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Faculty of Social Sciences

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Rigorous Thesis

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RIGOROUS THESIS

Real Estate Cycle in the Czech Republic and Office Capitalization Rate Forecasts

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Prohlášení

Prohlašuji, že jsem diplomovou práci vypracoval samostatně za použití pouze uvedených pramenů.

Declaration

I hereby declare that the thesis was worked up solely by myself and I have used only the cited sources and literature.

Prague, 11th September 2011 .....

Radek Zelenka

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Abstract

The presented study describes commercial real estate markets with focus on office sector. We identify the capitalization rate (investment yield) as one of the fundamental variables in the commercial property valuation. Based on historical office investment yield observations and various econometric models we predict the office capitalization rate development in the Czech Republic. We use data of the United Kingdom, Ireland and Sweden to identify common yield trend especially with respect to their real estate crises dating in 1990s which indicate similar features to real estate crisis in 2008-2010. As explanatory variables for the econometric models (ARIMA, OLS, VAR) we use financial and macroeconomic variables. We use the OLS models to identify optimal set of explanatory variables, which we than apply in VAR models. On dataset of the comparable countries we compare the fitness of the VAR and ARIMA models, the best variants are used for prediction of the Czech office yield. We then improve our forecasts by implementing exogenous forecasts of macroeconomic variables used in the models. Majority of our predictions forecast a slow decrease of the prime office capitalization factor in next three years (2011 - 2014) in magnitude of 0.25% - 1.25% (to 6.25% - 5.75%).

Keywords: capitalization rate, office yield, real estate, forecasting models, macroeconomic and financial fundamentals

Bibliographic record

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Abstrakt

Předkládaná práce popisuje komerční trh nemovitostí se zaměřením na kancelářský sektor. Pro oceňování komerčních nemovitostí identifikujeme míru kapitalizace jako fundamentální proměnou. Na základě pozorování historických měr kapitalizace a různých ekonometrických modelů predikujeme budoucí vývoj míry kapitalizace kancelářských nemovitostí v České republice. Za použití dat z Velké Británie, Irska a Švédska identifikujeme společný trend této veličiny zejména s ohledem na prodělanou nemovitostní krizi v devadesátých letech, která se v mnohém podobá nemovitostní krizi v let 2008-2010. V ekonometrických modelech (ARIMA, OLS, VAR) používáme jako vysvětlující proměnné finanční a makroekonomické ukazatele. Za použití OLS modelů identifikujeme optimální složení vysvětlujících modelů, které poté využíváme v modelech VAR. Na datech ze srovnávaných zemí porovnáváme predikční účinnost těchto VAR a ARIMA modelů, nejvhodnější používáme k predikcím české míry kapitalizace kancelářského trhu. Následně zpřesňujeme naše předpovědi implementací nezávislých odhadů makroekonomických faktorů, které v modelech využíváme. Většina našich predikcí předpovídá pomalé snižování kapitalizační míry kancelářských nemovitostí v příštích třech letech (2011 - 2014) v rozsahu 0.25% - 1.25% (na úroveň 6.25% - 5.75%).

Klíčová slova: tržní kapitalizace, kancelářské nemovitosti, předpovědní modely, makroekonomické a finanční fundamenty

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Abbreviations

3M	Three month interest rate
10Y	Ten year government bond (yield)
ADF	Augmented Dicky-Fuller
ARIMA	Autoregressive Integrated Moving Average
BIS	Bank for International Settlement
CZ	Czech Republic
IRE	Ireland
KPSS	Kwitlowski, Phillips, Schmidt, Shin
OLS	Ordinary Least Squares
RMSE	Root Mean Square Deviation
VAR	Vector Autoregression
SWE	Sweden
UK	United Kingdom

Introduction

The resent turmoil in financial markets that was triggered by the subprime crisis in 2007 caused significant fall of real estate prices globally. The Central and Eastern European region was one of the most severely hit. The Czech Republic witnessed and unprecedented suspension of commercial real estate transactions.

In this thesis we focus on Czech office real estate sector. We identify the capitalization rate (investment yield) as one of the fundamental variables in commercial (office) property valuation. Based on different methods we prepare predictions of the capitalization rate evolvement in the next four years.

The first method uses historical movement of investment yields in the United Kingdom, Ireland and Sweden. We attempt to identify common yield movements and imply them to Czech yield predictions as these comparable countries went in 1990 – 1993 through similar financial and real estate crisis that occurred in 2008 in the Czech Republic. We describe the Swedish crisis in more detail and identify common events and features to the Czech crisis.

The second method uses econometric analysis of financial and macroeconomic variables to explain and predict movements of the capitalization factor. We exploit Autoregressive Integrated Moving Average (ARIMA), Ordinary Least Squares (OLS), and Vector Autoregression (VAR) models. We use Granger causality test to discover relations between office investment yields, number of transactions and value of transactions undertaken in the Czech (Prague) office sector.

We divide this paper into three main parts. The first addresses theoretical description of a real estate market, its specific features and behavior. We describe variety of price and appraisal real estate indices. The second explores the historical comparison and the third examines econometric modeling.

The presented work is an expansion of a master thesis defended in February 2011. Compared the original work, several essential expansions were added, reacting to all comments and questions raised up by the opponents. We have expanded the dataset

for three quarters of observations which turned out to be crucial in applicability of some models. We have added evaluation of the VAR models for the Czech Republic by calculating sums of Root Mean Square Errors for the two years in-the-sample forecasts. We have modified tables with econometric results so it more corresponds to reporting convections. We have further explained some relations between variables (e.g. USD as explanatory variable) and introduced a model showing the office real estate cycle in the Czech Republic.

1 Description of Real estate

Real estate has always been an essential part of the general economy. It is used for living and working (consumption) purpose and at the same time it serves as an investment asset. In most of developed countries real estate is one of the most significant parts of household's property (Michael & Lizieri & Macgregor, 1998). Due to these features it has been considered as a specific sector with its unique economic characteristics. Real estate is closely linked to almost all sectors of the economy having a big influence on its micro structure and macro evolvement. The real estate is not only a product, good or investment asset but it is also a powerful tool in politician's hands with a vast social implication.

Most of the researches done in the real estate field have been undertaken in USA and the United Kingdom, mainly because of the existence of many historical datasets in these countries and the maturity of these markets. Immovableness and long durability allow the real estate to behave as consumption good and as investment asset at the same time. These features and progress in finance made possible a creation of new financial tools. First mortgage backed securities emerged in 1970s and shortly afterwards the commercial backed securities and other financial tools[1] were created. The invented commercial papers made possible to trade the real estate in secondary markets and furthermore, they became a new proxy variable for the property prices traded in the primary real estate investment market.

[1] Nowadays there is huge amount of financial products connected to the real estate. First commercial rent securitization are known to be Olympia and York. An example of financial assets closely imitating the features of real estate and at the same time being traded in the secondary markets is REIT (Real Estate Investment Trust).

The typical features of real estate, implying from being commodity and investment asset at the same time, complement each other and in a real world cannot be separated. (DiPasquale and Wheaton, 1996). If an investor builds a building which no one would like to occupy (or the occupation/use would be much lower than expected) than the value of this property becomes negligible (in comparison with the market price, invested capital and/or owners expected worth[2]) or even from the economic point of view could become negative (cost of demolition can exceed the value of potential building lot).

The convenient characteristic of a property is its materiality. Unlike many of other (financial) assets you can go and literally touch the real estate. The realness (materiality) and durability have plenty of advantages. It is generally easy to prove its existence[3] but above all, there exists a psychological value which can take many forms as well (Hoesli, 1993). The valuation can be based on relatively objective criteria such as historical value of old buildings or significant cultural value but it can also depend on just a simple personal worth for an individual (buyer/owner).

All these features are depicted in real estate markets, which in many cases behave specifically comparing to usual financial or good markets. The main differences (difficulties) are:

Heterogeneity – there don't exist two same (absolute interchangeable) buildings. There could be two buildings having same size, same construction and same age but there will always be some differences (at least they cannot stand on the same place). Problems can also arise due to the dual nature the real estate is perceived. Even a single individual can evaluate a property with two prices. One price stands for seeing the property as consumption good and the other one as an investment asset.

High transaction costs – properties (especially commercial) are usually big structures and the investment in their construction or the consequential trade

[2] We have to distinguish between Price, Value and Worth. If not familiar with the terms, please see for instance The International Valuation Standards.

[3] Although it can be difficult by some real estate assets which includes for example underground construction or building which undertook many reconstructions

represents large amounts of money. During negotiations a presence of a third party is usually required. Professional agencies and lawyers prepare due diligence reports and provide other services to confirm the trading parties about the true state of the property; in general they attempt to cover every aspect of the transaction. The procedure can be costly not just because of the fees and provisions for the third parties but also for its time consumption. Transaction costs include for instance taxation[4] and time for changes in the Land Register Office.

Small number of transactions – this drawback is closely related to the high transaction costs. The relatively few numbers of transactions (in compare with financial market) cause a problem of the information function of the market and by that slower (or even hinder) discovering the optimal price.

Rigidity of supply – sellers seem to be very unwilling to trade for prices cheaper than the amount they have paid for the property because it leads to significantly inelastic prices in the downside direction due to the durability nature that allows postponing the transaction to the "better time" (Case & Glaeser & Parker, 2000). Short sales and other tools of derivative markets which would allow making profit also in case of price decrease are generally not used in the direct real estate market.

Imperfect information – this issue is fundamentally connected with (almost) all markets trading physical goods. Lack of full information can lead to exploiting one trading party or to adverse selection. The specificity of the real estate market consists in extraordinarily high transaction amounts that cause the investors not to buy or sell frequently[5]. The little practical experience and not awareness of all aspects connected with the transaction and subsequent use of the property can lead to ex post contentions. These problems are mitigated by the involvement of a third party. Although the absolute service fee amount is high, it is quite low relative to the value

[4] The property transfer taxation in the Czech Republic is 3%. It is usual that the transactions of commercial real estates are done on the level of purchasing scellet firms (Special Purpose Vehicle) which 100% owns the property. These transactions are perceived as financial transaction and they are, after certain period of time (in case of shares of limited enterprise it is half a year), freed from the tax.

[5] It is common in the Czech Republic (Central and Eastern Europe) that an individual buys a house or flat just once in lifetime. This lack of experience may lead to moral hazard associated with one shot games. For more see the concepts of Game theories, for instance Camerer (2003)

of traded property (1% - 3%) and generally can safe multiple amounts. In case of real estate it is often mentioned that there is never enough due diligence.

2 Theory of real estate market

In this chapter we describe a real estate market from the theoretical point of view. We present the main factors that create and influence a real estate market. Based on microeconomic definitions we derive a basic behavior of agents and the whole market. We focus on a commercial property market. As an example we use office real estate sector because of intuitive description but the implications of the theories can be used for any other sector (retail, logistics or residential). We describe a real estate market as four interlinked markets (Ball & Lizieri & MacGregor, 1998).

Closer analysis of the supply and demand in a real estate market discovers more complicated structure than described in standard microeconomics texts; in fact the property market is made up of several interlinked markets. These markets are: User market, Financial market, Development market and Land market. We outline a brief description of the markets and than look on each with a more detail.

A stock of offices (amount of square meters used as office space) existing in the user market is used for an activity of users or remain vacant (for some time). The users rent the office space. In case of owner occupiers (owner and occupier is the same person) we talk about an implicit rent. The existing stock of offices requires maintenance because it is subjected to wear-and-tear depreciation and becomes technologically obsolescent.

The stock of offices is a set of assets. As any other (financial) asset, the ownership of properties can be described from the risk and return perspective and consequently compared to the other (financial) assets. In the financial market we evaluate the opportunity costs of invested capital into the office stock.

The development market is considered when the demand for office stock increases. When the existing stock of office doesn’t satisfy the demand, the new construction

(higher than replacing the obsolete buildings) has to be undertaken. In the development market, investors order new office buildings to be built.

The user and the development market connect in the urban land market. Land is a scarce factor and its limited availability influences its price. Development projects don't compete only among new potential projects but also among the existing properties. The economic value added of a new development project has to be higher than potential refurbishment or demolition and followed redevelopment. The rent and price of land is mainly determined by the opportunity costs, it means from the profitability of different projects.

2.1 User market

Rents created in the user market represent a product in the microstructure theory of a firm; it is the ultimate evaluator of success or fail. For describing a simple model of user market behavior we admit two fundamental assumptions. First, we consider the property market being competitive (no matter how much this assumption stands in contradiction with the description of the real situation) and second, we consider a discrete time horizon referring to short run gradient, which means that at least one factor is fixed and can not be replaced.

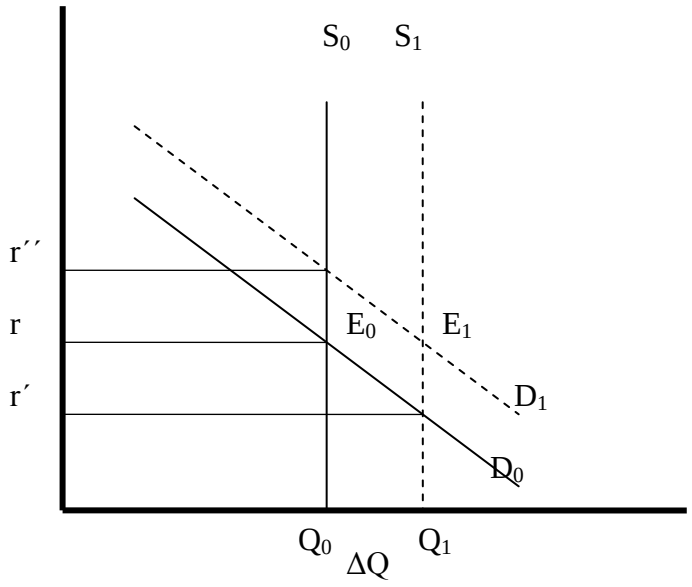
In the user market we consider very inelastic supply of real estate. For a short run when the technical obsolescence of buildings can be neglected and the stock of offices is given, we can consider the supply to be infinitely inelastic[6]. In order to aggregate the whole market we work in the analysis with equal representative samples of real estate (same quality of all office space).

The demand for the office space in the market can be derived from the demand of a representative firm. It follows the classical features of demand for factors. It means with increase of price for a factor the demanded quantity decreases and hence the demand curve is downwards sloping. We consider rents to be net payments for

[6] In the office sector we neglect the possibility to allow working (use the office space) on a smaller floor space or at home. There are similar possibilities in case of other sectors that allows artificially increase the demanded factor in a short run.

reimbursing the use of occupied space (including for instance servicing fees), in case of owner occupied properties we talk about implicit rent which is equal to opportunity cost (rent to somebody else). The demand is furthermore considered to be dependent on an output of the firm and the average requirements of the space per worker.

Figure 1 – User market



The user market and discrete changes (of rents and floor space) in the user market can be graphically depicted as shown on the Figure 1. In the example we assume a shift up of the demand curve from the previous equilibrium E_0 (where for given stock of offices the market found appropriate value of rent). If in the next period the supply stays the same Q_0, the higher demand D_1 will cause an increase in the rent level to *r''*. If the supply anticipates the move of the demand curve and increase the amount of offered office stock ΔQ, the market will stabilize in the intersection of the new supply and demand curves E_1 (for instance in the same rent level *r*). The third possibility is that the anticipated increase of the demand was just illusory and the new supply will decrease the equilibrium value of rent *r'*.

There are many reasons for a shift of the demand curve. Most common is an increase of the output of firms and the need for expansion. Alternative reason can be a significant rise of some other input factor (transportation, storage, communication costs) which would relatively decrease the rent costs. In this sense the demand for

office space is derived from the demand for goods and services produced with use of the office space. The "productivity" of the office space doesn't have to depend on the physical quality or quantity of facilities it provides but the main objective of an occupied space can be a signaling effect as we can see in banks´ lobbies (Baum & Crosby, 1995).

2.2 Financial market

We can assimilate a property to a financial asset because when we look away from all the unique behavior of the real estate market we can compare a property to a long term bond or perpetuity. First we have to make an initial investment (buying a bond/perpetuity, purchasing or building a property), than we receive periodical payments (coupons, rents) and at the end we receive an amount (face value or market value, market value of the building or the value for the location in case of total depreciation of the building[7]).

A valuation of real estate is very complex and requires individual approach to each property because each building is unique and the final price includes even things like esthetic contribution to its surrounding. However the major determinants of the property market price (at a proper time and place) are the estimated annual efficient rent (understood as free cash flow to the investor net of operating costs like managing fees, insurance, sinking funds, repairing costs)[8] and capitalization rate, known as investment yield[9]. The estimated price is calculated as fraction of the annual efficient rent and the capitalization rate (similarly as calculating the value of perpetuity).

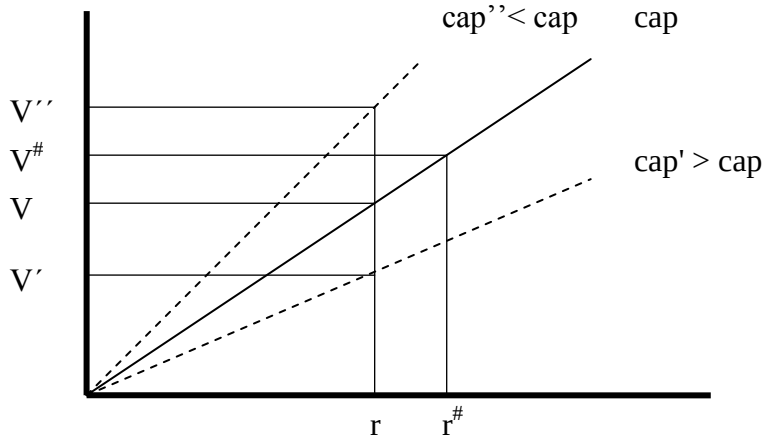
[7] See more in chapter 2.4. Land market

[8] In the theoretical approach we also neglect cases when an owner provides the rental space for symbolic rents. Such cases are usual especially between municipalities and non profit organizations. If so, the value of this way rented property should be calculated based on common market rent value which could be potentially achieved.

[9] In whole this paper we understand the yield and capitalization rate as the same variable. In real estate sector we recognize many different kinds of yields like Initial yield (calculated as Rent in year 1 divided by the market value), Running yield (yield of an investment at any point of time), Reversionary yield (yield applied to reversionary income), Equated yield (yield on equity invested, used in discounted cash flow valuations) but when we refer to (real estate) yield we mean only the initial investment yield.

$$(1) \qquad V = \frac{Rent}{cap}$$

Figure 2 – Financial market



As we can derive from the formula *(1)* or see in the Figure 2, with increasing rent the price of the property rises and for a given income stream the price of the property moves in the opposite direction with the value of the capitalization factor.

The simple formula *(1)* can be derived from the Gordon dividend growth model. We can replace the dividend income stream by rental income stream. For both cases we assume an infinite horizon of receiving (income/dividends) the rents, which means keeping the property for ever[10]. Variance of rent value over time is solved by the assumption of constant growth *g*. The Gordon formula modified for calculating the value of a property looks then:

$$(2) \qquad V_0 = \frac{Rent_1}{(1+r_E)} + \frac{Rent_2}{(1+r_E)^2} + ... = \frac{Rent_0(1+g)}{(1+r_E)} + \frac{Rent_0(1+g)^2}{(1+r_E)^2} + ...$$

$$(3) \qquad V_0 = \sum_{t=1}^{\infty} \frac{Rent_0(1+g)^t}{(1+r_E)^t}$$

$$(4) \qquad V_0 = \frac{Rent_1}{(r_E - g)} = \frac{Rent_1}{cap}$$

[10] In case of just a terminal holding period, the value would be calculated the same way as the new buyer purchases the same income stream. The core assumption is that the property can generate such rental stream.

The expression (r_E-g) is our capitalization factor (yield) and we can directly see that it doesn't include only a discount factor (required compensation for undertaken risk) but also includes an assumed growth of rents. This means the capitalization factor reacts on financial events as well as on direct rents affections.

The values of the capitalization factors (yields) move around 5% in the mutual markets[11] and around 10% in the developing markets (DTZ, 2008). Even a small change of the yields causes a significant change in the properties' value[12] and it is the reason why the yields are carefully monitored by real estate investors. The value of the yields depends on many different factors which are connected with features of properties as well as with the state of the whole economy. According to Ball & Lizieri & MacGregor (1998) the capitalization rate is considered to be a function of risk free rate, risk premium, anticipated growth of rent and depreciation rate.

There are several studies examining the determinants of the yields. Froland (1987), Ambrose & Nourse (1993), Sivitanides & Southard & Torto & Wheaton (2001) show different connections between capitalization rates and financial, real economy and specific real estate characteristics factors like vacancy rate, completion rate and absorption rate. All these studies work with datasets of mature real estate markets in the USA. D'Argensio & Laurin (2008) investigated the determinants of office capitalization rate on panel of 52 countries (developed and emerging) in period 2000 – 2006. They found the 10 year government bond yield being the main determinant of the office capitalization rate. In this paper we focus on financial and macroeconomic factors influencing real estate (yields) in the Czech Republic.

2.3 Development market

By the development market we understand creating and adding a new stock of buildings (offices space) to the market which doesn't include the repairing work on the obsolescent buildings. In our simplified description, we can observe in the development market the transformation of a flow variable (new offices) into a stock (existing offices). If we recall the model of the user market, than the development

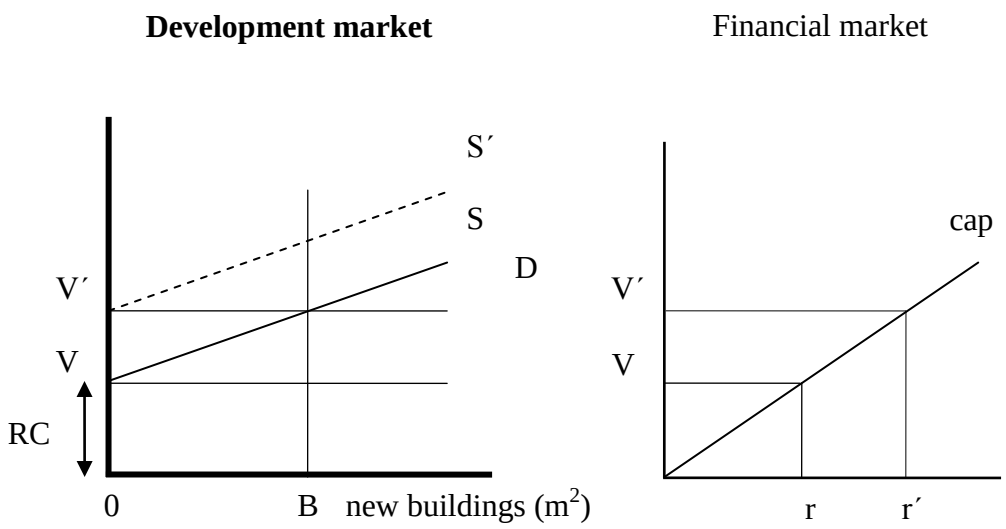
[11] Refers to prime office locations in capital and major cities in Europe, North America and Asia
[12] As shown in Table 5

market stands between the two discrete time periods and determinate the shift of the supply curve. Moreover we also assume a connection with the financial market by an assumption that the developer sells it to an investor as an (financial) asset, after the creating the new stock of offices. It means we keep the development and financial businesses separated.

As our model shows the development starts when the price of the property exceeds a certain level. This threshold (intercept crossing the vertical axis) is called the Replacement costs and defines the point where the development becomes lucrative, it means when the revenues from the new development increase the construction costs. The supply function demonstrates the developers´ expenditures for financing, land cost, site clearance, construction and selling costs. The variable costs like construction expenditure or financing costs usually don't change much (relatively to developing scale), which is the reason why we keep the slope of the supply function the same.

Let's assume that firms start to demand more office space and the demand in the user market rises. It causes the increase of rents and ceteris paribus appreciates the value of the existing buildings (offices). Because firms are considered to be indifferent between the existing offices and new developed ones and the price of the buildings (office space) on the market exceed the costs of development (replacement cost), new development will occur. The demand curve is in fact the same for the user market and for the development market but if we consider the development market in the moment between the two time periods in the user market, we can consider a flat demand as is shown in the Figure 3.

