The Dynamics of House Prices - International Evidence

Sorensen, Jens Kjaer

University of Copenhagen

10 March 2006

The Dynamics of House Prices

International Evidence

Jens Kjaer Soerensen

March, 2006

Abstract

'New' long run data regarding Norway, the Netherlands, United Kingdom and USA has been collected and will be graphically, statistically and econometrically compiled and analyzed to prove that real house prices in the long run are constant and mean reverting. Co-integration of nominal house prices show that the long run fundamentals of real estate are income, rent and construction costs consistently across markets. In contrast an ECM analysis underscores that house prices in the short run are momentum drive, and house prices can deviate substantially from equilibrium in the SR. This fact is supported by theoretical insight about behaviourism and herding behaviour.

Analyzing the empirical evidence of dynamics of house prices and relating it to history shows that the housing markets have become synchronized for the first time in history. The latest boom in house prices have been strong and could have created an international housing bubble. The main reason for the creation of bubbles has been identified as liberalization of credit. Turning points are highly correlated with credit constraints being imposed, but other shocks can initiate the process too: interest rate increases or public regulation. All it takes is a change in sentiment, which will make the short run house prices correct towards equilibrium.

Orientator:

Jakob Broechner Madsen

Department of Economics

University of Copenhagen

The Dynamics of House Prices
International Evidence

Jens Kjaer Soerensen
March, 2006

EXECUTIVE SUMMARY

Real estate is the largest single contributor to GDP, and has been increasingly important in the latest years making the economies highly dependent on the housing market. By being the largest asset and liability for households, the investment is crucial for households. Today there are concerns about the existence of a housing bubble. A bubble has been defined to be able to combine theory and econometrical tools to make it possible to observe a bubble before it bursts. Bubbles are, according to this view, described as the unexplained factor, which in the LR converge to 0. Deviations from equilibrium defined by fundamentals will only be temporary.

A combination of Potherba's model and Tobin's q will give the theoretical basis to analyze how shocks affect the housing market. One of the most important features is that supply of housing is very inelastic (especially in city areas) in the SR and MR highly dependent on regional planning.

Real house prices in N, NL, UK and USA are all at the highest level ever, especially due to the increases that have occurred in the latest decade. Returns on houses have therefore been abnormally high compared to historic averages. Periods of price increases are in general found to be longer than periods of price decreases and the latest increases has been identified to be one of the longest with the highest aggregated price increases in history.

I have performed an econometrical analysis of annual data further back than any other previous research has done and it will be the foundation to explain the latest development. Income, rent and construction costs are found to be the most important variables in the dynamics of long run house prices. All variables have the expected sign and are statistically significant. I have tried to include a demographic variable was not significant in the prediction of house prices in the SR or LR.

In the SR previous house price movements are the only factor being able to explain the dynamics. The housing market is in the SR driven by momentum, since prices tend to experience clustering of either price increases or decreases making the housing market boom and bust likely. In the LR prices will however follow a mean reverting process, but this process is discovered to be very slow, whereas deviation from equilibrium can be large.

None of the fundamentals have been capable of explaining the latest decade of house price increases, whereas there is a risk that a structural change has occurred or that an explaining variable has not yet been discovered.

There are a great variety of explanations and models for the housing market, but none of these have been able to explain the latest increases in house prices and other periods throughout history. The main alternative explanation that no one has yet been able to model, because of its complexity, is a variable to describe financial liberalization and credit. Lately financial innovations has changed the financing of houses, but it remains uncertain if it can explain the residual that then it is hard not to support the concept that a bubble could be present.

To understand why house prices can divert from the fundamental level, then one crucial element is that the housing market is only partly efficient. There is a strong need for a new financial instrument to deal with diversification and risk. One possibility of creating a more advanced market is to develop futures and to make houses more flexible by being able to shift instantly between owning and renting a house at any given time. Another factor is the asymmetries that make it impossible to arbitrage. The existence of reinforcing processes helps prices to drive further away from equilibrium.

The marginal house buyer is said to have a strong influence on the market and because of the typical first-time house buyer being characterized as inexperienced and thereby being more likely to follow the trend of the market. A large group of researchers have found that the housing market is influenced by speculation; investors are extrapolating past gains (ex ante) into their expectations for future appreciation (ex post), that it mostly occurs when supply of houses are relatively inelastic and that they are more typical in city areas. At the same time, new loan types and historic low interest rates have encouraged people to take risk and enforced herding behaviour. The herding itself can be explained by Anderson's model where rational people discard personal information to follow the majority through signals in the market.

