CoRE
Campus of
Real Estate

ROBERT GÖÖTZ

Introducing a six quadrant model of the housing market in the short-term view

Introducing a six quadrant model of the housing market

in the short-term view

-

The influence of real interest rate changes on the stock prices of residential real estate,

side effects of the interest policy of the European Central Bank

on the German housing market

by

Robert Göötz[*]

robert.gootz@hfwu.de

Working Paper No. 1/2017

February 2015; this version: October 2017

Abstract

This paper introduces a six-quadrant model of the housing market in the short-term view. It brings up a combination of a short-term real estate market model for investment purposes with parts of the financial markets – here especially a slightly modified debt market. It is a simple and handy model, tested with empirical data of the German stock prices for residential real estate for the period of 2000 to 2013. The analyses show that the evolution of the housing prices is mainly associated with the change of selected interest rates and yields on mortgage bonds.

Date of Submission: 27.10.2017

JEL codes: R31, E37, E44

Keywords: housing market, short-term, house prices, indicator model, six quadrant model, interest effects, German housing prices

* Robert Göötz is a professor for real estate asset management at the Nurtingen-Geislingen University. He is also the director of the idiw – institute for real estate and housing economics. Department of Real Estate, Nurtingen-Geislingen University, Parkstrasse 4, D-73312 Geislingen.

I. Introduction and literature review

One of the major efforts in the economic science is to develop models for markets that ultimately reflect the creation of a market equilibrium. This could be done for the short term or the long view.

In the past, several models for the real estate markets were invented to explain a long-term equilibrium. One of the most discussed models was created by DiPasquale / Wheaton in 1992.[1]

Decades before various models in different alignments were invented to examine "the" real estate market from different points of view. As some early papers the works of Muth (1960)[2] and Maisel (1963)[3] should be mentioned. Quickly papers followed which integrated the mortgage market in their argumentative models. As examples the works of Sparks (1967)[4], Smith (1969)[5] and Fair (1971)[6] should be mentioned. These housing models mainly dealt with the four characteristics durability, heterogeneity, spatial fixity and government involvement.[7] The discussion of these characteristics has its roots in the famous paper of Tiebout (1956) "a pure theory of local expenditures".[8]

A very nice overview upon the literature of the 1970s and the 1980s was given by Smith, Rosen, Fallis (1988).[9] DiPasquale / Wheaton (1992) put those approaches together as already mentioned above and create a general model of the housing market.[10] They also invented a model to describe future prices for owner-occupied housing (1994).[11] This model is based on

---

[1] See Di Pasquale, D. / Wheaton, W. (1992), p. 188 et seq.
[2] See Muth, R. (1960).
[3] See Maisel, S. (1963).
[4] See Sparks, G. (1967), p. 304 et seq.
[5] See Smith, L. (1969), p. 799 et seq.
[6] See Fair, R. (1971), p. 2 et seq.
[7] Ibid. pp. 34-41.
[8] See Tiebout, C. (1956).
[9] See Smith, L. / Rosen, K. / Fallis, G. (1988).
[10] Almost all of these models were intended to explain a long-term equilibrium with a certain examined characteristic. Steps forward were made to create a general model of the housing market with relaxing the restrictive assumptions to explicit discuss the four basic characteristics of the housing market.
[11] See Di Pasquale, D. / Wheaton, W. (1994).

macroeconomic values like demographics, real permanent income, real price level of housing, the costs of financing and the alternative cost of renting.

With the bursts of several real estate bubbles the focus changed towards a short-term view – mainly in prediction to forecast the next bubble explosion and possibly give a warning right in time. Starting in the late 1990s and the early 2000 years short term models of the housing market were developed in different ways to forecast housing prices. As examples the works of Kenny (1998)[12] and Mayer / Somerville (2000)[13] should be mentioned. The short-term models considered different determinants to explain the evolution of house prices and the elasticity of these to determine the influence of the considered variable.[14]

A completely different approach was selected by Sivitanides / Torto / Wheaton (2003).[15] With the example of the US office market they examined the relationship between the vacancy and the effects on the cap rate on the one hand and on the other hand, the impact of the interest rate or the "broader capital market forces"[16] on the evolution of the asset prices. To determine the effect of the interest rates on the office market, they constructed a spread of cap rate minus interest rate and came to the conclusion that inflation and therefore real interest rates „have a very strong effect on the cap rate-interest rate spread“.[17]

The Bank for International Settlement gave a very interesting emphasis on the dynamics of housing prices with the “Quarterly Report” of March 2004. Tsatsaronis and Zhu were discussing the evidence of international lending practises[18] while Dabelle was examining the relationship between household debt, asset prices, income and other macroeconomic values.[19] Borio and McGuire were focussing on time shifts between equity peaks and peaks in housing prices.[20] Based on their conclusions Milleker (2004) made a regression analysis on some

---

[12] See Kenny, G. (1998). The work of Kenny brings up the relationship between inflation expectation and housing price inflation, and also the monetary policy, the banking system and the housing prices. However, he considered these effects static and isolated from each other in a purely descriptive way. See Kenny, G. (1998), pp. 2 – 13. Later in his work Kenny focussed on the well know long-term relationship between the price of housing and the quantity of housing units demanded and variables such as income and interest rates.

[13] See Mayer, C. / Somerville, T. (2000). Mayer / Somerville put their focus on the relationship of supply elasticity and land development. Ibid.), p. 86 et seq.

[14] Ho / Haurin / Wong studied, for example, the impact of the transaction volume on the market dynamics based on a filtering model for the housing market of Hong Kong. See Ho, L. / Haurin, D. / Wong, G. (2003).

[15] See Sivitanides, P. / Torto, R. / Wheaton, W. (2003).

[16] Ibid. p. 46.

[17] Ibid. p. 51. They also point out that – due to this relationship – the US monetary policy had a great effect on the cap rate changes on the office market in the examined period of time. Ibid. p. 52.

[18] See Tsatsaronis, K. / Zhu, H. (2004).

[19] See Dabelle, G. (2004).

[20] See Borio, C. / McGuire, P. (2004).

selected macroeconomic values to examine the price dynamics of the years 1989 to 2000 for Spain, UK and the US. This was done with the aim to give the Allianz Group, as an institutional investor, a suitable application to see whether housing prices are over-valued.[21] Jacobsen and Naug made a similar attempt for the Norges Bank[22] and the banks in Norway in 2005.[23] They wanted to give an explanation whether an increase in housing prices has a substantial value or not.[24] All these models have in common that they state that macroeconomic values like "interest rates, housing construction, unemployment and household income are the most important explanatory factors for house prices."[25]

The banks and the "institutionals" had realized peaks in equity prices and housing prices and adopted the market cycles as valuable information. But the had to learn their lessons the hard way as the 2007/08 bubble burst showed. Anyhow lots of papers were available warning about bubble bursts, long and short terms risks. As examples are mentioned the works of Tang and Chau (2006) dealing with an "Empirical Study of the Relationship between Housing Prices and speculative activities in Hong Kong"[26] and the OECD paper of Schich and Ahn (2007) about housing markets, household debt and the short-term and long-term risks.[27] Schich and Ahn gave an explicit warning that the OECD households have taken too much debt and have an increase "in the share of real estate holdings in total household assets."[28] Both effects were driven by constantly rising housing prices and an assumed constant increase in private wealth. They also warned that the – at that time – "most recent data show that the (negative) correlation between real estate and some financial assets such as equities may have diminished somewhat."[29]

Unfortunately Schich and Ahn were wrong with their 2007 assumption that "only some parts of the household sector appear to be vulnerable to cooling housing markets, so that financial stability risks are limited at least over the short term."[30]

In 2008 Adams and Fuess presented a macroeconomic co-integration model to the Deutsche Bundesbank[31] to explain the long-term impact and the short-term dynamics of selected

---

[21] See Milleker, D. F. (2004).
[22] The Norwegian Central Bank.
[23] See Jacobsen, D. H. / Naug, B. E. (2005).
[24] Housing prices have tripled from 1992 to 2004 in Norway. Ibid. p. 1.
[25] Ibid. p. 1.
[26] See Tang, W. K. / Chau, K. W. (2006). For the Hong-Kong market Tang and Chau could show that increasing housing prices led to speculative activities, not vice versa – even in the highly regulated Chinese market.
[27] See Schich, S. / Ahn, J.-H. (2007).
[28] Ibid. p. 194 and p. 198.
[29] Ibid. p. 195.
[30] Ibid. p. 194.
[31] Central Bank of Germany.

macroeconomic values.[32] Based on data from 15 OECD countries they came to the conclusion that typical macroeconomic values as employment, industrial production, money supply, short-term and long-term interest rates are evident and that "short-run deviations from the long-run equilibrium result in several years of adjustment until all variables are back in equilibrium."[33]

The most recent literature (2009 – 2014) bears upon the 2007/08 real estate crisis which ended up in a global financial crisis. The "new" attempts are picking up and re-define the well-known models, knowledge and results with at least three alignments:

- explaining housing market dynamics
- forecasting housing prices and
- short-term trading.

Based on the work of Capozza et al. (2004), Goa, Lin and Na (2009) were examining data of the US housing markets and invented a model to determine whether a local market is in a volatile or in a tame stadium. They came to the conclusion that US housing markets tend to "overshoot" fair-value prices in an upward movement and persist to price drops in declining periods.[34] There are asymmetric patterns in the US housing market dynamics.