Figure 3 – Development market



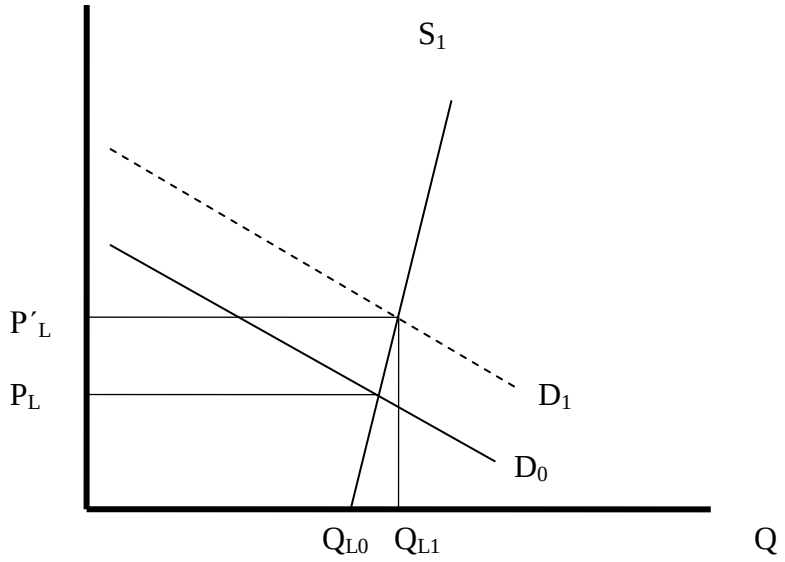
The new development is in fact a disequilibrium phenomenon as we can see from the user market. There are basically two ways of returning back to equilibrium state. The first possibility is that the flow of new office space will satisfy the new demand at the previous rent level and the demand curve in the development market will decrease to the point V. The second possibility is that the new rent level will retain but the development supply curve will shift up to point V´ where again the new development is equal to zero. The reason for moving the intercept up is connected with the fixed costs of the development. An elementary example is that when the demand for new development sustains, the cost for land (scarce factor) rises.

2.4 Land market

The land market is based on one fundamental characteristic of the land. Land is a scarce factor. To clearly describe the land market, we should first of all understand land as a place, where the real estate (offices) already stands or where new development potential is considered. It means that there are other possibilities of the land use and the projects of new (office) development or redevelopment (known as building on a brown field) are considered on the base of opportunity costs. This follows the theoretical concept of Carl Menger which in our case means that the gain from new offices is bigger than the next best use of the land. This brings us to a steep up sloping supply curve (not vertical).

The demand curve has a classical downward sloping shape. There are basically two reasons for that. First, the higher the cost of land the higher the required rents (cash flow allowing the investors earn their investments back) and higher rents in the user market causes less demanded stock of offices, which brings us back to the fewer demanded stock of land. The second reason is the switching mechanism between capital and land. If the land price rises too much, the construction become more intensive (developers start to build higher buildings), which is economically describe as substitution effect between capital and land.

Figure 4 – Land market



Intuitively we can suggest that the main changes on the land market are caused by the changes of the demand curve, either by changes in the user or financial market, or by introducing a new technology which lowers the construction costs. But in reality there are changes of the supply curve much more common. The reason is in the secrecy of the land. Because the state authorities usually control the use of land through various permits, taxes or subsidies[13] the supply curve can move significantly even in a short period of time. This state influence connected with political interferences brings sometime big problems, especially in the developing countries.

[13] For instance contribution on infrastructure costs needed for implementing the new development into the existing urbanization

2.5 Simultaneous equation on the four markets

We summarize the whole system by showing a possible occasion and describing the implication it has on the particular markets. Let's assume that the demand for offices rose as a consequence of higher output of firms. The higher demand for office space increases the demand in the user market and because of the inelastic supply the rent rises. When we assume no change of the capitalization factor in the financial market, the higher rents will lead to a price increase of the properties above the replacement costs, which will trigger the creation of new offices as it is shown in the development market. Higher development activity will cause a price increase of the land required for the development. The equilibrium will be established again after the replacement costs (including the land price) drive up to the price required on the financial market and the demand for offices will be satisfied on the user market. In equilibrium there is no new development.

2.6 Long run perspective

The models that we showed above are based on a short run perspective but they can be also used for the long run analysis of the real estate market as well. The major difference is in the user market because the rigidity of the supply function can not be valid any more. Along run is defined by adjustability of all factors. So the supply in the user market becomes more elastic and the supply curve in the model inclines to upward curve. But the connection with the other markets doesn't change and the behavior can be described very similarly as we made it in the section 2.5.

3 Real Estate indices

After theoretically introducing the complexity of real estate markets and outlining the factors that influence its behavior and features, we present the empirical observations of real estate aggregates. There are many kinds of real estate price indices. They differ from the observed variables (flats, family houses, retail, offices, and quality measures of the properties) to calculation methods (different econometric techniques). The price indices are important not only as acceptable comparable tool for valuation of properties during transactions but they are especially useful for investors who need to estimate the value of their real estate portfolio also during their holding period.

3.1. Appraisal based indices

The usual method of valuating commercial real estate is to use appraisals (Fisher, 2005). If we want to aggregate and quantify the price on a certain area we create a property index. There are many types of commercial property indices. The most straight forward index, the appraisal-based index, has however many drawbacks.

One of the problems is the frequency of appraising, due to significant costs connected with unbiased estimate of the property value. Such procedure are usually done not more than in monthly frequencies and they are always dated (refer to past values). But a more serious problem is the possibly inaccurate appraisals caused by lack of current market information about the value of commercial properties. These drawbacks cause appraisal-based indices to lag behind market changes in the value of commercial property and its smoothing compared to its price volatility on date to date basis (Wang, 2001).

3.2. Transaction based indices

Another method to construct an index of commercial property values is to use the prices recorded in transactions. Indices based on residential transactions[14] are well

[14] In the Czech Republic it is possible to acquire the needed data about the prices of residential transactions from the Ministry of finance. This department collects the information from tax declaration. In Czech Republic, every direct real estate transaction is subjected to a tax.

known and have been created and used in US and other western countries since 1970s.

There are many ways how to use transactions to construct a price index. The most frequently used are the "hedonic-price" method, the "repeat-sales" method and the "hybrid" method (Haurin, 2005). Each of them uses econometric regression methods to explain price levels or price changes and afterwards uses the results to create an index of changes in price for a "typical" property. That means that the price index created by these methods represents a property with constant qualities[15].

The hedonic method is based on finding a relationship between the price of a property and its characteristics. Basic characteristics used for both commercial and residential estimates are land area, structural area, quality of the structure and location attributes. The list of input variables depends only on the amount of the available data. Collected data from different time periods allows creating a set of valuations of each of the characteristics of properties in each time period. These time-varying valuations can then be applied to a particular set of property characteristics, yielding an estimate of property value for each time period.

The repeat-sale method is relatively younger. It is used especially in US thanks to half-state agencies Freddie Mac and Fannie Mae[16], which have sufficiently extensive databases. The advantage of this method is that the dataset does not have to describe property characteristics when creating the index but only transaction prices for the same property from two periods need to be observed. The drawback in this method is the assumption that the property does not change its quality over time and especially the fact that commercial properties are seldom sold.

The critique of the repeat-sale method aims the assumption that properties do not change over time. All properties age and depreciate, though by commercial properties part of the rents is usually used for permanent upgrades of the facilities to keep up with standards in certain time and place. To deal with qualitative changes a

[15] Frequently used and released by (residential) real estate agencies. In the Czech Republic Czech Statistical Office publishes official price indices of flats and family houses since 2005
[16] The agencies create the Conventional Mortgage Home Price Index

hybrid technique was developed (Quigley, 1995). The hybrid method modifies the repeat-sales method and includes selected property characteristics (similar to the hedonic technique) in the estimation model.

These methods are frequently used for residential property because of the data availability. Unfortunately such techniques are difficult to use in case of commercial properties and can be applied only with great difficulty. The reasons for poor datasets and only a small number of transactions in general are the longer finalization processes of commercial properties contracts, its complexity and above all frequent confidentiality[17]. This is probably all caused by the size of such contracts which values are counted in multiples of usual residential properties.

When we choose the hedonic methods for creating a transaction based on commercial index as the most suitable technique, we come up to two problems which can cause biases of estimates of the coefficients in the econometric models. The issues are the sample selectivity and the time-varying liquidity.

The sample selection bias occurs when the observed transactions don't represent the entire stock of properties. In this case, the standard econometric technique cause biases of model's coefficients and may lead to a biased price index. For instance, in standard market, some properties (or simply goods) will raise their real values and at the same time the real value of some properties will decline. If only the owners of those properties which real value has risen would choose to sell them (or the other way round), then the transacted properties sample wouldn't fairly represent the value movements of the entire market. It is also very probable that the decision, whether to buy or sell a property which real value relatively changes (to its peers), depends on a moment of real estate business cycle and by that the biases change over time. Such biases cause a difference between transaction based index and a property index based on market value of the stock of properties[18].

[17] Commercial properties are usually bought and sold through a shell companies (SPV). Through this procedure it is possible to avid paying transfer taxes.

[18] For instance REITs are publically traded or some open end real estate funds can be relatively easy accessible for variety of investors. The easy access (purchasing only small portion of a property/portfolio) and relatively small transaction costs allow such instruments to behave similarly to standardized financial tools.

We can test the empirical data whether biases are included in a sample. When we discover such drawback we can use in the models the multi-step statistical technique that corrects for possible sample selection bias (Heckman, 1979). However, such approach requires more data for hedonic estimate such factors that influence the likelihood of a property selling (Fisher et al,2004).

3.3. Methods addressing time-varying liquidity

A real estate price index stands for value variation of a standardized property which means that the characteristics of such property stay constant over time. By using the hedonic econometrics methods we implicitly use dataset which allows keeping the characteristics of properties unchanged. The problem which we can not influence by collecting any particular data and which significantly influences the transactions is the liquidity of the market.

Liquidity is the speed or ease in which properties are transacted or expected to transact. We can measure the liquidity of a market as transaction frequency. The liquidity is fundamentally dependent on relative numbers of buyers and sellers at particular time. Relative numbers are particularly connected to changes of buyers and sellers over time. When the number of market participants rises from one period to another, the liquidity increases.

Transaction prices and market liquidity are related. When you want to sell a property (at a certain price), it is much easier and quicker when there are more buyers, simply said, when the market is more liquid. When sellers are ready to spend a certain time on a transaction process, in more liquid market they can ask a higher price for relatively same quality of a property. This features hold also on the aggregate level that means the number of transactions (liquidity) is positively correlated with asset market cycle (Fisher et al. 2003). Keeping the size of a market constant, transaction frequency is higher when praises are high or goes up and is lower vice versa. Comparing with the cycle of the general economy, changes in transaction frequency are found to be procyclical and persistent.

To conclude, transaction prices don't include just characteristics of each individual property but reflect the liquidity of the market as well. The issues of heterogenic properties we can mitigate by using hedonic-price econometric methods. For addressing the price biases caused by market liquidity, we have to focus on intertemporal variations.

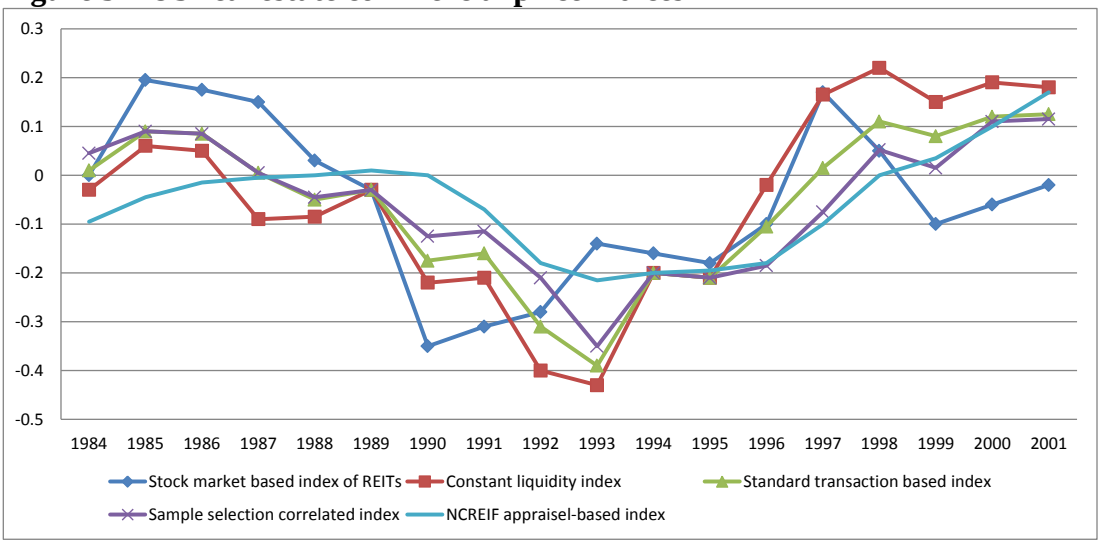
Methods dealing with such time-varying liquidity are complex. One of them was introduced by Fisher et al (2003). The method consists of three step approach where the first two are similar to the sample selection biases correction. The final step includes parameters which manage to keep the market liquidity constant. This procedure is based on observing the frequency of successful transactions, that means when a reservation price of a seller (under which is he not willing to sell) and an offer price of a buyer (above which is he not willing to buy) match.

This model allows to get rid of the mutually effecting relation between property prices and transaction frequency. Empirical observations of rich property databases of some property markets make it possible to separate this effect and create liquidity constant property indexes.

On the following graph we can see log curves of various indices of US commercial price movements in years 1984 – 2001. The indices were created by Fisher, Gatzlaff, Geltner and Haurin (2003) based on dataset provided by National Council of Real Estate investment Fiduciaries (NCREIF)[19]. We can see an appraisal-based index, a transaction price index, an index based on transacted prices including a correction for selection bias, an index which holds constant liquidity and a stock exchange based index. Although the indices show a remarkable value differences in a long run they follow the same pattern.

[19] The dataset included 3,311 properties, with an aggregate appraised value of just over $100 billion. Properties were distributed across the four major regions of US (East, Midwest, West and South). The database included all four property types: office (29%), industrial (29%), apartment (24%) and retail (18%).

Figure 5 – US real estate commercial price indices



Estimated log value levels

Source: BIS, 2005

4 Predictions based on examples of other countries

In this part of the paper we focus on predicting the real estate value development in the Czech Republic. We use empirical evidence from countries that underwent real estate market crisis in the years 1989-1993. The symptoms of this development resemble the latest crisis that started in the US in late 2007 as what is commonly referred to as subprime crisis, of which considerable consequences have been apparent in the CEE region. For this purpose we will use data from the United Kingdom, Ireland and Sweden.

Firstly, we investigate the relation between real estate indices calculated by the international agency Investment Property Databank (IPD)[20] and an artificial index calculated with use of historical rent values and investment yields. Than we try to select financial and macroeconomic fundamentals that may predict the future values of real estate and/or office investment yield.

[20] IPD is the world leader in performance analysis of real estate in most of the countries of the world. The organization doesn't participate in real estate investment markets or doesn't offer consultancy services. IPD creates its calculations based on gathered information from all major real estate agencies like Atisreal, CB Richard Ellis, Colliers, Cushman & Wakefield, Drivers Jonas, DTZ, Gerald Eve, Jones Lang LaSalle, King Sturge, Knight Frank and Strutt & Parker.

4.1. Comparable countries

We have chosen Ireland and Sweden because of the current and especially historic similarities to the Czech Republic. Each of them is a small country (measured by GDP output) with highly open economy. For each of them is the capital city by far the main center of government, finance, culture, trade and commerce. The United Kingdom (London) we chose because of its maturity of its real estate market. London is one of the world financial hubs and as we mentioned in the theoretical part of this paper, financial atmosphere has direct influence on the real estate valuation.

We can also find some geographical and sociological similarities. For instance in case of Sweden and Czech Republic the population of the capitals is 12%-14% of the entire country population. But the most interesting is the lagged development of Czech Republic (and the other post-communist countries) behind the "west" countries. On the example of their previous development (of democracy, legislation, economy) the CEE countries plan and predict as well as learn from mistakes and deadlocks. There will always be differences and nothing like perfect comparables exist, however we believe this country mix gives us a good pool for observations and fits to our objective of explaining yield movement based on macroeconomic fundamentals.

Following table shows the countries macroeconomic indicators where we can observe similarities.

Table 1 – Macroeconomic indicators

	CZ	IRE	SWE	UK
Population, total (millions)	10,4	4,4	9,2	61,4
Population of capital city (thousands)	1 251,1	506,2	829,4	7 556,9
Population growth (annual %)	0,9	1,6	0,8	0,7
GNI per capita, Atlas method (current US$)	16 670,0	49 480,0	52 460,0	46 150,0
GNI, PPP (current international $) (billions)	250,1	164,6	376,4	2 356,4
GNI per capita, PPP (current international $)	23 990,0	37 190,0	40 830,0	38 370,0
Life expectancy at birth, total (years)	77,0	80,0	81,0	80,0
Forest area (sq. km) (thousands)*	26,5	6,9	275,5	28,7
Agricultural land (% of land area)*	55,0	62,1	7,6	72,9
Energy use (kg of oil equivalent per capita)*	4 428,0	3 457,0	5 512,0	3 465,0
CO2 emissions (metric tons per capita)*	12,1	10,2	5,4	8,8
Electric power consumption (kWh per capita)*	6 496,0	6 263,0	15 238,0	6 123,0
GDP growth (annual %)	2,5	-3,0	-0,2	0,5
Inflation, GDP deflator (annual %)	1,8	-1,2	3,0	3,0
Agriculture, value added (% of GDP)	3,0	2,0	2,0	1,0
Industry, value added (% of GDP)	38,0	34,0	27,0	24,0
Services, etc., value added (% of GDP)	60,0	64,0	71,0	76,0
Exports of goods and services (% of GDP)	77,0	80,0	53,0	29,0
Imports of goods and services (% of GDP)	73,0	69,0	46,0	32,0
Gross capital formation (% of GDP)	25,0	26,0	19,0	17,0
Market capitalization of listed companies (% of GDP)	22,6	18,5	51,8	69,6
Military expenditure (% of GDP)	1,3	0,6	1,2	2,5
Merchandise trade (% of GDP)	133,7	78,7	71,9	41,0

*Values for 2008, *2007*

Source: World Bank

According to real estate market we anticipate the Swedish market to be the most suitable example for the Czech Republic. We base our assumption on relative openness of the market (structure of foreign and domestic investors) banks and financial system, size and disposition of the capital city. Ireland with its size of the economy may seem to be the most similar country to the Czech Republic[21] but the Irish real estate sector is very specific compared to other mature countries of similar size and economic power (DTZ, 2010, Deloitte, 2010). This fact may be caused by specific nationalistic behavior of the population and structure of Irish banking system (Central Bank of Ireland, 2010), which mainly consists of banks with Irish based equity. The irregularities cause a different cyclical movement of real estate investment yields than are visible in other European countries. Despite the heterogeneities we try to deduce certain regularities which may hold also for the Czech Republic real estate market.

[21] In the period 2000 - 2005 Ireland, the European tiger, was presented (by some politicians and economists) as good example and a proper model of economic reforms (stimulated by foreign investments)

4.2. Real estate indices of comparable countries

As we could see in the chapter 3, there are many valuation indices of real estate. They differ in values and slightly in timing but generally they follow similar pattern. In the Czech Republic, there isn't any official discrete index for commercial real estate[22]. Therefore, we try to simulate a simple index created from accessible information. We also build the index same way for the United Kingdom, Ireland and Sweden. Based on historical data of real estate indices, macroeconomic indicators and financial figures from the three comparable countries, we try to confirm the application of this approach. Consequently we try to predict development of real estate prices based on results of our research.

Following graphs were created from dataset provided from Investment Property Databank (IPD). The real estate index represents a normalized value of office commercial properties in particular countries[23]. It doesn't include rental giants flowing from holding a property. In sense of financial indicators it can be liken to a stock exchange index like PX, DAX or Dow Jones.

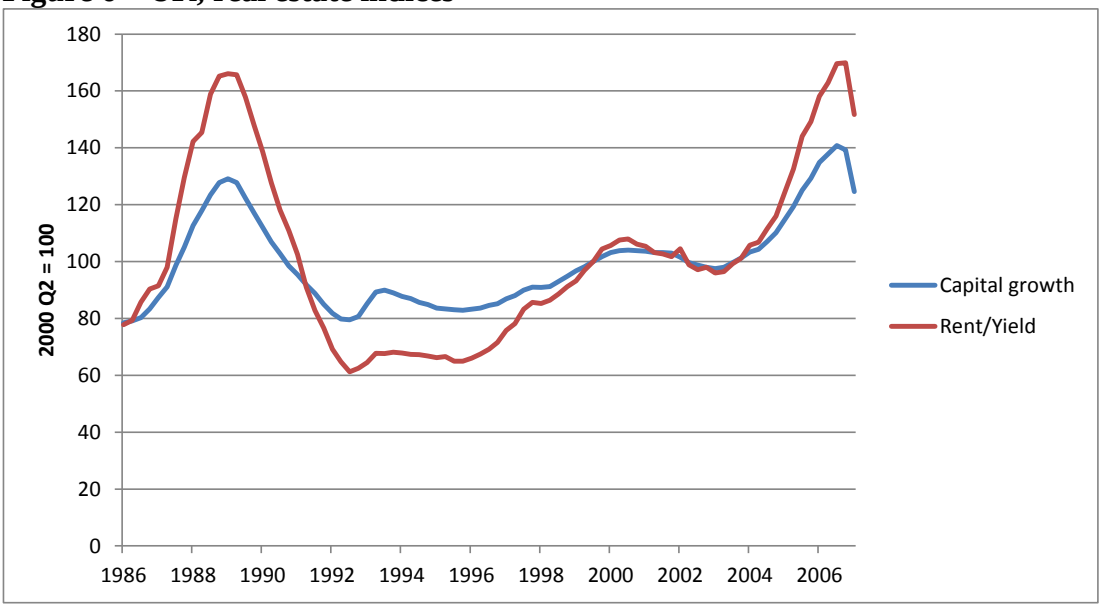
The second value (Rent/Yield) is calculated as normalized A-class office rents divided by initial yield. As we can see in the theoretical part, the real estate values can be computed by dividing rents (net rental stream coming to the investor) by initial yield (presented on a market).

The dataset from the three countries doesn't cover same periods. For the United Kingdom we have available data from forth quarter 1986 to forth quarter 2007[24]. For Ireland we have been provided with data range of forth quarter 1993 to forth quarter

[22] As far to the knowledge of the author. There exists a Central and Eastern European Property index prepared by IPD. The values of the index started in 2005.
[23] Technically the index represents an increase in the value of the properties held throughout the time period, net of capital expenditure, expressed as a percentage of the capital employed over the time period.
[24] IPD doesn't provide the latest two years dataset of real estate indexes and other related data for academic purposes.

2007[25]. For Sweden IPD provides only annual data from 1997 to 2007. In case of Sweden we used quarterly data of initial yield and rents from DTZ in range of 1985 Q4 – 2009 Q3. In order to compare the calculated figure of Rent/Yield with RE value index we have linearly extrapolated the IPD data into quarterly basis.