Real house prices are however constant in the LR and the most likely way that the market will re-establish equilibrium would be through limitation of credit. If banks or regulators enforce such credit stop then it would be likely to initiate a downward pressure on house prices. Alternatively a credit crunch will happen automatically when an economic downturn appears, where banks will forecast lower income, worse outlook for the economy, unemployment and bad loans and then be more hesitant to give out credit. This effect will be much stronger than if restrictions are implemented at an early stage. A monetary tightening (interest rate increases) will have a stronger effect today due to the fragile households being more in debt and their use of new loan types. Behaviourism is one of the factors explaining the recent deviations. If the change in sentiment reverse the reinforcing process would have a major impact. Therefore the bust does not necessarily need to happen because of a certain economically measurable variable, but could initiate from a change in sentiment.

The presented data show that especially NL and UK looks bubbly, and these markets would need a long time to adjust to equilibrium, which could lead the economy into a period of slow economic growth. Equity and real estate busts are frequently synchronized, and when this happens, the correlation for a banking crisis is high, which has severe effects on the economy. This time the bubble is synchronized internationally making the world economy fragile. Due to the size of the bubble, the consequences of a bust would be larger than ever before. International guidance is therefore needed to set up a financial system where moral hazards have less influence on financial stability, where supply of credit and especially mortgage finance is relatively stable and not enforcing credit cycles that enlarge imbalances. Bubbles have huge distributing effects on wealth between house owners and non-owners, which polarizes society and creates large wealth distortions between generations.

Changes should make the housing market more flexible and more freely traded: The rental market should be under free market conditions with a more adjustable rent. Local authorities should have more power to make supply of houses more responsive to changes in demand. Higher taxes on investors buying 2nd or more homes, would limit people from speculating. On an international level then debt tools have to be overviewed, standardized internationally, and controlled to make sure that credit expansion will not get out of control. Such changes should go hand in hand with more focus on interest relief and tax deductions from debt, which are highly influencing the incentives of households.

Preface

This thesis is inspired by a series of graduate courses that I have participated in at University of Copenhagen and University of Sydney during the academic years 2004-05. Additionally I made an assignment autumn 2004, focusing on the housing market, which made me want to seek explanation for the latest increases that have occurred in house prices in most of the western world. I will approach this issue by addressing theoretical and intuitive fundamentals by finding the reasons for the latest boom that has changed the house from being a necessary good to an investment object.

This problem cannot be viewed in isolation and will therefore be compared to e.g. the share market, which experienced a stock market crash mainly in IT-shares, and spread out into other industries.

Real estate has a major impact on the economy in general on many different levels. First of all, everyone has to choose between buying and renting a house and for most people buying a house is the biggest asset and liability. Houses have become a very popular subject to discuss. The issue of house price movements has become one of the hottest issues in the media and there has been extensive debate about whether or not a bubble in real estate exists. For this reason I have been fortunate to deal with a problem that is of people's interest and concern. I will approach this problem by using a LR perspective introducing data, which has not yet been analyzed in depth.

I would like to acknowledge the assistance of a number of people who have generously provided me with their insight and comments. I am grateful to especially my orientator Professor Jakob Brøchner Madsen (University of Copenhagen) and Professor Robert J. Shiller (Yale University) for their great inspiration, Associate Professor Heino Bohn Nielsen (University of Copenhagen) for his econometrical expertise and the statistical bureaus of N, NL, UK and US for their help in my search for historical data.

This dissertation is based on a new theoretical combination of Poterba and Tobin's q considering the housing market, research for LR empirical data, statistical, econometrical and economical analysis, which has all been made independently by the undersigned.

Jens Kjaer Soerensen, March, 2006

Table of Contents

1. Importance of the housing market

In US the construction of new houses and remodelling accounts for 15-33% of GDP, which makes the housing market the largest single contributor to the economy (NAHB, 2004). However, it is not only at aggregated levels where real estate has a huge influence. Housing is the single largest component of a household's wealth (roughly 33% in USA) and households in the western world have at least twice as much of their wealth tied up in housing as in equities. At the same time the financing of houses is the largest part of household debt making the households very dependent on housing, as it is their biggest asset and liability. (Economist, 11.2003, 03.2002).

Real estate is a necessary good, since people have to live somewhere. It is possible to own (invest) or to rent a house, which is considered as each other's alternatives. Typically, around 65% of households in the western world have owner-occupied property, but every one faces different market conditions over time making it a crucial private investment for individuals.