Piazzesi and Schneider (2009) performed a cluster analysis and invented a kind of a "behavioural finance model".[35] With the introduction of a "housing price-dividend ratio" their paper shows why and when different types of housing buyers are actually investing and "how a small number of optimistic investors can have a large effect on prices without buying a large share of the housing stock."[36]

The papers from Edelstein and Qian (2011)[37], Gomes and Mendicino (2011)[38] and Madsen (2011)[39] are dealing with the housing market dynamics in different ways. Edelstein and Qian point out that the composition of possessed real estate tends to be short-term oriented in rising markets while it tends to be long-term oriented in declining markets. Gomes and Mendicino were examining the US housing prices from 1965 to 2008 with focus on the price peaks in those decades. They acknowledge that house prices are influenced by the expectations of market

---

[32] See Adams, Z. / Fuess, R. (2010).
[33] Ibid. p. 50.
[34] See Goa, A. / Lin, Z. / Na, C. F. (2009).
[35] See Piazzesi, M. / Schneider, M. (2009).
[36] Ibid. p. 406.
[37] See Edelstein, R. / Qian, W. (2011).
[38] See Gomes, S. / Mendicino, C. (2011).
[39] See Madsen, J. B. (2011).

participants regarding macroeconomic variables and also by news shocks as a generator of co-movements.[40] Madsen was more a step back and tested on the basis of a Tobin q model, whether current house prices are above or below of their long-run equilibrium.[41]

Based on a vector error correction model, Arestis / Gonzáles (2013) were examining the long-run housing prices from 18 OECD countries from a global perspective "to model the long-run equilibrium relationship and the short-run dynamics."[42] Given the fact that the real house prices in Sweden have more than doubled during the years 1995 - 2011, Sørensen (2013)[43] gave a very detailed report on trends and risks about the Swedish housing market. Based on the error correction model of Claussen (2013)[44] for the Swedish market, he studied the evolution of prices for owner-occupied housing for the years 1995 – 2011 and was able to confirm the results of Claussen.[45] He came to the conclusion that the question of a price bubble could not be answered one-one, since other factors from other macroeconomic and financial theory models also play a role.[46]

Augustyniak et al. (2014)[47] went back to the tradition of Fair (1971) and DiPasquale / Wheaton (1992) and invented a demand-driven model for the primary housing market calibrated to Warsaw. Their starting point is an optimal allocation of households founds between consumption of housing services and consumption of other goods. They come to the conclusion that primary housing markets are always in the stadium of disequilibrium.[48]

---

[40] See Gomes, S. / Mendicino, C. (2011), p. 14. News shocks "turn out to be an important source of business cycle fluctuations since they can generate the co-movement among the most relevant macroeconomic variables (…)."
[41] See Madsen, J. B. (2011), p. 23.
[42] See Arestis, P. / Gonzáles, A. R. (2013), p. 1.
[43] See Sørensen, P. B. (2013).
[44] See Claussen, C. A. (2013).
[45] The main influencing factors for the rising prices in Sweden were an increasing household disposable income and falling mortgage rates. In addition, Sørensen examined whether the prices for owner-occupied housing were above their fundamental values and therefore there was an indication of price bubble. See Sørensen, P. B. (2013), pp. 39 et seq.
[46] Although the observed prices were well above their fundamental values, newly invented financial instruments examined from other model approaches supported these prices. Ibid. p. 66: „We argued that the innovations in housing finance over the last 10-15 years have probably increased equilibrium house prices by loosening liquidity and credit constraints." Sørensen pointed out, that estimations on the evolution of macroeconomic values and also housing prices do play a certain role. In his paper Sørensen combined different approaches of popular models from the current literature. In sum, he has been able to confirm more or less these approaches through his empirical investigation for the Swedish market for owner-occupied housing.
[47] See Augustyniak, H. / Laszek, J. / Olszewski, K. / Waszczuk, J. (2014).
[48] A similar approach is made by Auterson (2014), in which he dealt with the forecast of house prices for UK. See Auterson, T. (2014). His model is "based on an inverted demand function for housing services, relating house prices to household income, the supply of houses, the number of households and a housing discount rate." Ibid, Summary. It is a demand-driven model to determine whether actual house prices match their equilibrium price.

The paper from Burnside, Eichenbaum and Rebelo (2014)[49] pushes forward the work from Piazessi and Schneider (2009). It is based on the observation that some booms in housing prices are followed by busts – and others are not. Real estate markets are driven by uncertainty. Different agents have heterogeneous expectations on the long-run fundamentals that drive house prices. Since it is not possible to say which expectations (optimistic or pessimistic) will come true, it is a question of "a critical mass" of agents who tend to be right and convince others to adjust their expectations and therefore their market decisions. The house price is in a path-dependency with the mood of the agents.[50]

Finally Wheaton, Chervachidze and Nechayev (2014)[51] provide a paper dealing with possible forecasts on housing price recoveries in US Metropolitan Statistical Areas (MSA) after the drop-down in 2007.

So, what do we know? It is commonly accepted that macroeconomic values (e.g. interest rates, housing construction, unemployment, household income) are evident and statically significant to explain the housing markets in the long-term view – and at least partly in the short-term. It is also accepted that expectations on macroeconomic values (e.g. future interest rates, coming inflation, income, taxes, ...) play a role. And of course fundamental values like land supply, construction costs, rents etc. are main factors, too.

There are several studies examining market data for rather transparent markets like UK or the US - and even for Sweden. The models used are more or less complicate and driven by mathematics taking into account the bunch of variables they have in focus. The general trend is to execute error correction models to track the real values with an estimated path.

The focus on "owner-occupied housing" in literature is understandable, as one's own house is the biggest stake of private wealth for the majority of people. On the other hand, it should be noted that in many countries (e.g. Germany, Switzerland) the majority of the population lives for rent. That means, conversely, that landlords rent out their property for the purpose to obtain a positive return. For them real estate is a capital investment. But as owner-occupied housing in the final analysis is just the same (rental in themselves, yield = saved rent) the rational motive

---

[49] See Burnside, C. / Eichenbaum, M. / Rebelo, S. (2014).
[50] It is driven by their expectations regarding the "fundamentals" and the benefits and costs of owning a house. Ibid. pp. 40 et seq.
[51] See Wheaton, W. / Chervachidze, S. / Nechayev, G. (2014). The work is based on an Error Correction Modell, and then on a Vector Error Correction Model examining long-term data from 1980 to the present.

is the investment purpose, too. The demand for buying housing real estate thus explains always due to the potential returns compared to alternatives and the respective associated risks.

So two things are missing. First, there seems to be a lack of studies examining the German market. Second, there is a simply question: Are market participants as a sum so sophisticated, well-educated and well-informed that they take all that data and variables and expectations of the whole market into account to find, formulate and execute their market decisions? Is the "the practical world of real estate" that complicate? Or is it much more simple? Perhaps some of the investigated values are not the cause but the consequence?

Maybe there is a "lighter" model to explain at least some fundamentals of the real estate market in the short-term view. What are the most important factors that influence the decisions of individual market participants for the purchase of real estate? This paper introduces a six-quadrant model, relating to the basics of the housing economy.

II. Model for the analysis

The residential real estate market is divided into two sub-markets: the market for owner-occupied housing and the market for residential space for lease. Both sub-markets are closely linked and are finally used to realize returns.

On the market for owner-occupied housing these returns consist of saved rents and a possible increase in value; on the other market the returns consist of a positive net rental income and also a possible increase in value of the property.[52]

Both submarkets are in competition with alternatives for capital investments and are thus connected through this competition with the markets of these alternatives. This is driven by an opportunity idea: the investment is made in consideration of the risk-return profiles of the alternatives.[53]

This paper is focussed on the sub-market for residential real estate for leasing purposes, as large (industrial) owners typically have no owner-occupied residential properties.[54] In turn, the so-

---

[52] See also: Göötz, R. (1996), p. 17 et seq. For a comparison of the sizes of the two sub-markets see e.g. Kott, K. / Behrends, S. (2010), p. 999 et seq.

[53] Buying decisions are determined by expectations on future benefits and costs of real estate and – in comparison – on future benefits and costs of investments alternatives, weighted with the associated risks. In consequence, the decisions are the same for landlords and owner-occupiers.

[54] A special feature would be to discuss certain embodiments of rental cooperatives, but this would go beyond the scope of this study.

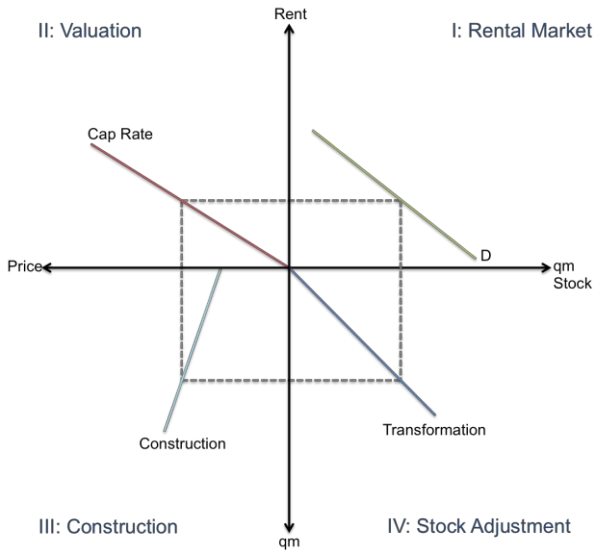
defined market is divided into two parts: the market in which the properties themselves are traded (residential properties for investment purpose) and the rental market (market for the use of these properties). In the latter rental contracts are traded. This market largely determines the current yield of the underlying asset and thus the current and future value of the properties.

The market for residential properties for investment purpose is in turn a part of the capital market. In the spirit of a Markowitz optimization, this market is influenced by the respective risk and return prospects of the real estate as well as alternative investment opportunities.[55]

II.1 The basic model

As a basis, the well-known model of DiPasquale / Wheaton (1992) is used, which models the long-run equilibrium in the real estate market. The pivotal point is the construction activity to compensate market evolutions and external effects.

Figure 1: The model of Di Pasquale / Wheaton



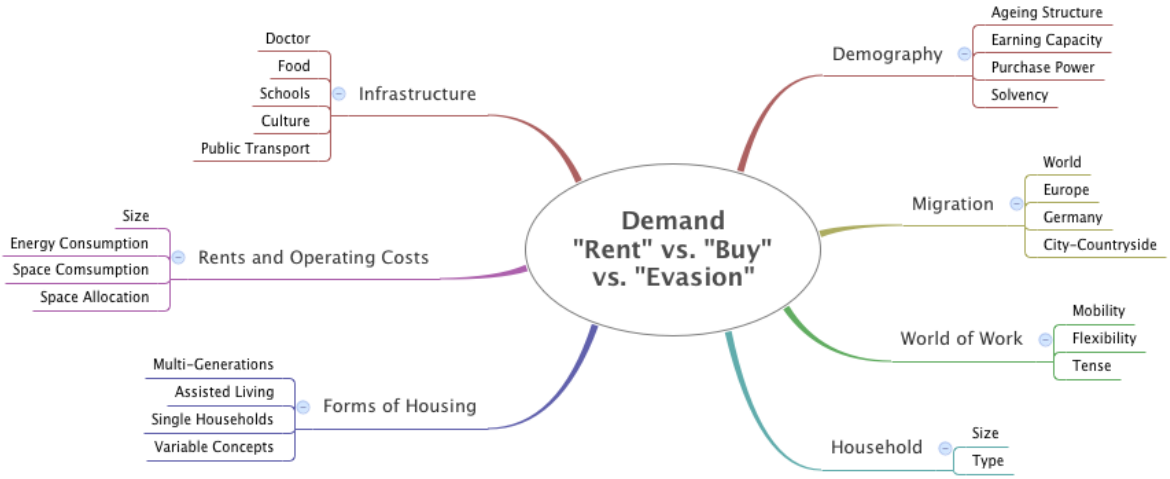
The model of Di Pasquale / Wheaton is a simple comparative static model that explains long-term movements, which lead to a market compensation. [56] For the short-term observation, the model is not suitable – also not for the simulation of the impact of effects on the rental and / or financial market in the short term. Yet it is precisely these effects that are relevant to the housing industry with great importance. To reflect this, a separate model must be developed on the housing market to describe the short-term effects, which are verified in a second step with real market data.