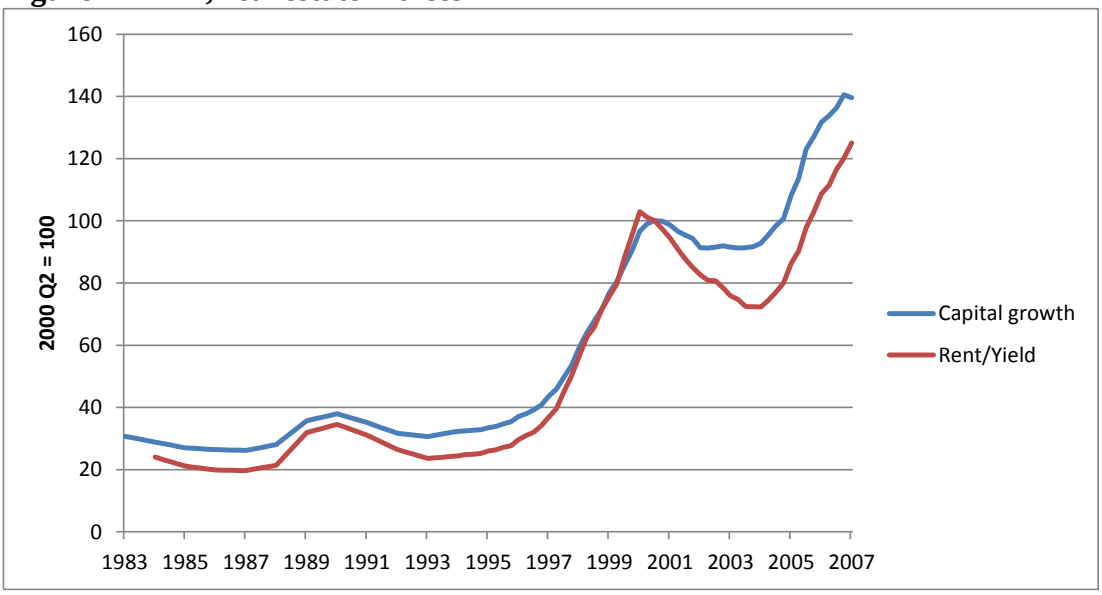
Figure 6 – UK, real estate indices



Source: IPD, author's calculation

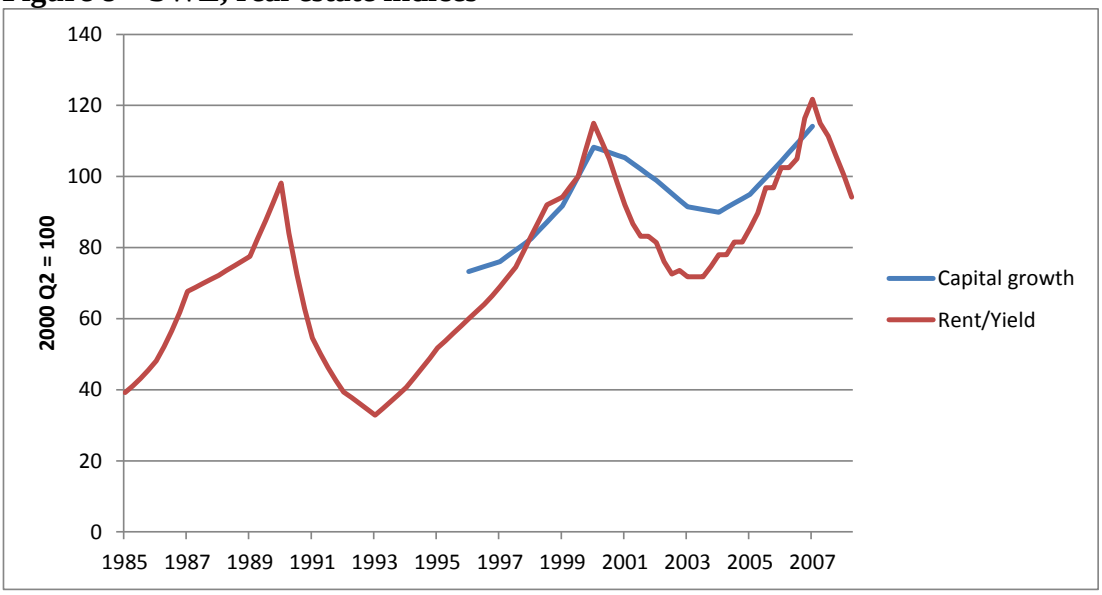
[25]For Ireland, IPD has in addition annual data from 1983 – 1994. In order to extend the data range we linearly extrapolated the annual period to quarterly data. We followed the same procedure as in case of Sweden.

Figure 7 – IRE, real estate indices



Source: IPD, author's calculation

Figure 8 – SWE, real estate indices



Source: IPD, DTZ, author's calculation

From the graphs we can see a co-movement of the two curves, from which we can imply two results. Firstly, we can confirm the theory that initial yield and rental income directly influence the total value of real estate. Secondly, if we don't have a real estate price index, we can substitute it (to a certain level) by the calculated figure of Rent/Yield. Although in absolute terms the figures can differ (the magnitude changes), they strictly follow same pattern (both rises or fall at the same moment).

For rigorous proof of relative substitutability of the figures, we present the initial statistical description of the relations between the two real estate indices, macroeconomic fundamentals (GDP growth, Inflation, Unemployment, Exchange rates, Good export, Industry production) and other financial figures (10 year government bond yield, 3 month interest rate, Repo rate, Stock exchange index, Residential price index).

There are two types of relationships, those of long run nature and those of short run characteristics. Long-run characteristics in economics and finance are usually associated with non-stationarity in time series and called trends. Whereas short-term fluctuations are stationary time series called cycles. Economic time series can be viewed as combinations of these components of trends and cycles. In order to prevent misleading interpretations caused by spurious regressions we have to achieve stationary in the time series. This can be achieved by detrending or differentiation of the time series (Wang, 2001). The short term is referred to stationary time series. The correlation statistic is usually used as an indicator about the short-term relationship between two stationary time series. For discovering whether the real estate lags or leads other sectors or components we compute the correlations between the variables by lagging or forwarding the real estate variables.

Cointegration is called a relation between two or more non-stationary time series for which we can find a linear combination which is stationary. This relation can be examined in several ways, for our analysis we will use Engel-Granger two step method, one of the most frequently used methods. The first step of this method is to run a regression of one time series on the other, and then we examine the residual for stationarity. For this purpose we use the Dicky-Fuller(DF) and augmented Dicky-Fuller (ADF) tests. The tests were originally created for checking the presence of unit roots in time series (Dicky and Fuller, 1979). The optimal lag length is determined by the Akaike information criterion (AIC) and the residuals are checked to be white noise using the Ljung-Box Q statistic. In the following Table 2. we show the result with the optimal lag length according to AIC. In Tables A30-A34 are reported all results from lag 0 (DF statistic) to lag 4 (ADF).

Following tables summarize correlation coefficients between first differences of the two indices with real economy indicators (short term relation) and cointegration of the indices and the economy indicators (long run relation). In Tables A35-A38 you can find the exact calculated numbers for different time lags in case of correlation and the results of cointegration proceeded by the Engle-Granger two step method as mentioned above.

Table 2 – Correlation, real estate indices

	UK				IRE				SWE				CZ	
	Capital growth		Rent/Yield		Capital growth		Rent/Yield		Capital growth		Rent/Yield		Rent/Yield	
	lead or 0	lag	lead or 0	lag	lead or 0	lag	lead or 0	lag	lead or 0	lag	lead or 0	lag	lead or 0	lag
GDP growth real	0,412 ***	0,586 ***	0,515 ***	0,540 ***	0,274 **	0,220	0,122	0,113	0,459 ***	0,303 **	0,464 ***	0,417 ***	0,464 ***	0,669 **
Inflation	-0,332 **	-0,351 ***	-0,376 ***	-0,341 ***	-0,280 **	0,426 ***	-0,332 **	0,303 **	-0,304 **	0,276 **	-0,580 ***	-0,203	-0,419 ***	0,209
Exchange EUR	-0,130	-0,278 **	-0,151	-0,318 **	-0,221	-0,087	-0,202	-0,058	-0,302 **	-0,497 ***	0,448 ***	0,091	0,305 **	0,194
Exchange USD	-0,164	0,147	-0,046	0,094	-0,145	0,424 ***	-0,271 **	0,365 ***	-0,785 ***	-0,298 **	0,104	-0,061	0,187	0,120
Good export	0,395 ***	0,641 ***	0,534 ***	0,526 ***	0,427 ***	0,394 ***	0,327 ***	0,306 **	0,422 ***	0,311 **	-0,154	0,316 **	-0,371 ***	-0,101
Industrial production	0,437 ***	0,632 ***	0,597 ***	0,640 ***	0,373 ***	0,386 ***	0,257 **	0,261 **	0,146	0,262 **	0,179	0,288 ***	0,440 ***	0,198
Unemployment	-0,243	-0,546 ***	-0,361 ***	-0,574 ***	-0,454 ***	-0,477 ***	-0,331 ***	-0,348 ***	0,774 ***	-0,572 ***	0,723 ***	0,259 **	0,497 ***	-0,250 **
10Y	-0,569 ***	-0,636 ***	-0,654 ***	-0,607 ***	-0,516 ***	-0,436 ***	-0,416 ***	-0,321	-0,480 ***	-0,143	-0,349 **	-0,093	-0,219	-0,242
3Y	-0,221	-0,144	-0,306 **	-0,183	-0,507 ***	-0,454 ***	-0,396 ***	-0,346 ***	-0,478 ***	0,160	-0,100	0,051	-0,117	0,244
1Y	-0,302 **	-0,047	-0,404 ***	0,271 **					-0,446 ***	0,563 ***	-0,109	0,317 **	-0,261 ***	0,045
6M									-0,465 ***	0,543 ***	-0,184	-0,044	-0,264 ***	0,036
3M	-0,318 **	0,319 **	-0,431 ***	0,289 **	-0,480 ***	-0,391 ***	-0,372 ***	-0,248	-0,483 ***	0,055	-0,183	-0,090	-0,258 ***	0,046
1M													-0,236	0,065
Repo rate	-0,325 ***	0,290 **	-0,437 ***	0,256 **	-0,638 ***	-0,671 ***	-0,494 ***	-0,617 ***	-0,526 ***	0,501 ***	-0,039	-0,194	-0,162	0,160
Stock Exchange	0,088	0,168	0,152	0,225	0,601 ***	0,654 ***	0,502 ***	0,528 ***	0,762 ***	0,806 ***	0,145	0,196	0,208	0,417 ***
Residential	0,343 ***	0,371 ***	0,403 ***	0,404 ***	0,413 ***	0,186	0,338 ***	0,148	0,289 **	0,235	0,428 ***	0,325 ***	0,386 ***	0,470 ***

Source: IPD, DTZ, OECD, Czech Statistical office, Global Financial Database, author's calculation

Critical value equals 0.25 and 0.325 at 5% and 1% significant levels respectively

** represents 5% level, ** 1% level*

Table 3 – Cointegration, Engle-Granger method

	UK		IRE		SWE		CZ
	Capital growth	Rent/Yield	Capital growth	Rent/Yield	Capital growth	Rent/Yield	Rent/Yield
CPI	0,001 ***	0,014 **	0,009 ***	0,232	0,022 **	0,126	0,074 *
Exchange USD	0,041 **	0,031 **	0,000 ***	0,000 ***	0,017 **	0,280	0,199
Exchange EUR	0,111	0,169	0,667 *	0,395	0,132	0,249	0,271
Good export	0,005 ***	0,002 ***	0,012 **	0,001 ***	0,080 **	0,111	0,072 *
Industrial production	0,014 **	0,030 **	0,004 ***	0,955	0,132	0,080 **	0,041 **
Unemployment	0,007 ***	0,036 **	0,232	0,026 **	0,021 **	0,334	0,371
10Y	0,008 ***	0,022 **	0,001 ***	0,011 **	0,017 **	0,021 **	0,461
Stock Exchange	0,041 **	0,055 *	0,000 ***	0,026 **	0,792	0,053 *	0,029 **
Residential	0,423	0,000 ***	0,000 ***	0,012 **	0,022 **	0,100 **	0,000 ***

P-values

Source: IPD, DTZ, OECD, Czech Statistical office, Global Financial Database, author's calculation

When we look on the tables analyzing the short term and long run characteristics of real estate, we see more similar results across all observed countries as well as by the two approaches (Capital growth index and Rent/Yield). Nevertheless the magnitude of correlations and cointegrations differs significantly and by that we can not proof our hypohesis, that with the variable Rent/Yield we could fully substitute the real estate index.[26]

In general we can proof the connection between real estate and gross domestic product, inflation, industrial production, unemployment and several product of the financial market. Specifically, a positive relation between the real estate (indices) and GDP growth, good export and industrial production and a negative relation with inflation (real estate in real values), 10 year government bonds (alternative investment), short term interests (cost of capital) and unemployment. The leads and lags of changes in value of real estate in compare to the variables suggest there are both way connections. The real estate sector is not only influenced by outcomes created in the other parts of the economy but it is an inseparable section that has direct effect on other parts. These outcomes are in compliance with the theory outlined in chapter 2.

Interesting relation is between the real estate indices and the stock exchange indices. As we can see specifically in the Tables A30-A34 the correlation between these two indices is high mainly for lagged values of real estate indices. We can observe higher correlations in Ireland, Sweden and Czech Republic. That is probably caused by the size and diversity of the British stock exchange which serve not only as domestic trading facility but as a world financial hub. Wang (2001) examined similarly the relation between real estate price indices, all share price index and real estate company price index in the United Kingdom. His results showed higher correlation with the real estate company price index. Wang's further examination pointed at

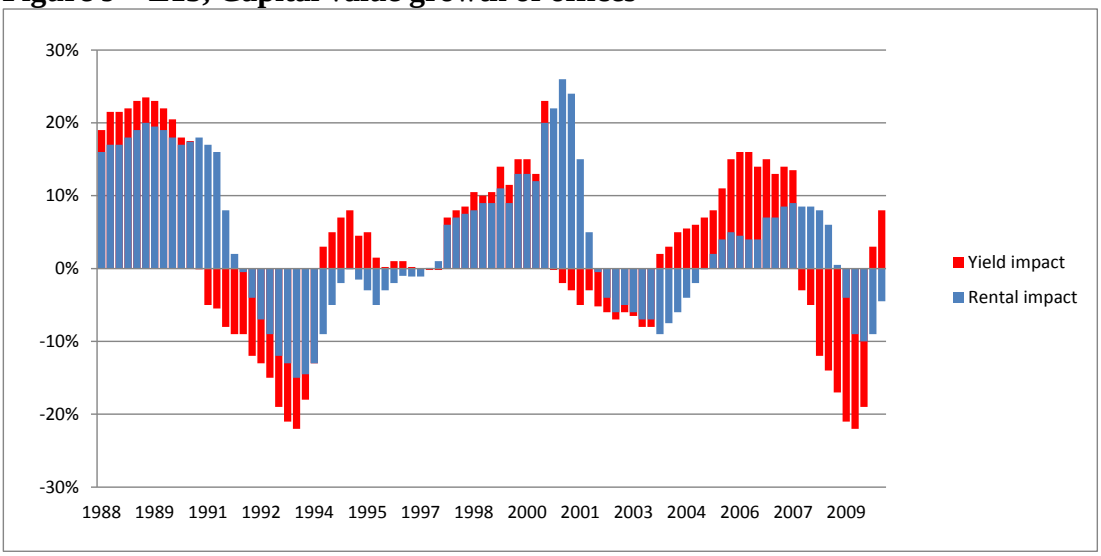
[26] That is probably the reason why the real estate agencies operating in the Czech Republic don't provide such indices.

price discovering processes[27] between real estate market and the secondary financial market.

Nevertheless we know that rents and yields have significantly major influence on the value of property. In following chapters we will focus on yield evolvement and its possible prediction for Czech Republic.

CBRE has undertaken a survey, were they examine the influence of rents and yields on office real estate prices in Europe.

Figure 9 – E15, Capital value growth of offices



Annualized values

Source: CBRE

From the graph we can observe that yield effects lead to rental impact. From such conclusion we can assume that for investors is the information about yield crucial. It is generally acknowledge that the lagged reaction of rents is caused by contracting rents for longer periods with seldom indexation periods (usually increasing the rents

[27] The price discovery mechanism occurs between two related markets. When new information occurs and this information has influence on prices of goods or services traded on those two markets, the price change takes place first on one of the markets. This so cold price discovery takes place in the more efficient market.

according to consumer price index) and renegotiation terms. Summary of lease structure of European countries is available in Table A39.

In the following sections we will focus on factors influencing the yield evolvement and try to predict the future values of yield based on variety of approaches and econometric models.

4.3. Swedish real estate crisis

In this chapter we describe the Swedish real estate cycle during the late 1980s and beginning of 1990s. This cycle, often described as "real estate crisis", has from today's perspective many similar features to present situation in the countries of CEE region. From events of the Swedish crisis we try to imply similarities to the Czech real estate crisis and potential future development of the real estate sector in the Czech Republic.

Swedish real estate market went through an extraordinary cycle during the 1980s and beginning of 1990s. The construction of multi-family houses and commercial properties witnessed an unusual rise since 1985. Even bigger increase was recorded in prices of these assets, which can be clearly demonstrated on the development of the investment yields. In 1980 the investment yields were around 10%, in 1985 fell to 7% and at the peak of the boom they came down even to 4%[28]. From 1990 to 1993 it increased back to 7%.

The boom reached its top in 1990 and during the next three years the real price plummeted. The average value of commercial properties fell (office buildings in urban areas were hit most) almost to one third of the peak value. In 1993 at the trough of the cycle, the real estate market suffered from high vacancy rates, high loan

[28] Wallander (1994) explains the unusual levels of yield at both ends of the period as an disequilibrium phenomena, where the high level in 1980 was caused by borrowing restrictions and the low yields in 1990 were influenced by real estate bubble.

default rates and financial distress for major lending institutions. In Table 4 we can see some highlight values in the key dates of the cycle.

Table 4 – Swedish real estate crisis

	Initial Period 1980	Start of Boom 1985	End of Boom 1990	End of Bust 1993
Construction				
1-2 Family	100	62	88	39
Multi-Family	100	198	241	195
Commercial	100	93	107	84
Prices				
1-2 Family	100	70	97	72
Multi-Family	100	94	165	93
Commercial	100	244	422	144

Source: SCB (1993), Bank for International Settlements (1994)

The main influence on the real estate crisis had the banking sector (Englund, 1999). Banks and other financial institutions went through waves of deregulation[29] during the 1980s. These deregulations caused a massive increase in lending volumes[30]. The financial institutions started to accept higher risk which was directly visible on increasing the Loan to Value ratios (LTV). These were kept at maximum of 75%[31] for the 3 years after deregulation but in 1988 the LTV was increased to 90%. During the following bust the LTV was again decreased and in 1992 fell even to 60% (Walander, 1994).

The credit expansion was in turn followed by asset price increase, which though were not grounded in fundamental appreciation of theses assets and created a bubble. At the end of 1989[32] the bubble burst and caused an avalanche effect of falling prices, disruption of asset markets (especially real estate) and bankruptcies (companies as well as personal).

[29] The deregulation started with abolition of the liquidity ratios for banks in 1983. Then interest ceilings were increased in the spring of 1985 and at the end of the same year the lending ceilings for banks and the placement requirements for insurance companies were canceled

[30] The increase rate of new lending from financial institutions rocketed from 11 – 17%, recorded during 1980 – 85, to 20% in 1986. In the period of 1986 – 90, lending increased by 136%, 73% in real terms (SCB)

[31] Mortgage loans to owner occupiers

[32] The change came in autumn 1989. The commercial properties started to have problems finding tenants because of the too high rent level. The stock market reacted promptly and from its peak in mid August, the construction and real estate stock price index fell by 25% in a year (more than double loss compared to the general index). By the end of 1990 the real estate index had plummeted 52%

The banks and financial institutions suffered huge losses. The landing related to real estate accounted for almost half of all loses; although created only 10-15% of supplied assets. At the peak of the crisis (end of 1992) the losses reached even 7.5% of lending, about twice the operating profit of the banking sector. Over the period 1990-3, the accumulated losses reached almost 17% of landings. In order to mitigate the credit crunch the Swedish government created Securum (a "bad bank") to where "non-performing" loans from some banks (Nordbanken, Gota) were transferred[33]. Despite of the fact that of Gota bank went bankrupt in September 1992, the role of banking sector as liquidity provider was inviolate during the whole crisis. The major role on this fact played Riksbank (Swedish national bank) with the in time measure of quarantine for all banks and all liabilities.

Englud (1999) identifies two rival explanations for the price boom of real estate (and other assets). One is the presence of bubbles (the demand for real estate is strong just because the investors think that the prices will keep raising) induced by the deregulated credit market allowing high leverage investments. The second are the major shocks to fundamentals (high inflation, expansionary macro policy and low post-tax real interest rates). Based on his investigation, the deregulation didn't play the crucial role. "However, once the price boom was under way it was amplified by the new borrowing opportunities and by lax risk analysis in financial institutions." (Englund, 1999, p. 89) The followed crisis was then a natural cause of such misbalances and logical face of a real estate cycle. Englund in his work further mentions a fundamental role of new financial tools traded on financial markets domestically and internationally.

Jeffe (1994) examined the Swedish commercial real estate sector with use of stock-flow model[34]. His results show that the wild price fluctuation of the commercial real

[33] More in Table 4 - Swedish banks during the banking crisis

[34] The stock-flow model calculates equilibriums for supply and demand of commercial properties and required rents. The variables for these calculations are demographic factors, employment, income, real estate prices, real interest rates, subsidies, tax factors, construction costs and required office space per employee.

estate can be interpreted from the changes of fundamental factors, concretely real income growth, real interest rates, financial deregulation, tax rates and housing subsidies. Moreover the study comes to conclusion that "the excessive lending stands alone as the critical necessary condition without which the dramatic real estate cycle would not have occurred." (Jeffe, 1994, p. 75)

4.4. Czech Crisis in 2008

Czech Republic as a small open economy is fully exposed to global financial and economic environment. This condition means to benefit in good times but also to be hit in case other countries come into troubles. When we look on the world development in last seven years we notice very positive trend. The average annual GDP in years 2005-2007 was 2.8% for developed countries and 8.0% for developing countries. The positive figures were coupled with low inflation, decreasing interest rates and rising assets value (OECD, 2010). The Czech Republic recorded same optimistic economic development. The average GDP growth in years 2005 – 2008 was 5.2%, unemployment 6.2% and inflation 2.3%. In 2004 the Czech Republic joined the European Union which had a positive economic impact as well.

The rapid change came with the spread of financial crisis in 2008. The crisis stated in August 2007 in the USA as subprime mortgage crisis[35]. From the beginning it was assumed as an isolated problem and America would deal it on its own. Unfortunately, thanks to financial derivates that were created from such loans the risky assets were distributed all over the world. Due to uncertainty of the members of the financial markets (about their counter parties[36]), developed economies were pulled into a mild recession in the first half of 2008. The situation changed rapidly in September 2008. The default of a large investment bank Lehman Brothers triggered the financial crisis that was quickly spread all over the world.

[35] For a better understanding of the financial crisis, their assumed causes and consequences we suggest a good summary prepared by Anup Shah, available at: http://www.globalissues.org/article/768/global-financial-crisis. For a quick and easy introduction into the topic we suggest a video http://vimeo.com/3261363.

[36] Derivatives are traded directly between two parties (Over the counter), not on an exchange so the traders take all the risk of default of the counter party.

The global interconnectivity of the financial sector caused that problems occurred not only in banks and institutions which had the "toxic" assets on their balance sheets but the credit lines dried up almost everywhere. Governments in many courtiers (USA, Germany, Great Britain, Ireland) had to act quickly and save several institutions (AIG, Royal Bank of Scotland, Hypo Real Estate in order to stop the credit crunch overgrow to total collapse.

The Czech Republic and its banking sector couldn't stay an isolated island, so the consequences of the financial crisis influenced the Czech banking sector. However, the Czech financial sector stayed stable during the financial crisis and its position relatively strong, the landing volumes decreased sharply and low liquidity, weak activity and higher volatility prevailed (Czech National Bank, 2010).

The risk credit premium for Czech state (from which most interest rates and financial indicators are derived) stays since the end of 2008 on increased levels. Moreover the combination of state indebting trend and the increasing global risk awareness (caused especially by the fiscal problems of PIIGS[37] countries) could the risk premium even increase.

From a positive point of view the advantage of the Czech Republic was no need of bank sanitation or any other not standard procedure performed by Czech National Bank. We assume that the fact was possible thanks to the significantly smaller exposure of the Czech banks to US subprime mortgages and wide spectrum of derivatives fastened on the underlying asset. The general higher conservatism of Czech banking institutions was probably caused by still vivid experiences of banking crisis and consolidation in 1997 (Stavarek, 2005). On the other hand the foreign ownership structure[38] of the majority of Czech banks generated uncertainty about the

[37] Abbreviation for first letters of European countries Portugal, Italy, Ireland, Greece and Spain, appeared in newspapers after the beginning of the financial crisis in 2007.
[38] For instance Komercni Banka - Société Générale (60,35 %), Ceska Sporitelna – Erste Bank (97,99%), CSOB - KBC Bank (81,5%), HVB Bank Czech Republic – Bayerische Hypo- und Vereinsbank (64,9%).

performance of the mother companies and influences on the Czech daughter companies in case of serious troubles[39].

4.5. Czech Real Estate in the crisis

Hlavacek & Komarek (2009) examined the Czech residential properties and identified property price bubbles in 2002/2003 and 2007/2008. Except for these bubbles they identified a significant rice of residential property values explainable by fundamental factors based on panel regression.

From 2005 the residential prices increased steadily in all subsectors. For instance the prices of multi-family houses almost doubled from 2005 to 2008. Since the spread of the crisis on the Czech residential sector (the value decrease started in 2008, several months later in compare with USA and west Europe) the average value of residential real estate decreased by 15% (King Sturge, 2010).

