years and the highest increase in jobs created in all 16 German federal states (GSW Immobilien AG, 2014). Berlin has by far the lowest purchasing power of all German A-cities. While Berlin is below the index (Germany is 100) with 92.6 the rest of the A-cities are above the index with Cologne second lowest with a score of 108.9 (see figure 2.11). When comparing GDP figures to other regions in Germany, Berlin shows a relative low GDP per capita and an average growth percentage from 2000 to 2013 (see figure 2.2). This reflects the relatively modest economic power of Berlin, but also the prospects for Berlin of becoming even more important in Germany's economy.

[2] Looking at the implications of the expanding EU, a case study for Vienna showed that when Vienna moved from its peripheral location to a more central position within the Central European economic system it showed changing economic and demographic conditions as well. Vienna experienced a depopulation trend for almost a century, but after the expanding EU it saw a reversal of this trend, not only in the number of its population, but also in the number of business headquarters, branch offices and companies looking for emerging markets. Vienna turned due to these events from a net recipient of FDI to a net investor. The city government saw this happening and as a reaction it created opportunities for commercial real estate development by designating brownfield areas for urban re-development and supported this process through strategic infrastructure investments (Maier et al., 2014).

[3] The Deutsches Institut für Wirtschaftsforschung (DIW Berlin) is one of the leading economic research institutes in Germany.

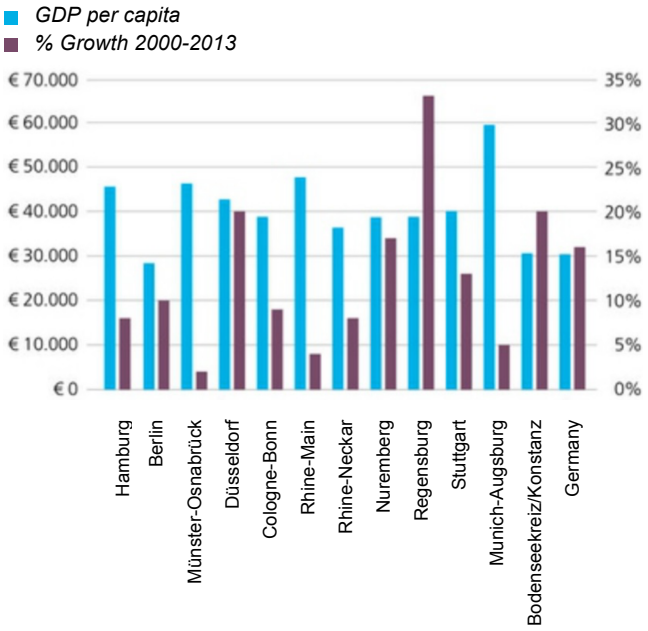


Figure 2.2 Gross Domestic Product per capita 2013
Source: Oxford Economics, adapted by BPD

Berlin's economic upturn of the last years and attractive looking prospects is underpinned by its large public sector, which for the most part remains unaffected by the economic cycle. Besides its public sector as underpinning factor, the sector with the largest number of employees, tourism, experienced an impressive growth since 2007. In 2012 the tourism sector accounted for almost 25 million overnight stays and just less than 11 million visitors (figure 2.3). Compared to 2011, these numbers rose respectively with 11,4 per cent and 13,5 per cent, which means that Berlin's largest industry is still growing. Compared to European destinations, Berlin is ranked third just behind London and Paris. The annual sales in tourism are more than €10 billion, which when converted to an average per capita income corresponds to an "employment equivalent" of about 275.000 jobs (GSW Immobilien AG, 2014).

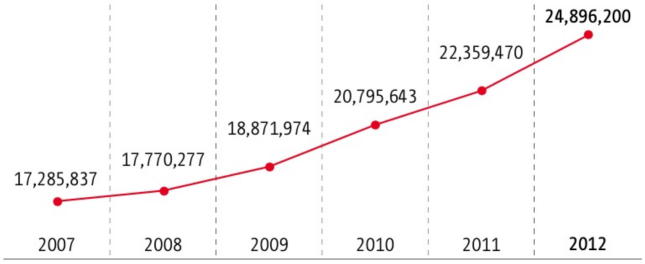


Figure 2.3 Overnight stays per year in Berlin
Source: Berlin-Brandenburg Statistics Office

The economic upturn and attractive prospects are also supported by the Information Technology sector, in which Berlin has a leading market position within Germany. Figure 2.4 shows the invested venture capital in IT start-ups. It is obvious that Berlin stands out as a fertile breeding ground for IT start-ups, when this capital flows into the sector. According to

Bitkom[4], Berlin registered almost 900 start-ups between 2008 and 2011, while Munich, coming second, registered around 500 new companies. This explains the large number of Internet-related young companies in Berlin and their growing financial output.

Figure 2.5 shows the increase in jobs that are subject to social security contributions from 2005 to 2012. Berlin has the largest increase of all the sixteen states during this period and a 6,9 per cent higher increase compared to Germany as a whole. In both 2012 and 2013 Berlin reported again the highest growth in employment of all the German states (GSW Immobilien AG, 2014). Figure 2.6 shows the unemployment rate of the German A-cities. While Berlin's unemployment rate is still far above the rates of the other cities, it also shows the largest decrease in unemployment rates from 2004 to 2011. This decrease is mainly due to the out-migration of older people and the creation of new jobs.

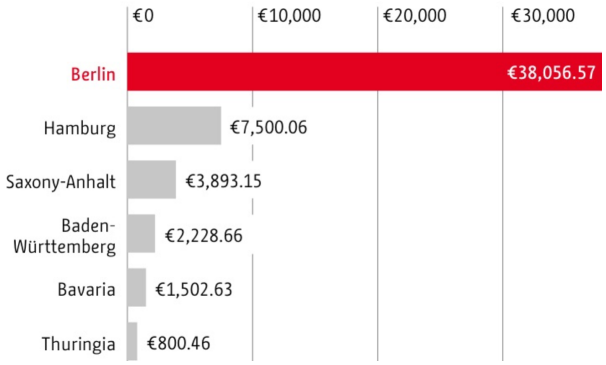


Figure 2.4 Venture capital invested in IT start-ups (in €) per 1.000 residents in 2012
Source: BVK[5]

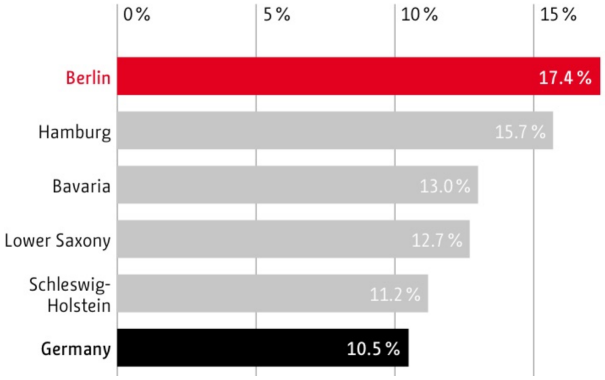


Figure 2.5 Increase in jobs with full social security coverage from 2005 to 2012 in %
Source: Federal Employment Agency

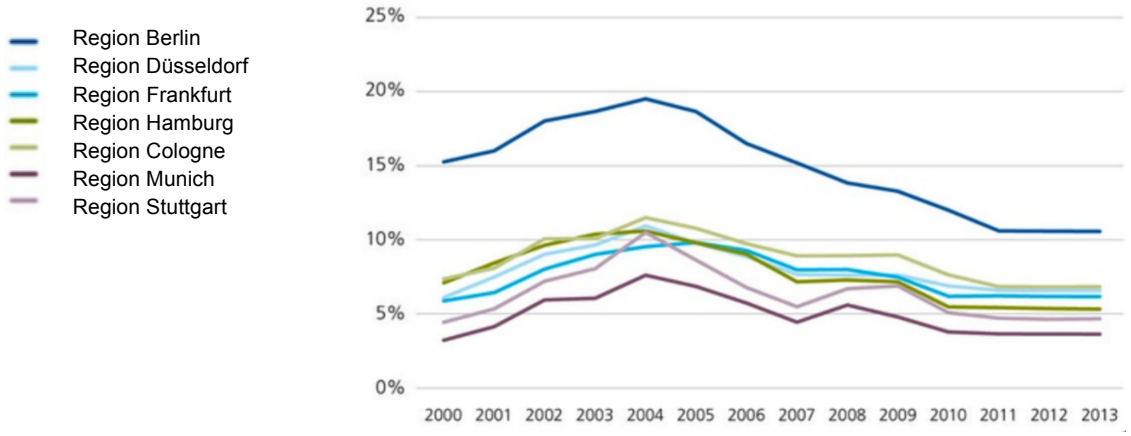


Figure 2.6 Unemployment rate A-cities.
Source: Oxford Economics, adapted by BPD

The growth of the labour market is accompanied by a steady increase of the population since 2004.[6] Before 2004 Berlin's population was declining, but since 2004 new arrivals have outnumbered departures and this number is expected to keep growing according to

[4] Bitkom is the Federal Association for Information Technology, Telecommunications and New Media in Germany.
[5] BVK = Bundesverband Deutscher Kapitalbeteiligungsgesellschaften
[6] In 2004 there was a review period that could influence the figures and data.

demographers (Federal State of Berlin, 2013). Figure 2.7 shows the influx and outflow of Berlin's population, showing that Berlin is a dynamic city. For example, in 2011 alone, 159.000 people moved to Berlin, while 119.000 people moved out. In 2012 these numbers were respectively 165.000 and 123.000. An underlying reason for this dynamics is that in particular young people are moving in and out of Berlin. In 2012 68 per cent of all new arrivals were between 18 and 32 years (Federal State of Berlin, 2013). Besides in- and outmigration, the number of births has outstripped the number of deaths for years, which also contributes to the growing population, but to a lesser degree.

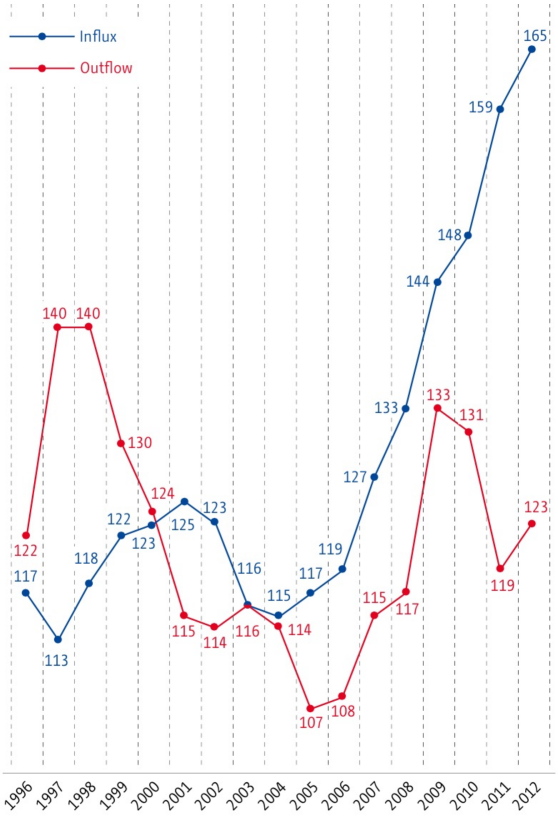


Figure 2.7 Population development in Berlin: influx and outflow (in thousands)
Source: Berlin-Brandenburg Statistics Office

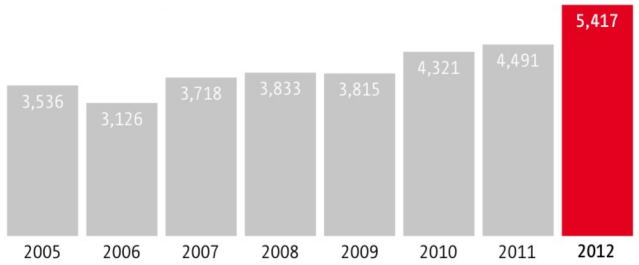


Figure 2.8 Apartments completed in Berlin
Source: Berlin-Brandenburg Statistics Office

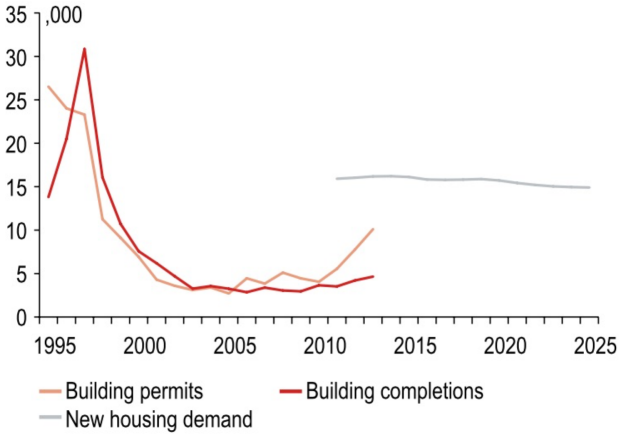


Figure 2.9 Housing supply and demand for new buildings in Berlin
Source: JLL (2014)

This growth of population has in turn led to an increase in the number of households. With an average size of 1.73 persons, the number of households in Berlin now grows by approximately 20.000 a year (GSW Immobilien AG, 2014). While, the construction industry develops more apartments each year (figure 2.8) and the Berlin Senate tries to increase the number of approvals of new permits, supply still has not been able to meet this growing demand. From 2000 until 2010 the number of approved building permits and building completions have been fairly stable. From 2010 onwards the construction industry reacted to the growing demand for housing. The number of approved building permits increased and subsequently, due to the long construction time, the number of building completions increased (figure 2.9). Due to this high level of demand, a new trend is recognized towards the development of larger residential projects. At this point in time there are several large-scale projects in the starting blocks, which mean that an increasing level of building activity is expected in the next two years (JLL, 2014).