Figure 2 shows an exemplary, non-exhaustive list of possible factors influencing the demand for residential space for rent. The basic decision of the demand is to consider whether the living

[55] Remark: Studies for G7 countries show that real estate have had a dampening effect on the overall volatility in households and investors balance sheets. See Schich, S. / Ahn, J.-H. (2007), p. 195.
[56] See Di Pasquale, D. / Wheaton, W. (1992), p. 188 et seq. To the following diagrams "S" applies as supply and "D" as demand.

space should to be rented or purchased for own use - or whether the local market will be abandoned in favour of other locations.[57]

Figure 2: Superordinate relationships



The further analysis is focussed on the rental market and the related market for the trading residential real estate for investment purposes. The rental market acts as a generator and source of cash flow, which affects all subsequent decisions on the related markets. Expectations on the net present and future value of real estate are mainly created in this market segment. It is characterized by the interplay of supply and demand in the considered spatial demarcation at the time under consideration. Market situations like excess demand or excess supply are immediately visible to all market participants and cause a possible adjustment of their expectations on a balanced market in the near future.[58] This may also lead to a situation that fundamental parameters of the demand side or the supply side are taken more or less into account when the market compensation is reached. The same is true for governmental interventions in the markets like price regulations, instruments of the subject or object promotion.[59]

---

[57] See Göötz, R. (2014) p. 7. The decision in the direction of "buying" (owner-occupied housing) is increasingly observed in market situations with strong demand overhang - often promoted by a low level of interest rates. The so-called "home ownership quota" in Germany which means owner-occupied housing was in 2010 at 45.7% (Source: Institut für Städtebau, Wohnungswirtschaft und Bausparwesen e.V.).

[58] This might be one of the reasons why housing prices tend to overshoot in certain market situations because participants tend to act like lemmings. See Goa, A. / Lin, Z. / Na, C. F. (2009) in this sense and also Burnside, C. / Eichenbaum, M. / Rebelo, S. (2014).

[59] Interventions of this kind distort the market. See also: Göötz (1996), p. 31, "Governmental regulated rent restrictions impede the free play of market forces and regulate the potential returns on the rental market. They provide an institutional barrier due to socio-political reasons."

Figure 3: The basic model for short-term observation

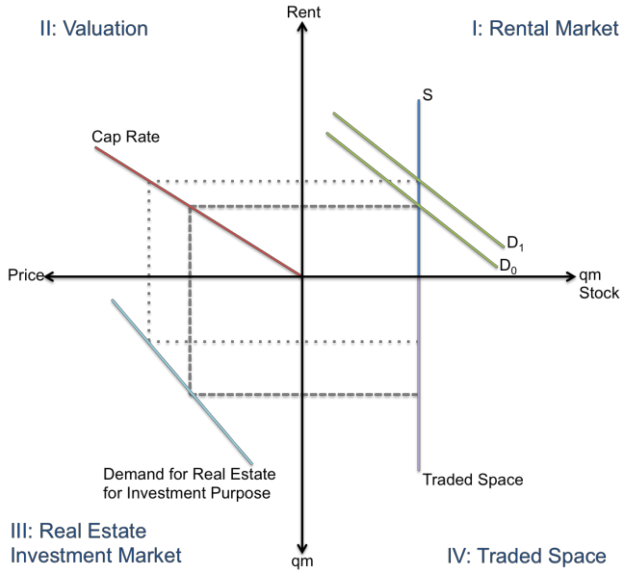
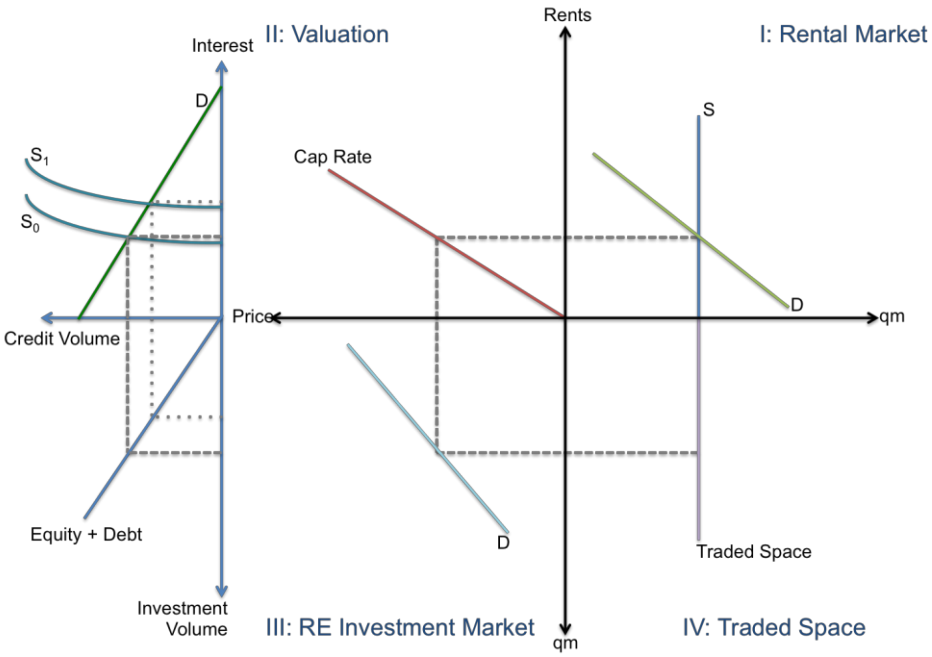


Figure 3 shows the effects of a demand-thrust of D_0 to D_1 in the short-term view, as currently observed in many German cities. People want to live in (economically) attractive cities. This leads to an increase in demand for housing. Since the supply can not be expanded in the short term[60], this will result in higher rents. With constant capitalization rates at first as an expression of the specific risk-return relation, the increase in rents directly lead to rising real estate prices. Rising real estate prices lead to a tendency of decreasing demand for real estate for investment purposes.[61] In turn, this leads to a more decreasing volume of traded space.[62] As a result, the expansion of demand in the model leads to rents levelling off at a higher level with rising property prices. In subsequence the construction activities come to bear within the meaning of the model by Di Pasquale / Wheaton.

The specific relation of the estimated net benefits of real estate and alternative investments gives the initial demand for real estate for investment purposes.[63] The so given demand in turn reflects the willingness to pay and thus determines the cap rate, which represents the valuation of the risk-adjusted, expected cash flow from the property.

[60] Or at most very limited. The supply is inelastic and limited to the stock. See also e.g. Kenny, G. (1998), p. 19.
[61] At a constant real rate of return more capital must be applied and bound to acquire the property.
[62] The volume of traded space represents the market volume of transactions, measured as the amount of space of the traded real estate for investment purposes. Obviously, transactions here have no effect on the supply on the rental market.
[63] It is caused by landlords, owner-occupiers and speculators.

Figure 4: Introduction of the credit market



In the next step, the extended credit market is introduced into the model.

Rising interest rates of the ECB lead to rising interest rates in the credit market and rising interest rates in the financial market, on which interest-bearing securities are traded for investment purposes.[64] Rising interest rates in the credit market lead to a declining demand for loans and thus to a decreasing volume of credit. As a result, the potential investment volume decreases as the sum of equity and debt decreases.[65]

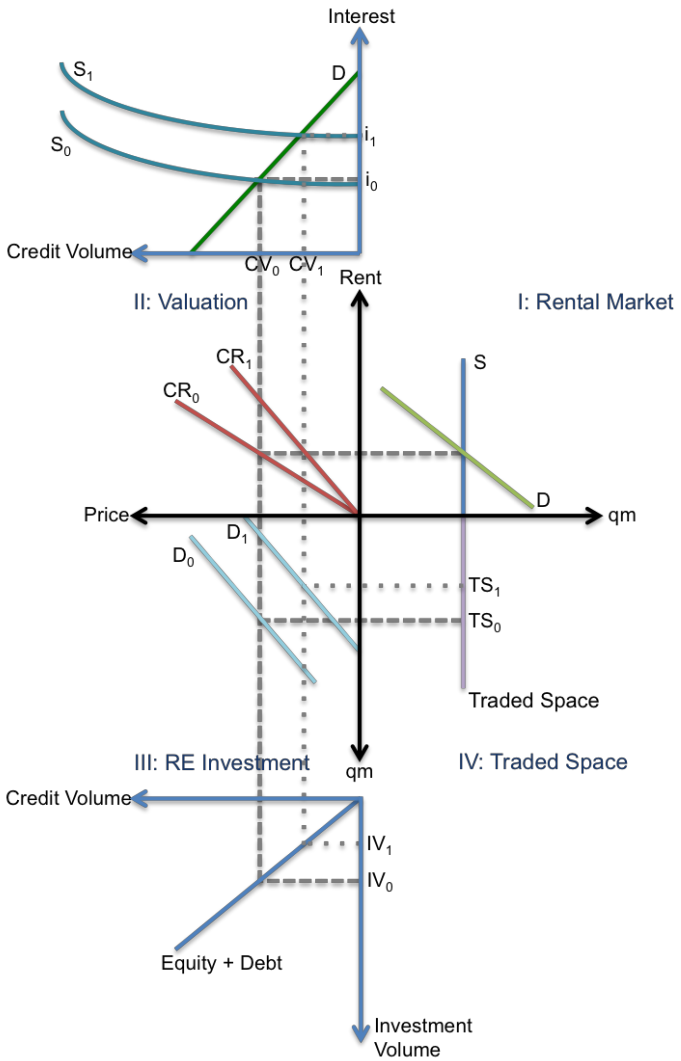
To be more precise, the real interests rates and real yields are the crucial parameters. The credit market should be viewed as modified in that sense as the real values do represent the true market conditions, as it will be shown in chapter III.2.