IMF(2003), OECD(2004) and Debelle (2004) have all found that changes in house prices will have a larger effect on the economy than price changes in the share market. These facts make the housing market and house price dynamics extremely important for the consumers in general and the world economy on an aggregated level.

What makes the housing market even more interesting is that monetary policy has one of its main effects here (through the 'wealth effect'). Especially after Alan Greenspan (Chairman of the Federal Reserve Board 1987-2006) chose to implement a 'Greenspan Put' in monetary policy whereas the focus has been primarily on short run (SR) inflation and the performance of the equity market as a leading indicator for economic growth. The biased concern is a lagged reaction to the price movements on the stock market and functions as a stabilizing leaning against the wind (or bubble) approach. By keeping investor confidence relatively high Greenspan has successfully escaped from a threatening recession, which was likely to follow the stock market crash in March 2000.

However, when using the monetary policy by changing the SR interest rate it has great impact on the rest of the economy. The recovery after the stock market crash has to a large extent been due to the expansive monetary policy by reducing the interest rate to historic low levels. The latest decade has been a time of financial innovations and credit expansion to an extent never observed before leading to consumption growth. The households and the housing market have therefore been essential for the recovery. (Economist, 03.2002). However, there

is a danger that the Greenspan Put has moved the asset bubble from the share market into the housing market and created a housing market bubble (the latest years with extraordinary increases in house prices) through historic low interest rates (December 2003 at its lowest), with strengthened effect from financial innovations making the households more sensitive to interest rate changes.

As the economic super power, the US and the Federal Reserve now led by Bernanke, has great impact on the world economy. Other nations followed the USA and Greenspan when the Greenspan Put became effective through a lowering of interest rates in July 2000 to keep a supporting hand underneath the share market. When the share market had gained momentum and the economy looked strong, USA started to increase its interest rate to dampen off the economy (early 2004). Again many nations have followed.

Greenspan has even been worried himself by stating that the US economy and the consumption in its current state could be too dependent on house price increases, that first time buyers who are too dependent on interest-only and other new loan types could head into trouble and that some local markets may experience a period of froth leading to house prices being at an unsustainable level (Greenspan, 26.9.05 and Greenspan, 9.6.05).

Lately we have experienced a booming housing market, which has saved the economy from a recession and let the share market recover. However, today we are in a situation where both equities and real estate are trading at prices that are above historic averages and not sustainable when relating the price to fundamentals. It will be interesting to find out whether the latest strength of the housing market will turn to a weakness and negatively affect the world economic growth and stability.

2. Economical framework of the housing market

One of the most discussed topics in recent economic history is whether or not there exists a bubble in the housing market. It has been discussed by researchers and commentators, first neglected but then discussed by central bankers and now the concern has spread out to the public through the media without any visible effect on prices.

When defining a bubble it is extremely important to make sure that there is no chance to misunderstand it, since it will be crucial for the conclusion. I will define a bubble by using some of the most referred definitions, but then refining it to integrate it into my setup of economical analysis. By doing so empirical evidence will clarify if a bubble exists or not.

2.1. Definition of bubble

Kindleberger (1987) defined a bubble as: 'A bubble may be defined loosely as a sharp rise in the price of an asset or a range of assets in a continuous process, with the initial rise generating expectations of further rises and attracting new buyers - generally speculators interested in profits from trading rather than in its use or earning capacity. The rise is then followed by a reversal of expectations and a sharp decline in price, often resulting in severe financial crises, which is when the bubble bursts.'

Stiglitz (1990) refined the definition by stating; 'There exists a bubble if house prices are high today because of market participators expect that house prices are higher tomorrow and if the fundamental value at the same time cannot justify such price.'

Both definitions have primarily been focusing on the share market. After the stock market crash many researchers have found different aspects of the concept by focusing on: rapidly rising prices (Baker, 2002); unrealistic expectations of future price increases (Case, 2003); the departure of prices from fundamental value (Garber, 2001); the drop in prices after the bubble pops or how often the bubbles occur (IMF, 2003) and how to deal with them.

The distinction between the two definitions is whether it is possible to observe a bubble before it bursts. It is not possible to observe the decline in prices when following Kindlebergers definition, whereas it is only possible to discover a bubble ex post. By taking Stiglitz definition it is unnecessary to observe any declines in house prices, whereas the bubble can be observed ex ante if the specified characteristics exist. The definition can be clarified from an investor's perspective when focusing on the market prices of a certain asset (e.g. real estate) and how far it rises above the present value of the anticipated cash flow from the asset. A bubble exists if the traded price has driven too far away from the present value.