Berlin's real estate market responds to these trends of growth, especially through its residential rental market. Where Berlin's rents were first based on young people wanting to pay cheap rents, the residential market in central districts now focuses more on higher rents for luxury apartments, because of a change of the city's residential landlords. An increasing amount of international pension funds, listed firms and private equity players are now among the city's residential landlords. Another trend can be recognized in migration. New arrivals are looking for homes in the central districts, while the Berliners are moving toward the outskirts of the city. These trends underpin the differences of rental price dynamics for new leases between districts. Looking at rental prices for Berlin in general, these prices have increased by 7,7 per cent in the first half of 2014 to almost €8,65 per square metre (figure 2.10). Especially since the second half of 2009 rental prices have increased significantly. While the insufficient supply of residential space makes a further increase in rental prices appear likely, it is possible that the limited income level and relative low purchase power will have a dampening effect on the rental price dynamic in terms of future demand (JLL, 2014). The asking rent for newly built residential space in the first half of 2014 is around €10,50 per square metre, while average asking rents in existing buildings are a third cheaper. This relative big gap indicates the growing potential of the rents in the short-term, but it also impacts the dynamics in the rental market. Tenants who started renting a large apartment years ago would only get a small apartment back for the same rent after moving. This means that many tenants don't move which influences the flow from tenants between residential premises. The market responds to this and it affects the structure of the supply in apartments; fewer large and more relatively small apartments are offered.

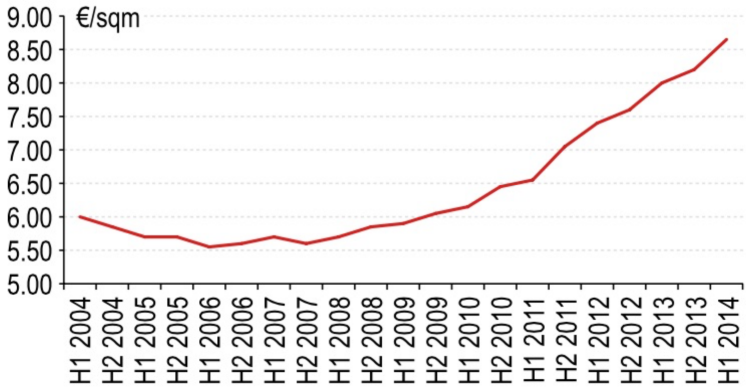


Figure 2.10 Development of residential rental prices in Berlin (Median in €/sqm)
Source: JLL (2014)

Looking at residential purchase prices, at the level of condominiums, the prices have risen by 13 per cent year-on-year and are offered at an average price of €2.770 per square metre. The development of residential purchase prices has been shown in figure 1.1. In the first half of 2014 prices for condominiums have risen significantly with 8 per cent compared to the previous year. The main drivers of this recent growth are the continued fall in financing costs, which stimulates the demand for freehold ownership and the low supply that cannot meet demand (JLL, 2014). Just like the rental prices, the purchase prices have shown since 2010 a stronger increase than the years before. Asking prices have risen from 2010 onwards with 65 per cent. This increase in purchase prices is a third higher compared to the increase in rental prices in the same period.

When Berlin is compared to Germany's seven A-cities[7] a few things stand out. While reports from GSW Immobilien AG and JLL report that Berlin's residential real estate market is catching up with other real estate markets in major cities, the figures for 2012 and 2013 show that Berlin is still behind (figure 2.11). As said before, the purchasing power of Berliners is by far the lowest and they have a relative low income. Together with the largest range of available residential space with the lowest asking rents compared to the high level of demand, it can be said that Berlin has a unique residential real estate market. These particular characteristics have historical, industrial and geographical causes. When Berlin was divided till 1989 the real estate markets, both West and East, have been heavily subsidized. This applies to both existing and new buildings and this has had to this day an impact on rent levels. Another cause is Berlin's geographical situation; its very broad city limits. The rents at the city borders, within the 892 square kilometres that make up Berlin's urban area, are significantly lower and therefore they also lower the statistical rent prices of the entire city. These characteristics also have some smaller impacts on Berlin's real estate market. For example Berlin has more industrial and railway areas, wall zones, waste lands and compactable areas that have hardly been developed.

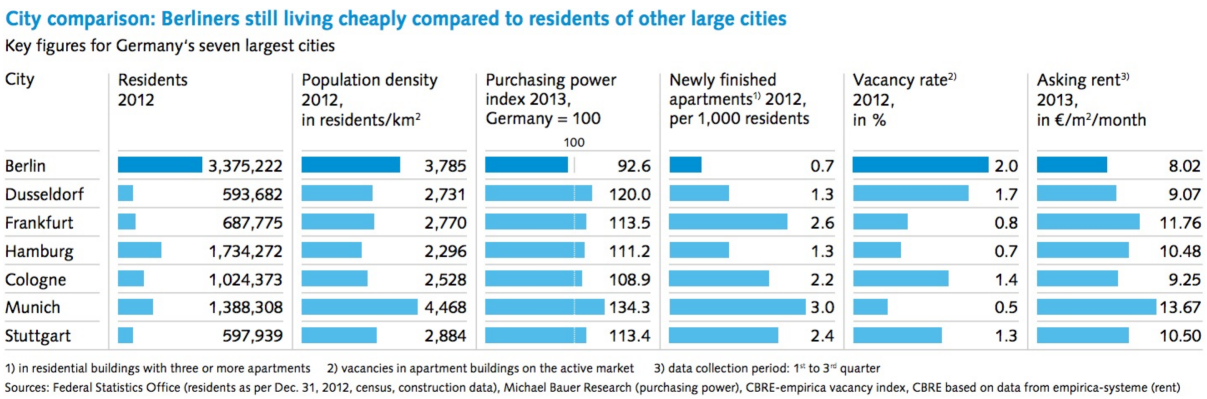


Figure 2.11 City comparison
Source: GSW Immobilien AG (2014)

2.3 Investment environment

Another way to look at Berlin's real estate market is to take a glance at the investment environment. Since 2011 the investment volume in Berlin's real estate market has been growing with almost equal steps. The first nine months of 2014 showed an increase of 18 per cent compared to the first nine months of 2013. It also represented the highest transaction volume since 2007 (figure 2.12). With an investment volume of almost €2,7 billion for the first three quarters, Berlin now holds a second place, right behind Munich with an investment volume of €3,47 billion. Office buildings have remained the most favoured asset class for the investors with a share of 45 per cent of the transaction volume, while retail has attracted considerably less capital than the year before (BNP Paribas Real Estate, 2014).

[7] These seven A-cities are Berlin, Dusseldorf, Frankfurt, Hamburg, Cologne, Munich and Stuttgart. These cities have Germany's largest economic markets in terms of functionality, real size, and influence on international, national and local levels.

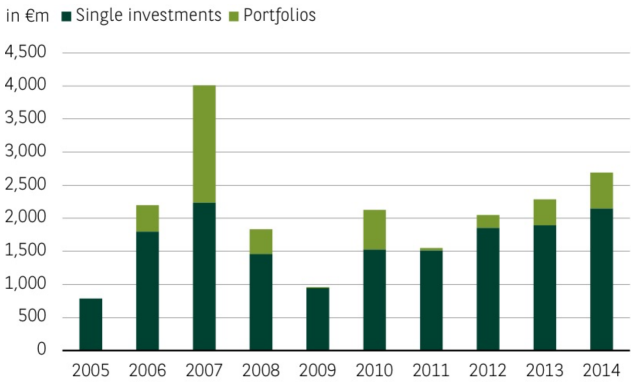


Figure 2.12 Investment volume in Berlin Q1-3
Source: BNP Paribas Real Estate GmbH, September 30, 2014

The pwc & ULI report (2013) expect more cross-border investors to focus on Germany's multifamily housing, due to the maturing of billions of debt in the sector. The companies that own these maturing portfolios are currently working on refinancing strategies. Looking at Berlin, the underlying demographic and economic factors are underpinning Berlin's attractiveness as an investment location within Germany. According to JLL (2014) Berlin is the top investment location for residential real estate in Germany and GSW Immobilien AG (2014) identifies Berlin as top location in Europe. In the first half of 2014 approximately €450 million has been invested in residential properties in Berlin, followed by Hamburg with €250 million, the Rhine-Ruhr region with €170 million and Frankfurt with €90 million.

The pwc & ULI (2013) 'Emerging Trends in Real Estate Europe' report ranked Berlin second, just behind Munich and followed by London, Istanbul and Hamburg on respectively the third, fourth and fifth place, for best city investment prospects (figure 2.13). This survey investigated the existing and new real estate investments as well as development opportunities. Since 2005 these investment prospects have been growing significantly compared to other cities (figure 2.14). Right after the impact of the crisis in 2008 a slight decrease can be noticed, but from 2010 onwards the investment prospects were rising again.

	Existing Investments	New Investments	Development
1 Munich	3.73	3.56	3.29
2 Berlin	3.72	3.46	3.09
3 London	3.57	3.23	3.13
4 Istanbul	3.55	3.47	3.46
5 Hamburg	3.49	3.45	3.21

Figure 2.13 City Investment prospects.[8,9] *Figure 2.14 Investment prospects Berlin*
Source: Emerging Trends in Real Estate Europe 2013 survey

Looking at sectors by city in which acquisitions prospects are best, Berlin stands out as a city in which acquisitions in the residential sector are highly recommended.[10] The long-term population growth, steady increase in rents and the type of investors, in this case cash-rich

[8] The score is on a scale of 1 to 5.
[9] The list with the Investment prospects for all 27 European cities, as well as an Outlook for Berlin, is attached in Appendix B.
[10] Appendix B gives the whole list of number of recommendations per sector by city.

investors, are important factors for these recommendations. Therefore Berlin's attractive investment opportunities are rooted in the growth of its technology, media and creative industry. This industry, with almost 37.000 companies and an annual turnover of €26 billion, creates the most new jobs. This attracts not only the small tech entrepreneurs, but also the large companies as Twitter. Besides residential acquisition opportunities, retail acquisitions also attracted strong support in the survey. Retail activity benefits strongly from Berlin's function as a 'retail test market' for Germany. In addition to the size of the market, retail activity also benefits from the high and growing number of tourists, whose purchases account for a quarter of retail sales (Bielmeier et al., 2014).

While private investors are traditionally one of the biggest sources of demand in Berlin's real estate market, the first three quarters of 2014 showed a different spectrum of investors. Due to some large transaction deals equity/real estate funds conquered first place in transaction volume with 21,2 per cent of all turnover. Second, but just before private investors (14,9 per cent), came project developers (15,2 per cent) who invested not only in a number of plots of land but also in several existing properties offering development potential (BNP Paribas Real Estate, 2014).

Figure 2.15 Investments according to buyers' group in Berlin Q1-Q3 in %
Source: BNP Paribas Real Estate GmbH, September 30, 2014

Figure 2.16 shows the development of FREI and domestic real estate investments (DREI) in the top 3 German cities with the best city investment prospects. It shows that in 2007, the year before the crisis, the volume of FREI exceeded DREI in all three cities. From 2008 onwards the volume of FREI did not exceed DREI, with an exception for Hamburg in 2012. DREI peaked in all cities in 2010, but it showed for Berlin a definite peak in 2013 due to the acquisition of several large residential portfolios. The development of FREI from 2007 onwards is quite the same for Berlin, Hamburg and Munich. The foreign investment volumes dropped in 2008 and 2009 and climbed steadily up to a peak in 2012. In 2013 all three cities showed a different path. Berlin's foreign investment volume dropped with €1,2 billion, while Munich's foreign investment volume grew slightly with €420 million and Hamburg's stayed the same.

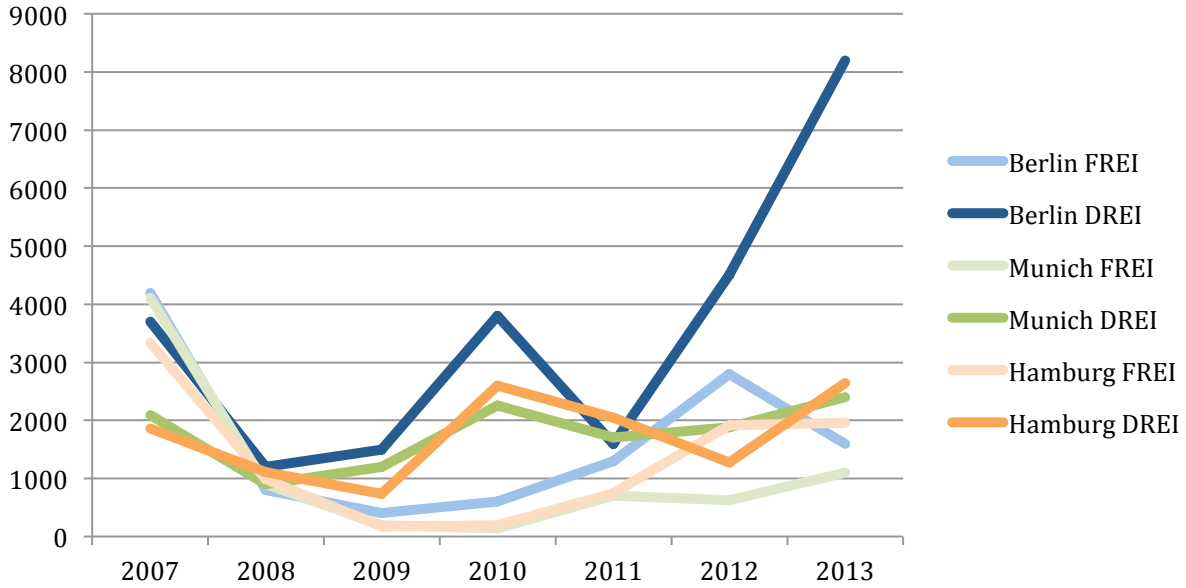


Figure 2.16 FREI and DREI in € million in the top 3 German cities for investment prospects
Source: Bulwiengesa AG, RIWIS

2.4 Conclusion

Through this chapter the first sub-question on the development, current situation and future prospects on Berlin's economy and in specific its real estate market has been answered. Concluding that Berlin has a relative large and unique real estate market due to its geo-political history since the Second World War with the division of the city until 1989, its specific political-territorial relations which made it a focal point during the Cold War and its shift from an economical peripheral location to a more central one due to the expanding of the EU in 2004. Berlin's economy has been growing above the German average since 2004, it showed the second highest growth in 2012 and the highest growth in 2013 of all sixteen states. Also, according to GSW Immobilien AG (2014) Berlin's economy is expected to keep showing the strongest economic growth for the upcoming years, as well as the highest growth in job creation. Berlin stands out when looking at the in- and outmigration. Since 2004 a steady increase of the population can be seen which heavily influences the demand for residential real estate. The supply of residential real estate cannot meet this increasing demand, forcing the prices to go up, which attracted large and international market players into Berlin's investment market.