II.2 The extended model

Figure 5 illustrates the hypothesis of this paper. The extended model shows that an interest rate increase from i_0 to i_1 has two effects that affect the short-term real estate market model simultaneously. First, the credit volume (CV) decreases - and thus the potential investment volume (IV) as equity can not be extended arbitrarily in the short term. In addition, rising interest rates make alternative investments more attractive to equity. As a result of both effects, the investment volume in real estate decreases.

[64] This will still be important in the further course of the investigation with a view on the current yields of mortgage bonds.
[65] Equity can not be increased arbitrarily in the short term. With a decreasing credit volume the sum of equity and borrowed funds decreases.

Figure 5: extended model for short-term forecasting



Second, the cap rate (CR) shifts. Rising interest rates lead to higher discount rates. The "multiplier" on rents falls, cap rates are rising.[66] This leads to a pressure on real estate prices and also to a pressure on rents. Falling property prices are necessary to obtain the profitability of the real estate upright and compensate the rising costs of financing.

For the same reason there is a pressure on rents. They will have to rise in tendency and in the sequence in order to compensate the higher interest costs. Since rents are inelastic in the short term - because of existing lease contracts - and can not be raised immediately in the stock or only very limited and with a time delay, the valuation of the property changes in form of a rising cap rate.[67]

The decline in property prices (and thus "constant" profitability of the investment type) would actually lead to an increase in demand (same return with less capital tied up). Since the volume of credit decreases and thus the investment volume, the demand decreases: there is less money,

[66] In the model this can be seen as the slope angle of the cap rate line. The Cap rate - as inverse of the multiplier – is typically used for the assessment of cost prices in the course of transactions and is a reflection of the current market value. Since with increasing discount rates the present value of net rents decrease and therefore the real estate value decreases, rising interest rates lead to an increasing cap rate to receive the same property valuation. See also e.g. Sivitanides, P. / Torto, R. / Wheaton, W. (2003), p. 47.

[67] In the longer view, portfolio holders seek a restoration of the former property prices, because the price correction downwards through the interest rate increase leads to depreciation and would have a negative impact on the books. The way to do this is to raise rents. This leads to increasing returns, which - at constant risk-return profile of the asset class - are leading to higher prices and so restores the compensation towards the "old level".

as the sum of equity and debt capital, available for investments. This leads to the result that the property prices decline and volume of traded space decreases (TS).

Thus, the working hypothesis of this paper is formulated: an increase in interest rates leads indirectly, but in a short time, to a decline in property prices. In the following review of empirical data, this is fixed to the change of stock prices for residential real estate in Germany.

II.3 Possible defining quantities

In Germany various indexes exist for representing the price evolution of residential real estate. Thus, the German *Real Estate Newspaper* ("Immobilienzeitung") publishes, for example, the indices of F+B, vdp, BulwienGesa and others. However, except for the index series of the vdp these data material is not suitable to reflect the performance of residential properties in the stock. In most cases, the reported results are based on prices for new buildings or on the detection of offering prices, which need not to match with real transaction prices.

Statements on the evolution of the stock prices are given with the independent analysis, observations and evaluations from acknowledged institutions such as the Federal Statistical Office and the Deutsche Bundesbank. They are valuating alongside their own market observations as well as data from the vdp, Bulwiengesa and real transaction data from the evaluations of tax authorities on the real estate transfer tax.[68]

In view of the long time series of the Federal Statistical Office is to be noted that this authority has changed fundamentally its methods of calculation retroactively to the year 2000 through the application of an EU Regulation.[69] With the established house price index, including its various sub-segments, the price index for existing homes is also published.

The following variables are used for the investigation of the assumed relationship with the price evolution:

- Harmonized Consumer Price Index („HCPI")
- Basic Interest Rate („BIR")[70]
- Deposit Facility ("DF")
- Main Refinancing („key rate", "KR")

---

[68] More about the source data used and their combination can be found, inter alia, at Dechent, J. (2011), p. 1128 et seq. More about the data model of the Deutsche Bundesbank is found, inter alia, in Deutsche Bundesbank (2013), p. 16 et seq.
[69] See Dechent, J. (2011), p. 1128.
[70] For an explanation of the terms used see e.g. European Central Bank or Deutsche Bundesbank.

- Marginal Lending (formerly: „Lombard“, “MLR”)
- 12-Month Money
- EONIA[71]
- Yield on the short-term mortgage bonds
- Yield on the long-term mortgage bonds

With these variables, both the main nominal interest rates of the European Central Bank ("ECB") as well as the German financial and credit market are covered. With the HCPI real interest rates and yields can be determined.

These are the crucial parameters for a rational investor. It is the inflation-adjusted return or interest which determine any investment decision, and thus the demand and thus also the value of investments.[72]

II.4 Simplifications

The extended base model is ultimately based on the idea that a discounted cash flow is leveraged proportionately from rents and is in fact the heart of the investment.

The main value driver is the equilibrium rent in the model. It is caused by the interplay of supply and demand in the rental market. Or, more precisely, on the rental markets. There is not "the real estate market" in Germany, but a variety of separate regional sub-markets, which in their totality form "the" property market - however they are subjected to partial diametrically different evolutions.[73]

The different data providers, such as the Federal Statistical Office and the Deutsche Bundesbank, carry out the aggregation of the sub-markets for the total market. These data never reflect the entire stock with all sub-markets. For all data suppliers two major simplifications are made:

1. Only a certain range of sub-markets is included in the calculation of the price index. So it is a sample of 125 cities in the case of the index of the Deutsche Bundesbank.

---

[71] EURO OverNight Interest Average.
[72] See in this sense: Sivitanides, P. / Torto, R. / Wheaton, W. (2003), p. 48: “The spread between an asset’s income return and the risk-free rate (such as ten-year Treasuries) is widely felt to reflect two factors: 1) investor expectations of longer- term property income growth, and 2) the risk or uncertainty in that income stream.”
[73] As an example, the rumoured housing shortage in the southern German cities should be named as well as the abandonment and demolition premiums in Eastern Germany.

2. The above-mentioned selection of sub-markets is aggregated to the index for the overall market - knowingly that there is no such “overall market”.

In consequence that market observations in a local sub-market may be completely different than the index for the entire market indicates.

For the following critical review of the extended base model, the equilibrium rent is assumed to be constant and given, in the short-term observation. The bases for this are the existing tenancies with their contractual arrangements that generally do not allow a short-term, abrupt adjustment of existing rents.

The real estate stock is also assumed to be constant in the short-term view; the balance of construction and demolition is considered to be negligible in relation to the total stock in the short-term.

With these simplifications the observable changes in the prices of residential real estate have to be determined, as assumed in the model, by other parameters than just by shifts in demand on the rental markets.

III. Selected parameters

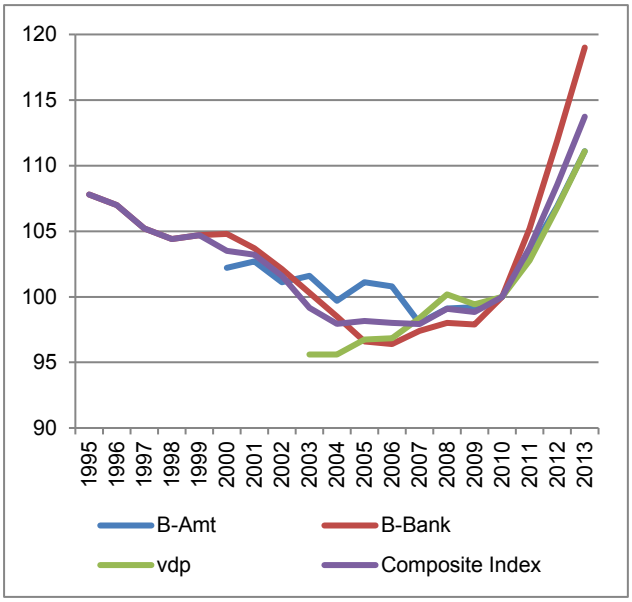
III.1 Analysis of the price indices

Figure 6 illustrates the evolution of the stock prices of residential properties in Germany for the years 1995 to 2013 inclusive. The time series of the Federal Statistical Office ("B-Amt")[74], the Deutsche Bundesbank ("B-Bank")[75], the Association of German Pfandbrief Banks ("vdp")[76] and a specially calculated composite index are presented.

It can be seen that the different indices have mostly concurrent evolutions. However, there are - as the detailed analysis shows - some distinct differences.

[74] Source: Federal Statistical Office of Germany, “Häuserpreisindex” – which is the Housing Price Index.
[75] Source: Deutsche Bundesbank, Housing Prices in German Cities.
[76] Source: Verband deutscher Pfandbriefbanken, Property Price Index.

Figure 6: The price indices over time



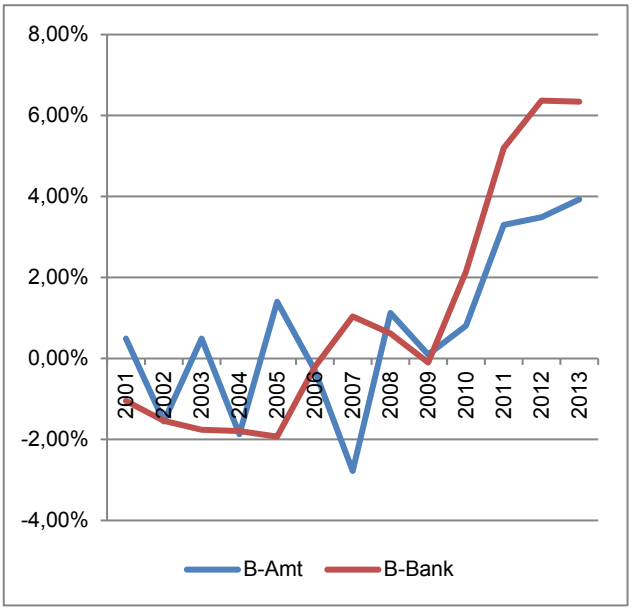
Since the data of the vdp is levied only from the year 2003 and is also part of the index of the Deutsche Bundesbank, the explicit evaluation of this data source is omitted in the following analysis. With the remaining data series of the Deutsche Bundesbank and the Federal Statistical Office there are two official market observations of respected, neutral and reputable sources for the evolution of stock prices of residential real estate.