Through similar development went even the commercial sector. Until autumn 2008 the Czech real estate sector appeared solid and relatively resilient to global credit scrunch. The dramatic change came with a sudden fall of the American investment bank Lehman Brothers in September 2008. The bankruptcy triggered a rapid rice of risk aversion and the emerging markets (CEE region in general) with significant reliance on foreign capital were confronted by financial deleveraging.

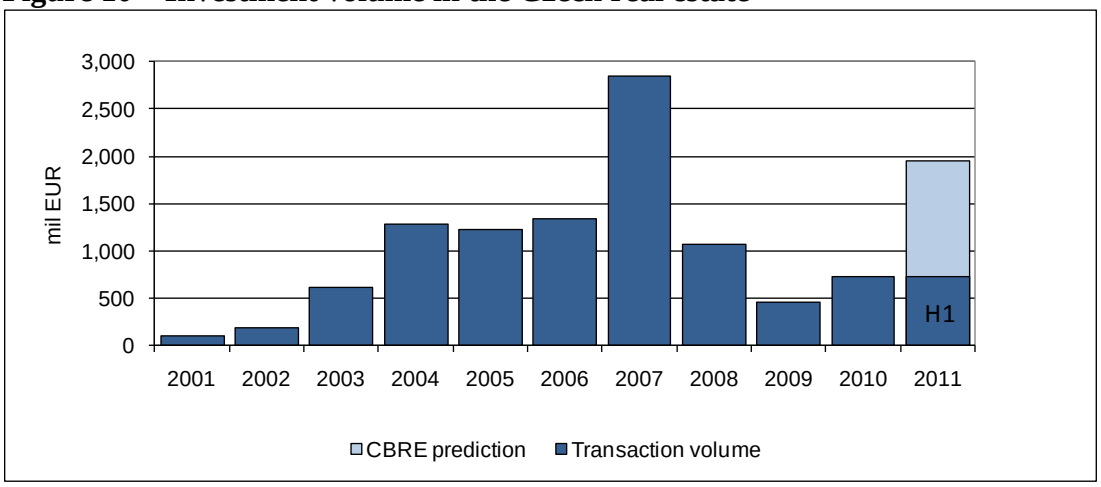
Short after the spread of the crisis only the equity robust buyers (DEKA, DEGI) remained trading. These investors however started to focus on property fundamentals with preferences in long-term rental income secured on a wider range of tenants in prime quality buildings and locations. During 2008 and 2009 the Czech office market witnessed unprecedented decrease of investment volume. The total real estate investment in 2009 fell to 450 mil EUR from more than 2,650 mil EUR in 2007.

[39] Because of Erste Bank poor performance, the bank withdrew all the profit from Ceska Sporitelna in form of 100% dividend in 2008

This sharp fall in transaction activity was caused by different real estate price expectations of vendors and buyers[40]. The sellers were not willing to accept lower capital gains (or even suffer losses) and the purchasers (usually western institutional investors) on the other side were expecting even higher discounts based on risk adjusted basis in compare to West Europe (DTZ, 2009). The ease of the almost frozen market came in second half of 2009 when few transactions were undertaken. The main difference came with nationality structure of investors. After the crisis we can observe a majority source of capital from the Czech Republic (CPI, Sekyra Group) instead of foreign countries.

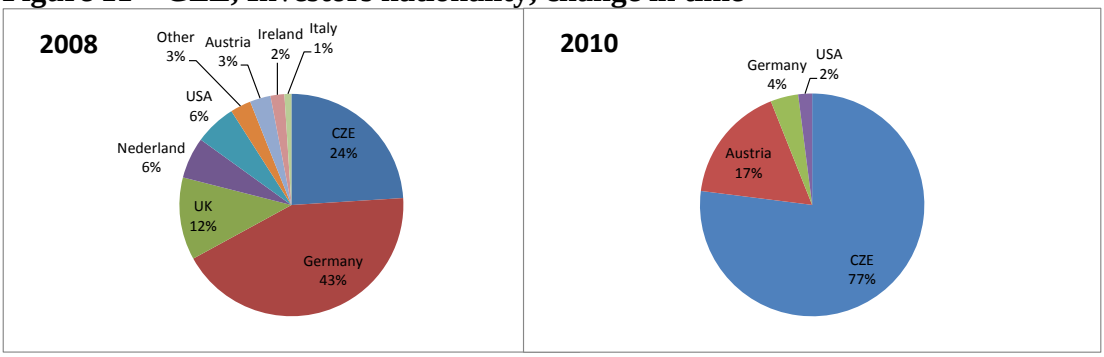
[40] As mentioned in chapter 2.1. and 3.2.

Figure 10 – Investment volume in the Czech real estate



Source: DTZ, CBRE

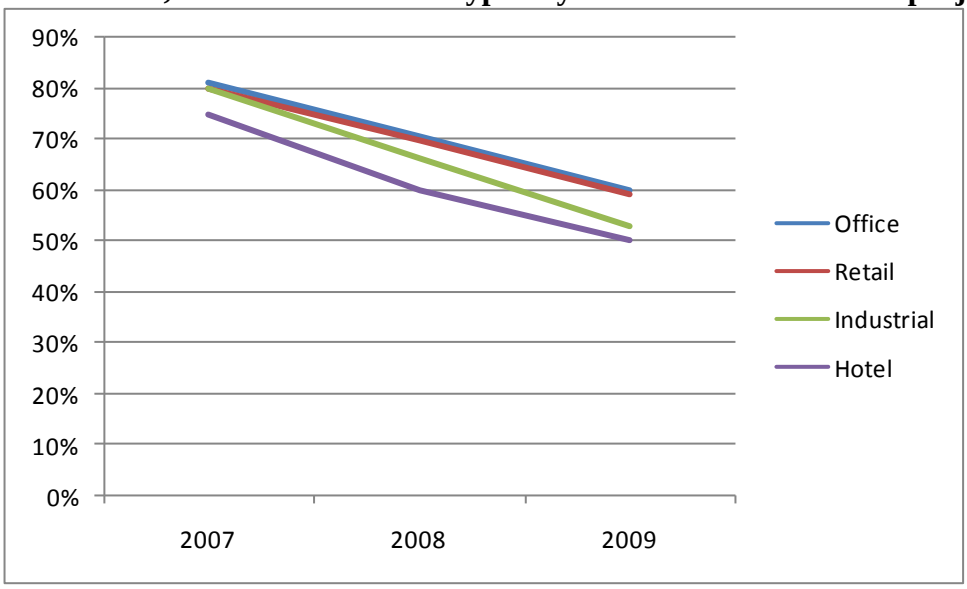
Figure 11 – CZE, Investors nationality, change in time



Source: DTZ

One of the sound indicators of commercial real estate attractiveness is the loan to value ratio (LTV). The ratio stands for percentage amount a bank is willing to land an investor to buy a property. The higher the amount the more confident is the bank about the project. Withers (2009) in his study shows a rapid decrease of the LTV ratio from 80% to less than 60% over the period 2007 to 2009. Similar pattern of the LTV can be observed in the Sweden example in the beginning of 1990s.

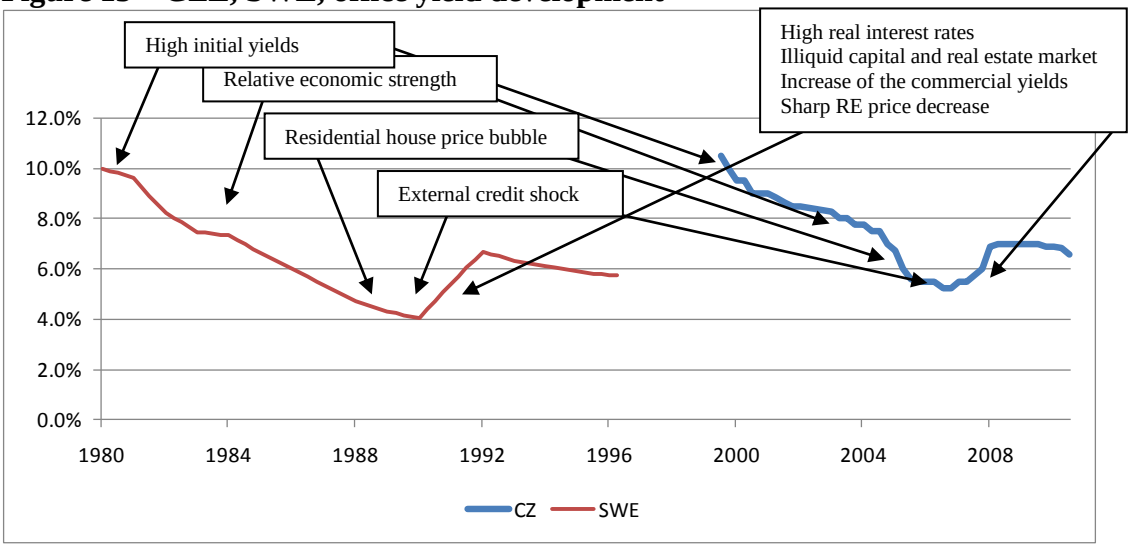
Figure 12 – CZE, Loan to Value ratio typically available for real estate projects



Source: Withers (2009)

4.6. Summary of similarities between Czech and Sweden real estate crisis

Figure 13 – CZE, SWE, office yield development



Source: DTZ

In the Figure 13 we can distinguish the similar pattern of office investment yield (capitalization rate) of Sweden and Czech Republic. In both countries the yield curve starts at levels around 10%, in Sweden in 1980 and in Czech Republic in 2000. In

following decade the yields decreased dramatically following a time of prosperous economy and booming real estate sector. During this period were ex post residential house price bubbles identified.

Real estate crisis were initiated by problems in financial sectors. The bank crisis in Sweden and credit crunch in Czech Republic were both imported from foreign financial markets which were caused by implementing new financial tools. The credit risk rocketed, real interest rates increased and the liquidity in real estate markets plummeted. In case of Sweden the sanitation of the banking sector (paid from public sector) cost more than 2% of annual GDP.

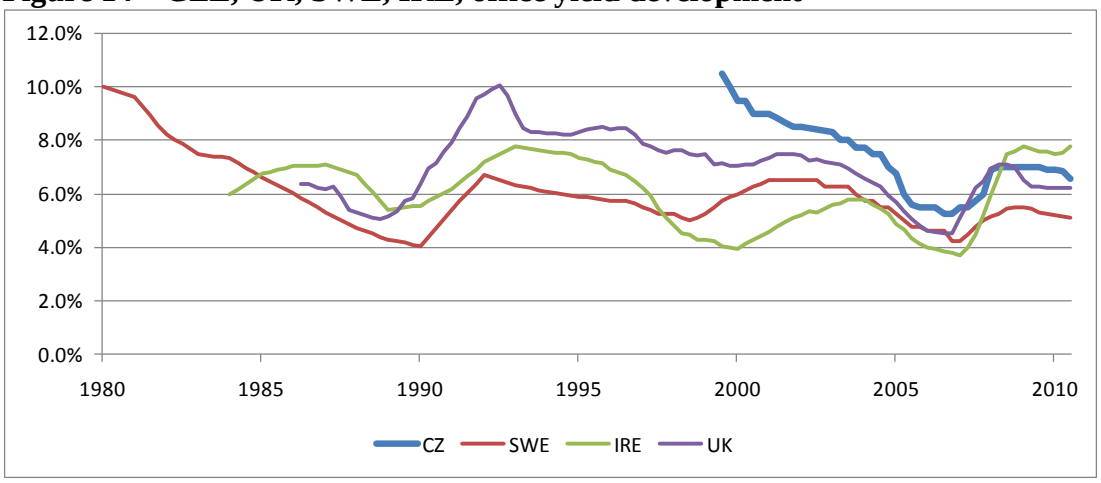
The through of the real estate crisis in Sweden came three years after the peak in 1990. The following years brought a slow upturn of the commercial real estate sector and only a mild decrease of investment yield. In the Czech Republic we can observe an increasing number of transactions approximately two years after the peak. Implying from the Swedish example we can expect only a mild decrease of the investment yield and slow regeneration of the Czech commercial real estate market.

4.7. Yield models based on comparable country examples

Previous sections described the Swedish crises and the consequences on its economy and real estate sector. Sweden was not the only country that had to deal with changes in financial markets and by that caused macroeconomic implications at the end of the 1980s and beginning of the 1990s. In this chapter we continue to analyze the other comparable countries and their real estate cycles.

When we look on the Figure 14, we can notice obvious similarity in movements of office yields across observed countries. The similar trends suggest some kind of international influence on all office yields. Especially in recent history we can observe some kind of global forces that influence the yield development more then the specific features of each local real estate market.

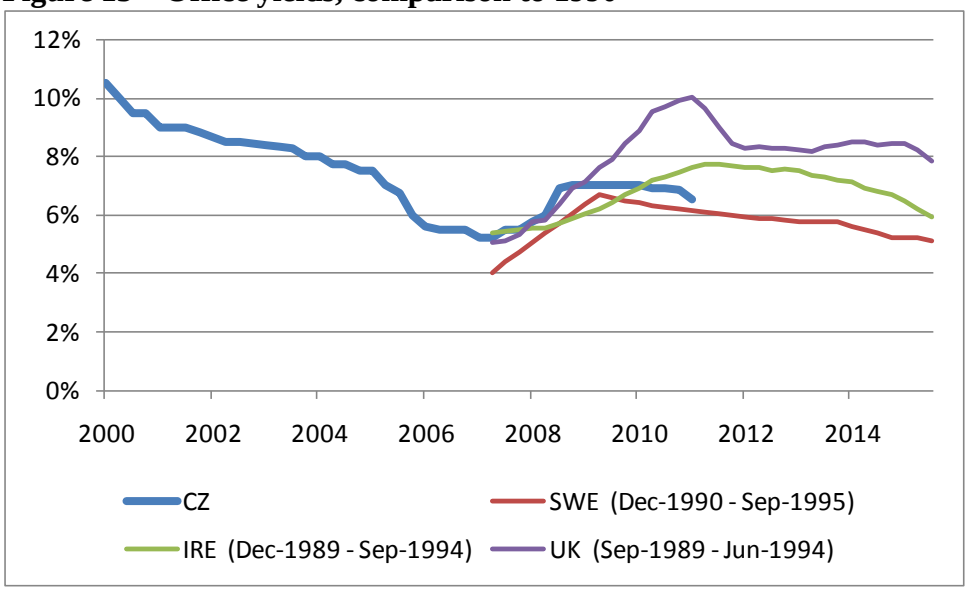
Figure 14 – CZE, UK, SWE, IRE, office yield development



Source: IPD, DTZ

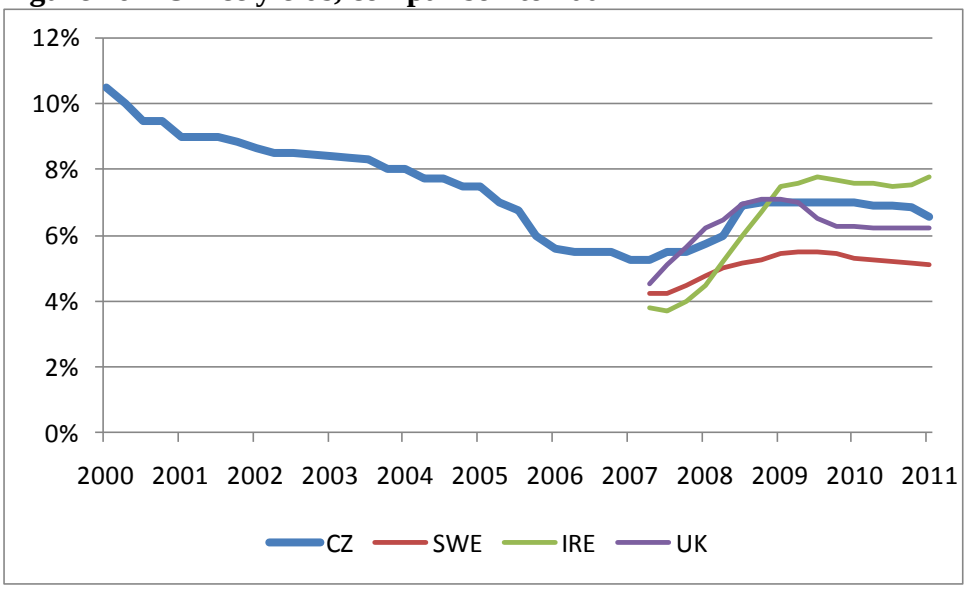
In the following graphs we show the office yield movements of the comparable countries on the background of Czech office yield. We put the lowest values of all the office yields in Q3 2007 (peak of Czech real estate cycle, the lowest yield). We use this method for the current real estate crisis and for the crisis in 1980 because comparing the initial booming atmosphere, new financial tools, macroeconomic circumstances, global scale and consequences of the crises, we emphasize many similarities to the crisis launched in 2007.

Figure 15 – Office yields, comparison to 1990



Source: IPD, DTZ, author's calculation

Figure 16 – Office yields, comparison to 2007



Source: IPD, DTZ, author's calculation

On the graphs we can see that in both periods the British yields reacted faster, they not only increased first but we can also observe a significant decrease (in 1990 it was after 3 years and in 2007 after 2 years). In case of Ireland and Sweden we see some kind of switching the yield movements. In 1990 the Swedish yield increased fast while the Irish yield movement seemed lagged. In 2007 it was the other way round, Irish yield increased fast and even with high magnitude while the Swedish increased only slowly. In both cases the subsequent yield decrease was slow.

In order to illustrate the influence of yield movement on real estate price we compiled the Table 5 where we can see the price movements[41] with change of the investment yields and different initial levels of the yields.

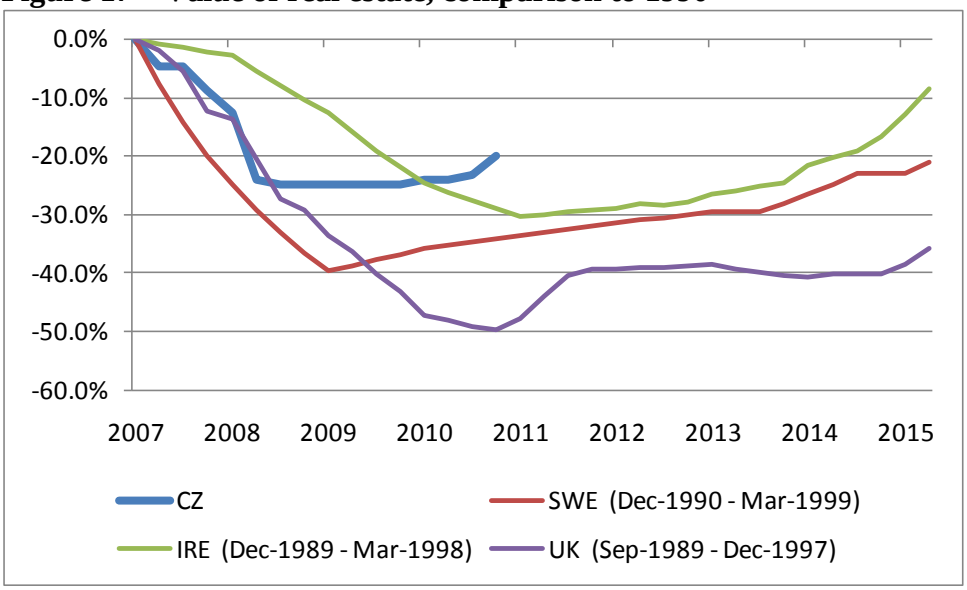
[41] We base the calculation on the formula *(1)* and keep the Rent value unchanged.

Table 5 – Price decrease influenced by yield change

		Yield increase of								
		Δ 0.50%	Δ 1.00%	Δ 1.50%	Δ 2.00%	Δ 2.50%	Δ 3.00%	Δ 3.50%	Δ 4.50%	Δ 5.00%
Initial yield	5.0%	-9.1%	-16.7%	-23.1%	-28.6%	-33.3%	-37.5%	-41.2%	-47.4%	-50.0%
	5.5%	-8.3%	-15.4%	-21.4%	-26.7%	-31.3%	-35.3%	-38.9%	-45.0%	-47.6%
	6.0%	-7.7%	-14.3%	-20.0%	-25.0%	-29.4%	-33.3%	-36.8%	-42.9%	-45.5%
	6.5%	-7.1%	-13.3%	-18.8%	-23.5%	-27.8%	-31.6%	-35.0%	-40.9%	-43.5%
	7.0%	-6.7%	-12.5%	-17.6%	-22.2%	-26.3%	-30.0%	-33.3%	-39.1%	-41.7%
	7.5%	-6.3%	-11.8%	-16.7%	-21.1%	-25.0%	-28.6%	-31.8%	-37.5%	-40.0%
	8.0%	-5.9%	-11.1%	-15.8%	-20.0%	-23.8%	-27.3%	-30.4%	-36.0%	-38.5%

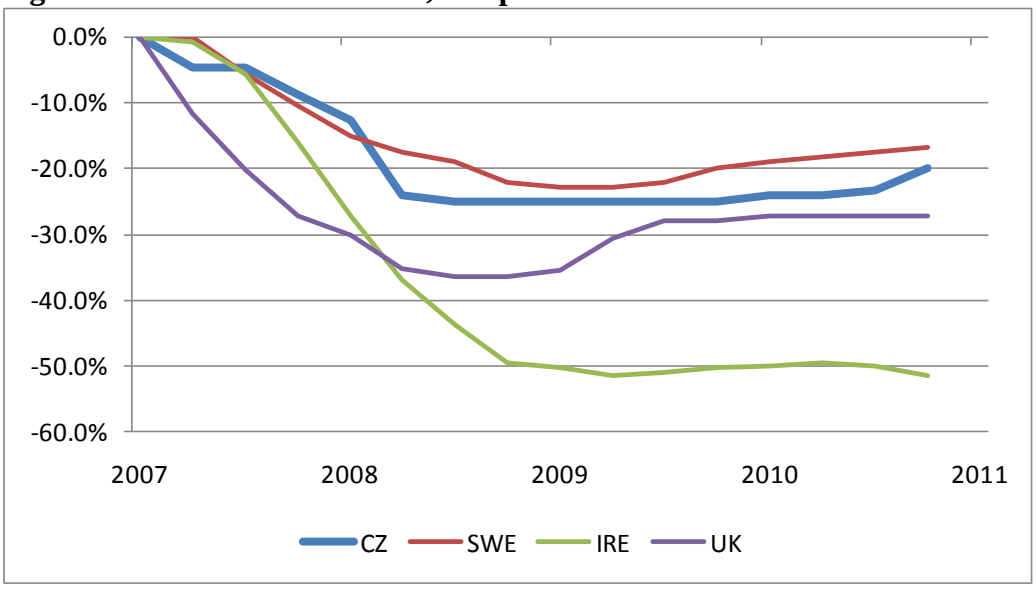
The following graphs show the commercial property price decrease influenced only by the change of the yields (same as in the Table 5). They better illustrate the influence of yield change on the real estate markets. Again we can see the consequences of both periods (1990 and 2007) on benchmark of the Czech Republic in 2007.

Figure 17 – Value of real estate, comparison to 1990



Source: IPD, DTZ, author's calculation

Figure 18 – Value of real estate, comparison to 2007



Source: IPD, DTZ, author's calculation

Claessens & Kose & Terrones (2008)[42] examined implications of recessions, credit crunches, house and equity price bust on micro- and macroeconomic indicators in 21 OECD countries over the period 1960 – 2007. They conclude that average credit crunch last 8 quarters, typically twice the average credit constraint (4-6 quarters). Furthermore they discovered that equity busts typically last 10 quarters and are associated with a 50% price decline. In last two years we are witnessing a combination of these two problems.

According to the results of the study (Claessens & Kose & Terrones, 2008) and showed observation of the yield development, we come to the conclusioin that condition of financial (banking) sector has major impact on the yield values. Further we can predict slow decrease of the Czech office investment yield because of the lapse of time since the beginning of the real estate crisis (9 quarters) and current progressive yield decrease also in the comparable markets. The predicted yield decrease ranges from 0.25% – 0.5% for the coming year 2011.

[42] The study identifies 122 recessions in output, 30 of them severe. The researchers find 112 contractions (28 crunches) in credit, 114 declines (28 busts) in house prices and 234 declines (58 busts) in equity prices.