The second sub-question that looks into the development of FREI in Berlin from 2000 onwards is covered in paragraph 2.3. No specific information on real estate investments in Berlin has been found before 2005. The data on FREI that has been used for the statistical analysis only starts from 2007 onwards. From 2005 the investment environment improved with a slight disimprovement during the economic crisis in 2008 and 2009. From 2011 onwards the investment volume and with that the prospects grew steadily. Especially investments in the residential and retail sectors attract strong support from influential market participants in the real estate sector. Figure 2.16 shows the development of FREI in Berlin from 2007 onwards. In 2007 the foreign investment volume of €4,2 billion exceeded the domestic investment volume of €3,7 billion. After a large decrease of the investment volume in 2008 and 2009 due to the economic crisis it started to grow again to €2,8 billion in 2012, while 2013 showed a decrease to €1,6 billion.

3. Theoretical framework: impact of foreign real estate investments

This section addresses the variables that could have an influence on house prices in general and discusses how these variables influence these prices, based on previous studies. The key theory underpinning this research is Barras' (1994) model. The choice of which variables to use for estimating the driving factors of Berlin's house prices largely depends on the DiPasquale & Wheaton (1996) model, hereafter DW model, as shown in three panels in appendix A. Both theories will be addressed first, followed by the variables to be included in the estimation. Lastly, the literature on these variables is transformed into testable hypotheses.

3.1 Theoretical models

The Barras' (1994) model gives the underpinning theory behind the hypothesis that capital inflows (e.g. FREI) have an effect on house prices in general. This is only a small part of Barras' theory on the property cycle. Following Barras (1994), there are more variables that influences house prices. These variables can be derived from the DiPasquale and Wheaton (1992) model. Both models will be further examined in the following sub-paragraphs.

3.1.1 Barras' model

The theoretical starting point behind this study is Barras' (1994) model. Barras (1994) illustrates how a building boom is generated by the interaction of the economic cycle, the credit cycle and the long cycle of development in the property market (see figure 3.1). Barras argues that an economic upturn occurs together with credit expansion and falling interest rates, which will reinforce economic growth. At that time banks will begin to fund speculative developments. There is already an increased demand for property while there is still little new supply on the market due to development time lags. Asset prices will rise, because demand is high while supply cannot meet up. Inflation will have risen at this stage in the cycle and therefore the interest rates rise as well to control the inflation. This moves the economy into a downswing. The new supply of buildings will come onto the market, while the demand has already dropped. It causes rents to fall, yields to rise and asset prices to drop. The economy goes into a recession.

Figure 3.1 shows Barras' (1994) model in which the left side of the model stands for the economic cycle, the middle stands for the long cycle of development in the property market and the right side stands for the credit cycle. This research focuses on a small component of Barras' (1994) model, namely the effect of credit expansion, e.g. (foreign) capital inflows, which will boost asset prices in the short run due to development cycles.

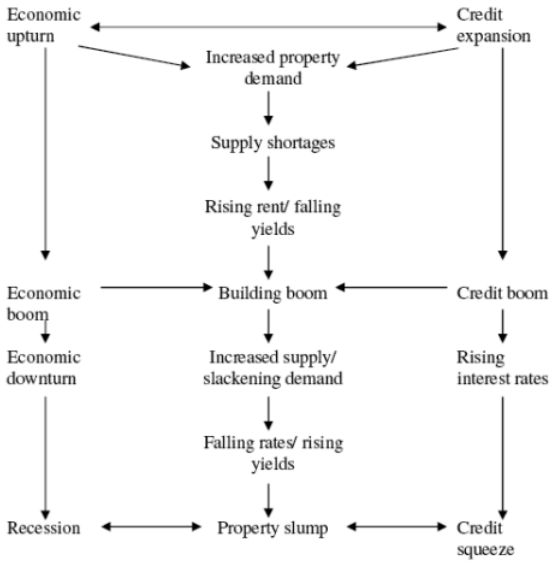
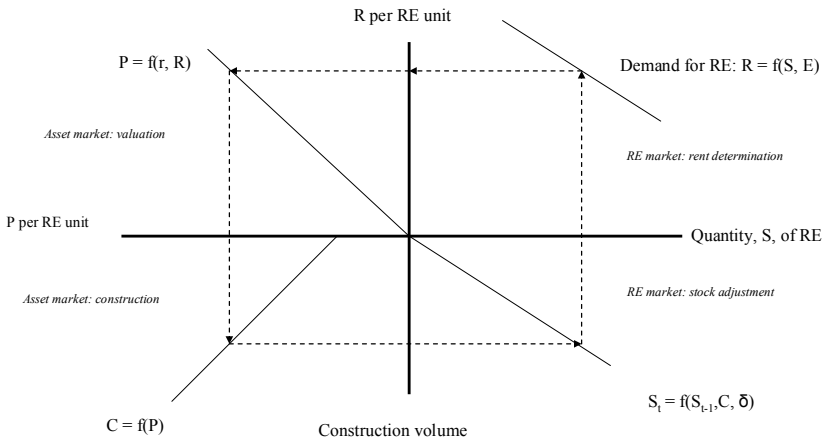


Figure 3.1 Barras' (1994) model

3.1.2 DiPasquale & Wheaton model

Macroeconomic variables that influence house prices can be derived from the DiPasquale & Wheaton model. This analytic framework divides the real estate market into two markets: the market for real estate space (property market), the two eastern quadrants, and the market for real estate assets, the two western quadrants. This framework, as shown in figure 3.2, examines how these markets are affected by the nation's macroeconomics and financial markets. It implies the impact from various variables, such as GDP, long-term interest rates, construction costs, stock of real estate and rents (DiPasquale & Wheaton, 1992). While this model is a generic one and is applicable to any type of real estate, it will only be used for residential real estate in this research. The expected effects of these variables will be explored in the second chapter.



R = rent, P = price, r = capitalisation rate, C = construction volume,
S = RE stock or space, δ = stock depreciation factor, E = exogenous determinant

Figure 3.2 DiPasquale & Wheaton (1992) model

3.2 Relevant variables

This section gives insight in previous studies relating to the development of house prices. It addresses the variables of interest that could influence house prices in general and discusses how these variables influence these prices, based on prior literature.

3.2.1 Foreign and domestic real estate investments

An obvious variable to include in the estimation is FREI, because this study examines the effect of FREI on house prices. Gholipour (2013) examined the same effect for emerging economies. With his panel vector auto regression model for 21 countries, he found that FREI is a significant determinant of house prices. However, Gholipour (2013) states that FREI only plays a *minor* role in house price appreciations in emerging countries. Another variable to include is domestic real estate investments (DREI). By including DREI the difference between foreign and domestic investments can be examined. Although, there are no further academic studies performed that focused specifically on foreign or domestic real estate investments and house prices, there are statistics of observed increases in FREI, which have gone with a rise in house prices in specific markets. For example, the case of Costa Rica, where between 2003 and 2006 FDI in the real estate sector rose extremely by one thousand per cent, accounting for 25 per cent of total FDI inflows. As a result, real estate prices have skyrocketed (Cordero & Paus, 2008). Mihaljek (2005) researched the possible effects of foreign investments in Croatia's property market, due to the accession of Croatia to the European Union. He implied that the increase of FREI would affect the house prices dramatically through an increase in demand and due to expectations of future house prices and housing supply rigidities. He already found evidence for his assumption, even before the accession of Croatia to the EU. Brixiova et al. (2010) did the same for Estonia during 2000 till 2007 and they found empirically backed evidence for a real estate building boom due to increasing international capital inflows. This empirical evidence of increasing amounts of foreign capital inflows leading to increased house prices implies that FREI in general will have a positive impact on house prices.

Ben-Yehoshua (2008) found with his study on statistics of FREI and house prices for the Republic of China that real estate prices in its metropolitan cities have dramatically increased due to an increase in FDI, of which FREI was a relative large component. [11] Most of this FREI is allocated to commercial real estate, but the local governments started to complain, that due to the growing number of foreigners in larger cities, the residential real estate market has been inflated beyond control. Also, in the case of Shanghai it is argued that FDI are making the real estate industry in Shanghai performing well, despite the government's tight monetary policy (Jiang et al., 1998).

Complementing the literature study on FREI, as inflows into a market, it is important to address a number of studies that provide scientifically backed insights on capital inflows in general, credit expansion and asset price appreciations. This is relevant information for FREI

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A small side step is taken here to briefly examine the relation between FDI and FREI. As prior studies show FREI can be a large component of FDI and is often a large component of a nation's capital inflow. Therefore, it is expected that the correlation between these two variables would be positive. The following correlationmatrix of the variables FREI, DREI and FDI for Germany show a relative strong and positive relation between the variables with a value of 0,525.

Correlationmatrix 3.1

	FDI*	FREI	DREI
FDI	1		
FREI	0,525	1	
DREI	0,221	0,633	1

*Source: OECD Stat

inflows, because as discussed before, FREI are a large component of a nation's capital inflows (e.g. Rodríguez & Bustillo, 2010; for Spain; Cordero & Paus, 2008; for Costa Rica). Another way to look at this discussion point is through Barras' (1994) model of credit expansion due to international capital inflows. Brixiova et al. (2010) and Mihaljek (2005) found evidence for increasing real estate prices due to increasing capital inflows. Bo & Bo (2007) empirically examined the relationship between housing prices and international capital flows into China for the period from 1998 to 2006. The main results they found showed that in the short run, the increase of house prices attracts the inflow of foreign capital and in the long run, foreign capital helps to boost the rise of house prices. All this evidence from previous studies implies that FREI has a positive relation to house prices, but that its effect only accounts for a relative small part of the house prices fluctuations.

3.2.2 Gross domestic product

Looking at macroeconomic variables that influence the development of house prices one main determinant that arises is economic activity. An increase in economic activity through, e.g. an increase in employment or real industrial production, increases the demand for space. This effect can be seen in the first panel of the DW model in appendix A. The demand shifts upwards in the NE quadrant. Since the housing stock cannot change in the short-run, rents increase, leading to higher house prices in the asset market (Adams & Füss, 2010). An increase in economic activities, or economic growth, is often linked to the income people are able to spend, i.e. disposable income. In relation with house prices; a higher disposable income increases the possibility to get a mortgage loan, which also translates into a higher demand for space and higher house prices (Demary, 2010). Therefore it can be argued that disposable income would be a good indicator to measure economic activities in relation to house prices. However, this variable is a measure of average income whereas homeowners typically have above average incomes (Adams & Füss, 2010). Égert & Mihaljek (2007) find with their research on determinants of house price dynamics, that changes in income, derived from GDP per capita, are strongly positively related to changes in house prices. Therefore, GDP per capita will be used to measure economic activities in relation to the development of house prices in this study.

3.2.3 Long-term interest rates

Interest rates have a twofold influence on the development of house prices. Firstly, on the owner-occupied market the equivalent to rent is the willingness to pay (WTP) on an annual basis by households to purchase a home. Therefore, this WTP is negatively linked to the height of annual mortgage payments, e.g. when these annual payments go up, the willingness to keep paying them will go down. Long-term interest rates affect mainly current closed fixed rate mortgage contracts while adjustable rate mortgages are mainly affected by short-term interest rates (Girouard et al., 2006). Germany stands out as a country where fixed rate mortgages are the main borrowing vehicle. Although, foreign investors could and will borrow money from outside of Germany, they generally have long-term investment goals in which they would borrow money for a long term. Therefore, long-term interest rates will be used instead of short-term interest rates. Also, during periods of low interest rates, such as now, and long-term investments goals in consideration, investors tend to fix this low interest rate for a long period. For these two reasons, short-term interest rates are not taken into account. So, when long-term interest rates go up, most of the mortgage payments go up leading to a lower WTP and therefore to a lower demand for buying a house. So, long-term interest rates have a negative relationship to house prices (DiPasquale & Wheaton, 1992).