Table 1: Correlation of the Indices

2003 - 2013	*B-Amt*	*B-Bank*	*vdp*	*Comp. Index*
B-Amt	100.00%			
B-Bank	96.03%	100.00%		
vdp	86.31%	93.43%	100.00%	
Comp.Index	96.34%	99.41%	95.98%	100.00%

The evolutions in these two indices are running in the same direction in principle, but not congruent. To have both observations in the own observation and taken into account, the arithmetic mean of the two indices is formed and a composite index is calculated. In this composite index indirectly all data of the primary sources used by both institutions are included.

Figure 7: yearly change rates of the indices

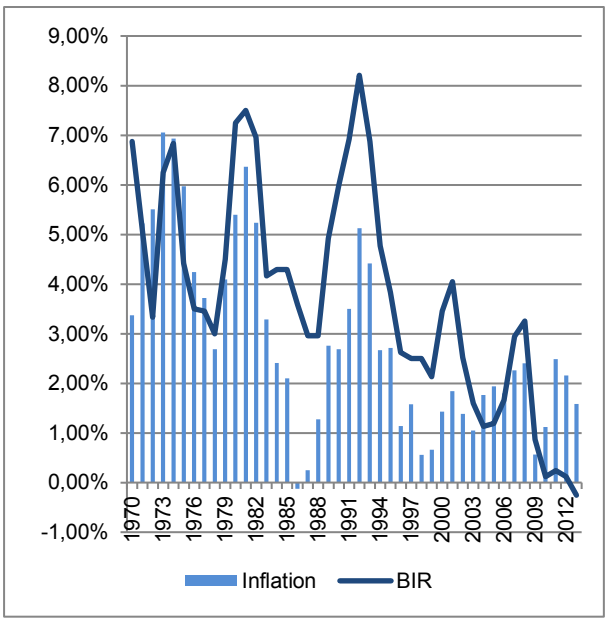


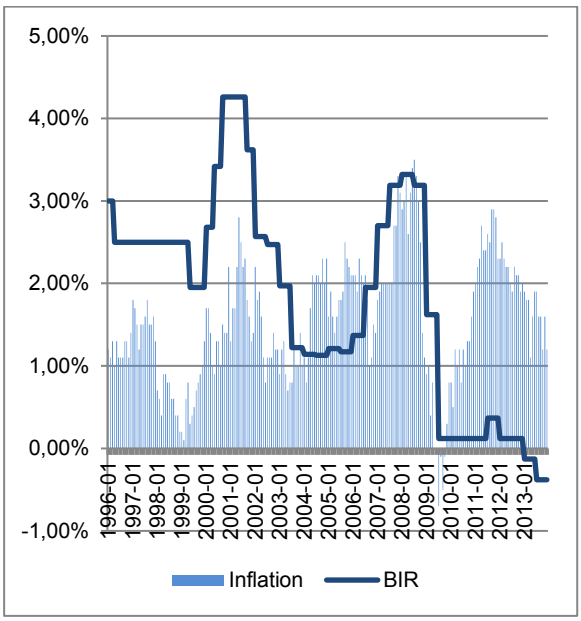
Since the data of the Federal Statistical Office is only available from the year 2000 on, in the sense of uniformity and comparability the following the analysis is set to the period from 2000 to 2013 inclusive.

Figure 7 shows the differences of the two indices on the basis of the annual rates of change of the determined stock prices for residential real estate. The data of the Federal Statistical Office are much more volatile than those of the Deutsche Bundesbank. Despite the higher volatility of the correlation of the change rates is still 74.52% over the period.

III.2 Analysis of interest rate and inflation

Figure 8, 9: Evolution of basic interest rate and inflation from 1970 to 2013 and 1996 to 2013





Figures 8 and 9 show the historical evolution of the inflation rate and the base rate as an expression of the monetary policy of the Deutsche Bundesbank.[77] The Deutsche Bundesbank typically responded with interest adjustments to a changing rate of inflation. With the change of responsibility for monetary policy to the European Central Bank the observation range of the central bank changed. While the Bundesbank only had the German monetary and price stability in focus, the ECB must focus on the entire euro area. This has the consequence that the previous harmony of German inflation rate and base rate is no longer given as Figure 7 illustrates. Rising inflation in Germany do not necessarily lead to a rise in the base rate.[78] Inflation rates are national; interest rates are European sizes.[79] Subsequently, uniform euro zone interest rates apply to different national inflation rates. This in turn has the consequence that real, inflation adjusted, values are the expression of the national market conditions.

III.3 Analysis of the Central Bank Interest Rates

Figure 10: ECB Interest Rates over time

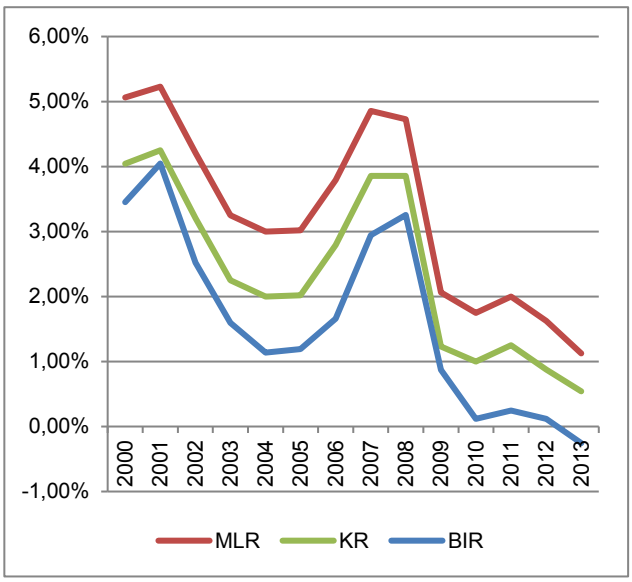


Figure 10 shows the variation of ECB interest rates in the years 2000 to 2013 inclusive as annual averages.[80]

Easy to see are the changes in the interest rate policy of the ECB: coming from a "high" level of interest rates in the years 2000/01, these are located - on an interim high in the years 2007/08 - now on their historically lowest level as a result of the European debt crisis.

The ECB is bound in its monetary policy to the evolution of the entire euro zone; its key rates apply just for this. In consequence, a direct relationship between the national inflation rate and

[77] Sources: Deutsche Bundesbank, BBK01.SU0115 and Federal Statistical Office, Harmonized Consumer Price Index - long series, 2005 = 100.
[78] On the contrary, never before the spread between the base rate and the inflation rate in Germany has been resistant for so long and high as in recent years.
[79] More precisely, the interest rates are applicable throughout the euro area. The inflation rates are different in the different the member states of the euro zone.
[80] Source: Deutsche Bundesbank, BBK01.SU0115, BBK01.SU0201, BBK01.SU0202.

interest rate changes is not given immediately. This, in turn, means that the different national conditions and changes in these find expression on the real national interest rates.

Figure 11: real national key interests over time for Germany

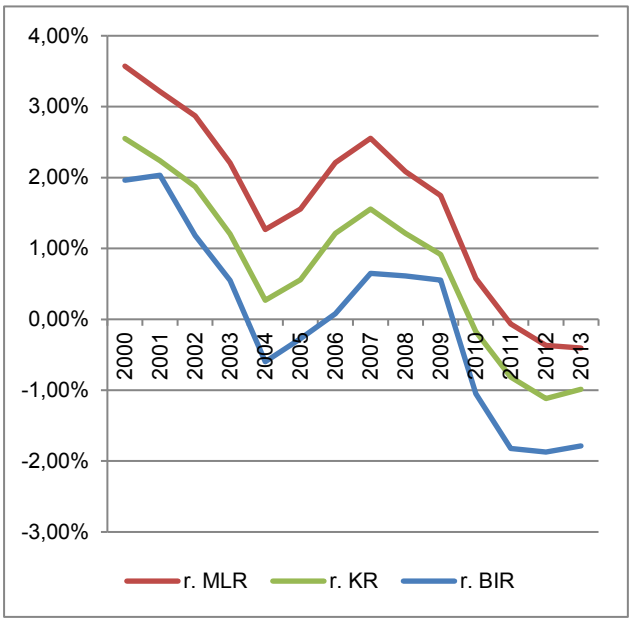


Figure 11 shows the evolution of the real, inflation adjusted interest rates for Germany for the years 2000 to 2013. The consideration of the real interest rates makes it clear that the historically lowest nominal interest rates will apply since the year 2013. And these rates are corrected or enhanced in parts in their shaping by the historically also particularly low national inflation. It is particularly striking that since 2010, the real interest rate (the real main refinancing), and since the year 2011, the real marginal lending in Germany is less than zero. For the first time in German history negative real refinancing interest rates are to be observed.

In the sense of the model to be verified, the interest rates in Germany should be accompanied by corresponding offsetting changes in prices of real estate. There are therefore sought negative correlations between interest rate trends and the evolutions in stock prices for residential real estate.

III.4 Analysis of financial market interest rates

Figure 12: Financial market interest rates in comparison

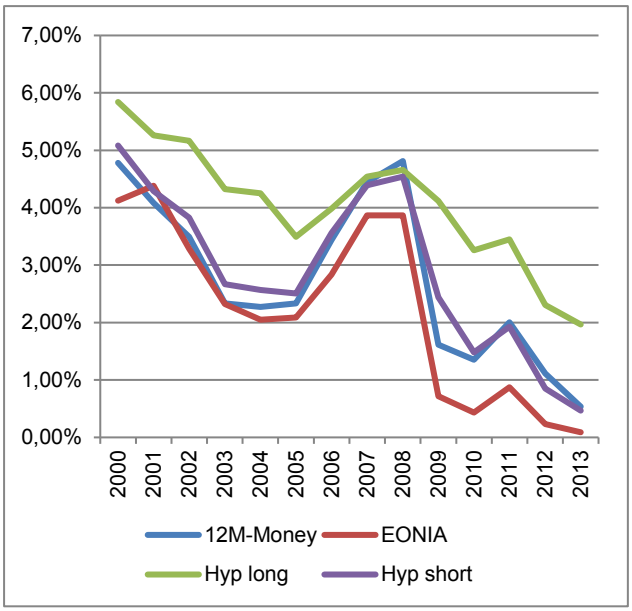


Figure 12 presents different interest rates in the financial market as annual averages in comparison: Yield on the long-term mortgage bonds ("Hyp long"), yields of mortgage bonds with a remaining term of more than nine years[81]; Yield on the short-term mortgage bonds, ("Hyp short"), yields of mortgage bonds with a remaining term of less than two years[82]; 12-Month-Money[83] and EONIA[84].