5 Econometric analysis

In this part of the paper we try to predict the future movement of Czech office yield based on econometric analysis of historical time series of macroeconomic fundamentals. To select the optimal mix of variables we pursue the standard econometrical methodology. We will start with models of the comparable countries, in case of Sweden we will expand the research by observing additional time periods (1980 – 1995 and 1990 – 2010).

First prediction we build on Autoregressive Integrated Moving Average models (ARIMA). These models have in case of real estate yields and generally real estate prices fairly good explanatory power (Wang, 2001). However, the economic background and theoretical causalities are usually tapered to rigid movements of such series (Tony McGough & Sotiris Tsolacos, 2001) caused by imperfection of real estate markets (see chapter 1).

The second approach is based on variety of standard Ordinary Least Square models (OLS). In that section we examine the relations between office yields and macroeconomic variables. In the OLS models we identify the most suitable model which would have the highest predictive power and would be in compliance with the described theory.

In the last section we use the Vector Autoregression models (VAR). We employ the technique because of mutual influences between the fundamental variables (Blanchard, 1989) and strong autoregression of yield time series[43]. The richer yield dataset of the United Kingdom, Sweden and Ireland (compared to Czech Republic)

[43] We also consider a mutual influence between yields and macroeconomic fundamentals because yields are one of the major factors influencing real estate (prices) and the real estate stands for significant part of general economy. For instance only investments in commercial real estate sector in Czech Republic in 2007 with cca. 2 700 mil EUR corresponded to 2.45% of total Czech GDP.

gives us the opportunity to examine the explanatory power of the models by comparing the Root Mean Square Errors (RMSE)[44] of different econometric models.

Theoretical background

Recalling the theoretical quantification of capitalization factor (yield) from chapter 2.2 and following D'Argensio and Laurin (2007) we come to a formula expressing the yield:

$$(5) \qquad cap_0 = \frac{Rent_1}{V_0}$$

From basic valuation theory we get a value of an asset:

$$(6) \qquad V_0 = \sum_{t=1}^{T} \left[\frac{CF_t}{(1+r_t)} \right]$$

Where CF_t stands for cash flow in period t and r_t is a discount factor for corresponding period. Further we can write:

$$(7) \qquad CF_t = \mathrm{Re}\,nt_t(1+g_t)$$

$$(8) \qquad V_0 = \mathrm{Re}\,nt_1 \left\{ \sum_{t=1}^{T} \left[\frac{(1+g_t)^t}{(1+r_t)^t} \right] \right\}$$

And putting the formula (8) back to formula (5) we get:

$$(9) \qquad cap_0 = \frac{Rent_1}{Rent_1 \left\{ \sum_{t=1}^{T} \left[\frac{(1+g_t)^t}{(1+r_t)^t} \right] \right\}}$$

According to Jud & Winkler (1995) and Sivitanidou & Sivitanides (1999) formula (9) can be interpreted as growth-adjusted nominal return required on property. Following this theory, we can substitute the discount factor r_t by required return on property derived from using the Capital Asset CAPM.

[44] The RMSE is calculated as $\sqrt{\sum_{t=T+1}^{T+s} (\hat{y}_t - y_t)^2 / s}$, where $\hat{y}_t$ stands for forecasted value of y_t. The sum of squared forecast errors ($\hat{y}_t - y_t$) is divided by the number of forest values s. RMSE attaches a high weight to larger errors.

$$(10) \qquad r_t = Rrf_t + \pi_t + \beta\left[Rop_t - (Rrf_t + \pi_t)\right]$$

Where we have Rrf_t the risk free rate, π_t inflation and Rop_t stands for opportunity cost of capital. D'Argensio and Laurin (2007) then add a component of risk specific to the real estate. The modified formula of CAPM looks then like:

$$(11) \qquad r_t - (Rrf_t + \pi_t) = \beta\left[Rop_t - (Rrf_t + \pi_t)\right] + Rre_t$$

Substituting the equation (11) in simplified formula (9) for r_t we get:

$$(12) \qquad cap_0 = \frac{1}{\left\{\sum_{t=1}^{T}\left[\frac{(1+g_t)^t}{(1+(Rrf_t+\pi_t)+\beta\left[Rop_t-(Rrf_t+\pi_t)\right]Rre_t)^t}\right]\right\}}$$

For empirical examination (in further econometric Ordinary least squares (OLS) and Vector auto regression (VAR) models) we will use the model:

$$(13) \qquad cap_0^e = \frac{1}{\left\{\sum_{t=1}^{T}\left[\frac{(1+g_t)^t}{(1+(Rrf_t+\pi_t)+\beta\left[Rop_t-(Rrf_t+\pi_t)\right]Rre_t)^t}\right]\right\}} + e_t$$

Based on the theoretical derivation we expect the capitalization factor (yield) to be positively related to risk free rate (long term government bonds), cost of capital (short term interest rates), spread to alternative investment and specific real estate risk. The yields are expected to be negatively related to growth of rental income. This can involve all kinds of macroeconomic factors influencing productivity, efficiency and general output.

Introductory observations

The following Table 6 shows the correlation coefficients of office yields and macroeconomic variables.

Table 6 – Correlation coefficients of yields with economic factors

	UK	IRE	SWE	CZ
GDP growth	0.133	-0.345 **	0.086	-0.068
Inflation	-0.097	-0.501 **	-0.145	-0.130
CPI	-0.481 **	-0.428 **	-0.140	-0.774 **
Exchange_USD	0.554 **		0.373 **	0.916 **
Exchange_EUR	0.244	-0.208	0.057	0.876 **
Good_Export	-0.736 **	-0.551 **	-0.780 **	-0.849 **
Indust_production	-0.286 *	-0.580 **	-0.361 **	-0.954 **
Long_interest	0.342 **	0.549 **	0.153	0.625 **
Unemployment	0.696 **	0.853 **	0.412 **	0.753 **
10Y	0.065	0.493 **	0.159	0.872 **
3Y		0.436 **		
1Y	-0.156		0.206	0.429 **
6M			0.075	0.476 **
3M	-0.205	0.334 *	0.111	0.446 **
Repo	-0.200	0.445 **	0.198	0.511 **
Stock Exchange	-0.178	-0.707 **	-0.450 **	-0.933 **
Residential change	-0.283 *	-0.223	-0.363 **	-0.205

Source: IPD, DTZ, OECD, Czech Statistical office, Global Financial Database, author's calculation

We can see that the correlation coefficients of some macroeconomic factors differ across the observed countries (Inflation, GDP growth, 3 moth interest rates, and Residential value index growth) but most of the correlation coefficients are similar. In particular we perceive the same (positive/negative) sign and high correlation values by Exchange dollar, Export of goods, Industry production and Unemployment. All of these variables have the predicted sign of correlation, positive by Exchange USD, 10 year government bonds and Unemployment. We can observe negative signs by Good export, Industry production, Stock exchange and Residential value index growth.

There are two types of stationarity. We recognize difference stationary and trend stationary time series (Wang, 2001). Because of recognizing cycles in real estate sector (business cycles in general) we require the examined time series to be stationary in levels in order to avoid various stochastic trends between explanatory and dependent variables. When we look on our dataset we don't recognize any significant trend according to theory (or examined time series plots). For rigorous proof of non-stationarity of our data samples we use ADF and KPSS tests[45]. The results of the testes were however ambiguous. For some variables the tests showed opposite conclusions. We may use the differences of the time series but we would loose (probably valuable) information. In order to keep the same structure of variables for all countries we decided to use the variables as presented[46]. The test results can be seen in Table A12.

5.1. ARIMA

The Autoregressive Moving Average (ARMA) model was introduced in 1970s. The model works with the assumption that the past development of some time series continues in the future and can be tracked.

The assumption can be mathematically expressed by the following formula:

$$y_t = \delta + \sum_{i=1}^{p} \alpha_i y_{t-i} + \varepsilon_t + \sum_{i=1}^{q} \beta_i \varepsilon_{t-i}$$

Where y_t stands for the dependent variable, α, β, δ are parameters of the development and ε_t is a residual value. The first part of the equation represents the autoregressive process (AR(p)) which predicts the y_t as the weighted sum of its own lagged values. The moving average process (MA(q)), represented by the second part of the

[45] ADF stands for Augmented Dicky Fuhler test, KPSS stands for Kwitlowski, Phillips, Schmidt, and Shin test. They both are tests used for discovering unit root but they have opposite null hypothesis. ADF has H_0: not-stationarity (time series has a unit root) and KPSS has H_0: stationarity. For rigorous join t application of Dickey-Fuller and KPSS tests see Charemzaa, & Syczewska (1998)

[46] Furthermore, with use of VAR models the importance is emphasized on stationarity of the whole system not on stationarity of each particular variable (Sims & Stock & Watson ,1990)

equation, incorporates an influence of random events on the predicted values. The values of p and q represent orders of the process which shows how many prior observations of the variable have an influence on the predicted value of y_t. Autoregressive Integrated Moving Average ARIMA (p,d,q) models work on the same principle, the only modification (the integration) stands for using differences of the dependent variable (and lagged values as independent variables). The value of d represents the steps of differentiating. When d is zero, than ARIMA (p,0,q) = ARMA(p,q). The differentiating is undertaken for achieving stationarity in the examined time series.

We have executed several ARIMA models for prediction of Czech office yields[47]. Quarterly date from Q3 1990 – Q2 2011 period (there were not long enough annual data set and for the Czech Republic there are not monthly data set calculated by an official agency) were used for this modeling. We have evaluated model ARIMA (2,1,0) as the most fitting[48], the results are shown in Table 7.

Table 7 – CZE, ARIMA (2,1,0)

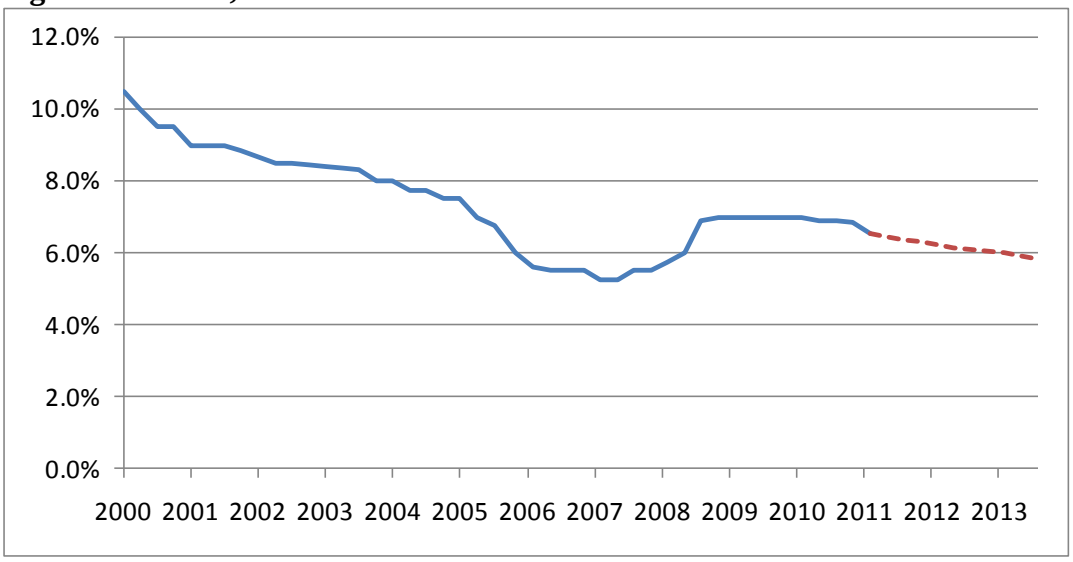
CZ	
Constant	**-0.111**
	(0.088)
AR1	**0.29** *
	(0.149)
AR2	**0.302** **
	(0.144)

Source: DTZ, author's calculation

Based on the results of this model, we predict a yield movement. On the Figure 19 we can see the predicted Czech office yield development. The model prediction shows a slow decrease of the office yield, 0.25% during the following year and 0.75% in two years time. In next 3-5 years the prime office yields should decrease back under 6%.

[47] For ARIMA we used JMulTi software
[48] According to on results of Information criteria, significances of parameters, residual tests (normality, auto regression, white noice)

Figure 19 – CZE, ARIMA forecast



Source: DTZ, author's calculation

5.2. OLS

Based on the theoretical model described in the section 2 of this paper and the following examples based on similar studies (Sivitanidou and Sivitanides,1999; Hollies, 2007) we define OLS models. The dependent variable is the investment yield and as explanatory variables we use macroeconomic and financial fundamentals of examined countries. The full model looks as follows:

$$Yield_i = \alpha_i + \beta_{1i}*GDP\ growth_i + \beta_{2i}*Inflation_i + \beta_{3i}*Unemployment_i + \beta_{4i}*3M\ interest_i + \beta_{5i}*10Y\ government\ bond_i + \beta_{6i}*Bond\ spread_i + \beta_{7i}*Echange\ USD_i + \beta_{8i}*Exchange\ EUR_i + \beta_{9i}*Export\ of\ goods_i + \varepsilon_i$$

For variants of models with different combination of explaining variables we use restricted versions of the full model.

According to the theory we would expect the β_1 coefficient to be negative because with growing output of an economy the society becomes richer, the capital turns to be relatively less expensive and capital investments (including real estate) starts to yield less (the value of real estate increases). Inflation depreciates the value of an

income stream. If we consider the yield as a real variable[49] and other interest rates (short term, long term) as nominal variables which operate as reference financial variables, than (according to the Fisher's equation[50]) we expect the β_2 coefficient to be negative. Unemployment reflects the general condition of the whole economy and should be depicted similarly as GDP growth. With increasing unemployment the yield is expected to rise, so β_3 should be positive.

The coefficient β_5 should be according to our theoretical approach positive because 10 year government bonds are long term investments and similarly the investors look at real estate (durable good that generate cash flow for long time). We expect lower value of coefficient β_4 (in absolute terms) because the 3 month interest rate represents the cost of money in short time horizon and by that smaller influence on the real estate sector, compared to long term interest rates. Even though the real estate investments are considered to be long time investments the influence of "short money" is considered to be significant[51]. The variable Bond spread is calculated as difference between 10 year government bonds in particular countries and German 10 year government bond. This variable is considered to approximate the risk premium of the countries. Derived directly form the equation *(8)* the β_5 is expected to be positive.

Export of goods and Exchange rates are included in the model because of the real estate output theory and as a direct indicator of the economies' condition comparing to foreign counties. The export can increase only when the production increases (and the domestic demand stays relatively stable). The higher production forces the capacity of production factors to increase. One of the factors is real estate and with scarcity the price goes up. Real estate price rise is caused by increased rent level or decrease of investment yields and accordingly the β_9 is expected to be negative.

[49] Imply from the theory outlined in the section 2.2.

[50] $r = \frac{(1+i)}{(1+inflation)} - 1$

[51] The financial optimization of transactions and especially development includes techniques and tools (options, pre-sale contrasts, loans roll-over) which allow set a preferable cash flow stream. In such operations the influence of short term interest rate is significant.

With the Exchange rates we could go one step further and deduce that with increase of exchange rates (making domestic goods relatively cheaper), the export of good rises and so we would predict a negative relation to the yields. But the yields are expected to be monetary variables with similar behavior as bond yields. According to the International Fisher Effect theory with increasing exchange rate the interest rates rise. With prevailance of this effect, the coefficients β_7 and β_8 should be positive.

In Tables A13 – A23 we can see the results of OLS models for Czech Republic in period 2000 Q1 – Q2 2010 and for other comparable countries (the United Kingdom, Ireland and Sweden) in period Q1 1990 – Q2 2010. We created detailed models for discovering the interaction between initial office yield, GDP and inflation in each of the countries. These models include nominal and real GDP growth, one and two lags and moving average[52] of mentioned values.

From the results of the OLS models describing the relation between Czech office yields and GDP growth, as shown in Table A19, we can not confirm the theoretical assumption. The coefficients have a negative sign but they are not significant and also the explanatory power of the models (represented by the Adjusted R^2) is very poor.

Better result we can confirm only in Sweden. As shown in Table A17, we can confirm a significant negative relation between office yield and GDP. However the explanatory power is not excellent (Adjusted R^2 = 0,09), we can see better results (higher values of Adjusted R^2) in models with higher degree of moving average (highest for MA4). That corresponds with the hypothesis of the real estate yields movement being smoothed (Wang, 2001).

In the United Kingdom and Ireland the results are in contradiction with our hypothesis. As shown in Tables A13 and A15, the GDP growth coefficients are

[52] MA2 means arithmetic average value of current value and one lagged value. MA3 means arithmetic average value of current value, one and two lagged values. MA4 similarly.

positive. Such results can point out not typical or not standard features of the real estate market in those countries. For further investigation for relation between office yield and GDP we examined relations between GDP growth and first differences of yields. As we can notice in Tables A14, A16 and A18, in all countries the change of office yields are negatively related to the value of GDP growth which means that with positive GDP growth the change of office yields is expected to be negative. This result complies with our theory. In all three countries (United Kingdom, Ireland, Sweden) models with real GDP growth recorded higher explanatory power.

In case of Inflation we can see negative coefficients in all four countries. The result of models for the Czech Republic and the United Kingdom don't show significant coefficients but models for Sweden and Ireland do. Furthermore the models for Ireland reach high adjusted R^2. Higher explanatory power is also visible by models using the moving averages of inflation[53]. These results are in compliance with our theoretical assumptions but there is a question of mutual causality. With increasing inflation the yields decrease and the values of real estate rise. But real estate is part of the price indices and with increasing prices of the real estate, the inflation increases as well. In order to deal with this relation we apply the VAR models in the following chapter.

[53] The moving averages of Inflation are calculated the similarly as described for GDP growth.

Table 8 – CZE, office yield and macroeconomic factors, OLS models

CZ													
Constant	1.839 **	5.880 ***	3.071 ***	6.941 ***	1.986 *	2.963 ***	-3.589 ***	0.760	7.480 ***	-0.548	-0.101	1.729 ***	-0.184
	(0.899)	(0.461)	(0.854)	(0.278)	(1.167)	(0.425)	(1.181)	(1.867)	(0.264)	(0.792)	(0.778)	(0.584)	(0.794)
GDP nom													-22.458
													(15.105)
Inflation											-16.038	-5.747	-0.121
											(12.815)	(11.401)	(0.138)
Unemployment	0.783 ***									0.645 ***	0.692 ***		0.637 ***
	(0.124)									(0.096)	(0.096)		(0.097)
3M		0.539 ***									0.328 **	-0.463 ***	
		(0.146)									(0.161)	(0.145)	
Long term			0.922 ***		1.219 ***					0.715 ***	0.368 *	0.510 ***	0.731 ***
			(0.176)		(0.281)					(0.123)	(0.212)	(0.180)	(0.123)
Bond Spread				0.815 ***	-0.547								
				(0.301)	(0.407)								
Exchange USD						0.171 ***		0.126 ***				0.180 ***	
						(0.016)		(0.041)				(0.020)	
Exchange EUR							0.370 ***	0.113					
							(0.039)	(0.094)					
Good export									-0.438				
									(2.595)				
Adj R^2	**0.487**	**0.236**	**0.405**	**0.137**	**0.417**	**0.754**	**0.686**	**0.757**	**-0.026**	**0.724**	**0.745**	**0.802**	**0.738**

(#.###) – standard deviation

Source: Czech Statistical Office, Global Financial Database, DTZ, OECD, author's calculations

Table 8 shows the results of OLS models for the Czech Republic. We can see that all our predictions for the signs of the coefficients were confirmed and also the explanatory power of the models is high. Moreover we can see that among interest rates the highest influence has the long term interest rate (10 year government bond yield). It has even higher explanatory power than the spread of the 10 year government bonds (between Czech and German) which we can observe from the separate models and also from joined model where the Spread coefficient becomes insignificant and even negative (in contradiction with the theory).

Interesting results show models with exchange rates. We can see a significant positive relation and high adjusted R^2 by both currencies. But although the Czech Republic trade the majority of foreign trade in euro, and therefore we would expect higher influence, the USD exchange rate seems to be a better explanatory variable for the values of office yield. This paradox could be explained by the nature of USD which is still considered to be the world currency number one with the highest influence on the world financial markets and in which majority of commodities and (national bank) reserves are denominated. That is why we can consider the USD as a reference variable and the positive correlation with the investment yield can represent the relative attractiveness of the local market. The question is whether the USD dollar stays the world's currency number one. The recent fiscal problems of the USA, FED's policy of quantitative easing and loss of unassailable credit worthiness[54] rise doubts about (future) employment of the USD as an appropriate reference variable[55].

The last models combine the different financial and macroeconomic variables. We can see that including additional variables doesn't change the coefficients of the fundaments much and except nominal GDP growth and Inflation all stay significant.

[54] For the first time in history The United States lost its top-tier AAA credit rating from Standard & Poor's in August 2011

[55] In the light of recent turmoil on financial markets we could consider gold as reference variable. But as the price of gold is derived only from speculative forces (gold doesn't yield a cash flow like interest or dividends) and suffers from sudden fundamentally unexplainable price corrections, the use as an explanatory variable in the short (medium) medium term doesn't look defensible.

These models serve us as a testing tool for further examination through VAR models and forecasts of Czech office yield.

We can see some similarities in the results of the comparable countries. The OLS models of the United Kingdom, Ireland and Sweden for period 1990 Q1 - 2010 Q2 (and Sweden 1980 Q1 – 1995 Q4) are shown in appendices A26 – A29. In all these three countries we can confirm the positive relation between office yield and unemployment. In case of Sweden and United Kingdom we see significant positive coefficient by USD exchange rate and in case of Ireland and United Kingdom significant positive coefficient by 10 year government bond.

When we look on the OLS models with more variables, we see very similar results of Sweden compared to the Czech Republic. The highest adjusted R^2 we get for the model combining Unemployment, 10 year government bond and USD exchange rate. In case of the United Kingdom this combination of variables also shows the highest explanatory power even though the coefficient for the long term interest rate is not significant. The results for Ireland are different in comparison to all the other countries. However the adjusted R^2s are high, some coefficients (10Y bond, Exchange USD) have opposite signs that the theory predicts. Under such circumstances we cannot make any conclusion but the irregular behavior of the Irish real estate market.

5.3. VAR models

Based on the results of the previous subchapter we prepare VAR models for the three comparable countries. We will prepare in the sample forecasts for two latest years and by comparing the RMSE of the VAR models and ARIMA models we will choose the most suitable model which we afterwards use to predict Czech office yield five years ahead.

Generally a vector autoregressive model can be described as:

$$\boldsymbol{x}_t = \boldsymbol{\phi}\boldsymbol{x}_{t-1} + ...\boldsymbol{\phi}_p \boldsymbol{x}_{t-p} + \boldsymbol{\varepsilon}_t$$

Where the $\boldsymbol{x}_t$ term stands for vector of dependent variables, Φ_t represents a matrix of coefficients and ε_t is considered as white noise. The VAR models can be also described in terms of lagged (or autoregressive) polynomials, mathematically expressed by:

$$\boldsymbol{\phi}(L) = \boldsymbol{I} - \boldsymbol{\phi}L - \boldsymbol{\phi}_2 L^2 - ... - \boldsymbol{\phi}_p L^p$$

In this paper we follow the pioneer VAR work of Sims (1980), the study undertaken by Stock and Watson (2001) which assesses the VAR methods in performing macroeconomic forecasts and Alexander Bönner (2009) who performed a variety of models forecasting the German office market.

We have created VAR models for each comparable country. The dataset was the same as we used for OLS models (financial and macroeconomic time series in the period of 1990 Q1 – 2010 Q4). We prepared a sequence of in the sample forecasts of office yields in each country for two latest years (1- 8 quarters). We evaluated the fits of these forecasts by calculating the RMSE.

In the following Table 9 we can see the used variables for each of the VAR models and the calculated RMSE. The order of the variables in the models follows the same order as shown in the table (from left to right). The columns of "Accuracy of forecast" show the order of best fitting models, from the best one to the worst based on the cumulative RMSE of different time periods.