Note that an increase in the long-term interest rate therefore do not directly change the demand for housing space in the DW model, but it changes the demand for owner-occupied houses (Adams & Füss, 2010). Secondly, long-term interest rates impact the required return on real estate of investors. Higher interest rates lead to a reduction of the yield, or vice versa, and will raise the asset prices (DiPasquale & Wheaton, 1992). This will be reflected on the asset market in a lower construction rate and therefore a lower housing stock in the long run, implying increasing rents. This negative twofold effect of a change in long-term interest rates on house prices is shown in the second panel of appendix A.

3.2.4 Construction costs

The third variable that can be obtained by looking at the DW model and is likely to affect the house prices is construction costs. Construction costs deviations, such as an increase in the price of construction materials or higher labour costs, impact the construction line in the SW quadrant of the DW model, as can be seen in the third panel of appendix A. Higher construction costs lead to a decrease in construction activity and in the long-run to a lower level of the housing stock. At a given demand the rents will rise and with these the house prices on the asset market (Adams & Füss, 2010).

3.2.5 Rents

The DiPasquale & Wheaton (1992) model extensively addresses the influence of a change in rents on the price of assets. It assumes that rents being determined in the property market are key in determining the demand for assets. In acquiring an asset, investors are actually purchasing current or future income. Therefore, rents have a direct impact on house prices; a change in rent immediately affects the demand for assets. Between rents and asset prices exists a positive relationship (DiPasquale & Wheaton, 1992).

3.2.6 Demographic factors

Another variable that need to be considered in determining the development of house prices is a demographic factor. A change in demographic factors, e.g. number of households and population, affects the demand for space. An increase in the demand for space would shift out the demand curve in the NE quadrant in the DW model. For a given level of space, so in the short run, rents must therefore rise. These higher rents lead to higher asset prices in the NW quadrant. Although, many studies found insignificant or negative effects of population growth on house prices (e.g., Berg, 1996; Hort, 1998 for Sweden, and Engelhardt & Poterba, 1991 for Canada; Poterba, 1991), since the frequently cited paper by Mankiw and Weil (1989), a demographic factor will make the model estimation more stronger and increases the explained variance. Therefore, the variable Population will be included in the estimation.

3.3 Conclusion

Based on literature study and analysis of the DW model, the following variables have been selected for the statistical analysis: house prices, FREI, DREI, GDP per capita, long-term interest rate, construction costs, rents and population size. An overview of these variables with authors and the predicted direction of the relation is shown in table 1.

As to an answer on sub-question three, whether FREI have impact on house prices in specific markets according to literature, it is given in subparagraph 3.2.1. Concluding that there are no extensive studies performed on the effect of FREI dynamics on house prices, but there are statistics of observed FREI dynamics, which have gone with a rise in house

prices in specific markets. The real estate markets of Costa Rica, Croatia, Estonia and the Republic of China all experienced house price increases after either observed increases of FREI or expected increases of FREI, due to market specific circumstances (Cordero & Paus, 2008; Mihaljek, 2005; Brixiova et al., 2010; Ben-Yehoshua, 2008). The extent to which the house prices were affected by the FREI fluctuations vary from dramatic increases in short time periods due to relatively larger increases in FREI to moderate increases in the long-run. This implies that FREI fluctuations do have a positive relation to house prices, but that its effect only accounts for a relative small part of the house prices fluctuations. This is also what Gholipour (2013) concluded for emerging countries.

Table 3.1 Overview included variables

Variables	Authors	Relation
Foreign Real Estate Investment	Gholipour, 2013	+
Domestic Real Estate Investment		+
Gross Domestic Product per capita	Adams & Füss, 2010 Demary, 2010 Égert & Mihaljek, 2007	+
Long-term Interest rate	DiPasquale & Wheaton, 1992	-
Rents	DiPasquale & Wheaton, 1992	+
Construction costs	Adams & Füss, 2010	-
Population	DiPasquale & Wheaton, 1992	+

3.4 Hypotheses

To draw conclusions pertaining to the effect of FREI on house prices hypotheses must be tested. Based on literature the main finding regarding the main question is that FREI will have effect on house prices, but that this effect will explain a relatively small part of Berlin's house price fluctuations (Chan, 2007; Gholipour, 2013). The first hypothesis formulated (H_0) is the null hypothesis and the second (H_A) states the alternative hypothesis.

- *$H1_0$. An increase in FREI will have **no** effect on Berlin's house prices.*
- *$H1_A$. An increase in FREI will have effect on Berlin's house prices.*

The second pair of hypotheses is formulated due to the discussion about the possibility of a difference in impact of FREI fluctuations compared to DREI fluctuations on house prices. These hypotheses relate to the sixth research question.

- *$H2_0$. There is **no** difference between the effect of FREI fluctuations on house prices compared to the effect of DREI fluctuations on house prices.*
- *$H2_A$. There is a difference between the effect of FREI fluctuations on house prices compared to the effect of DREI fluctuations on house prices.*

The third pair of hypotheses is formulated to show evidence that the control variables, as discussed in literature, do have an explaining value.

- *$H3_0$. An increase in GDP/LTIR/RENTS/CC/POP/DREI will have **no** effect on Berlin's house prices.*
- *$H3_A$. An increase in GDP/LTIR/RENTS/CC/POP/DREI will have effect on Berlin's house prices.*

The last pair of hypotheses focuses on Barras' (1994) model and credit expansion through foreign capital inflows, which will boost asset prices in the short run and lead to a building boom in the long run. Increasing building activity is measured through the indicators planning permits and building completions. Authors like Brixiova et al. (2010) did find evidence in emerging countries on that relation.

- *$H4_0$. Increasing FREI will **not** lead to indications of increasing building activity.*
- *$H4_A$. Increasing FREI will lead to indications of increasing building activity.*

4. Methodology and data

This empirical research aims to quantify a possible relation between FREI dynamics and the development of house prices. This chapter explains the methodology that is used to quantify this relationship between both variables. To do so, it first offers an accurate description and operationalization of the compiled data. Secondly, it describes step by step how the dataset is transformed to overcome regression assumptions and how the model comes to its best results possible due to a lacking amount of data.

4.1 Data composition

To be fully transparent on the data to be used for the estimation this paragraph gives an exact description on how the data are compiled.

The variables used for the regression analysis are obtained from three different independent sources, namely Bulwiengesa AG, DeStatis and the OECD. Bulwiengesa AG is a German research company specialized in real estate economics, which provides data to important institutes like the Deutschen Bundesbank. Therefore Bulwiengesa AG can provide reliable data about the development of house prices, FREI and other real estate related variables. DeStatis is the federal statistical office in Germany, which gather, collect, process, present and analyse general demographic and economic data about Germany as a whole and also for specific areas, such as the German A-cities. DeStatis is part of the Department of Home Affairs.

The first issue that arose in finding an appropriate dataset was the limited availability of data on FREI, since Bulwiengesa AG started collecting FREI specific data in Germany from 2007 onwards. Therefore, only a very short timespan of seven years could be obtained. Due to this short timespan and to make sure the sample size became large enough, the dataset was expanded with six A-cities. These A-cities are Berlin, Dusseldorf, Frankfurt, Hamburg, Cologne, Munich and Stuttgart. The economic markets of the seven A-cities are Germany's largest ones in terms of their functionality, real size and influence on international, national and local levels. The expanding of the sample size from 7 cases to 49 cases results in measuring the effect of FREI fluctuations on house price developments for the seven cities, instead of only for Berlin. By including a dummy-variable for Berlin the effect of FREI on house prices in Berlin can be filtered. This regional pooling of data allows the dataset to better meet data assumptions of a regression model and it results in a higher robustness and power of the estimation due to a larger sample.

The second issue that arose in relation with FREI data is the analysis with which the data are compiled. First of all, there is no differentiation in the data between asset and share deals. In share deals the investor acquires all (or a part of the) shares in the German real estate company from one or more sellers. With the acquisition of this stake in the company, the investor automatically becomes the owner of the legal entity including all its real estate assets. In an asset deal the foreign investor purchase individual real estate assets or portfolios including multiple assets. Although, the number of share deals won't be very high, the sum includes both deals. Secondly, only commercial transactions are part of the analysis of which the data are compiled. Therefore, foreign private asset deals are not included in the data, but there are some transactions where the investment cannot be allocated exactly. For example, larger investments of private persons where it is not known if this private person buys a property privately or with the help of a company in the background. The analysis of

these foreign private deals, almost exclusively in relationship with residential properties, is a grey area in contrast to well-documented deals for institutional investors. Therefore, the data do not include foreign private deals to start with, but there is this risk of a lack of definition. For example, in Berlin there are a lot of private foreign persons from Russia or Norway that have bought secondary residences for their pension plans. These non-commercial investments do have an impact on the real estate market. The best description for this FREI data can be defined as followed. FREI include both institutional and individual commercial investments through either share deals or asset deals.

The property price index used in the estimation is based on the "Bulwiengesa Property Market Index", which is a year-by-year population weighted average. Since 1975 Bulwiengesa has been monitoring the property market in 50 West-German cities, and in 125 German cities since 1990. The index has been based on empirical research and data collection. The 'Deutsche Bundesbank' accredited the quality of these data in 2003 and after examining several data sources available on the market, the Bundesbank decided to use the "Bulwiengesa Property Market Index" for their own calculations, which they are providing to the European Central Bank. The residential price index used in the estimation is an unweighted average of 7 residential indicators that include information about the purchase prices of houses, apartments and building sites (figure 4.1).

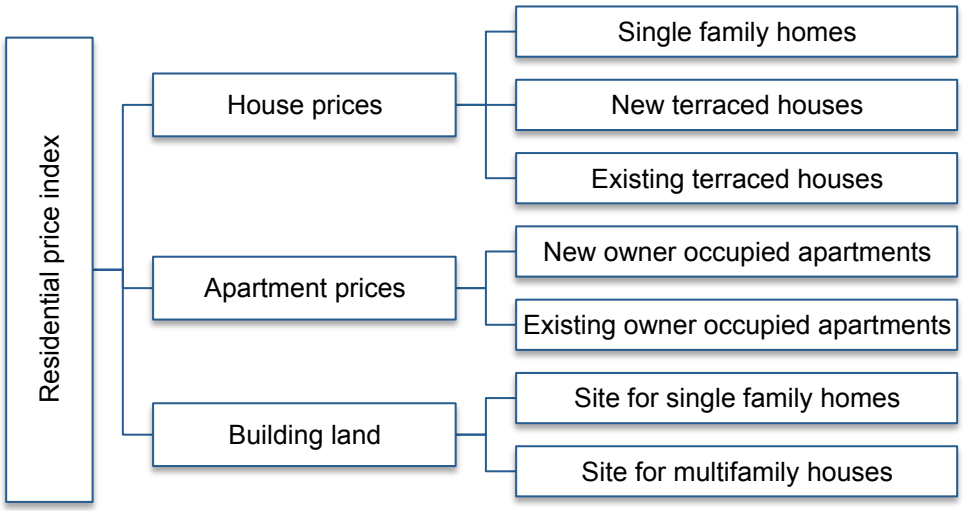
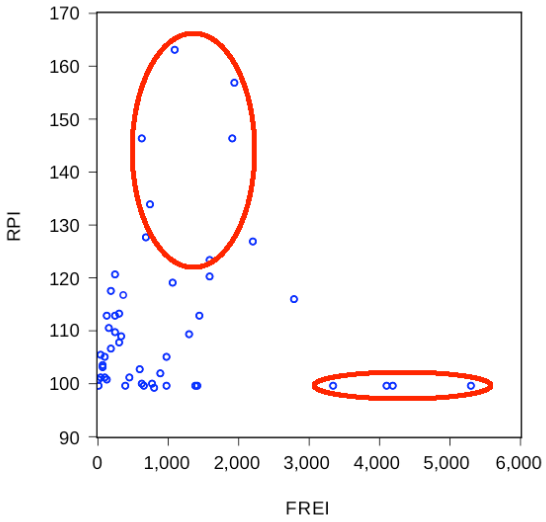


Figure 4.1 Composition Residential Price Index
Source: Bulwiengesa AG, RIWIS

The residential rents are included in the estimation as a price index consisting of two indicators; real residential rents for existing flats and for new flats. The price index for construction costs has been based on 33 separate price indicators for residential buildings.



Graph 4.1 Scatterplot RPI (price index) and FREI (in Millions €)

Graph 4.1 shows that the two measurements of the variables do not give an obvious relation between these two. At the 100 per cent level of RPI, FREI shows a divergent array of observations. The same applies to RPI, when FREI observations are between 1.000 and 2.000. Therefore, it is obvious to convert the FREI variable into a price index as well to rule out any error due to this measurement difference. Measuring FREI as a price index is also common in real estate practice and therefore this statistical argument can be adopted. To be consequent, the variable DREI is also converted into a price index.

Table 2 gives a full overview of the variables with the source and type of data. All price indices have 2007 as the index year.

Table 2. Variable overview

Variable[12]	Abbreviation	Unit	Source
Residential purchase prices	RPI	Price index (%)	Bulwiengesa AG, RIWIS
Foreign real estate investments	FREI	Price index (%)	Bulwiengesa AG, RIWIS
Gross domestic product per capita	GDP	€ (per capita)	DeStatis
Long-term interest rate	LTIR	Price index (%)	OECD
Residential rents	RENTS	Price index (%)	Bulwiengesa AG, RIWIS
Construction costs (residential buildings)	CC	Price index (%)	DeStatis
Population	POP	Real number	DeStatis
Domestic real estate investments	DREI	Price index (%)	Bulwiengesa AG, RIWIS

4.2 Methodology

An ordinary least squares (OLS) regression will be used to estimate the effect of FREI fluctuations to the development of house prices. The OLS regression will be performed on a time series cross-section (TSCS) dataset. The cross-sections that are included are the seven cities over a time span of seven years from 2007 till 2013, which adds up to 49 cases. The dependent variable is RPI, explained by the variable of interest, FREI, and six control variables that are selected on the basis of prior literature. The following equation will be used.