Figure 13: Real values in comparison

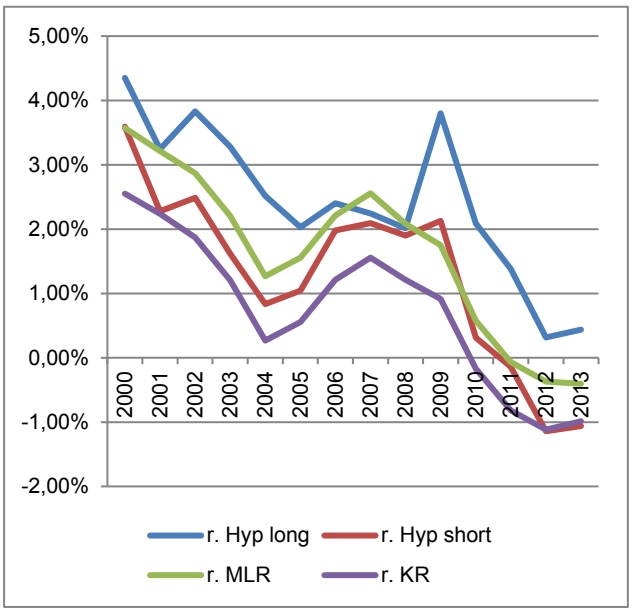


Figure 13 shows the comparison of the real values for Germany. The evolution of real key interest rates is not reflected congruent in the evolution of real yields. In particular, the evolution of the current yield on long-term mortgage bonds has significant deviations. Easy to see is the high correlation with the key ECB interest rates, their changes are reflected in varying expressions in the financial market.

[81] Source: Deutsche Bundesbank, BBK01.WX4260.
[82] Source: Deutsche Bundesbank, BBK01.WX4251.
[83] Source: Deutsche Bundesbank, BBK01.SU0343.
[84] Source: Deutsche Bundesbank, BBK01.SU0304.

IV. Examination by means of Indicators

IV.1 Selected Correlations

Figure 14: Price changes and real interest rates from 2001 to 2013

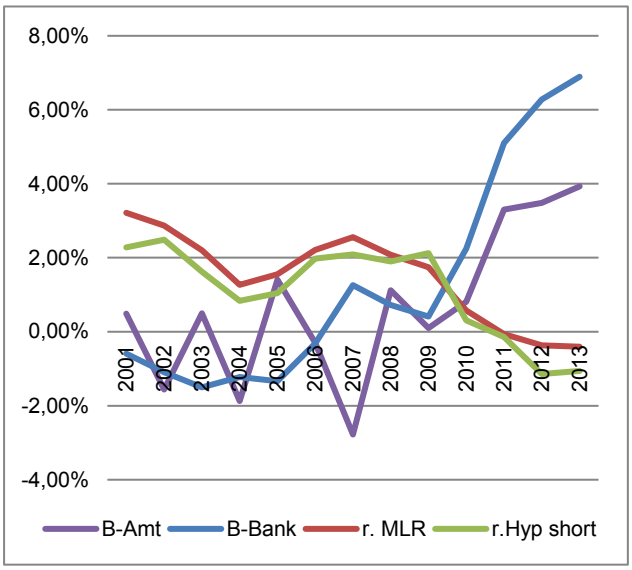


Figure 14 shows the evolution of the annual rates of change in stock prices of properties in comparison to the real interest rates and returns for the years 2001 to 2013. Table 2[85] shows the corresponding correlation matrix. It is shown that the observed indices are particularly responsive to the real marginal lending and the real yields on the mortgage bonds. With this, information is given for the construction of a (multi-variate) indicator to verify this model further on.

The further investigation of the relationship of interest rate changes and the evolution of the stock prices is done by a regression analysis. Indicators are built that attempt to replicate as closely as possible the performance of the respective target. To achieve this, different input variables are placed in different weights in a linear relationship with the objective to maximize the coefficient of determination R^2.

IV.2 Testing the Prices of the Federal Statistical Office

The indicator used is constructed as follows:

$$I = \alpha * r.MLR + (1 - \alpha) * r.Hyp\ long$$

For the maximization of R^2 a value of $\alpha = 96.89\%$ was determined.[86]

[85] See Appendix Table 2.
[86] See Appendix Table 3.

Figure 15, 16: Regression analysis, indicator to the evolution of stock prices by the Federal Statistical Office

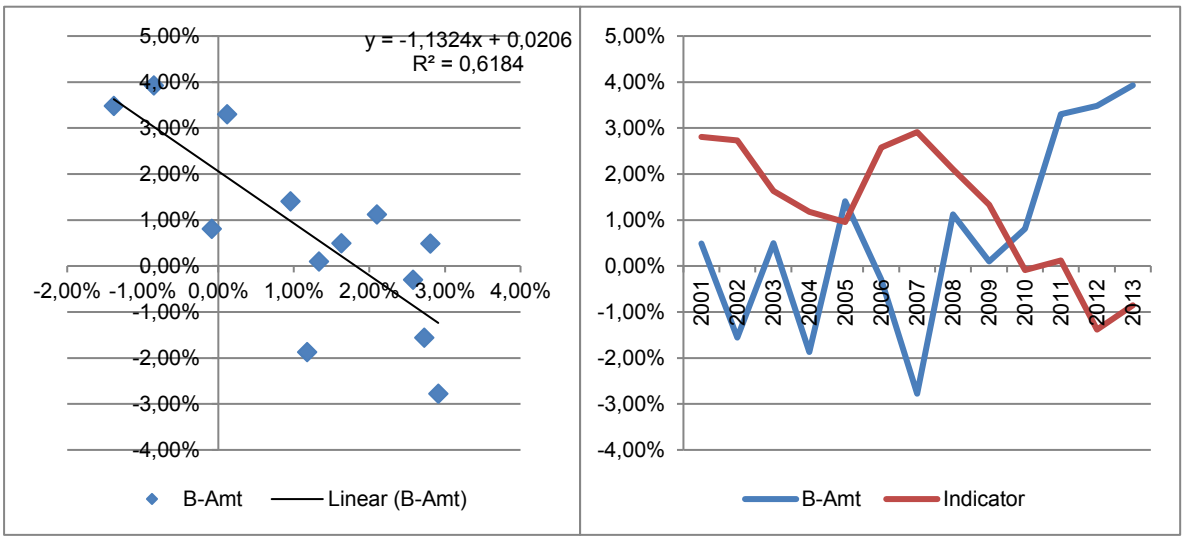


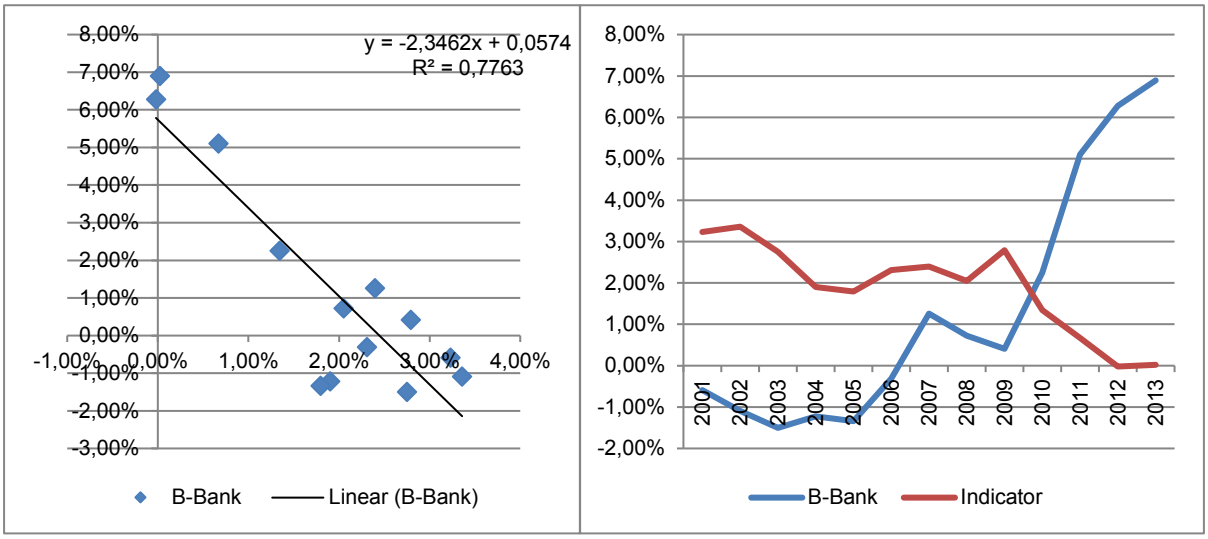
Figure 15 shows the regression analysis; Figure 16 shows the history of the indicator and change the stock prices of homes according to the investigation by the Federal Statistical Office. The calculated correlation of the indicator and the changes in stock prices is -78.64%; R^2 is 61.84%.[87] In comparison with Table 2 it is shown that the correlation could be increased by the formation of the indicator compared with the "pure", solely base values. The balanced mix of real marginal lending and real net yield on long-term mortgage bonds explains the rate of change of the observed prices better than the individual sizes do each for themselves.

IV.3 Testing the Prices of the Deutsche Bundesbank

The indicator is constructed as before; the value $\alpha = 49{,}17\%$ shows that the evolution of stock prices, as identified by the Deutsche Bundesbank, depends significantly more on the real net yield of long-term mortgage bonds as the evolution of stock prices according to the Federal Statistical Office.[88]

[87] This means that the variation of the stock price can be explained to 61.84% with the change of the indicator.
[88] See Appendix Table 4.

Figure 17, 18; Regression analysis, indicator to the evolution of stock prices by the Deutsche Bundesbank



Figures 17 and 18 show the regression analysis of the indicator and the history of the indicator and evolution of the stock prices. The calculated correlation of indicator and the changes in stock prices is -88.11%; R^2 is 77.63%. In comparison with Table 2 it is shown once again that the correlation could be increased by the formation of the indicator compared with the "pure" base values. The balanced mix of real marginal lending and real net yield on long-term mortgage bonds explains the rate of change of the observed prices better than the individual sizes could do when used solely.