Table 9 – SWE, IRE, UK, comparing ARIMA and VAR models (RMSE)

SWE

	Variables								Accuracy of forecast			Sum of RMSE			RMSE of forecasted quarters							
Model	GDP growth	Inflation	3M	10Y	Ex USD	Ex EUR	Unempl	Office Yield	Q1-Q2	Q1-Q4	Q1-Q8	Q1-Q2	Q1-Q4	Q1-Q8	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
ARIMA								x	6	6	6	0.427	1.028	5.056	0.126	0.301	0.317	0.283	0.798	0.932	0.976	1.323
VAR - A		x	x	x			x	x	4	4	2	0.114	0.579	1.090	0.079	0.034	0.081	0.384	0.141	0.093	0.112	0.164
VAR - B		x	x	x	x			x	5	2	1	0.207	0.473	1.040	0.123	0.083	0.166	0.101	0.116	0.184	0.146	0.121
VAR - C	x	x		x			x	x	2	1	3	0.098	0.384	1.220	0.052	0.046	0.036	0.250	0.046	0.123	0.240	0.427
VAR - D				x	x		x	x	1	3	5	0.076	0.486	1.466	0.051	0.026	0.028	0.382	0.150	0.106	0.199	0.526
VAR - E				x		x	x	x	3	5	4	0.106	0.599	1.286	0.085	0.022	0.056	0.437	0.086	0.108	0.112	0.380

IRE

	Variables								Accuracy of forecast			Sum of RMSE			RMSE of forecasted quarters							
Model	GDP growth	Inflation	3M	10Y	Ex USD	Ex EUR	Unempl	Office Yield	Q1-Q2	Q1-Q4	Q1-Q8	Q1-Q2	Q1-Q4	Q1-Q8	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
ARIMA								x	3	1	1	0.341	1.905	5.090	0.323	0.018	0.816	0.748	0.199	0.200	1.107	1.679
VAR - A		x	x	x			x	x	1	3	3	0.050	2.189	5.930	0.005	0.045	1.338	0.801	1.071	0.978	0.576	1.115
VAR - B		x	x	x	x			x	2	5	5	0.243	2.559	8.102	0.017	0.226	1.401	0.915	1.046	1.456	2.316	0.725
VAR - C	x	x		x			x	x	5	4	4	0.442	2.262	6.500	0.209	0.233	0.455	1.365	1.235	1.333	1.046	0.624
VAR - D				x	x		x	x	4	2	2	0.406	2.118	5.858	0.041	0.365	0.130	1.582	1.413	1.187	0.569	0.571

UK

	Variables								Accuracy of forecast			Sum of RMSE			RMSE of forecasted quarters							
Model	GDP growth	Inflation	3M	10Y	Ex USD	Ex EUR	Unempl	Office Yield	Q1-Q2	Q1-Q4	Q1-Q8	Q1-Q2	Q1-Q4	Q1-Q8	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
ARIMA								x	6	6	6	1.391	1.992	4.978	0.591	0.800	0.275	0.326	0.381	0.210	1.273	1.122
VAR - A		x	x	x			x	x	1	1	1	0.451	0.992	2.896	0.179	0.272	0.269	0.272	0.297	0.612	0.312	0.683
VAR - B		x	x	x	x			x	4	2	4	0.652	1.020	3.501	0.239	0.412	0.199	0.169	0.294	0.646	0.935	0.606
VAR - C	x	x		x			x	x	5	5	2	0.927	1.477	3.075	0.270	0.657	0.295	0.255	0.119	0.108	1.038	0.332
VAR - D				x	x		x	x	2	4	5	0.543	1.454	3.585	0.205	0.338	0.337	0.573	0.793	0.757	0.438	0.144
VAR - E				x		x	x	x	3	3	3	0.567	1.221	3.283	0.278	0.289	0.310	0.344	0.595	0.349	0.795	0.323

Source: IPD, Global Financial Database, DTZ, OECD, author's calculations

We can see that for all models the values of RMSE for Sweden are only approximately half of the British ones and one quarter of the Irish. The table also shows that for Sweden and the United Kingdom the worst results were reached when using the ARIMA models, the RMSE were highest for all cumulated results from two quarters to two years. The accuracy of the models differ form country to country and also between the different horizons of forecast. Based on the diversity of results we decided to construct all five models for predicting the Czech office yield.

We have also tested the five selected models on the Czech data set. Because of the shorter time period of observed office yields (Q2 2000 – Q2 2011) we have also calculated the in the sample yield predictions with macroeconomic fundamentals as exogenous variables. The cumulated RMSE of the tested models for one and two years are shown in the Table 10.

Table 10 – CZ, comparing ARIMA and VAR models (RMSE)

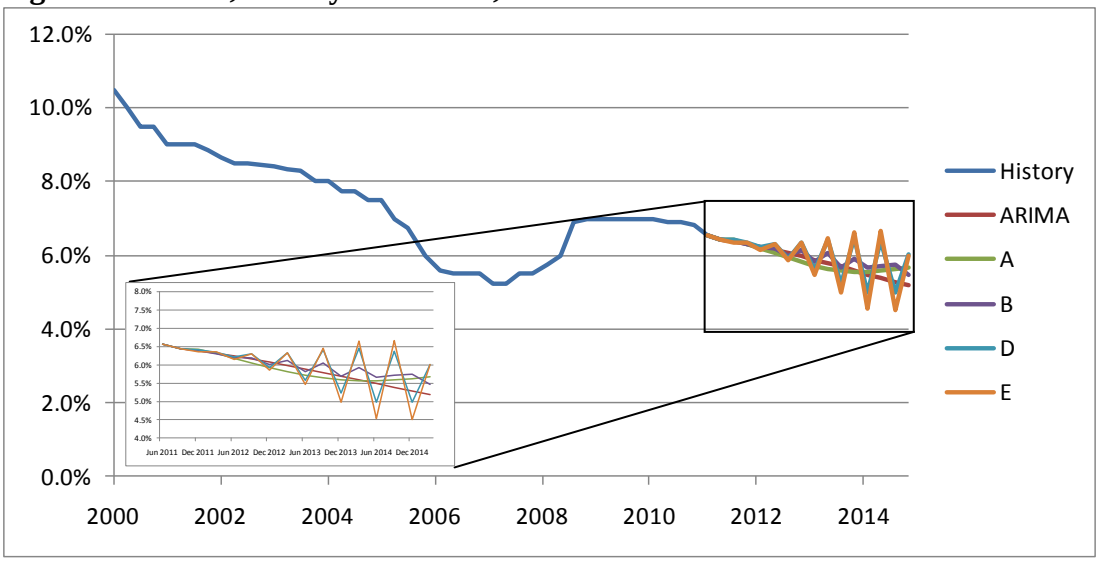
CZ - all variables endogenous												
	Variables								Accuracy of foreststst		Sum of RMSE	
Model	GDP growth	Inflation	3M	10Y	Ex USD	Ex EUR	Unempl	Office Yield	Q1-Q4	Q1-Q8	Q1-Q4	Q1-Q8
ARIMA								x	6	6	2.035	5.110
VAR - A		x	x	x			x	x	1	2	0.839	2.749
VAR - B		x	x	x	x			x	3	1	0.974	1.712
VAR - C	x	x		x			x	x	5	5	1.253	3.556
VAR - D				x	x		x	x	2	3	0.894	2.946
VAR - E				x		x	x	x	4	4	1.139	3.324

CZ - macroeconomic fundamentals exogenous												
	Variables								Accuracy of foreststst		Sum of RMSE	
Model	GDP growth	Inflation	3M	10Y	Ex USD	Ex EUR	Unempl	Office Yield	Q1-Q4	Q1-Q8	Q1-Q4	Q1-Q8
ARIMA								x	6	6	1.328	1.905
VAR - A		x	x	x			x	x	1	1	0.521	1.238
VAR - B		x	x	x	x			x	2	3	0.592	1.463
VAR - C	x	x		x			x	x	4	5	0.881	1.798
VAR - D				x	x		x	x	3	2	0.630	1.342
VAR - E				x		x	x	x	5	4	1.139	1.681

The process of calculation the Czech office yield forecast consisted of two steps. In the first, we have filled the VAR models with historical data of the selected variables up to date (Q2 2011). W have run the models and the graphical outcomes can be seen on Figure 20. During the process the model **E** (10 Y government bond, Exchange EUR, Unemployment and Office yield) turned out to give unrealistic predictions and so we denied apply it.

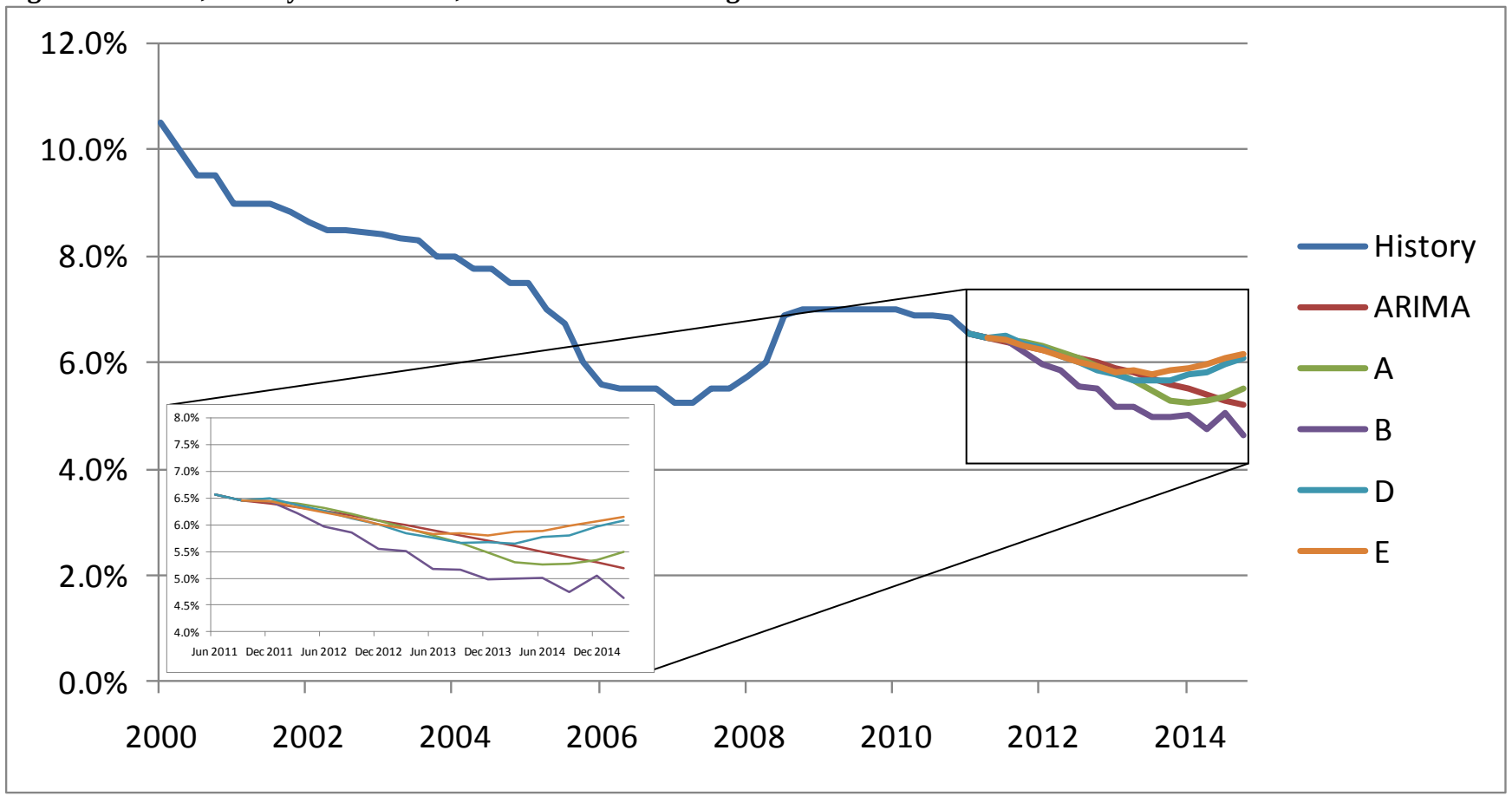
In the second step we have incorporated into the modeled formula macroeconomic and financial predictions for the Czech Republic. GDP growth, Unemployment, Inflation and EUR Exchange rate were obtained from Czech national bank, Ministry of Finance and International monetary fund. Prediction of USD exchange rates was calculated as an average value between bid and ask prices of USD forward rates. The outcome of such modified models can be seen on following Figure 21.

Figure 20 – CZE, office yield forests, VAR models



Source: Czech Statistical Office, Global Financial Database, DTZ, author's calculations

Figure 21 – CZE, office yields forecast, VAR models with exogenous macroeconomic forecast



Source: Czech Statistical Office, Global Financial Database, DTZ, IMF, Ministry of Finance, Czech National Bank, author's calculations

Figure 20 shows predictions based on calculated models and keeping all variables endogenous. Except model **A** (Inflation, 3M interest rates, 10Y government bonds, Unemployment and Office yield) we see an unrealistic fluctuations after fourth predicted values (one year). However, until the fourth forecast all models predict a slow yield decrease around 0.25% in one year. The fluctuations are probably caused by multicollinearity within the dataset and small number of observations. With the increasing track record of office investment yields we should reach better results.

When we look on Figure 21 we see the predictions based on VAR models with implemented exogenous variables[56]. Except model **B** each model forecasts relatively stable trend and predict similar forecast of the office yield till Q3 2013 (5.65% – 5.84%). After that horizon the predictions start to differ. Models **D** and **E** (10Y government bond and exchange rates) predicts stabilization followed by slow increasing of the yield to the level around 6%. Models **A** and **B** (interest rates and Inflation) keep decreasing till Q2 2014 (model **A** reaches the historical minimum of 5.25%) and then start to rise as models **D** and **E**.

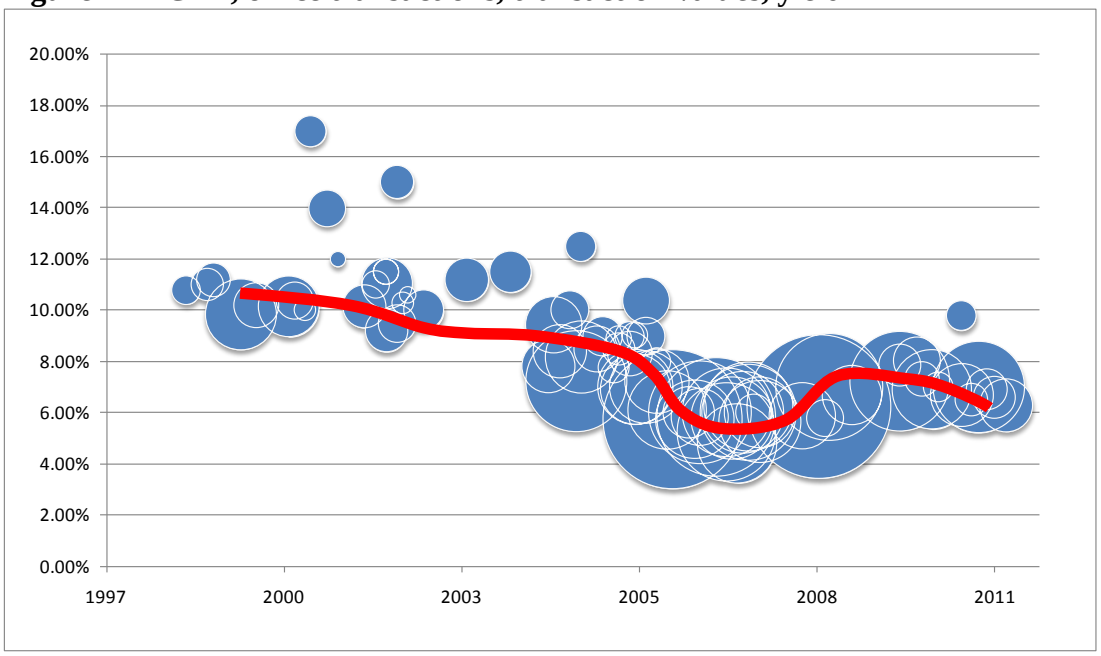
To conclude we can say that our adjusted VAR models predict slow decrease of office investment yield to the level of under 6% in next 3 years. After that period they assume a short stabilization and slow increase. This pattern probably reflects the current external forecasts of the macroeconomic situation based in the fundamentals.

[56] Forecasts of GDP growth (10 quarters), Unemployment (10 quarters), 3M interest rates (10 quarters) Euro exchange rate (10 quarters) and USD exchange rate (6 quarters)

5.5 Granger causality, direct market observation

In this chapter we examine the relation between yield development and number of transactions (preceded during one quarter) and value of the transactions realized in the Czech real estate market. We will use the Granger causality (Granger, 1988) test implied on the data set of collected office transactions[57].

Figure 22 – CZE, office transactions, transaction values, yield



Location of bubble depicts traded yield, size of bubble value of transaction, solid line represents prime office yield reported by the agency

Source: Discovery Group Fund, DTZ, author's research, author's calculations

We examine the hypothesis whether the number of transactions or the value of transactions has any significant influence on the capitalization rate. Theoretically we would expect no connection between number of transactions and value of office yield if the market works effectively. Any causality between number of transactions and yield decrease (higher property price) would point to selection bias and

[57] The dataset was collected from open sources like real estate agencies reports, magazines and newspapers. Core of the dataset (1998 – 2009) was provided by Discovery Group Fund. The dataset contains 103 transactions undertaken in Prague with quality details of the transacted properties.

inefficiency of the market[58]. For relation between yields and volume of transactions we would expect a one way causality from yield to volume of transactions because with decreasing yield the properties appreciate and so the transaction volume increases.

For testing this we use one period (quarter) lagged variables of office yield, number of transactions undertaken in a period and total price amount of transactions realized in a period. Following table summarizes the Granger causality results.

Table 101 – CZE, office real estate, Granger causality

CZ		Effect variable		
		Office Yield	Number of transactions	Price value of transactions
Cause variable	Office Yield		F = 1,816 p-value = 0,171	**F = 4,897** **p-value = 0,011**
	Number of transactions	**F = 2,674** **p-value = 0,077**		
	Price value of transactions	F = 0,587 p-value = 0,559		

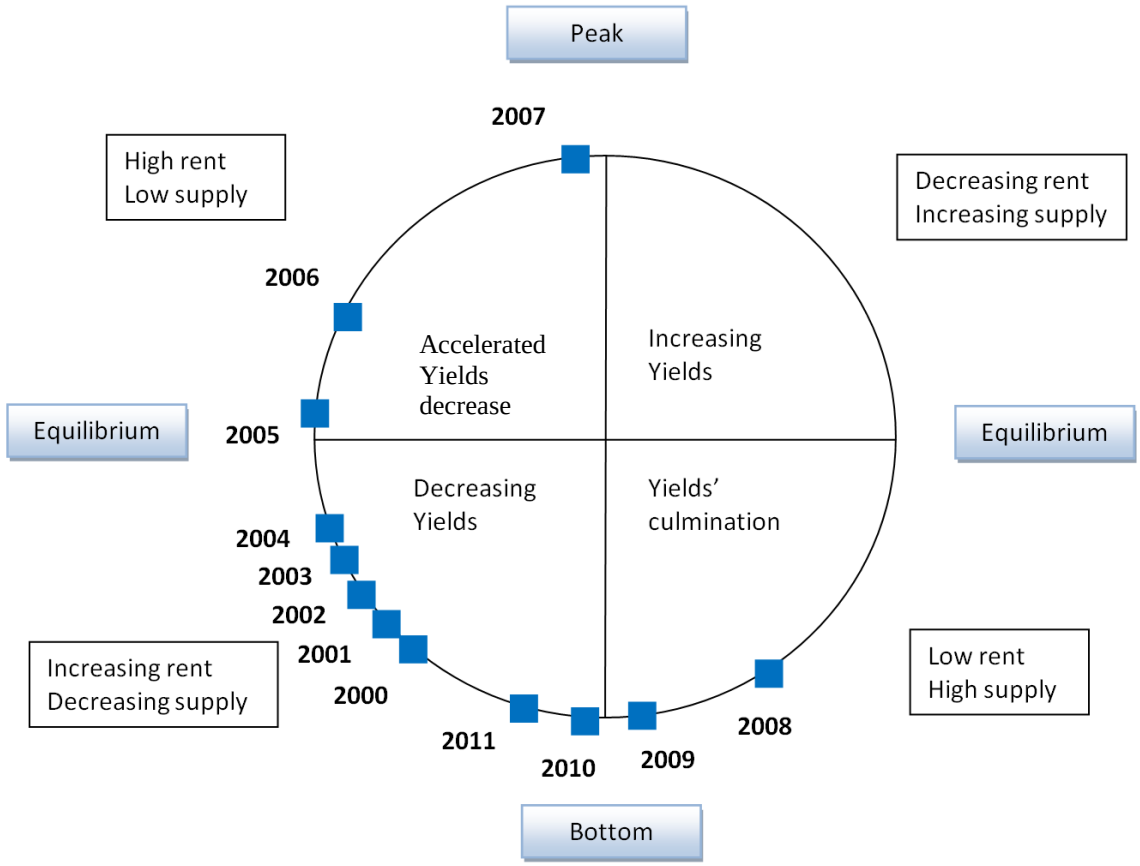
Source: Discovery Group Fund, DTZ, author's research, author's calculations

The showed statistics reveal a strong Granger causality from office yield to price value of transactions and no (proofed) causality in the opposite direction. These results correspond to our predictions. The Granger causality from number of transactions to office yield points at selection bias and/or herding effect in the Czech office real estate market. It means the significant increase of transactions after 2004 was influenced by positive results recorded on the previous transactions. The rocketed demand (of investors) compressed the office yields more then would correspond to (objective) risk classification of this sector. The subsequent yield increase in 2008 can be then explained by herding behavior in reverse direction. The constant yield value since Q1 2009 was caused by lack of (benchmarking) transactions and uncertainty about the "true" market capitalization rate[59].

[58] See chapters 1 and 3.2
[59] Based on interviews with real estate consultants and real estate portfolio managers

The following Figure 23 illustrates the development of real estate capitalization value in the Czech Republic. The axes divide the space between supply of the office stock (relative to demand) and prevailing rents on a market and create four quadrants. In the up-left space we can observe high rents and low supply, in the up-right space high rents and high supply, in the down-right space low rents and high supply and in the last down-left low supply and low rents. The investment yields follow similar pattern as the office stock supply, that is why on the left part of the vertical axis we can observe yield decreasing and on the left side yield increasing. When we are on the top of the circle (the yields are at its minimum, rents are high) we are on the peak of the real estate cycle. Other way round, when we are on the bottom (high yield and low rents) we are at the trough of the cycle.

Figure 23 – CZE, real estate cycle



Source: author's research

The Figure 23 approximately illustrates the development of the Czech real estate cycle. We can see a slow movement on the circle during years 2000 – 2004 when the big foreign investors[60] started to "discover" the Czech Republic. During this period the rents were increasing and yields followed a decreasing trend. After 2004 (in May 2004 Czech Republic joined the European Union) the demand for office real estate investment rocketed and despite the huge development and increasing supply the prices for office space went up faster than the rents which was decreasing investment yields and demonstrate very optimistic assumptions from the buyer side.

The big change came with the global credit crunch in 2008 when transactions quickly stopped and yields went fast up. On the figure it is nice visible the difference in duration between the booming phase and declining phase. The restart of the real estate price increase can be reached by two ways. First is reduction of the supply (demolition of stock or changing the utilization of space – e.g. from office to residential) and the second is increase of rental income. It means increasing assumed rental income, for example in reduction of the rent free[61] incentive provided to future tenants. This nature of the real estate market enables (supports) the herding behavior of the investors.

[60] Open ended funds and other big institutional investors
[61] Rent free provision is a nice tool which allows decreasing the effective rent (the rent what the tenant actually pays) and maintaining the blended (reported) rent.

6 Conclusion

In this paper we examined Czech office real estate sector. Identifying the capitalization rate (investment yield) as a major factor influencing the value of property, we prepared predictions of the yield movement in the next two years. Our predictions are based on two basic methods. In the first one, we observed historical yield values in United Kingdom, Ireland and Sweden and deduced potential development of office yield in the Czech Republic. In the second one, we discovered relations between office yield and financial and macroeconomic fundamentals with use of econometric models.

We consider the comparable countries to be relevant examples for Czech office sector because during 1990 – 1993 they went through similar financial and real estate crisis what occurred in 2008 in the Czech Republic. Results of correlation and cointegration statistics showed similar relations between financial and macroeconomic factors and real estate variables (office real estate price indices and office yields) across all studied countries. Our research identified common development of office yields in all the comparable countries (especially during crisis) which points at broader than just domestic influence on the commercial real estate sector.

Using OLS method we found in the Czech Republic no significant relation between office yield and GDP growth and Inflation. Our OLS models confirmed positive relations of office yields with Unemployment, 3M interest rates, 10Y government bond, EUR and USD exchange rates all in compliance with depicted hypothesis. According to OLS models the most suitable model for predicting office yield in the Czech Republic is a model using Unemployment, 10Y government bonds and USD exchange rate as explaining variables.