[12] All variables are ratio variables.

$$Y_t = \alpha + \beta_X X_t + \beta_z Z_t + \varepsilon_t \qquad \text{(eq. 1)}$$

Y_t	=	Dependent variable RPI at time t
α	=	Intercept
β_X	=	Coefficient for FREI
X_t	=	Independent variable FREI at time t
β_z	=	Coefficients for the control variables
Z_t	=	Vector of control variables at time t
ε_t	=	Error term

According to Hair et al. (2010) a researcher need to follow a four-stage decision process to come to the best model fit. In stage one the researcher examines the appropriateness of his research problem in applying a multiple regression, specifies the statistical relationship and selects dependent and independent variables. The application of the multiple regression falls into two broad classes of research problems: 'prediction' and 'explanation'. The research problem, as stated in paragraph 1.2, falls into both classes. 'Prediction' involves the extent to which the independent variable can explain the dependent variable, while 'explanation' examines the regression coefficients for each independent variable. In the second step, defining the statistical relationship, it is obvious that the relationship trying to be measured is a statistical one and not a functional relationship. The data used to measure the relationship is partially representing human behaviour and it is not a perfect prediction and therefore an error in prediction is present; a random component is always present in the relationship (Hair et al., 2010, p168). The last step, selecting the variables based on prior literature, has been done in chapter 3.

4.2.1 Descriptive statistics

In this section stage two of the decision process will be further examined. First of all, as earlier explained in paragraph 4.1, obtaining an adequate sample size to ensure sufficient statistical power and a high generalizability is problematic. Due to the limited availability of data a sample size of 49 cases has been obtained, which is according to Hair et al. (2010) larger than a small sample, which is characterized as having fewer than 30 cases. However, the sample size is small enough to have implications for its statistical power in relation to the R^2. Secondly, the generalizability of the results can be questioned when having a small sample size. A general rule is that the ratio of cases to independent variables should never fall below 5:1 and the desired level is between 15 to 20 cases for each independent variable. The dataset to be used meets the minimum requirement but it does not meet the desired level. A ratio of 7 cases for each independent variable is measured.

4.2.2 OLS assumptions

To judge whether an OLS regression is appropriate to answer the research problem the dataset must meet four assumptions to draw justified conclusions from the regression results. This implies if the errors in prediction are a result of an actual absence of a relationship among the variables, or are they caused by some characteristics of the data not accommodated by the regression model. The four assumptions will apply both to the individual variables and to the relationship as a whole (Hair et al., 2010). These four assumptions will be explained in this subparagraph and the data will be examined in response to these assumptions. This is part of stage three of the decision process.

Linearity of the phenomenon measured
The linearity of the relationship between dependent and independent variables represents the degree to which the change in the dependent variable is associated with the independent variable. Therefore the regression coefficient is constant across the range of values for the independent variable. The concept of correlation is based on a linear relationship, thus making it a critical issue in regression analysis (Hair et al., 2010). Graph C1 in appendix C reveals the difference in relationship between RPI and FREI, when based on raw data and first differences. In the second scatterplot of Graph C1, after taking the first differences of the variables, a linear relationship is achieved.

Independency of the error terms
The 'independency of the error terms' is in general a problem for time series data as well as for cross-section data. Relating to the dataset to be used; time series data are easily correlated from year to year per city (spatial correlation of the errors), while cross-section data are easily correlated between cities per year (contemporaneous correlation of the errors). The correlograms per variable in appendix C show that GDP and POP are highly autocorrelated over time. When taking the first differences, none of the variables are autocorrelated. Also, the correlation between variables, as shown in the correlationmatrices C1 and C2 in appendix C, gives lower values when taking first differences. Lastly, the Durbin-Watson statistic, which also detects autocorrelation, is taken into account when assessing a model's overall fit.

Constant variance of the error terms
Assessing the satisfaction of the homoscedasticity criteria can be problematic, because of the cross-section data. This type of data tends to be heteroscedastic, such that they may have differing variances across cities. To comply with this assumption fixed effect for the cities will be taken into account. The results of these fixed effects will be taken into account later, when the regression results in different models are described.

Normality of the error term distribution
To assess the condition of 'normality of the error term distribution' the standardized residuals of the model that fits best will be plotted in a histogram. This histogram should be normally distributed and this can be checked visually. Because this assumption will be checked for the error term of the model that fits best the histogram of the standardized residuals will be discussed later on.

4.2.3 Regression approach
TSCS designs often violate the standard OLS assumptions and encounter diverse statistical problems with for example autocorrelation when applying in a regression. This section addresses stage four and presents the choices that have been made in estimating the models and to arrive at the best overall model fit.

To begin an equation is estimated with the raw data, without statistic transformations of the variables. This pooled regression, as shown in model 1 appendix D, gives no explanation between various cities. Therefore the heterogeneity of the cities that may exist is denied. Although the model as a whole is significant, only the variable RENTS is significant on a five per cent level. Although model 1 has no variables that are significant on a ten per cent level, it is interesting to look at this significance level due to the small sample size. The Durbin-

Watson statistic is used to detect the presence of autocorrelation in the residuals of an OLS regression. The value is always between 0 and 4, in which close to 0 means there is positive autocorrelation and close to 4 indicates negative autocorrelation. A value of 2 means there is no autocorrelation. The results of model 1 give a value of 0.25 for the Durbin-Watson statistic, so positive autocorrelation.

The next step to improve the model fit is to correct for the autocorrelation, which model 1 encounters, by estimating the model for first differences. This second model has 42 observations, because the cases of the variables with first differences are calculated as "Dvariable = variable – variable(-1)" and therefore six years are included instead of seven years. In spite of the smaller sample size, taking the first differences gives a better model fit; the Durbin-Watson statistic is higher, the unexpected high R^2 of the first model is now lower and the variable of interest is significant. CC is now significant on a ten per cent level. By taking the first differences a second equation is formulated as following.

$$\triangle Y_t = \beta_X \triangle X_t + \beta_z \triangle Z_t + \triangle \varepsilon_t \qquad \text{(eq. 2)}^{13}$$

A next step in achieving a better model fit could be using fixed effects for the unobserved variables per city, assuming that something within the individual entity (in this case the cities) may impact or bias the regression outcome. This city specific information, for example, location, composition of the housing supply and demography, is not yet taken into account in the first model, but it is already in the second model. This is because first differences actually already corrects for this city specific information, only the fixed effects model allows for heterogeneity amongst the cities by allowing having its own intercept value. Although these intercepts differ across the cities they do not differ over time, showing it is time invariant. Model 3 gives a fixed effects model based on the raw data and model 4 gives a fixed effects model based on first differences. Model 3 does not give a good model fit, while the Durbin-Watson value is too low, indicating positive autocorrelation and no variables have a significant P-value. Model 4 gives the best model fit so far, with a Durbin-Watson value of 1,62, FREI and CC significant on a one per cent level and DREI is significant on a ten per cent level.

As said before designing a model with both fixed effects and first differences is taking the same unobserved city specific information into account. However, the coefficients of models 2 and 4 vary more than expected which indicates that there are extra differences between cities that the fixed effects are taking into account and first differences do not. Therefore, the fixed effects model based on first differences has the best model fit so far.

A last option to achieve the best model fit is to estimate a random effects model instead of a fixed effects model. While fixed effects allow for the cross-sections to have its own intercept value, random effects do not. The fixed effects model treats the explanatory variables as if the quantities were non-random, while the random effects model treats them as if they arise from random causes. Therefore a fixed effects model would theoretically be a better choice, because the variables that influence the development of house prices are non-random and city specific. From a statistical viewpoint it can be negotiable to use the random effects model when that model would give a better model fit and the benefits outweigh the disadvantages.

[13] The intercept in the difference equation is the time trend.

Due to the composition of the dataset a random effects model cannot be estimated, because a random effects model requires a larger number of cross sections than the number of coefficients for a between estimator. The dataset has eight coefficients versus seven cross-sections. Alternately, only the fixed effects model can be estimated.

4.3 Conclusion

After analysing the descriptive statistics, checking for the OLS assumptions and searching for the best model fit an answer can be given on subquestion 4. By taking the first differences the first problems that arose are overcome. There now is a linear relationship between the dependent variable RPI and the variable of interest FREI. The autocorrelation problem with the variables GDP and POP have disappeared and there is no high correlation between independent variables any more. The correlograms and the correlationmatrix C2 in appendix C give proof. The advantages of taking first differences outweigh the disadvantages of the smaller sample size. Model 4 has the best model fit with three significant variables by taking the fixed effects into account together with the first differences. This is consistent with the solutions to overcome the OLS assumptions, because the fixed effects take the heterogeneity of the cities into account and the histogram of the standardized residuals of model 4 (graph C3 appendix C) shows a normal distribution of the error term. It can be concluded that the most favourable method to measure the impact of FREI on Berlin's house prices is a fixed effects model with first differences.[14] To filter out the effect of FREI for Berlin the fixed effects have to be manually inserted, so that the dummy variables per city appear in the results. This has been done in model 5 appendix D.[15] The city with the lowest price development, that is Stuttgart, is taken as reference so that the results are easily interpreted (see graph C6 for the price development per city). The second part of subquestion 4 tries to find an answer in which data should be appropriate to use in the estimation. In chapter 3 variables are selected based on prior literature. These seven control variables can be maintained as data to use in the estimation, because there is no statistical argument found why one or more of these variables cannot be used.

[14] A transformation of the variable of interest (D)FREI to (D)FREI^2 did not improve the model fit and neither the distribution of the variable.

[15] A check whether the coefficients are exactly the same proofs that the fixed effects (dummy variables per city) are entered correct.

5. Results

Now that the most favourable method and the model fit have been discussed in the previous chapter, this chapter interprets the results of the regression analysis. This interpretation allows giving answers on subquestions 5 and 6. The first three hypotheses will be tested on the results of the fifth model as shown in table 5.1 and the last hypothesis on the results of the sixth and seventh model as shown in table 5.2. Lastly, it states the restrictions this research had to cope with.

5.1 Regression results

To draw conclusions pertaining to the effect of FREI on house prices the first pair hypotheses is tested through the regression results. First, the model gives that FREI is significant on a one per cent level. Second, the dummy variable for Berlin is not significant meaning that the regression results for Berlin do not differ from the results for the reference city Stuttgart. Based on these conclusions the null hypothesis $H1_0$ is rejected and the alternative hypothesis $H1_A$ is adopted. An increase in FREI will have a positive effect on the development of Berlin's house prices. This gives a positive answer on subquestion 5, while empirical data showing impacts of FREI on house prices. The results specifically interpreted reveal that if the FREI price index increases with one per cent from one year to another, the RPI increases with 0,051 per cent. This measured effect is comparable with the outcome of Gholipour (2013), but on a different spatial level and for different markets. Both effects of FREI fluctuations on house price developments are significant and positive, but rather small. Other studies where comparable effects are measured find more dramatic results with larger increases of foreign capital inflows and larger house price appreciations (Cordero & Paus, 2008; Ben-Yehoshua, 2008).

- *$H1_0$. An increase in FREI will have **no** effect on Berlin's house prices.*
- *$H1_A$. An increase in FREI will have effect on Berlin's house prices.*

The second pair of hypotheses is formulated due to the discussion about the possibility of a difference in impact of FREI fluctuations compared to DREI fluctuations on house prices. These hypotheses are related to subquestion 6. Firstly, the correlationmatrix C1 shows that FREI is positively correlated by 0,46 with DREI. This is corresponding with Barras' (1994) model of economic and credit expansion due to capital inflows. So, if investments in real estate increase, this is reflected through both domestic and foreign investments. The regression results show that FREI and DREI are significant, but on a different level. The coefficients differ with a 0,034 per cent change. Therefore, the null hypothesis $H2_0$ is rejected and the alternative hypothesis $H2_A$ is adopted. Apparently, there is a difference between FREI fluctuations on house prices and DREI fluctuations on house prices. According to the results, FREI fluctuations have 0,034 per cent more impact than DREI fluctuations on the residential price index (RPI).

- *$H2_0$. There is **no** difference between the effect of FREI fluctuations on house prices compared to the effect of DREI fluctuations on house prices.*
- *$H2_A$. There is a difference between the effect of FREI fluctuations on house prices compared to the effect of DREI fluctuations on house prices.*

Besides the real estate investment variables, CC is also significant. An increase of one per cent of the construction cost price index leads to an increase of RPI by 2,079 per cent. This

impact on RPI is relative large compared to the relation between the real estate investment variables and RPI. Due to the fact that only these three discussed variables are significant in the regression model it is concluded that a fluctuation in the other five control variables do not have effect on Berlin's house prices. These variables are selected based on multiple prior studies and literature sources. Therefore it is peculiar that only two out of seven control variables are significant. A possible explanation for this peculiarity is the short time span of the dataset. It could be that the control variables do have an impact on Berlin's house prices but that this effect becomes perceptible when a longer time span is taken into account. A second possible explanation and a rather explicable one can be found in the light of the peculiarity of the time span. The time span covers the start of the financial crisis in 2008 and the Eurozone crisis in 2009 and ending with the beginning of recovery in 2013. Studies from Gholipour (2013), DiPasquale & Wheaton (1992), Adams & Füss (2010) and Égert & Mihaljek (2007), which are central in selecting the control variables, cover a longer time span and a different period of the economic cycle. Therefore, it is plausible that the peculiarity of the time series underpins the unexpected outcome of the results, i.e. the non-significance of the four control variables that are expected to have a large effect on house prices. At last, it should be noted that Germany's economy resisted the 2008 economic crisis better than other European countries and outperformed them as well.