IV.4 Testing the Composite Index

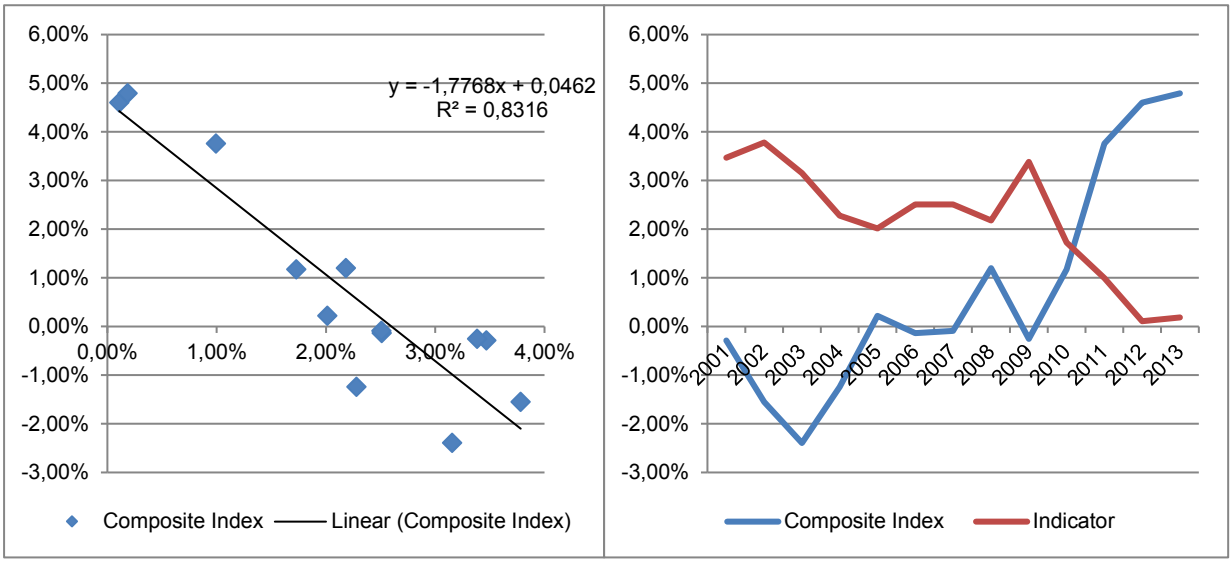
For testing the evolution of the stock prices calculated with the composite index the construction of the indicator was changed slightly.

$$I = \alpha * r.MLR + \beta * r.Hyp\ short + \gamma * r.Hyp\ long$$

The figures 19 and 20 show the regression analysis of the indicator and the history of the indicator and the evolution of the stock prices on the basis of the composite index. The calculated correlation of the indicator and the changes in stock prices is -91.19%; R^2 is 83.16%.[89]

[89] See Appendix Table 5.

Figure 19, 20: Regression analysis, indicator to the evolution of stock prices based on the composite index



Once again it is shown in comparison with Table 2 that the correlation could be increased by the formation of the indicator compared with the pure base values. For the validation of the influence of short-term mortgage bonds not only the real net yield on long-term mortgage bonds and the real marginal lending were taken into account, also the real net yield on short-term mortgage bonds was considered.

The examination of the parameters α, β and γ shows that the real marginal lending and the real net yield on long-term mortgage bonds are still the determining sizes. The weight of the real net yield of short-term mortgage bonds was determined with 0% in order to maximize the correlation of indicator and index over the period.

In summary, it can be stated that for the exact replica of the evolution of the stock prices of all considered indices is not necessary to take into account the real net yield of short-term mortgage bonds to create an indicator. The combination of real marginal lending and real net yield on long-term mortgage bonds is sufficient. A further increase in the correlation of indicator and index by adding more of the parameters presented above was not possible in conducting this study.

V. Notes and Interpretation

The model developed in this study for the relationship between interest rate changes and the evolution of stock prices of residential properties in the short-term observation was validated with real market data for the Federal Republic of Germany in the period 2000-2013.

Within the model increasing real interest rates lead to two simultaneously acting effects on the property market:

- On the one hand, rising interest rates lead to rising cap rates and thus lower prices.
- On the other hand, rising interest rates lead to a decreasing volume of lending, thus decreasing investment volume and thus to a decline in demand for real estate for investment purposes.[90]

In sense of the developed model it is reflected in the analysis of market data that there is a negative correlation between real interest / real yields and the rate of change of stock prices of residential real estate.[91] In particular, a high negative correlation is shown between the real marginal lending, real net yield on long-term mortgage bonds and the observed indices of the stock prices of residential real estate.

This negative relationship was furthermore confirmed further by the analysis using multivariate indicators. As a result, a statistically resilient connection between the aforementioned input parameters and the evolution of stock prices for the period 2000 - 2013 could be shown.

1. real marginal lending

Changes in real marginal lending have an effect in the short-term view on the stock prices of residential real estate. A rise in these interest rates has a dampening effect on the prices.
This could be explained as follows: The marginal lending has replaced with the introduction of the ECB the “Lombard business” of Deutsche Bundesbank in the German financial market. It is offered permanent and unlimited in volume. The marginal lending provides the commercial banks the opportunity to obtain a pledge of eligible collateral liquidity. The marginal lending is an essential instrument of the ECB and important indicator of the monetary market. The marginal lending costs have a direct impact on the supply of credit and credit prices. Taking into account the respective inflation the real conditions in each national market are recorded. The real marginal lending is thus an important indicator of the supply of credit in the national

[90] At the same time fixed-interest investments become more attractive.
[91] See also: Table 2 in Chapter IV.1.

market. An increase of the real marginal lending has affects – over the mechanisms of the credit market - on the real costs for (mortgage) loans and thus on the demand for loans on the one hand and the debt sustainability of investments in real estate on the other.[92]

2. real net yield of long-term mortgage bonds

Mortgage bonds meet a dual function in the financial market[93]. On the one hand, they serve as an alternative form of financing of real estate; on the other hand they are a popular form of investment. Their yields thus represent the returns for the opportunity of the asset class[94] and at the same time the cost of an alternative form of financing.

The current yields are an explicit assessment of the risk and thus the attractiveness of investments in the asset class "real estate" from the perspective of the capital market. A change in the current yields means that the demand of the market has changed to the risk-adjusted return on invested capital in real estate. Here, there is no need for a change in quality of the real estate and / or the real estate market; also a change in the returns of alternative investments leads to a reassessment of the return claimed to the asset class "real estate".

Since (residential) properties are typically financed for a longer term and the investment of capital in (residential) real estate is generally long-term oriented, the current yields of mortgage bonds with long remaining term provide an appropriate indicator.

Result

The results of the analysis of the market data presented in this study revealed that there was a statistically reliable relationship between the evolution of stock prices of residential properties and the change in real marginal lending and the real yields on long-term mortgage bonds in the years 2000 - 2013.

Real marginal lending and real current yield are negatively correlated with the evolution of stock prices.[95] Put simply, rising real interest rates of the marginal lending go hand-in-hand with rising real yields on long-term mortgage bonds associated with a fall in the stock prices of residential real estate.

The tests with the indicators used shows that the marginal lending and yield not isolated from each other affect the stock prices, but together. A combination of the parameters results in an

---

[92] Further notes on the marginal lending can be found, inter alia, on the web site of the ECB http://www.ecb.europa.eu/.../lingua.de.html

[93] Credit and capital market.

[94] Indirect investment in real estate with a "detour" of the “Pfandbrief”/ mortgage bond.

[95] See also Table 2.

increase in the negative correlation. The interaction of both variables has a reinforcing effect on the evolution of stock prices.

Notes

The calculated weights of each parameter in the calculation of the indicators are only valid for the considered period of time. They do change with the change of the considered time period.

As a result, they "only" give an indication that the interaction of several variables simultaneously can have a stronger effect on the evolution of stock prices than the individual sizes may have used individually.

- The analysis of the evolution of the stock prices as the Federal Statistical Office determines these, shows that these are particularly sensitive to changes in real marginal lending. The real yields on the mortgage bonds do play a role; however, much lower than the real marginal lending.
- The analysis of the evolution of the stock prices as these were determined by the Deutsche Bundesbank, shows that they react strongly to changes in both the real marginal lending and strongly to changes in real net yield on long-term mortgage bonds. During the considered period both sizes were almost equal weighted in the indicator to maximize the correlation. This means that the evolution of stock prices of the Deutsche Bundesbank reacts particularly strongly to the interaction of the marginal lending and current yield.
- The analysis of the composite index shows, as expected, the highest value of negative correlation, taking into account the simultaneous interaction of real marginal lending and real net yield on long-term mortgage bonds.

In simple terms, in the considered period the stock prices of the Federal Statistical Office responded mainly to the evolution of real interest rates and thus on the credit market, while the stock prices of the Deutsche Bundesbank responded to the interaction of credit and capital market.[96]

Based on the analysis above, this study concludes that the aforementioned relationship exists and can be statistically proven. Further or detailed examinations - for example, tests on the 125 individual cities - are incumbent on the inclined reader. These analyzes are beyond the scope of this work, which was intended only to show the basic mechanics and to prove them as such.

---

[96] This striking assessment is based on the assumption that the marginal lending is rather close to the credit market, while the current yield of the mortgage bonds is more influenced by the capital market.

References

Adams, Z. / Fuess, R.

(2010), Macroeconomic Determinants of International Housing Markets, reprinted in *Journal of Housing Economics*, Vol. 19, No. 1, 2010, pp. 38 – 50

Arestis, P. / Gonzáles, A. R.

(2013) Modelling the Housing Market in OECD Countries, Working Paper No. 764, The Levy Economic Institute, May 2013

Augustyniak, H. / Laszek, J. / Olszewski, K. / Waszczuk, J.

(2014) Housing market cycles – a disequilibrium model and its application to the primary housing market in Warsaw, MPRA Paper No. 59018, 2014

Auterson, T.

(2014) Forecasting house prices, Working Paper No. 6, Office for Budget Responsibility of the United Kingdom, 2014

Borio, C. / McGuire, P.

(2004) Twin peaks in equity and housing prices?, BIS Quarterly Report March 2004, Bank for International Settlement, 2004, pp. 79 – 93

Burnside, C. / Eichenbaum, M. / Rebelo, S.

(2014) Understanding Booms and Busts in Housing Markets, NBER Working Paper No. w16734, Rev. August 2014, National Bureau of Economic Research, 2014

Capozza, D. / Hendershott, P. / Mack, C.

(2004) An Anatomy of Price Dynamics in Illiquid Markets: Analysis and Evidence from Local Housing Markets, *Real Estate Economics*, Vol. 32, 2004, pp. 1-32

Claussen, C. A.

(2013) Are Swedish houses overpriced?, Research Centre, Sveriges Riksbank (Central Bank of Sweden), 2012, reprinted in *International Journal of Housing Markets and Analysis*, Vol. 6, 2013, pp. 180 – 196

Debelle, G.