We prepared ARIMA (2,1,0) and variety of VAR models to forecast the Czech office yield. Almost all models (except one) predict a slow decrease of the yields in next

three years. In average the models forecasted decrease of 0.25% (to 6.25%) in one year time (end 2012) and 0.75%-1% (to 6%) in two years time (end 2013).

With the use of Granger causality test, implied on quantitative data of transactions undertaken in Prague in last 12 years, we found that the Czech office sector doesn't behave efficiently and we can expect decreasing office yields (increasing value of properties) with growing number of transactions.

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Appendix

Table A12 – Experience of major Swedish banks during the banking crisis

	Total lending in 1985 (billion SEK)	Losses in % of lending	Increase in lending, 1985-8 (%)	Real estate lending 1990 (%)	Development
SE-banken	65,60	11,70	76,00	12,00	New capital from owners in 1993
Handelsbanken	73,10	9,50	38,00	9,00	Survived, met capital requirementments without new capital
Nordbanken	84,20	21,40	78,00	12,00	New capital from owner (state). Non-performing loans into Securum
Gota	29,80	37,30	102,00	16,00	Bankrupt. Bought by the state, merged with Nordbanken. Non-performing loans into Securum
Sparbanken Sverige	78,30	17,60	88,00	14,00	One bilion SEK loan from government, new capital from owners
Förenigsbanken	23,10	16,60	67,00	10,00	Received "capital reqirement quarantee", that was never used
Total		**16,80**	**77,00**	**12,00**	

Table A13 – Stationarity tests

	CZ		SWE		IRE		UK	
	ADF	KPSS	ADF	KPSS	ADF	KPSS	ADF	KPSS
Office yield	-0,737	1,117 ^^^	-0,155	0,423 ^	-0,548	0,710 ^^	-0,620	1,354 ^^^
GDP growth nom	-2,387 **	1,539 ^^^	-2,238 **	0,178	-0,874	0,984 ^^^	-1,713 *	0,734 ^^
GDP growth real	-1,902 *	0,297	-2,452 **	0,290	-2,192 **	0,712 ^^	-2,284 **	0,366 ^
Inflation	-1,941 **	0,837	-4,395 ***	0,440 ^	-2,487 **	0,204	-3,208 ***	0,671 ^^
Unemployment	-0,082	0,320	-0,259	0,211	-0,516	1,566 ^^^	-0,252	1,635 ^^^
3M	-1,116	1,673 ^^^	-2,352 **	2,220 ^^^	-1,949 **	2,162 ^^^	-2,801 ***	1,640 ^^^
10Y	-1,823 *	0,615 ^^	-2,483 **	2,418 ^^^	-1,668 *	2,207 ^^^	-2,929 ***	2,354 ^^^
Sread	-2,436 **	0,185	-2,686 ***	2,138 ^^^	-0,301	0,691 ^^	-2,855 ***	1,678 ^^^
Exchange USD	-2,602 ***	1,387 ^^^	-0,173	0,598 ^^	0,110	0,849 ^^^	0,291	0,431 ^
Exchange EUR	-1,918 *	1,374 ^^^	0,308	1,594 ^^^			0,663	0,387 ^
Export good	-3,447 ***	0,104						

ADF			KPSS		
1%	5%	10%	10%	5%	1%
-2,560 ***	-1,940 **	-1,620 *	0,347 ^	0,463 ^^	0,739 ^^^

Table A11 – IRE, office yield and GDP growth, OLS models

IRE	Nominal								Real				
Constant	5.180 ***	5.216 ***	5.258	5.202 ***	5.221 ***	5.192 ***	5.207 ***	5.214 ***	5.262 ***	5.307 ***	5.286 ***	5.304 ***	5.278 ***
	(0.185)	(0.192)	(0.200)	(0.187)	(0.191)	(0.189)	(0.193)	(0.198)	(0.176)	(0.183)	(0.177)	(0.181)	(0.180)
GDP	12.695 ***			24.595 **	21.572 *				16.355 ***		34.002 **	29.366 **	
	(2.816)			(10.475)	(10.924)				(3.790)		13.154	(13.977)	
GDP -1		11.850 ***		-11.606	-0.256					14.859 ***	-17.169	-1.678	
		(2.912)		(10.383)	(16.550)					(3.921)	12.956	21.555	
GDP -2			10.880 ***		-8.305							-10.850	
			(3.013)		10.703							13.578	
GDP MA2						12.225 ***							15.586 ***
						(2.862)							(3.857)
GDP MA3							11.723 ***						
							(2.909)						
GDP MA4								11.374 ***					
								(2.961)					
Adj R	**0.193**	**0.163**	**0.132**	**0.20805**	**0.208**	**0.176**	**0.158**	**0.145**	**0.179**	**0.154**	**0.201**	**0.201**	**0.159**

Source: IPD, Global Financial Database, author's calculations

Table A15 – IRE, first difference office yield and GDP growth, OLS models

IRE		
Constant	0.109 ***	0.107 ***
	(0.037)	(0.034)
GDP - nominal	-1.770 ***	
	(0.572)	
GDP - real		-2.592 ***
		(0.757)
Adj R^2	**0.097**	**0.118**

Source: IPD, Global Financial Database, author's calculations

Table A126 – UK, office yield and GDP growth, OLS models

UK	Nominal								Real						
Constant	7.198 ***	7.343 ***	7.252 ***	6.890 ***	6.640 ***	5.278 ***	5.295 ***	5.306 ***	7.157 ***	7.234 ***	7.165 ***	7.200 ***	7.163 ***	7.203 ***	7.252 ***
	(0.301)	(0.256)	(0.194)	(0.328)	(0.333)	(0.180)	(0.184)	(0.189)	(0.186)	(0.186)	(0.180)	(0.186)	(0.180)	(0.185)	(0.192)
GDP	3.377			19.196	-5.527				17.343		41.093	39.120			
	(21.716)			(24.733)	(35.433)				(25.606)		30.679	(30.793)			
GDP -1		3.354		-9.853	-12.737					5.954	-17.942	-4.446			
		(5.456)		(20.672)	(44.217)					(25.466)	30.639	38.020			
GDP -2			3.154		-50.429							-14.785			
			(8.463)		35.702							30.721			
GDP MA2						15.586 ***							23.106		
						(3.857)							(23.170)		
GDP MA3							14.815 ***							18.852	
							(3.928)							(24.554)	
GDP MA4								14.236 ***							12.501
								(4.008)							(25.970)
Adj R	**0.044**	**0.039**	**0.036**	**0.061**	**0.066**	**0.159**	**0.140**	**0.125**	**-0.007**	**-0.012**	**0.001**	**-0.010**	**0.000**	**-0.005**	**-0.010**

Source: IPD, Global Financial Database, author's calculations

Table A137 – UK, first difference office yield and GDP growth, OLS models

UK		
Constant	0.053	0.092 **
	(0.064)	(0.037)
GDP - nominal	-3.410	
	(4.661)	
GDP - real		-16.982 ***
		(5.114)
Adj R^2	**-0.006**	**0.111**

Source: IPD, Global Financial Database, author's calculations

Table A148 – SWE, office yield and GDP growth, OLS models

SWE	Nominal								Real						
Constant	6.059 ***	6.085 ***	6.071 ***	5.952 ***	6.097 ***	6.123 ***	6.171 ***	6.214 ***	5.764 ***	5.815 ***	5.859 ***	5.805 ***	5.791 ***	5.818 ***	5.848 ***
	(0.147)	(0.145)	(0.143)	(0.142)	(0.151)	(0.150)	(0.152)	(0.155)	(0.106)	(0.103)	(0.100)	(0.105)	(0.107)	(0.107)	(0.108)
GDP	-33.177 ***			9.604 ***	-5.662				-14.987			10.829			
	(10.956)			(2.396)	(18.550)				(12.208)			(20.155)			
GDP -1		-34.027 ***		-21.495	-29.608					-22.214 *					
		(10.762)		(17.022)	(18.076)					(11.942)		-30.959			
												(20.218)			
GDP -2			-31.573 ***	-25.5601							-27.987 **				
			(10.606)	(16.440)							(11.580)				
GDP MA2						-38.724 ***							-20.749		
						(11.189)							(12.791)		
GDP MA3							-42.743 ***							-26.639 **	
							(11.410)							(13.225)	
GDP MA4								-45.992 ***							-32.811 **
								(11.667)							(13.648)
Adj R	**0.092**	**0.101**	**0.089**	**0.2343**	**0.091**	**0.119**	**0.139**	**0.163**	**0.006**	**0.030**	**0.058**	**0.021**	**0.020**	**0.036**	**0.056**

Source: IPD, DTZ, Global Financial Database, author's calculations

Table A159 – SWE, first difference office yield and GDP growth, OLS models

SWE		
Constant	0.061 *	0.062 ***
	(0.035)	(0.022)
GDP - nominal	-4.485 *	
	(2.609)	
GDP - real		-10.559 ***
		(2.529)
Adj R^2	**0.024**	**0.170**

Source: IPD, Global Financial Database, author's calculations

Table A20 – CZE, office yield and GDP, OLS models

CZ	Nominal								Real							
Constant	7.665 ***	7.759 ***	7.857 ***	7.768 ***	7.911 ***	7.750 ***	7.844 ***	7.978 ***	7.530 ***	7.580 ***	7.624 ***	7.608 ***	7.692 ***	7.607 ***	7.689 ***	7.762 ***
	(0.439)	(0.428)	(0.434)	(0.453)	(0.487)	(0.450)	(0.466)	(0.488)	(0.293)	(0.285)	(0.277)	(0.317)	(0.332)	(0.312)	(0.324)	(0.334)
GDP	-16.796			36.112	23.606				-0.099			-0.019	0.007			
	(27.877)			(63.294)	(65.341)				(0.220)			(0.250)	(0.253)			
GDP -1		-24.638		-59.815	1.452					-0.175		-0.174	-0.087			
		(27.376)		(64.215)	(98.316)					(0.216)		(0.251)	(0.272)			
GDP -2			-31.539		-58.075						-0.244		-0.215			
			(27.605)		70.347						(0.212)		(0.254)			
GDP MA2						-22.972								-0.193		
						(28.727)								(0.257)		
GDP MA3							-29.568								-0.293	
							(29.848)								(0.280)	
GDP MA4								-38.983								-0.380
								(31.361)								(0.297)
Adj R	**-0.016**	**-0.005**	**0.007**	**-0.01964**	**-0.028**	**-0.009**	**0.000**	**0.013**	**-0.021**	**0.009**	**0.008**	**-0.035**	**-0.043**	**-0.011**	**0.002**	**0.016**

Source: Global Financial Database, DTZ

Table A161 – CZE, office yield and Inflation, OLS models

CZ								
Constant	7.500 ***	7.542 ***	7.493	7.586 ***	7.668 ***	7.585	7.673	7.719
	(0.267)	(0.268)	(0.275)	(0.298)	(0.360)	(0.295)	(0.342)	(0.386)
Inflation	-11.879			-8.893	-12.654			
	(24.519)			(25.100)	(26.938)			
Inflation -1		-18.330		-16.725	-14.195			
		(24.556)		(25.239)	(26.227)			
Inflation -2			-9.651		-11.063			
			(24.325)		(26.630)			
Infla MA2						-25.582		
						(31.853)		
Infla MA3							-38.589	
							(41.476)	
Infla MA4								-45.034
								(49.145)
Adj R2	**-0.019**	**-0.011**	**-0.021**	**-0.034**	**-0.056**	**-0.009**	**-0.003**	**-0.004**

Source: Global Financial Database, DTZ

Table A172 – UK, office yield and Inflation, OLS models

UK								
Constant	7.390 ***	7.342 ***	7.292 ***	7.446 ***	7.410 ***	7.457 ***	7.457 ***	7.426 ***
	(0.183)	(0.183)	(0.184)	(0.211)	(0.238)	(0.211)	(0.232)	(0.246)
Inflation	-23.759			-18.863	-12.799			
	(18.639)			(18.952)	(20.651)			
Inflation -1		-12.588		-10.406	-8.769			
		(18.646)		(18.776)	(19.175)			
Inflation -2			-1.726		0.257			
			(18.652)		(19.001)			
Infla MA2						-(34.194)		
						24.764		
Infla MA3							-34.220	
							(28.973)	
Infla MA4								-29.189
								(31.521)
Adj R^2	**0.008**	**-0.007**	**-0.013**	**-0.007**	**-0.031**	**0.011**	**0.005**	**-0.002**

Source: IPD, DTZ, Global Financial Database, author's calculations

Table A183 – IRE, office yield and Inflation, OLS models

IRE								
Constant	6.284 ***	6.338 ***	6.355 ***	6.467 ***	6.612 ***	6.466 ***	6.605 ***	6.707 ***
	(0.164)	(0.161)	(0.163)	(0.165)	(0.166)	(0.163)	(0.161)	(0.163)
Inflation	-80.320 ***			-45.509 **	-40.282 **			
	(16.706)			(18.877)	(18.290)			
Inflation -1		-88.428 ***		-63.607 ***	-36.913 *			
		(16.280)		(18.863)	(20.278)			
Inflation -2			-89.293 ***		-53.704 ***			
			(16.445)		(18.379)			
Infla MA2						-109.184 ***		
						(17.782)		
Infla MA3							-130.012 ***	
							(18.247)	
Infla MA4								-144.234 ***
								(18.896)
Adj R^2	**0.214**	**0.263**	**0.265**	**0.305**	**0.367**	**0.312**	**0.381**	**0.414**

Source: IPD, DTZ, Global Financial Database, author's calculations

Table A194 – SWE, office yield and Inflation, OLS models

SWE								
Constant	5.774 ***	5.775 ***	5.771 ***	5.816 ***	5.809 ***	5.835 ***	5.852 ***	5.864 ***
	(0.098)	(0.098)	(0.097)	(0.109)	(0.114)	(0.106)	(0.109)	(0.113)
Inflation	-14.403 *			-8.573	-5.749			
	(7.922)			(9.841)	(10.803)			
Inflation -1		-11.299		-11.108	-3.019			
		(7.873)		(7.888)	(9.827)			
Inflation -2			-8.160		-6.357			
			(7.755)		(8.660)			
Infla MA2						-(25.024) **		
						10.679		
Infla MA3							-27.667 **	
							(11.658)	
Infla MA4								-29.384 **
								(12.566)
Adj R^2	**0.028**	**0.013**	**0.001**	**0.010**	**-0.019**	**0.053**	**0.054**	**0.052**

Source: DTZ, Global Financial Database, author's calculations

Table A205 – SWE, first difference office capital growth index and macroeconomic factors, correlation

SWE											
	σ+5	σ+4	σ+3	σ+2	σ+1	σ	σ-1	σ-2	σ-3	σ-4	σ-5
SWE_Inflation	-0,304	-0,269	-0,253	-0,288	-0,179	-0,137	-0,027	0,055	0,239	0,276	0,237
SWE_Exchange USD	-0,785	-0,766	-0,712	-0,635	-0,548	-0,444	-0,298	-0,174	-0,050	0,063	0,190
SWE_Exchange EUR	0,119	0,052	-0,041	-0,154	-0,302	-0,419	-0,497	-0,442	-0,349	-0,188	0,032
SWE_Export	0,429	0,426	0,408	0,389	0,368	0,347	0,309	0,275	0,231	0,189	0,121
SWE_GDP_growth	0,230	0,320	0,377	0,292	0,459	0,369	0,303	0,003	-0,122	-0,207	-0,203
SWE_Good_Export	0,411	0,422	0,399	0,384	0,360	0,350	0,311	0,281	0,237	0,203	0,137
SWE_Indus_production	-0,009	0,009	0,052	0,093	0,146	0,189	0,237	0,262	0,239	0,220	0,157
SWE_Unemployment	0,774	0,747	0,670	0,561	0,393	0,173	-0,070	-0,231	-0,401	-0,518	-0,572
SWE_10Y	-0,478	-0,441	-0,382	-0,307	-0,219	-0,152	-0,110	-0,063	0,052	0,127	0,160
SWE_1Y	-0,456	-0,446	-0,378	-0,247	-0,064	0,069	0,198	0,322	0,486	0,563	0,557
SWE_6M	-0,465	-0,433	-0,331	-0,183	-0,046	0,106	0,252	0,439	0,543	0,517	0,498
SWE_3M	-0,445	-0,483	-0,471	-0,384	-0,241	-0,105	0,055	0,209	0,396	0,517	0,520
SWE_Repo	-0,446	-0,515	-0,526	-0,465	-0,346	-0,213	-0,045	0,119	0,297	0,446	0,501
SWE_Stock exchange	-0,107	0,046	0,271	0,487	0,634	0,762	0,806	0,767	0,726	0,618	0,507
SWE_Residential change	0,182	0,204	0,169	0,220	0,257	0,289	0,235	0,196	0,074	0,000	-0,135

Source: IPD, Global Financial Database, OECD, author's calculations

Table A216 – SWE, first difference of Rent/Yield and macroeconomic factors, correlation

SWE											
	σ+5	σ+4	σ+3	σ+2	σ+1	σ	σ-1	σ-2	σ-3	σ-4	σ-5
SWE_Inflation	-0,239	-0,335	-0,379	-0,580	-0,383	-0,314	-0,203	0,014	0,157	0,081	0,128
SWE_Exchange USD	0,011	0,057	0,104	0,094	0,082	0,024	-0,015	-0,061	-0,049	-0,003	0,053
SWE_Exchange EUR	0,367	0,422	0,448	0,360	0,280	0,117	0,091	0,051	0,015	-0,026	-0,034
SWE_Export	0,038	0,070	0,116	0,099	0,094	0,099	0,156	0,204	0,240	0,248	0,206
SWE_GDP_growth	-0,030	0,144	0,256	0,284	0,430	0,464	0,417	0,318	0,125	0,186	0,047
SWE_Good_Export	-0,125	-0,154	-0,112	-0,090	-0,039	-0,022	0,089	0,187	0,289	0,314	0,316
SWE_Indus_production	0,030	0,084	0,152	0,160	0,170	0,179	0,213	0,253	0,274	0,288	0,287
SWE_Unemployment	0,645	0,688	0,723	0,629	0,515	0,375	0,259	0,163	0,062	-0,033	-0,114
SWE_10Y	-0,068	-0,100	-0,093	-0,069	-0,041	0,033	0,035	0,042	0,051	0,046	0,030
SWE_1Y	-0,109	-0,106	-0,096	-0,079	-0,021	0,098	0,126	0,171	0,197	0,292	0,317
SWE_6M	-0,177	-0,184	-0,160	-0,156	-0,123	-0,044	-0,044	-0,029	-0,029	-0,003	-0,003
SWE_3M	-0,124	-0,169	-0,183	-0,159	-0,161	-0,109	-0,090	-0,062	-0,049	-0,051	-0,021
SWE_Repo	-0,039	-0,120	-0,138	-0,124	-0,129	-0,136	-0,134	-0,127	-0,132	-0,194	-0,192
SWE_Stock exchange	-0,202	-0,173	-0,097	0,010	0,092	0,145	0,176	0,178	0,191	0,196	0,186
SWE_Residential change	-0,080	0,017	0,012	0,024	0,175	0,428	0,325	0,248	0,201	0,307	0,199

Source: IPD, Global Financial Database, OECD, author's calculations

Table A227 – UK, office yield and macroeconomic factors, OLS models

UK														
Constant	3.968 ***	7.123 ***	6.024 ***	7.013 ***	4.996 ***	-0.192	4.423 ***	-2.000	4.018 ***	4.184 ***	0.143	3.600 ***	-1.138	7.460 ***
	(0.415)	(0.316)	(0.386)	(0.227)	(0.461)	(1.257)	(1.279)	(1.550)	(0.416)	(0.445)	(1.194)	(0.465)	(1.001)	(1.032)
GDP nom												0.312		
												(0.198)		
Inflation										-47.383 ***	-42.552 ***	-37.963 **		
										(14.734)	(14.483)	(15.075)		
Unemployment	0.487 ***								0.542 ***	0.444 ***		0.608 ***	0.402 ***	0.786 ***
	(0.060)								(0.077)	(0.108)		(0.087)	(0.070)	(0.099)
3M		0.020								-0.080	-0.213 ***			
		(0.049)								(0.095)	(0.071)			
Long term			0.193 ***		0.542 ***				-0.066	0.132	0.490 ***	-0.090	0.013	-0.158 **
			(0.058)		(0.112)				(0.058)	(0.152)	(0.088)	(0.080)	(0.052)	(0.060)
Bond Spread				0.229	-1.190 ***									
				(0.182)	(0.333)									
Exchange USD						12.274 ***		11.812 ***			9.091 ***		9.246 ***	
						(2.067)		(2.046)			(1.947)		(1.679)	
Exchange EUR							3.905 **	2.895 *						-6.248 ***
							(1.763)	(1.498)						(1.736)
Adj R^2	**0.447**	**-0.010**	**0.112**	**0.007**	**0.226**	**0.297**	**0.046**	**0.321**	**0.448**	**0.505**	**0.529**	**0.526**	**0.598**	**0.521**

Source: IPD, DTZ, Global Financial Database, OECD, author's calculations

Table A238 – IRE, office yield and macroeconomic factors, OLS models

IRE														
Constant	3.681 ***	5.330 ***	3.899 ***	4.885 ***	4.933 ***	9.415 ***			4.452 ***	4.021 ***	6.359 ***	4.949 ***	4.102 ***	
	(0.185)	(0.248)	(0.370)	(0.139)	(0.343)	(0.560)			(0.222)	(0.244)	(0.767)	(0.213)	(0.677)	
GDP nom												9.090 ***		
												(1.888)		
Inflation										-14.019	-47.434 ***	-31.938 ***		
										(10.497)	(13.750)	(9.982)		
Unemployment	0.238 ***								0.360 ***	0.314 ***		0.320 ***	0.372 ***	
	(0.019)								(0.029)	(0.031)		(0.030)	(0.036)	
3M		0.090 **								-0.145 ***	-0.206 ***			
		(0.041)								(0.037)	(0.053)			
Long term			0.312 ***		-0.011				-0.306 ***	-0.033	0.472 ***	-0.367 ***	-0.310 ***	
			(0.058)		(0.069)				(0.060)	(0.082)	(0.084)	(0.065)	(0.061)	
Bond Spread				1.245 ***	1.267 ***									
				(0.135)	(0.198)									
Exchange USD						-4.721 ***					-2.733 ***		0.359	
						(0.712)					(0.735)		(0.655)	
Exchange EUR														
Adj R^2	**0.664**	**0.045**	**0.257**	**0.510**	**0.504**	**0.347**			**0.743**	**0.791**	**0.591**	**0.808**	**0.741**	

Source: IPD, DTZ, Global Financial Database, OECD, author's calculations

Table A249 – SWE, office yield and macroeconomic factors, OLS models

SWE														
Constant	4.522 ***	5.642 ***	5.590 ***	5.573 ***	5.829 ***	3.802 ***	5.164 ***	4.649 ***	3.766 ***	3.832 ***	2.221 ***	4.269 ***	0.885	3.995 ***
	(0.247)	(0.133)	(0.188)	(0.110)	(0.436)	(0.535)	(1.056)	(0.993)	(0.377)	(0.380)	(0.614)	(0.383)	(0.607)	(1.443)
GDP nom												-32.148 ***		
												(10.364)		
Inflation										-11.901	-24.774 ***	-9.180		
										(8.345)	(7.561)	(8.085)		
Unemployment	0.152 ***								0.197 ***	0.211 ***		0.151 ***	0.188 ***	
	(0.034)								(0.039)	(0.047)		(0.041)	(0.034)	
3M		-0.012								0.101 *	0.054			0.200 ***
		(0.020)								(0.059)	(0.053)			(0.045)
Long term			-0.002		-0.061				0.086 ***	-0.012	0.084	0.122 ***	0.142 ***	0.083 **
			(0.027)		(0.101)				(0.028)	(0.074)	(0.066)	(0.029)	(0.026)	(0.035)
Bond Spread				0.111	0.238									
				(0.064)	(0.218)									
Exchange USD						0.249 ***		0.281 ***			0.369 ***		0.342 ***	
						(0.070)		(0.076)			(0.071)		(0.061)	
Exchange EUR							0.059	-0.122						-0.026
							(0.118)	(0.120)						(0.157)
Adj R^2	**0.189**	**-0.008**	**0.014**	**0.024**	**0.016**	**0.125**	**-0.009**	**0.126**	**0.239**	**0.268**	**0.316**	**0.324**	**0.448**	**0.230**