- *$H3_0$. An increase in GDP/LTIR/RENTS/POP/DREI will have **no** effect on Berlin's house prices.*
- *$H3_A$. An increase in CC will have effect on Berlin's house prices.*

Besides the pre-stated hypotheses the results show that Hamburg and Munich have city specific determinants that influence the development of house prices in these cities. These city specific determinants are not taken into account in the analysis and are therefore not known.

Table 5.1 Regressionmodel 5

	B	sig	(SE)
Intercept	-1,484		(2,025)
FREI	0,051	***	(0,015)
GDP	0,000		(0,000)
LTIR	-0,483		(1,269)
RENTS	0,050		(0,210)
CC	2,079	***	(0,721)
POP	0,000		(0,000)
DREI	0,017	*	(0,009)
Berlin	0,438		(1,806)
Cologne	0,256		(1,674)
Düsseldorf	-0,101		(1,774)
Frankfurt	0,544		(1,737)
Hamburg	6,088	***	(1,737)
Munich	7,781	***	(1,702)
N			42
R-squared			0,759
Adj. R-squared			0,647
F-statistic			6,782
Durbin-Watson stat			1,622

*,**,***: 10%, 5%, 1% significance level

Reference city: Stuttgart

Brixiova et al. (2010) found for Estonia during 2000 till 2007 that increasing amounts of international capital inflows led to a building boom, which is underpinned by Barras' (1994) model of credit expansion through foreign capital inflows. In the short run this capital inflow will boost asset prices followed by a building boom in the long run. Brixiova et al. (2010) statistically examines the underlying factors for Estonia's house price increases finding that these house prices increases are mainly explained by real disposable income and real after-tax mortgage rate and less by housing stock per person. Brixiova et al. (2010) also concludes that a housing boom is fuelled by capital inflows and credit expansion. According to this, hypotheses four are formulated and will be tested. A housing boom is translated into building activity, which is measured through the indicators planning permits (PPI) and building completions (CI).

To test the hypotheses an OLS regression with fixed effects is estimated for both dependent variables planning permits and building completions. Table 5.2 shows the results of these estimations. Firstly, it is important to light out the restrictions of these last models. Taking first differences, as in model 5, would lead to a non-significant model and therefore only taking fixed effects into account led to the best model fit. The error terms are normally distributed as graphs C4 and C5 in appendix C show. Although the correlograms suggest that there is a positive autocorrelation in the variables GDP and POP, the Durbin-Watson test with values of 2,17 and 2,38 reveal that there is very little negative autocorrelation for the models as a whole. Also, there exist high negative correlation between the variables GDP and POP and between LTIR and CC. Lastly, the scatterplots in Graph C2 show hardly any linear relationship between the dependent variables and the independent variable. This is a result of not taking first differences into account.

Theoretically, a time lag is expected in the reaction of PPI and CI to FREI instead of an immediate reaction. It is arguable that a planning permission is issued within the year of increasing capital inflows, but the completions index cannot react within the same year of capital inflow dynamics. This is the result of the long real estate cycle and the long building period. This time lag is not taken into account in the statistical analysis.

Concluding in light of the restrictions of the dataset and of this poor model fit, the following results can be considered. In model 6 with planning permissions as dependent variable FREI is significant on a one per cent level and GDP on a ten per cent level. In model 7 FREI is significant on a one per cent level. Thus, increasing amounts of FREI lead to an increase in the building activity indicators PPI and CI. Therefore, the null hypothesis is rejected and the alternative hypothesis is adopted.[16] The intercept is significant on a five per cent level, which means that *y* is -551,64 when *x* is zero. Further, a one per cent change in FREI leads to a 0,215 per cent change in the completions index and to a 0,236 per cent change in the planning permissions index. This result is underpinning what Brixiova et al. (2010) found for Estonia and is underpinning Barras' (1994) model of credit expansion and building booms.

- *$H4_0$. Increasing FREI will **not** lead to indications of increasing building activity.*
- *$H4_A$. Increasing FREI will lead to indications of increasing building activity.*

[16] Rejecting and adopting hypotheses should be done based on solid and powerful statistical models. Therefore, this conclusion can be doubted in light of the poor model fit and the easing of the statistical assumptions.

Table 5.2 Regressionmodels 6 and 7[17][18]

	Model 6 (PPI)			Model 7 (CI)		
	B	sig	(SE)	B	sig	(SE)
Intercept	72,110		(248,545)	-551,640	**	(267,417)
FREI	0,236	***	(0,068)	0,215	***	(0,073)
GDP	-0,003	*	(0,001)	0,001		(0,002)
LTIR	1,891		(8,066)	13,097		(8,678)
CC	2,333		(1,972)	3,403		(2,121)
POP	0,000		(0,000)	0,000		(0,000)
N			49			49
R-squared			0,522			0,683
Adj. R-squared			0,380			0,589
F-statistic			3,675			7,257
Durbin-Watson stat			2,377			2,168

*,**,***: 10%, 5%, 1% significance level

5.2 Research restrictions

The results of this research and the conclusion in the following chapter should be considered in light of its limitations.

First of all, the short time span of seven years had as a consequence that only a maximum of 49 cases could be obtained when taking a cross section of the seven A-cities. Also, to achieve the best model fit it required to transform the variables to first differences resulting in an even smaller sample size. Therefore, with a longer time span more statistical power could be achieved due to a larger sample size and more FREI fluctuations over time that could influence house price developments. Secondly, the peculiarity of the time series, which includes the start of the economic crisis in 2008 and the financial crisis in 2009 is also a restriction. During this period of crisis and little recovery in 2013 the economy and house price developments react accordingly to this period. The possibility is relatively large, due to these two restrictions, that when the same research is conducted for a different period the results will differ as well.

Another limitation is the availability of disaggregated FREI data on specific types of real estate. It is arguable that foreign residential real estate investments have a larger impact on house price developments than for example foreign industrial real estate investments. Logically, a larger impact of foreign residential real estate investments on house prices could be found than can be found with aggregated FREI data.

[17] When dummy variables are manually entered to filter out any city specific information no dummy variable appeared to be significant. Therefore, these dummies are not shown in the results and the results are applicable to all cities.

[18] Both dependent variables PPI and CI are price indices with 2007 as index year.

6. Conclusion

This chapter finalizes this research with the main conclusion from its analysis. It starts with an answer to the central question and it continues with implications of these findings. Furthermore, it presents recommendations for further research and lastly, a reflection on the research itself is given.

6.1 Central question

The aim of this research is to give insight in the effect of foreign real estate investments on Berlin's house prices. The challenge throughout this research is the limited availability of data and studies on this particular topic. Nevertheless, a TSCS dataset has been compiled with foreign real estate investments as independent variable and seven control variables over a cross-section of seven German cities during a period of seven years (2007-2013). In order to empirically address the central question an OLS regression has been conducted on the dataset.

The regression results indicate that FREI is a determinant for house price developments in Berlin. A positive relation exists between both variables, acknowledging Barras' (1994) model and Gholipour's (2013) findings. After a FREI fluctuation of one per cent from one year to another, ceteris paribus, the residential price index changes with 0,051 per cent. The knowledge of this result has implications for policymakers, namely that they now can decide to attract or focus more on foreign investors to invest in real estate in their country or city to influence house prices. Since the impact of FREI on house prices is rather small it is important to emphasize other benefits of attracting FREI. Attracting foreign investors into real estate market segments results in a stimulus of financial resources, generating employment, facilitating urban development, introducing additional competition in specific real estate segments, introducing new practices in the operation of the real estate industry, attracting international tourists and leaving a favourable impact on the enrolment in higher education (Gholipour, 2013; Rodriguez & Bustillo, 2009; Basu and Yao, 2009; Wei et al., 2006; He et al., 2009; Jiang et al., 1998). Although, these researchers found these enumerated benefits of attracting foreign investors in real estate market segments it is important for policymakers to prevent speculative foreign capital inflows into these segments inflating house prices. Nevertheless, one of the motives for this research were the news reports from the Bundesbank (2013) and Ross (2014) that foreign investors increased house prices in Germany's largest cities leading to an overvaluation of houses.

To prevent this undesirable overvaluation policymakers can consider the difference between the effect of FREI fluctuations on house prices and the effect of DREI fluctuations on house prices. To put this difference in perspective; DREI fluctuations have the same positive relation to house price developments as FREI fluctuations, but with a smaller impact. If DREI fluctuate one per cent from one year to another, ceteris paribus, the residential price index changes with 0,017 per cent instead of 0,051 per cent for a FREI change of one per cent. Data show that since 2008 the volume of DREI exceeded FREI.

Interesting is that the results that Gholipour (2013) found for 21 emerging markets[19] are similar to the results of this research for a mature market, both for different time periods and

[19] The 22 emerging markets are: Bulgaria, China, Croatia, Czech, Estonia, Hungary, Israel, Kazakhstan, Latvia, Lithuania, Malaysia, Mexico, Philippine, Poland, Romania, Serbia, Slovakia, South Korea, Thailand, Tunisia and Turkey.

different parts of the economic cycle. Firstly, it is expected that house prices in emerging and mature markets would react different on FREI dynamics. Nozeman & Van der Vlist (2014) present foreign real estate investment differences between European countries, showing that emerging East-European countries have a small average per year in real estate investments with a large share of foreign investments, while West-European countries have a large average per year in real estate investments with a small share of foreign investments. Thus, it is arguable that emerging markets would react different on foreign investments than mature markets. Secondly, it seems that the peculiarity of the time series does not influence the effect of FREI on house prices. While Gholipour (2013) examined a period of economic upturn and prosperity (2000-2008) this research examined a period of economic downfall (2007-2013). The second time span covers the start of the financial crisis in 2008 and the Eurozone crisis in 2009 and ending with the beginning of recovery in 2013. It is arguable that house prices react different to FREI dynamics during different periods of the economic cycle. Also, it should be noted that Germany, as a mature market, endured the financial crisis different than emerging markets.

Brixiova's (2010) findings for Estonia during 2000 till 2007 and the Barras' (1994) model imply that increased capital inflows are followed by a building boom. Model 6 and 7 (table 5.2) give empirical evidence underpinning this theory, i.e. that foreign real estate investments lead to indications of increased building activity. Building activity is measured through the indicators planning permissions and building completions. There is a slight difference in definitions, meaning that indications of increased building activity does not directly lead to a building boom, but they do support the theory of increased capital inflows leading to a building boom.

6.2 Recommendations for future research

Firstly, the experienced research restrictions point out issues for future research. A longer time span with at least one complete economic cycle increases the sample size leading to more statistical power and a higher possibility in finding significant variables influencing the residential price index.

While this research focused on Berlin's modest but exceptional real estate market, future research could focus on higher spatial levels, for example on regions or countries. Nozeman & Van der Vlist (2014) address the division between domestic and foreign real estate investments for European countries. They reveal considerable differences between countries in their attractiveness for foreign investment related to market size and institutional conditions. While their data from 2000 until 2012 show that West-European countries have a large total of average investments per year in real estate teaming up with a large share of domestic investments, East-European countries have a significant smaller average per year, but with a large share of foreign investments. Future research could focus on these differences and try to find empirical data underpinning these divisions.

Studies show that FREI can be a large component of FDI (Ben-Yehoshua, 2008) and that FREI is often a large component of a nation's capital inflow (e.g. Rodríguez & Bustillo, 2010; for Spain; Cordero & Paus, 2008; for Costa Rica). Therefore, it is interesting to complement this research with FDI data or to concentrate on FDI as a variable of interest instead of FREI. There exist a positive correlation between both variables suggesting that FDI fluctuations do have an impact on the development of house prices. FDI data are available on national level

from 2000 onwards. Also, several companies such as fDi Markets and UNCTAD can provide FDI data on a regional level and even city level.

This research used aggregated FREI data and does not differentiate for specific types of real estate. It is arguable that investments in residential real estate have a different impact on house price developments than for example investments in commercial or industrial real estate. Further research could focus on differences in real estate investments and the effects of these different investments on house price dynamics. OECD has disaggregated FDI data on specific real estate types on national level. The same kind of approach and methodology of this research could be used.

6.3 Reflection

This research underpins Gholipour (2013) findings on the effect of FREI fluctuations on house prices. Also, the results of model 6 and 7 imply that there is empirically backed evidence underpinning Barras' (1994) model and Brixiova's (2010) findings of increasing capital inflows leading to increased building activity. These results must be considered in light of the research restrictions and the poor model fit. However, I am glad that I can make such a contribution to these theories.

Looking back at the research process the most time consuming part was to understand the encountered problems with the dataset and the statistical analysis and to find solutions to overcome these problems. TSCS datasets can be rather complicated, because these datasets combine two statistical disciplines; time series and cross sections. Each discipline comes with unique problems and solutions, but when combining these two the problems and solutions blend together, making it even more difficult. At first, I would have said that with the experience I have now I would have taken a different approach in finding a subject. The approach I followed now was first to choose a subject that I am interested in and subsequently, after writing the research proposal, finding suitable data for the statistical analysis. Because of this approach I encountered the difficulties with the dataset. It is easy to follow a different approach so to make sure that there is sufficient data available and it is a lot more challenging to select problems when data restrictions are at stake. I am glad that I overcame this challenge. After all, would science have made such a progress when every scientist had waited till sufficient data were available?