(2004) Household debt and the macroeconomy, BIS Quarterly Report March 2004, Bank for International Settlement, 2004, pp. 51 – 64

Dechent, J.

(2011) Preisindizes für Wohnimmobilien, Wirtschaft und Statistik, Heft November 2011, Statistisches Bundesamt, 2011, pp. 1126 – 1134

Deutsche Bundesbank

(2013) Die Preissteigerungen bei Wohnimmobilien, Monatsbericht 10/2013, Deutsche Bundesbank, 2013

DiPasquale, D. / Wheaton, W.

(1992) The markets for real estate assets and space, *Journal of the American Real Estate and Urban Economics Association*, Vol. 20, 1992, pp. 181 – 197

(1994) Housing Market Dynamics and the Future of Housing Prices, *Journal of Urban Economics*, Vol. 35 (1), 1994, pp. 1 – 27

Edelstein, R. / Qian, W.

(2011) Short-term Investors and Housing Market Dynamics, IRES Working Paper Series, IRES2011-036, 2011

Fair, R.

(1971) Disequilibrium in housing models, Economic Research Program, Princeton University, Research Memorandum No. 132, November 1971

Gao, A. / Lin, Z. / Na, C. F.

(2009) Housing Market Dynamics: Evidence of Mean Reversion and Downward Rigidity, *Journal of Housing Economics*, Vol. 18, 2009, pp. 256-266

Göötz, R.

(1996) Die Effizienz der steuerlichen Förderung des selbstgenutzten Wohneigentums vor dem Hintergrund der Reform des § 10 e EStG, Reihe V Volks- und Betriebswirtschaft, Bd. 2065, Verlag Peter Lang, 1996

(2013) Zukünftige Herausforderungen für die Immobilienwirtschaft durch globale wirtschaftliche Veränderungen, Studie des idiw Institut der Immobilienwirtschaft im Auftrag der BG Arlinger e.G., 2013

(2014) Die Entwicklung des Marktes für Wohnimmobilien in der Stadt Heilbronn im Jahr 2030, Studie des idiw Institut der Immobilienwirtschaft im Auftrag der Stadtsiedlung Heilbronn, 2014

Gomes, S. / Mendicino, C.

(2011) Housing market dynamics: any news?, Working Papers 21-2011, Economics and Research Department, Banco de Portugal, 2011

Ho, L. / Haurin, D. / Wong, G.

(2003) Short Run Housing Market Dynamics: An Application to Hong Kong, Mimeograph, Economic Department and Centre for Public Policy Studies, Lingan University, 2003

Jacobsen, D. H. / Haug, B. E.

(2005) What drives house prices?, Economic Bulletin 01/2005, Central Bank of Norway, 2005

Kenny, G.

(1998) The Housing Market and the Macroeconomy: Evidence from Ireland, Research and Publications Department, Central Bank of Ireland, 1998

Kott, K. / Behrends, S.

(2010) Haus- und Grundbesitz – im Zeitvergleich und nach Art der Immobilie, *Zeitschrift für Wirtschaftspolitik*, ZBW – Deutsche Zentralbibliothek für Wirtschaftswissenschaften / Leibniz-Informationszentrum Wirtschaft, Heft 2, 2010, pp. 999 – 1015

Madsen, J. B.

(2011) A q Model of House Prices, Discussion paper 03/11, Department of Economics, Monash University, 2011

Maisel, S.

(1963) A theory of fluctuations in residential construction starts, *American Economic Review*, Vol. 53, 1963, pp. 359 – 379

Mayer, C. / Somerville, T.

(2000) Residential Construction: Using the Urban Growth Model to estimate Housing Supply, *Journal of Urban Economics*, Vol. 48, 2000, pp. 85 – 109

Milleker, D. F.

(2004) International real estate markets: cycle, over-valuation or bubble?, Economic Research Working Paper Nr. 11, 14.05.2004, Allianz Group, 2004

Muth, R.

(1960) The demand for Non-Farming Housing, in: The demand for durable goods, Arnold C. Harberger (ed.), Chicago University Press, 1960, pp. 29 – 96

Piazzesi, M. / Schneider, M.

(2009) Momentum Traders in the Housing Market: Survey Evidence and a Search Model, *American Economic Review: Papers & Proceedings*, 99:2, 2009, pp. 406 – 411

Schich, S. / Ahn, J.-H.

(2007) Housing Markets and Household Debt: Short-term and long-term risks, Financial Market Trends, No. 92, Vol. 2007 / 1, OECD, 2007, pp. 191 – 214

Sivitanides, P. / Torto, R. / Wheaton, W.

(2003) Real Estate Market Fundamentals and Asset Pricing, *The Journal of Portfolio Management*, Special Issue 2003, 2003, pp. 45 - 53

Smith, L.

(1969) A model of the Canadian housing and mortgage markets, *Journal of Political Economy*, Vol. 67, 1969, pp. 795 – 816

Smith, L. / Rosen, K. / Fallis, G.

(1988) Recent Developments in Economic Models of Housing Markets, *Journal of Economic Literature*, Vol. 26, 1988, pp. 29-64

Sørensen, P. B.

(2013) The Swedish housing market: Trends and risks, Report to the Swedish Fiscal Policy Council, Studier i finanspolitik (Studies in fiscal policy) No. 5, Conference of June 10th, 2013

Sparks, G.

(1967) An econometric analysis of the role of financial intermediaries in postwar residential building cycles, in: *Determinants of Investment Behaviour*, Robert Ferber (ed.), National Bureau of Economic Research, 1967, pp. 301 – 331

Tang, W. K. / Chau, K. W.

(2006) An empirical study of the relationship between housing prices and speculative activities in Hong Kong, *Surveying and Built Environment*, Vol. 17 (2), 2006, pp. 29 – 36

Tiebout, C.

(1956) A pure theory of local expenditures, *The Journal of Political Economy*, Vol. 64, 1956, pp. 416-424

Tsatsaronis, K. / Zhu, H.

(2004) What drives housing price dynamics: cross-country evidence, BIS Quarterly Report March 2004, Bank for International Settlement, Basel, 2004, pp. 65 – 78

Wheaton, W. / Chervachidze, S. / Nechayev, G.

(2014) Error Correction Models of MSA Housing "Supply" Elasticities: Implications for Price Recovery, 2nd Draft, Working Paper Series, Massachusetts Institute of Technology, Department of Economics, 2014

Appendix

Table 2: Correlation of prices and interest rates / yields

	B-Amt	B-Bank	Comp. I.
B-Amt	100,00%		
B-Bank	74,98%	100,00%	
Composite I.	82,74%	95,67%	100,00%
BIR	-57,43%	-61,08%	-56,65%
MLR	-64,72%	-65,48%	-60,83%
KR	-61,37%	-60,87%	-56,21%
Inflation	6,95%	22,84%	32,24%
r. BIR	-66,18%	-77,94%	-77,69%
r. MLR	**-75,65%**	**-84,36%**	**-83,82%**
r. KR	-73,59%	-81,71%	-81,55%
12-M-Money	-59,89%	-56,31%	-50,38%
Hyp long	-75,20%	-80,42%	-80,89%
Hyp short	-69,62%	-69,13%	-64,71%
r.Hyp long	**-70,69%**	**-83,91%**	**-89,41%**
r.Hyp short	**-77,24%**	**-84,33%**	**-84,15%**

Table 3: Indicator on the evolution of stock prices (prices of the Federal Statistical Office)

	B-Amt	r.MLR	r.Hyp long	Indi-cator		
2001	0,49%	3,22%	-9,99%	2,81%	α	96,89%
2002	-1,56%	2,87%	-1,74%	2,73%	Corr.	-78,64%
2003	0,49%	2,21%	-16,29%	1,63%	R^2	61,84%
2004	-1,87%	1,27%	-1,73%	1,18%		
2005	1,40%	1,56%	-17,84%	0,95%		
2006	-0,30%	2,21%	14,08%	2,58%		
2007	-2,78%	2,56%	14,02%	2,91%		
2008	1,12%	2,09%	2,57%	2,10%		
2009	0,10%	1,75%	-11,63%	1,33%		
2010	0,81%	0,58%	-20,85%	-0,09%		
2011	3,30%	-0,07%	5,88%	0,12%		
2012	3,48%	-0,37%	-33,09%	-1,38%		
2013	3,93%	-0,40%	-14,80%	-0,85%		

Table 4: Indicator on the evolution of stock prices (prices of the Deutsche Bundesbank)

	B-Bank	r.MLR	r.Hyp long	Indi-cator		
2001	-0,59%	3,22%	3,24%	3,23%	α	49,17%
2002	-1,09%	2,87%	3,83%	3,36%	Corr.	-88,11%
2003	-1,50%	2,21%	3,28%	2,75%	R^2	77,63%
2004	-1,22%	1,27%	2,52%	1,90%		
2005	-1,34%	1,56%	2,03%	1,80%		
2006	-0,31%	2,21%	2,40%	2,31%		
2007	1,26%	2,56%	2,24%	2,40%		
2008	0,72%	2,09%	2,01%	2,05%		
2009	0,41%	1,75%	3,80%	2,79%		
2010	2,25%	0,58%	2,09%	1,34%		
2011	5,10%	-0,07%	1,38%	0,67%		
2012	6,28%	-0,37%	0,32%	-0,02%		
2013	6,89%	-0,40%	0,44%	0,02%		

Table 5: Indicator on the evolution of stock prices (prices according to the composite index)

	Comp. Index	r.MLR	r.Hyp short	r.Hyp long	Indi-cator		
2001	-0,29%	3,22%	2,28%	3,24%	3,47%	α	33,62%
2002	-1,55%	2,87%	2,49%	3,83%	3,78%	β	0,00%
2003	-2,39%	2,21%	1,62%	3,28%	3,15%	γ	73,55%
2004	-1,24%	1,27%	0,83%	2,52%	2,28%	Corr.	-91,19%
2005	0,22%	1,56%	1,04%	2,03%	2,01%	R2	83,16%
2006	-0,14%	2,21%	1,98%	2,40%	2,51%		
2007	-0,09%	2,56%	2,09%	2,24%	2,51%		
2008	1,20%	2,09%	1,90%	2,01%	2,18%		
2009	-0,26%	1,75%	2,13%	3,80%	3,38%		
2010	1,17%	0,58%	0,31%	2,09%	1,73%		
2011	3,76%	-0,07%	-0,14%	1,38%	1,00%		
2012	4,60%	-0,37%	-1,14%	0,32%	0,11%		
2013	4,79%	-0,40%	-1,06%	0,44%	0,19%		