Source: IPD, DTZ, Global Financial Database, OECD, author's calculations

Table A30 – SWE, office yield and macroeconomic factors, OLS models (1980-1995)

SWE													
Constant	6.164 ***	6.293 ***	4.276 ***	2.532 *	6.543 ***	1.328	6.777 ***	9.536 ***	-1.944	-2.139	1.927	-1.909	-1.107
	(0.314)	(0.375)	(0.927)	(1.407)	(0.646)	(1.396)	(1.310)	(0.487)	(1.941)	(1.994)	(2.150)	(1.929)	(2.174)
GDP nom												18.350 **	
												(8.118)	
Inflation	17.693									-1.419	-5.273	-1.966	
	(15.814)									(16.442)	(17.932)	(15.947)	
Unemployment		0.034							0.274 ***	0.293 ***		0.296 ***	0.302 ***
		(0.077)							(0.088)	(0.090)		(0.086)	(0.093)
3M			0.191 **							0.131	0.081		
			(0.080)							(0.106)	(0.116)		
Long term				0.342 ***		0.628 ***			0.637 ***	0.520 ***	0.284	0.592 ***	0.647 ***
				(0.122)		(0.153)			(0.148)	(0.187)	(0.188)	(0.157)	(0.149)
Bond Spread					-0.028	-0.526 ***							
					(0.157)	(0.185)							
Exchange USD							-0.051				0.065		-0.156
							(0.191)				(0.191)		(0.181)
Exchange EUR													
Good export								-0.819 ***					
								(0.122)					
Adj R^2	**0.004**	**-0.014**	**0.072**	**0.102**	**-0.016**	**0.198**	**-0.016**	**0.424**	**0.219**	**0.212**	**0.064**	**0.258**	**0.215**

Source: IPD, DTZ, Global Financial Database, OECD, author's calculations

Table A251 – UK, first difference office capital growth index and macroeconomic factors, correlation

UK											
	σ+5	σ+4	σ+3	σ+2	σ+1	σ	σ-1	σ-2	σ-3	σ-4	σ-5
UK_Inflation	-0,280	-0,332	-0,244	-0,257	-0,271	-0,276	-0,298	-0,351	-0,217	-0,194	-0,041
UK_Exchange USD	-0,164	-0,089	0,017	0,079	0,121	0,148	0,147	-0,020	-0,102	-0,149	-0,197
UK_Exchange EUR	-0,019	0,011	0,026	-0,001	-0,065	-0,130	-0,208	-0,278	-0,272	-0,269	-0,257
UK_Gdp_growth	0,216	0,262	0,249	0,312	0,374	0,412	0,459	0,586	0,508	0,332	0,119
UK_Good_export	0,126	0,274	0,334	0,363	0,384	0,395	0,380	0,634	0,641	0,559	0,503
UK_Indus_production	0,237	0,277	0,315	0,348	0,382	0,437	0,462	0,632	0,624	0,575	0,505
UK_Unemployment	-0,171	-0,184	-0,189	-0,207	-0,219	-0,243	-0,272	-0,450	-0,505	-0,531	-0,546
UK_10Y	-0,218	-0,210	-0,210	-0,210	-0,221	-0,202	-0,144	-0,089	-0,046	0,015	0,089
UK_1Y	-0,295	-0,302	-0,296	-0,272	-0,234	-0,155	-0,047	0,050	0,119	0,209	0,321
UK_3M	-0,312	-0,318	-0,309	-0,282	-0,246	-0,166	-0,070	0,031	0,116	0,212	0,319
UK_Repo	-0,319	-0,325	-0,317	-0,287	-0,255	-0,190	-0,103	-0,005	0,090	0,172	0,290
UK_Stock exchange	0,053	0,053	0,044	0,048	0,059	0,088	0,096	0,126	0,135	0,154	0,168
UK_Residential change	0,041	0,163	0,132	0,149	0,178	0,343	0,371	0,319	0,362	0,180	0,082

Source: IPD, Global Financial Database, OECD, author's calculations

Table A262 – UK, first difference of Rent/Yield and macroeconomic factors, correlation

UK											
	σ+5	σ+4	σ+3	σ+2	σ+1	σ	σ-1	σ-2	σ-3	σ-4	σ-5
UK_Inflation	-0,371	-0,351	-0,352	-0,376	-0,363	-0,305	-0,341	-0,297	-0,281	-0,177	0,040
UK_Exchange USD	-0,046	0,004	0,041	0,071	0,098	0,108	0,094	0,046	-0,016	-0,099	-0,254
UK_Exchange EUR	0,036	0,034	0,010	-0,028	-0,092	-0,151	-0,217	-0,277	-0,302	-0,298	-0,318
UK_Gdp_growth	0,398	0,400	0,368	0,467	0,509	0,515	0,540	0,484	0,476	0,391	0,279
UK_Good_export	0,294	0,421	0,483	0,505	0,530	0,534	0,526	0,506	0,447	0,378	0,443
UK_Indus_production	0,367	0,421	0,465	0,509	0,548	0,597	0,618	0,640	0,633	0,575	0,584
UK_Unemployment	-0,214	-0,240	-0,261	-0,298	-0,324	-0,361	-0,405	-0,456	-0,504	-0,534	-0,574
UK_10Y	-0,306	-0,292	-0,291	-0,278	-0,261	-0,246	-0,183	-0,135	-0,101	-0,040	0,018
UK_1Y	-0,404	-0,394	-0,376	-0,324	-0,257	-0,190	-0,069	0,031	0,094	0,179	0,271
UK_3M	-0,431	-0,422	-0,401	-0,344	-0,284	-0,205	-0,086	0,026	0,110	0,192	0,289
UK_Repo	-0,437	-0,428	-0,415	-0,359	-0,304	-0,231	-0,124	-0,012	0,085	0,154	0,256
UK_Stock exchange	0,117	0,121	0,132	0,139	0,127	0,152	0,167	0,190	0,195	0,210	0,225
UK_Residential change	0,119	0,217	0,219	0,216	0,246	0,403	0,404	0,287	0,320	0,192	0,116

Source: IPD, Global Financial Database, OECD, author's calculations

Table A273 – IRE, first difference office capital growth index and macroeconomic factors, correlation

IRE											
	σ+5	σ+4	σ+3	σ+2	σ+1	σ	σ-1	σ-2	σ-3	σ-4	σ-5
IRE_Inflation	-0,280	-0,099	-0,110	0,067	0,112	0,182	0,145	0,311	0,321	0,426	0,317
IRE_Exchange USD	-0,145	-0,105	-0,041	0,030	0,092	0,156	0,219	0,278	0,322	0,364	0,424
IRE_Exchange EUR	-0,221	-0,205	-0,174	-0,155	-0,139	-0,124	-0,087	-0,053	-0,018	0,010	0,026
IRE_Gdp_growth	-0,021	0,150	-0,162	0,274	0,064	0,053	0,220	-0,035	0,130	-0,040	0,090
IRE_Good_Export	0,398	0,427	0,400	0,407	0,400	0,406	0,394	0,384	0,378	0,381	0,378
IRE_Indust_product	0,305	0,322	0,318	0,342	0,347	0,373	0,373	0,373	0,371	0,364	0,386
IRE_Unemployment	-0,307	-0,338	-0,372	-0,399	-0,425	-0,454	-0,462	-0,472	-0,477	-0,473	-0,474
IRE_10Y	-0,484	-0,504	-0,506	-0,507	-0,492	-0,476	-0,454	-0,428	-0,399	-0,370	-0,368
IRE_3M	-0,478	-0,480	-0,470	-0,453	-0,436	-0,419	-0,391	-0,369	-0,335	-0,317	-0,307
IRE_3Y	-0,498	-0,510	-0,504	-0,491	-0,465	-0,443	-0,420	-0,393	-0,363	-0,334	-0,331
IRE_Repo	-0,425	-0,469	-0,523	-0,560	-0,596	-0,638	-0,661	-0,671	-0,664	-0,632	-0,594
IRE_Stock exchange	0,460	0,482	0,517	0,538	0,581	0,601	0,632	0,654	0,654	0,642	0,578
IRE_Residential change	0,341	0,413	0,237	0,384	0,358	0,339	0,136	0,186	0,023	0,055	-0,066

Source: IPD, Global Financial Database, OECD, author's calculations

Table A284 – IRE, first difference of Rent/Yield and macroeconomic factors, correlation

IRE											
	σ+5	σ+4	σ+3	σ+2	σ+1	σ	σ-1	σ-2	σ-3	σ-4	σ-5
IRE_Inflation	-0,332	-0,165	-0,153	0,084	0,133	0,211	0,091	0,289	0,248	0,303	0,112
IRE_Exchan_USD	-0,271	-0,225	-0,175	-0,099	-0,036	0,045	0,120	0,192	0,250	0,308	0,365
IRE_Exchan_EUR	-0,202	-0,184	-0,151	-0,129	-0,111	-0,096	-0,058	-0,019	0,021	0,055	0,070
IRE_Gdp_growth	-0,031	-0,099	0,107	0,081	0,122	0,094	0,113	-0,025	-0,022	-0,257	-0,024
IRE_Good_Export	0,299	0,327	0,316	0,319	0,304	0,320	0,306	0,301	0,279	0,261	0,258
IRE_Indust_product	0,199	0,219	0,217	0,226	0,235	0,257	0,261	0,257	0,252	0,231	0,250
IRE_Unemployment	-0,179	-0,215	-0,248	-0,275	-0,304	-0,331	-0,341	-0,348	-0,339	-0,328	-0,313
IRE_10Y	-0,388	-0,396	-0,390	-0,385	-0,377	-0,365	-0,346	-0,312	-0,286	-0,251	-0,233
IRE_3M	-0,372	-0,371	-0,358	-0,325	-0,299	-0,273	-0,248	-0,223	-0,214	-0,204	-0,208
IRE_3Y	-0,388	-0,388	-0,374	-0,353	-0,328	-0,305	-0,285	-0,253	-0,238	-0,212	-0,207
IRE_Repo	-0,313	-0,365	-0,410	-0,428	-0,461	-0,494	-0,520	-0,560	-0,576	-0,617	-0,583
IRE_Stock exchange	0,376	0,404	0,446	0,464	0,487	0,502	0,513	0,528	0,491	0,463	0,393
IRE_Residential change	0,207	0,309	0,259	0,338	0,154	0,234	0,069	0,148	-0,057	-0,136	-0,144

Source: IPD, Global Financial Database, OECD, author's calculations

Table A295 – IRE, first difference of Rent/Yield and macroeconomic factors, correlation

CZE											
	σ+5	σ+4	σ+3	σ+2	σ+1	σ	σ-1	σ-2	σ-3	σ-4	σ-5
CZ_Inflation	-0,214	-0,048	-0,419	0,008	0,094	0,312	-0,128	0,037	0,131	0,209	-0,229
CZ_Exchange EUR	0,262	0,305	0,305	0,265	0,250	0,212	0,142	0,173	0,194	0,104	0,055
CZ_Exchange USD	0,167	0,187	0,174	0,174	0,155	0,126	0,114	0,120	0,090	0,021	-0,020
CZ_Gdp_growth	0,127	0,296	0,292	0,350	0,464	0,398	0,669	0,197	0,168	0,247	0,170
CZ_Good_export	-0,310	-0,371	-0,327	-0,303	-0,210	-0,157	-0,101	-0,090	-0,002	0,027	0,244
CZ_Industry_production	-0,282	-0,298	-0,244	-0,181	-0,076	0,005	0,054	0,063	0,116	0,207	0,228
CZ_Unemployment	0,492	0,467	0,497	0,453	0,390	0,288	0,159	0,022	-0,090	-0,149	-0,250
CZ_10Y	-0,117	-0,008	-0,013	0,078	0,025	0,165	-0,100	0,026	0,244	0,114	0,137
CZ_12M	-0,171	-0,224	-0,256	-0,261	-0,210	-0,189	0,003	0,013	0,007	0,037	0,045
CZ_6M	-0,169	-0,224	-0,261	-0,264	-0,208	-0,188	-0,005	0,015	0,008	0,036	0,019
CZ_3M	-0,159	-0,226	-0,257	-0,258	-0,201	-0,177	-0,002	0,027	0,021	0,046	0,001
CZ_1M	-0,137	-0,201	-0,236	-0,225	-0,173	-0,141	0,018	0,058	0,045	0,065	-0,008
CZ_Repo	-0,137	-0,162	-0,156	-0,123	-0,092	0,034	0,120	0,115	0,109	0,160	0,047
CZ_Stock exchange	-0,257	-0,194	-0,059	0,064	0,136	0,208	0,178	0,188	0,185	0,281	0,417
CZ_Residential change	-0,050	-0,187	-0,213	0,011	0,312	0,386	0,408	0,427	0,351	0,438	0,470

Source: DTZ, Global Financial Database, OECD, author's calculations

Table A306 – UK, office capital growth index, Rent/Yield and macroeconomic factors, cointegration

UK										
	Capital growth					Rent/Yield				
	DF	ADF(1)	ADF(2)	ADF(3)	ADF(4)	DF	ADF(1)	ADF(2)	ADF(3)	ADF(4)
Residential	-0.471	-0.679	-0.390	0.017	0.109	-5.152	-3.605	-3.582	-3.587	-3.193
	(0.512)	(0.423)	(0.544)	(0.688)	(0.717)	(0.000)	(0.006)	(0.006)	(0.006)	(0.020)
CPI	-4.354	-3.509	-3.239	-3.139	-3.067	-3.410	-3.118	-3.196	-3.103	-2.840
	(0.001)	(0.008)	(0.018)	(0.024)	(0.029)	(0.014)	(0.025)	(0.020)	(0.026)	(0.053)
Exchange USD	-2.325	-2.943	-2.121	-2.561	-2.501	-2.765	-3.046	-2.058	-2.224	-2.055
	(0.167)	(0.041)	(0.236)	(0.101)	(0.115)	(0.069)	(0.031)	(0.262)	(0.198)	(0.264)
Exchange EUR	-1.449	-2.519	-2.079	-2.512	-2.332	-1.892	-2.310	-1.729	-1.993	-1.703
	(0.553)	(0.111)	(0.253)	(0.112)	(0.162)	(0.334)	(0.169)	(0.417)	(0.290)	(0.430)
Good export	-3.793	-3.352	-3.362	-2.820	-3.365	-4.061	-3.422	-3.192	-2.689	-3.139
	(0.005)	(0.013)	(0.012)	(0.055)	(0.012)	(0.002)	(0.010)	(0.020)	(0.076)	(0.024)
Industrial production	-1.539	-3.274	-3.328	-2.989	-0.684	-1.685	-2.810	-3.055	-2.945	-2.545
	(0.509)	(0.016)	(0.014)	(0.036)	(0.421)	(0.434)	(0.057)	(0.030)	(0.040)	(0.105)
Unemploy	-1.841	-3.553	-3.323	-3.220	-3.321	-2.357	-2.750	-2.836	-2.919	-2.986
	(0.358)	(0.007)	(0.014)	(0.019)	(0.014)	(0.158)	(0.066)	(0.053)	(0.043)	(0.036)
10Y	-2.018	-3.506	-3.472	-2.848	-2.689	-1.946	-2.949	-3.161	-2.902	-2.480
	(0.279)	(0.008)	(0.009)	(0.052)	(0.076)	(0.310)	(0.040)	(0.022)	(0.045)	(0.120)
Stock exchange	-2.435	-2.618	-2.942	-2.783	-2.442	-2.699	-2.569	-2.821	-2.718	-2.372
	(0.136)	(0.089)	(0.041)	(0.061)	(0.130)	(0.079)	(0.099)	(0.055)	(0.071)	(0.150)

Source: IPD, Global Financial Database, OECD, author's calculations

Table A317 – IRE, office capital growth index, Rent/Yield and macroeconomic factors, cointegration

IRE										
	Capital growth					Rent/Yield				
	DF	ADF(1)	ADF(2)	ADF(3)	ADF(4)	DF	ADF(1)	ADF(2)	ADF(3)	ADF(4)
Residential	-0.923	-1.460	-2.388	-2.418	-4.029	-1.516	-1.089	-1.663	-1.428	-2.502
	(0.317)	(0.135)	(0.016)	(0.015)	(0.000)	(0.122)	(0.251)	(0.091)	(0.143)	(0.012)
CPI	-0.848	-1.421	-2.151	-1.909	-2.584	1.744	0.208	-0.886	-1.140	-0.702
	(0.349)	(0.145)	(0.030)	(0.054)	(0.009)	(0.981)	(0.747)	(0.333)	(0.232)	(0.413)
Exchange USD	-2.813	-3.562	-2.567	-3.099	-3.026	-3.346	-3.686	-2.490	-2.691	-2.486
	(0.157)	(0.038)	(0.222)	(0.095)	(0.108)	(0.064)	(0.029)	(0.247)	(0.186)	(0.248)
Exchange EUR	3.731	0.641	0.111	0.253	-0.048	2.391	-0.271	-0.743	-0.346	-0.421
	(1.000)	(0.855)	(0.718)	(0.760)	(0.667)	(0.996)	(0.589)	(0.395)	(0.561)	(0.532)
Good export	-1.516	-1.089	-1.663	-1.428	-2.502	-1.292	-1.172	-2.168	-2.159	-3.302
	(0.122)	(0.251)	(0.091)	(0.143)	(0.012)	(0.182)	(0.221)	(0.029)	(0.030)	(0.001)
Industrial production	-1.354	-1.947	-2.852	-2.612	-3.680	3.106	0.577	0.092	0.258	-0.026
	(0.600)	(0.311)	(0.051)	(0.090)	(0.004)	(1.000)	(0.989)	(0.965)	(0.976)	(0.955)
Unemploy	1.744	0.208	-0.886	-1.140	-0.702	0.684	-0.850	-2.159	-2.207	-1.538
	(0.981)	(0.747)	(0.333)	(0.232)	(0.413)	(0.864)	(0.348)	(0.030)	(0.026)	(0.117)
10Y	-0.826	-1.404	-2.318	-2.368	-4.060	-1.856	-1.319	-2.108	-1.811	-3.391
	(0.805)	(0.582)	(0.166)	(0.151)	(0.001)	(0.351)	(0.623)	(0.242)	(0.376)	(0.011)
Stock exchange	-0.923	-1.460	-2.388	-2.418	-4.029	0.684	-0.850	-2.159	-2.207	-1.538
	(0.317)	(0.135)	(0.016)	(0.015)	(0.000)	(0.864)	(0.348)	(0.030)	(0.026)	(0.117)

Source: IPD, Global Financial Database, OECD, author's calculations

Table A328 – SWE, office capital growth index, Rent/Yield and macroeconomic factors, cointegration

SWE										
	Capital growth					Rent/Yield				
	DF	ADF(1)	ADF(2)	ADF(3)	ADF(4)	DF	ADF(1)	ADF(2)	ADF(3)	ADF(4)
Residential	0.114	-2.282	-2.187	-2.223	-2.229	-1.233	-2.475	-2.410	-2.568	-2.471
	(0.719)	(0.022)	(0.028)	(0.025)	(0.025)	(0.656)	(0.122)	(0.139)	(0.100)	(0.123)
CPI	0.114	-2.282	-2.187	-2.223	-2.229	-1.355	-2.457	-2.324	-2.386	-2.143
	(0.719)	(0.022)	(0.028)	(0.025)	(0.025)	(0.600)	(0.126)	(0.165)	(0.146)	(0.228)
Exchange USD	-0.785	-2.778	-2.770	-2.989	-3.248	-0.766	-2.015	-1.877	-1.874	-1.788
	(0.812)	(0.061)	(0.063)	(0.036)	(0.017)	(0.823)	(0.280)	(0.344)	(0.345)	(0.387)
Exchange EUR	-1.446	-2.180	-1.867	-2.354	-2.436	-0.838	-2.089	-2.037	-2.070	-1.925
	(0.549)	(0.214)	(0.348)	(0.155)	(0.132)	(0.803)	(0.249)	(0.271)	(0.257)	(0.321)
Good export	-0.680	-2.324	-2.558	-2.448	-2.664	-1.443	-2.518	-2.478	-1.680	-2.394
	(0.839)	(0.164)	(0.102)	(0.129)	(0.080)	(0.557)	(0.111)	(0.121)	(0.441)	(0.143)
Industrial production	-1.446	-2.180	-1.867	2.354	-2.436	-0.680	-2.324	-2.558	-2.448	-2.664
	(0.549)	(0.214)	(0.348)	(0.155)	(0.132)	(0.839)	(0.164)	(0.102)	(0.129)	(0.080)
Unemploy	-0.908	-2.332	-2.352	-3.189	-2.959	-0.673	-1.897	-1.588	-1.632	-1.545
	(0.774)	(0.162)	(0.156)	(0.021)	(0.039)	(0.847)	(0.334)	(0.489)	(0.466)	(0.511)
10Y	-0.785	-2.778	-2.770	-2.989	-3.248	-0.908	-2.332	-2.352	-3.189	-2.959
	(0.812)	(0.061)	(0.063)	(0.036)	(0.017)	(0.774)	(0.162)	(0.156)	(0.021)	(0.039)
Stock exchange	-0.199	-0.599	-0.890	-0.735	-0.309	-1.210	-2.474	-2.733	-2.840	-2.681
	(0.930)	(0.869)	(0.792)	(0.836)	(0.921)	(0.667)	(0.122)	(0.068)	(0.053)	(0.077)

Source: DTZ, Global Financial Database, OECD, author's calculations

Table A339 – CZE, office Rent/Yield and macroeconomic factors, cointegration

CZE					
	Rent/Yield				
	DF	ADF(1)	ADF(2)	ADF(3)	ADF(4)
CPI	-0.429	-1.109	-1.416	-2.077	-2.700
	(0.894)	(0.715)	(0.576)	(0.254)	(0.074)
Exchange USD	-1.102	-1.347	-1.703	-1.928	-2.222
	(0.705)	(0.610)	(0.430)	(0.320)	(0.199)
Exchange EUR	-1.541	-1.722	-1.681	-1.872	-2.036
	(0.503)	(0.420)	(0.441)	(0.346)	(0.271)
Good export	-1.981	-1.972	-2.709	-1.584	-2.110
	(0.294)	(0.300)	(0.072)	(0.491)	(0.241)
Industrial production	-2.860	-2.940	-2.798	-1.925	-1.804
	(0.060)	(0.041)	(0.059)	(0.321)	(0.379)
Unemploy	-1.225	-1.607	-1.579	-1.819	-1.780
	(0.654)	(0.479)	(0.493)	(0.371)	(0.391)
10Y	-1.089	-1.309	-1.035	-1.641	-1.549
	(0.710)	(0.628)	(0.743)	(0.461)	(0.509)
Stock exchange	-1.680	-2.630	-3.065	-2.075	-2.164
	(0.433)	(0.087)	(0.029)	(0.255)	(0.220)

Source: DTZ, Global Financial Database, OECD, author’s calculations

Table A40 - Lease structure of European countries

Country	Standard lease document	Rent payable every	Deposit	Typical lease length	Statutory right to renew	Frequency of rent review
Austria	No	Month	1-3 months	Indefinite or fixed term for 5-10 years	No	None
Belgium	No	Month/quarter	1-3 months	2-3 years	Yes	Once during term of occupation (not lease term) or as per lease
Czech Republic	No	Quarter	3-6 months	5 years	No	None
Finland	Yes	Month	3 months	3-5 years of 5-10 years for a new building	No	None
France	Yes	Quarter	3 months	3/6/9 years or fixed term of 6, 9 or 12 years (offices), 9 years (shops)	Yes	None
Germany	Yes	Month	3 months	5+5 years	No	Rare
Greece	No	Month	2-3 months	12+4 years	Yes	None
Hungary	No	Month/quarter	3 months	3-5 years	No	None
Ireland	Yes	Quarter	0-6 months	4 year 9 months or 25 years lease with a break option in year 10/15	Yes (if lease term exceeds 5 years-unless tenant renounces rights)	5 years (upwards only)
Italy	Yes	Quarter	3 months	6+6 years	Right to renew after first term, but not subsequently, if given the correct notice by landlord	None
Poland	No	Month	3 months	3-7 years	No	Rare
Portugal	No	Month	1-12 months	5 years	No	Rare
Slovakia	No	Quarter	3 months	3-5 years	No	By agreement
Sweden	Yes	Quarter	0-12 months	3-5 years	Yes	None
UK	No	Quarter	3-18 months	10-15 years	Yes	5 years (upwards only)

Source: DTZ, Global obligations of occupations, 2011