Also, I found it sometimes frustrating to do this research far away from my supervisor and therefore not able to speak face-to-face with him. Although, I had some help from the Humboldt University, the meetings with my supervisor and co-reader proved to be most helpful. Nevertheless, conducting this research and writing my thesis in Berlin helped me to improve myself on a professional level.

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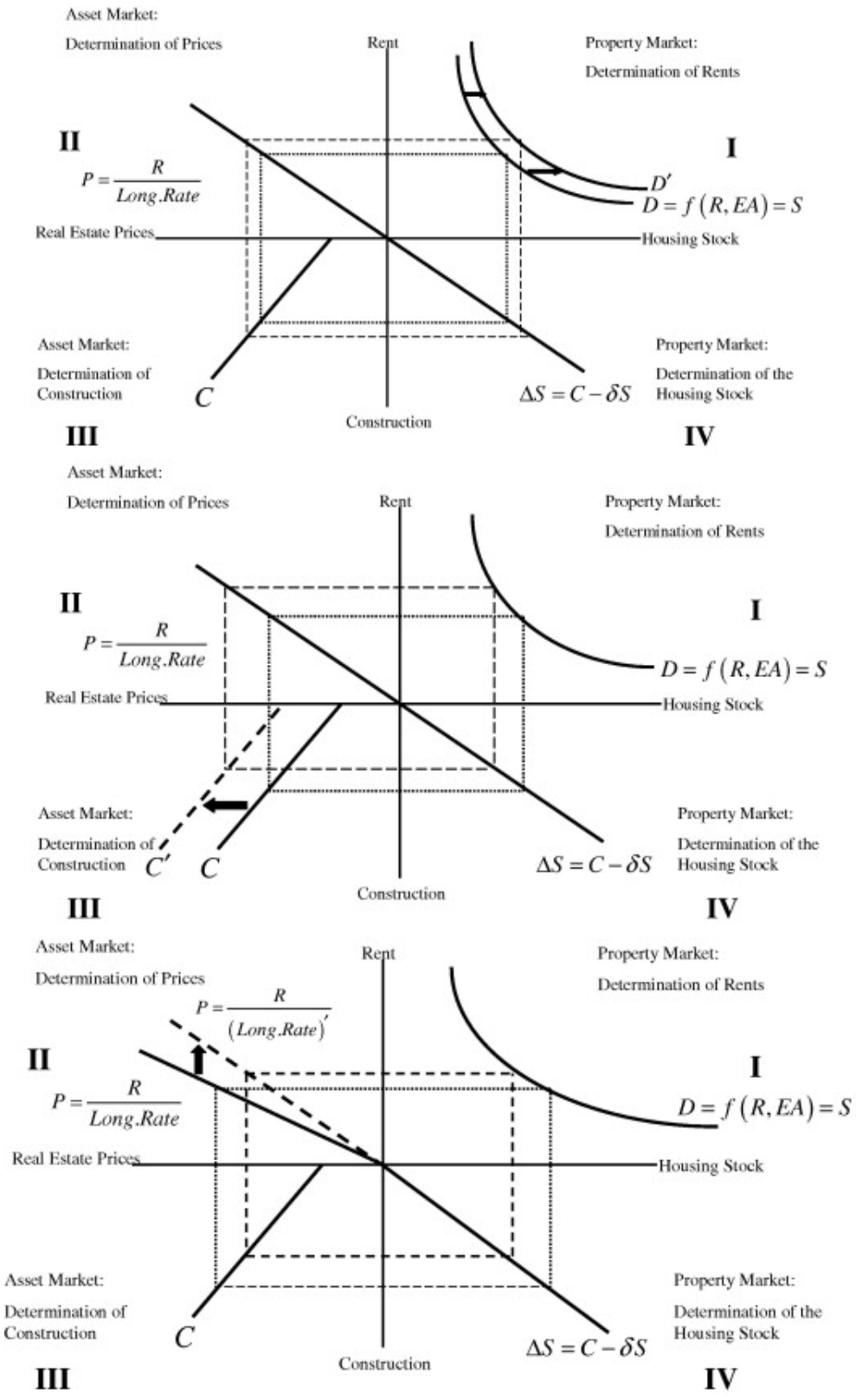
Appendix A The impact of macroeconomic variables on real house prices

The first panel shows the effects of an increase in economic activity. The second panel shows the effects of an increase in long-term interest rates. The third panel shows the effects of an increase in general construction costs. Source: Adams & Füss (2010).



Appendix B Berlin's investment environment 2013

City Investment prospects

		Existing Investments	New Investments	Development
1	Munich	3.73	3.56	3.29
2	Berlin	3.72	3.46	3.09
3	London	3.57	3.23	3.13
4	Istanbul	3.55	3.47	3.46
5	Hamburg	3.49	3.45	3.21
6	Paris	3.36	3.20	3.08
7	Zurich	3.33	3.28	3.25
8	Stockholm	3.31	3.13	2.90
9	Moscow	3.31	3.15	3.08
10	Warsaw	3.24	3.20	3.12
11	Frankfurt	3.20	3.16	2.73
12	Copenhagen	3.11	3.14	2.69
13	Vienna	3.10	3.07	2.89
14	Edinburgh	3.03	2.95	2.61
15	Lyon	2.90	2.78	2.60
16	Milan	2.75	2.55	2.16
17	Prague	2.73	2.68	2.38
18	Brussels	2.70	2.62	2.42
19	Helsinki	2.68	2.67	2.41
20	Dublin	2.66	2.88	2.30
21	Rome	2.61	2.48	2.12
22	Amsterdam	2.49	2.55	2.03
23	Barcelona	2.42	2.31	1.73
24	Madrid	2.29	2.37	1.79
25	Budapest	2.07	2.17	1.90
26	Lisbon	2.03	2.24	1.85
27	Athens	1.67	1.97	1.65

Good Fair Poor

Note: On a scale of 1 to 5
Source: *Emerging Trends in Real Estate Europe 2013* survey.

Berlin outlook

Investment Prospects

	Prospects	Rating	Ranking
Existing Property Performance	Good	3.72	2nd
New Property Acquisitions	Fair	3.46	3rd
Development Prospects	Fair	3.09	7th

All-Property Returns

Sources: Investment prospects: *Emerging Trends in Real Estate Europe 2013 survey.*
All-property returns: Investment Property Databank.

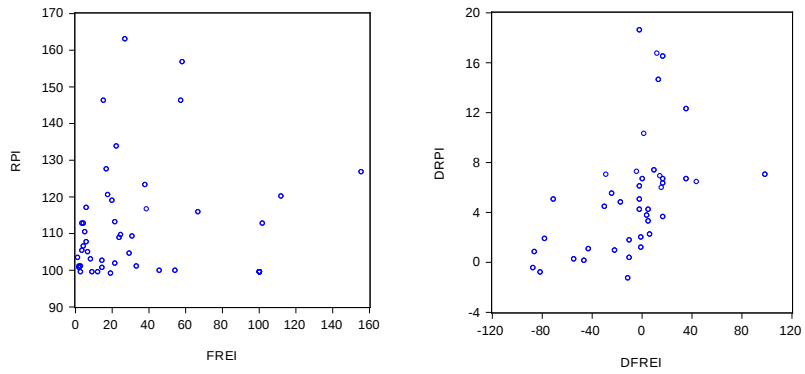
Best Sectors for Acquisitions by City

	Office	Retail	Industrial	Apartment	Hotel
Amsterdam	8	9	5	9	2
Athens	4	6	0	3	10
Barcelona	10	13	4	8	12
Berlin	13	21	5	40	10
Brussels	15	13	4	9	3
Budapest	6	9	2	3	1
Copenhagen	2	12	0	9	1
Dublin	12	5	3	7	5
Edinburgh	8	4	3	6	5
Frankfurt	20	22	9	18	6
Hamburg	17	22	16	24	8
Helsinki	7	10	2	4	1
Istanbul	16	16	14	10	17
Lisbon	8	9	2	5	3
London	31	15	12	31	17
Lyon	11	11	12	7	2
Madrid	12	14	1	9	9
Milan	8	24	3	12	8
Moscow	8	10	7	5	4
Munich	28	26	7	25	11
Paris	33	28	6	10	8
Prague	10	11	3	3	0
Rome	3	18	2	10	8
Stockholm	10	15	4	11	4
Vienna	10	10	0	5	3
Warsaw	16	17	7	5	3
Zurich	11	12	3	11	3

Sector recommended by: 30 or more 15-29 14 or fewer respondents

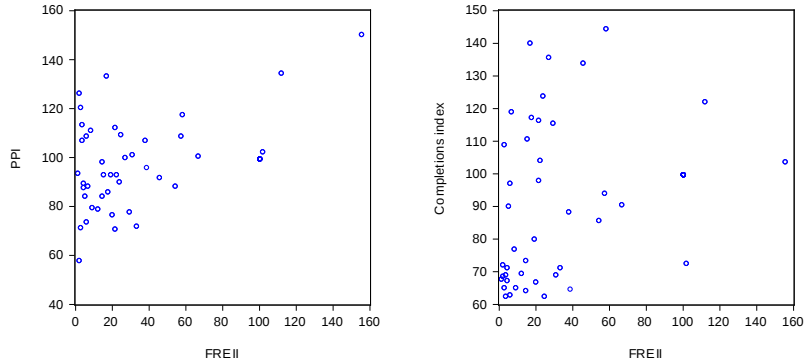
Source: *Emerging Trends in Real Estate Europe 2013* survey.

Appendix C Descriptive statistics

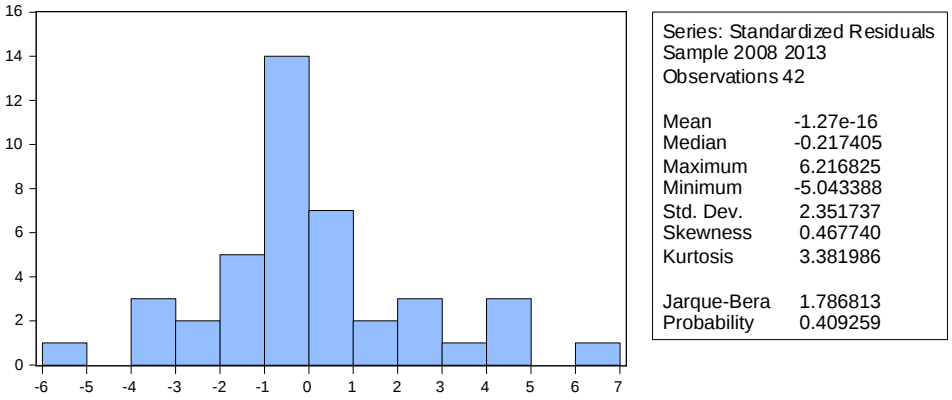


Graph C1 Scatterplots (D)RPI – (D)FREI

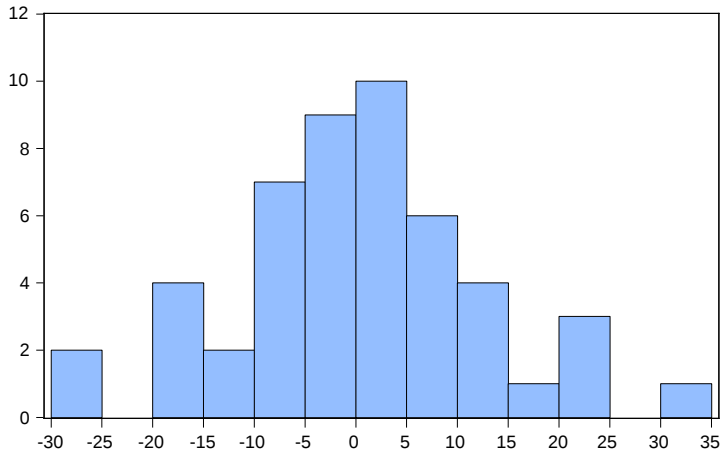
Lights out the difference in relationship between variables when based on raw data and first differences (D). In the second scatterplot a linear relationship can be seen.



Graph C2 Scatterplots PPI and CI - FREI

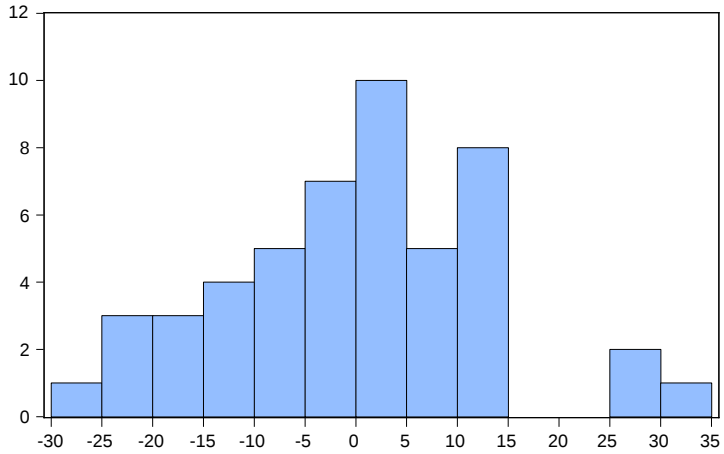


Graph C3 Histogram of the standardized residuals of model 4



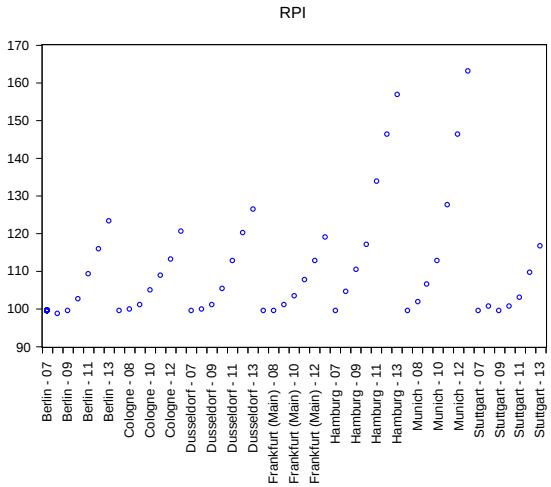
Series: Standardized Residuals	
Sample 2007 2013	
Observations 49	
Mean	2.90e-16
Median	0.063629
Maximum	31.21463
Minimum	-27.31127
Std. Dev.	12.27651
Skewness	0.136656
Kurtosis	3.103065
Jarque-Bera	0.174200
Probability	0.916586

Graph C4 Histogram of the standardized residuals of model 6



Series: Standardized Residuals	
Sample 2007 2013	
Observations 49	
Mean	1.16e-15
Median	0.117962
Maximum	32.58275
Minimum	-27.39288
Std. Dev.	13.20864
Skewness	0.126048
Kurtosis	2.953665
Jarque-Bera	0.134137
Probability	0.935131

Graph C5 Histogram of the standardized residuals of model 7



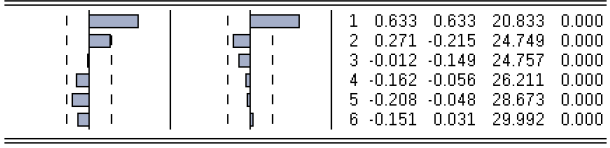
Graph C6 Dot plot: RPI

The city with the lowest price development (Stuttgart) is taken as reference city in regression model 5.

Correlograms

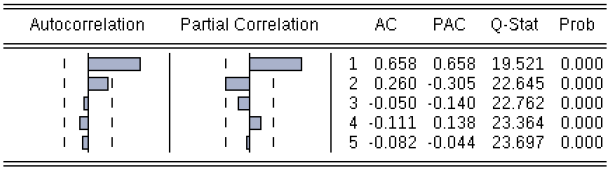
Correlograms show a graphic representation of the autocorrelation of variables.

RPI



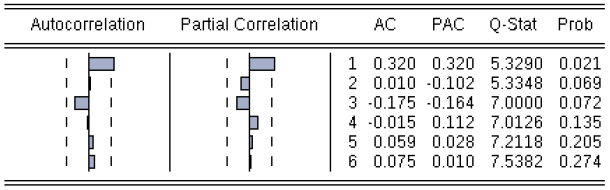
	AC	PAC	Q-Stat	Prob
1	0.633	0.633	20.833	0.000
2	0.271	-0.215	24.749	0.000
3	-0.012	-0.149	24.757	0.000
4	-0.162	-0.056	26.211	0.000
5	-0.208	-0.048	28.673	0.000
6	-0.151	0.031	29.992	0.000

DRPI



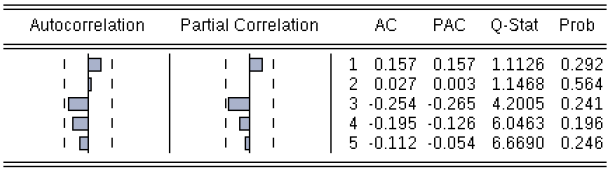
	AC	PAC	Q-Stat	Prob
1	0.658	0.658	19.521	0.000
2	0.260	-0.305	22.645	0.000
3	-0.050	-0.140	22.762	0.000
4	-0.111	0.138	23.364	0.000
5	-0.082	-0.044	23.697	0.000

FREI



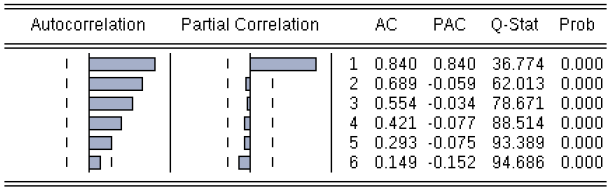
	AC	PAC	Q-Stat	Prob
1	0.320	0.320	5.3290	0.021
2	0.010	-0.102	5.3348	0.069
3	-0.175	-0.164	7.0000	0.072
4	-0.015	0.112	7.0126	0.135
5	0.059	0.028	7.2118	0.205
6	0.075	0.010	7.5382	0.274

DFREI



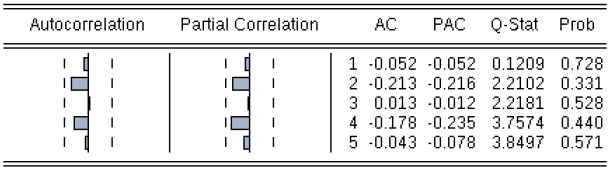
	AC	PAC	Q-Stat	Prob
1	0.157	0.157	1.1126	0.292
2	0.027	0.003	1.1468	0.564
3	-0.254	-0.265	4.2005	0.241
4	-0.195	-0.126	6.0463	0.196
5	-0.112	-0.054	6.6690	0.246

GDP



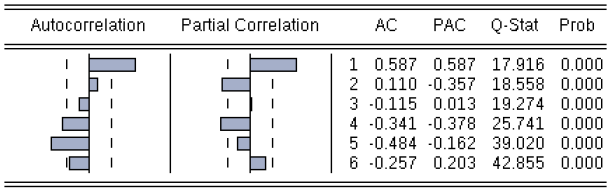
	AC	PAC	Q-Stat	Prob
1	0.840	0.840	36.774	0.000
2	0.689	-0.059	62.013	0.000
3	0.554	-0.034	78.671	0.000
4	0.421	-0.077	88.514	0.000
5	0.293	-0.075	93.389	0.000
6	0.149	-0.152	94.686	0.000

DGDP



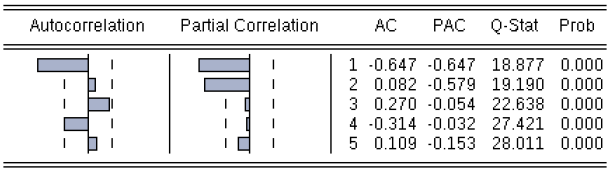
	AC	PAC	Q-Stat	Prob
1	-0.052	-0.052	0.1209	0.728
2	-0.213	-0.216	2.2102	0.331
3	0.013	-0.012	2.2181	0.528
4	-0.178	-0.235	3.7574	0.440
5	-0.043	-0.078	3.8497	0.571

LTIR



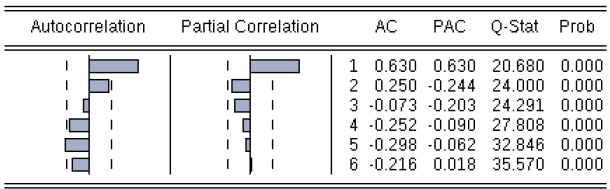
	AC	PAC	Q-Stat	Prob
1	0.587	0.587	17.916	0.000
2	0.110	-0.357	18.558	0.000
3	-0.115	0.013	19.274	0.000
4	-0.341	-0.378	25.741	0.000
5	-0.484	-0.162	39.020	0.000
6	-0.257	0.203	42.855	0.000

DLTIR



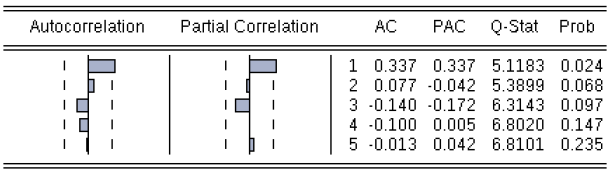
	AC	PAC	Q-Stat	Prob
1	-0.647	-0.647	18.877	0.000
2	0.082	-0.579	19.190	0.000
3	0.270	-0.054	22.638	0.000
4	-0.314	-0.032	27.421	0.000
5	0.109	-0.153	28.011	0.000

RENTS



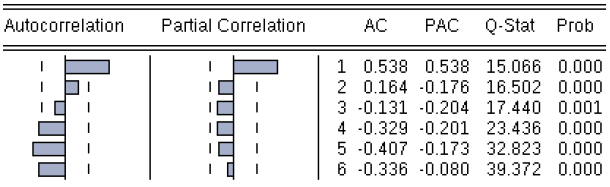
	AC	PAC	Q-Stat	Prob
1	0.630	0.630	20.680	0.000
2	0.250	-0.244	24.000	0.000
3	-0.073	-0.203	24.291	0.000
4	-0.252	-0.090	27.808	0.000
5	-0.298	-0.062	32.846	0.000
6	-0.216	0.018	35.570	0.000

DRENTS



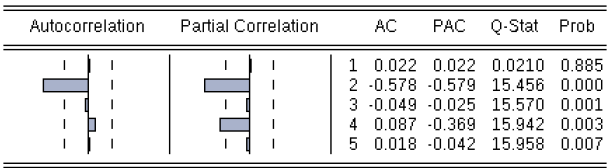
	AC	PAC	Q-Stat	Prob
1	0.337	0.337	5.1183	0.024
2	0.077	-0.042	5.3899	0.068
3	-0.140	-0.172	6.3143	0.097
4	-0.100	0.005	6.8020	0.147
5	-0.013	0.042	6.8101	0.235

CC



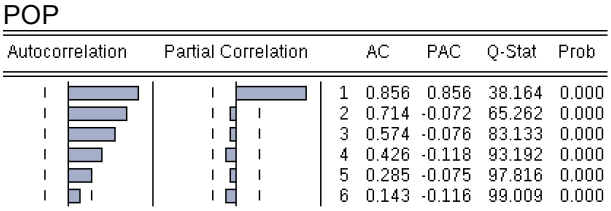
	AC	PAC	Q-Stat	Prob
1	0.538	0.538	15.066	0.000
2	0.164	-0.176	16.502	0.000
3	-0.131	-0.204	17.440	0.001
4	-0.329	-0.201	23.436	0.000
5	-0.407	-0.173	32.823	0.000
6	-0.336	-0.080	39.372	0.000

DCC



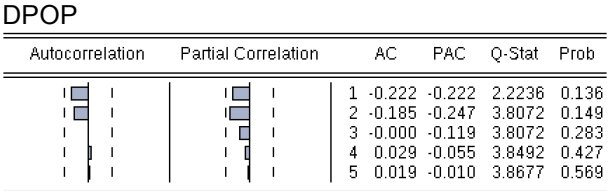
	AC	PAC	Q-Stat	Prob
1	0.022	0.022	0.0210	0.885
2	-0.578	-0.579	15.456	0.000
3	-0.049	-0.025	15.570	0.001
4	0.087	-0.369	15.942	0.003
5	0.018	-0.042	15.958	0.007

POP



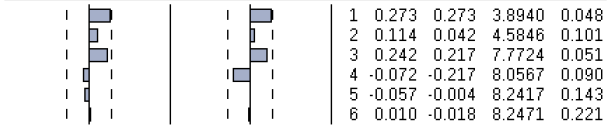
	AC	PAC	Q-Stat	Prob
1	0.856	0.856	38.164	0.000
2	0.714	-0.072	65.262	0.000
3	0.574	-0.076	83.133	0.000
4	0.426	-0.118	93.192	0.000
5	0.285	-0.075	97.816	0.000
6	0.143	-0.116	99.009	0.000

DPOP



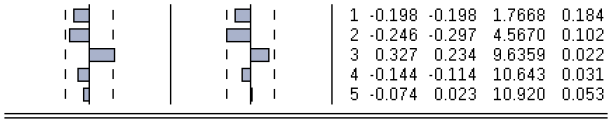
	AC	PAC	Q-Stat	Prob
1	-0.222	-0.222	2.2236	0.136
2	-0.185	-0.247	3.8072	0.149
3	-0.000	-0.119	3.8072	0.283
4	0.029	-0.055	3.8492	0.427
5	0.019	-0.010	3.8677	0.569

DREI



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.273	0.273	3.8940	0.048
		2	0.114	0.042	4.5846	0.101
		3	0.242	0.217	7.7724	0.051
		4	-0.072	-0.217	8.0567	0.090
		5	-0.057	-0.004	8.2417	0.143
		6	0.010	-0.018	8.2471	0.221

DDREI



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.198	-0.198	1.7668	0.184
		2	-0.246	-0.297	4.5670	0.102
		3	0.327	0.234	9.6359	0.022
		4	-0.144	-0.114	10.643	0.031
		5	-0.074	0.023	10.920	0.053

The correlationmatrices in the tables below show the extent to which the independent variables are correlating with each other. The highest correlations that cause problems are in red.

Correlationmatrix C1. Raw data

	FREI	GDP	LTIR	RENTS	CC	POP	DREI
FREI	1						
GDP	0.051372	1					
LTIR	0.167569	-0.055831	1				
RENTS	0.103229	0.042382	-0.831455	1			
CC	-0.135875	0.066003	-0.964627	0.855014	1		
POP	-0.027589	-0.848845	-0.005516	0.133941	0.005046	1	
DREI	0.463808	-0.053444	-0.370631	0.485393	0.381647	-0.018789	1

Correlationmatrix C2. First differences

	DFREI	DGDP	DLTIR	DRENTS	DCC	DPOP	DDREI
DFREI	1						
DGDP	0.326149	1					
DLTIR	-0.059500	0.298466	1				
DRENTS	0.386317	0.198778	-0.040984	1			
DCC	-0.003486	0.144044	0.211379	0.329034	1		
DPOP	-0.089372	0.017777	-0.199197	-0.204487	-0.171581	1	
DDREI	0.319695	0.146485	0.011497	0.068190	-0.342261	0.313797	1