When focusing on an ideal real estate market for an investor, the price dynamics (P_t) would tend to converge towards a standard rate of return, adjusted for perceived risk (i_t). The price of a house at time *t* would be equal to the expected discounted present value of the rents accruing to real estate owner (r_t), plus the price of the house at which it could be sold at time *t+1*. More formally:

$$P_t = \frac{E_t(r_{t+1} + P_{t+1})}{(1+i)}$$

When generalizing this result for an infinite number of expected future prices by using the law of iterated expectations we get:

$$P_t = \sum_{r=1}^{\infty} \left[\frac{1}{1+i} \right]^r E_t(d_{t+r})$$

This is often referred to as the m*arket fundamentals price*, which is simply the expected discounted present value of all future rents accruing to the real estate owner. Thus, any house price deviation from the fundamental price can be thought of as including some "bubble component" in its valuation. By introducing B, which represents the deviation from the Market Fundamental Price it is possible to have prices that are not in equilibrium.

$$P_t = \sum_{r=1}^{\infty} \left[\frac{1}{1+i} \right]^r E_t(d_{t+r}) + B$$

If several houses in the real estate market are priced with a non-zero one-sided (either positive or negative) value for B, then one may say that the market is away from the fundamental value and contains a bubble element. As discussed previously then at some point the price will have to return to the correct price (equilibrium), whereas B eventually has to drop to zero. If or when this happens, the bubble bursts (Steimetz, 1999).

This definition is related to the existence of two choices: renting or owning and that the relative relationship between the two possibilities will remain stable over time. If they divert from each other there will be automatic stabilizers bringing the relation back to the fundamental ‘equilibrium’.

It is possible for asset prices to rise rapidly if fundamental values and hereby the cash flow of the asset changes. In this way even expectations of future higher cash flow can be interpreted in the setup as long as they can be justified as realistic. Smaller deviations from a strict equilibrium can be justified by shocks to the system.

When comparing real estate and shares then house prices do not fluctuate as much as share prices, because rents are relatively stable. Individual shares, in contrast, are instantaneously being influenced by changes in the market together with the frequent reporting of earnings that gives the market the possibility to adjust to new information.

For an individual house, there is no reporting of earning, (rents are considered relatively stable), and no quick adjustment. However, these definitions are mainly focusing on the share market where several bubbles have occurred and influenced the market substantially with large price volatility. In the housing market the earnings are not stated on a quarterly basis and they do not fluctuate as much. This is because they are typically based on long contracts making earnings more stable. Moreover the houses are not publicly traded, nor is the market constantly pricing the specific asset.

Relative to the share market, the housing market is not experiencing the same fluctuations over time and deviations from 'equilibrium' in general, but that is also one of the reasons why real estate prices divert from values to such extent that they can be named bubbles.

Differences also exist between real estate and shares, which Case (2003) emphasizes by stating that it is possible to reach 'a situation in which excessive public expectations for future price increases cause prices to be temporarily elevated. During a period of house price increases homebuyers with adaptive expectation think that a home that normally would be considered too expensive could be acceptable due to expectations of further price increases. They will not save as much as they otherwise might, since they expect the increased value of their game to do the saving for them. First time buyers may not worry about decreasing prices during a housing bubble that if they do not buy now, they will not be able to afford a house later. Furthermore, the expectations for high price increases may have a strong impact on demand if people think that home prices are very unlikely to fall, and certainly not all for long, so there is little perceived risk associated with investment in homes.' (Smith, 2005).

IMF (2003) has identified a weak association between booms and busts; First the distress phase at the end of a boom, where some investors suffer from being financially overextended, which may be long-lasting but economic activity remaining largely unaffected in the absence of a large shock (possible to burst later due to vulnerability). Second, large enough adverse shocks rendering previously healthy balance sheets. Besides these observations IMF (2003) has used a practical definition of bubbles by defining a house price contraction exceeding 14% a bubble. This view is in line with Kindleberger's definition, because it is depending on house price decreases.

A bubble will on the basis on the above discussion be defined to be observable (ex ante) in accordance to previous findings and described: There exists a bubble in real estate exists if house prices are above what fundamentals can sustain and if market participators in general

have unrealistic positive belief in future house price increases, which is characterized by attracting new buyers in the form of speculators interested in profits from trading rather than its use or earning capacity.

The practical problem arise if fundamentals can explain most of history, but not the current situation. The reasons could be that a structural change has occurred, a certain unidentified or immeasurable shock that has to be implemented, that the assumptions needed to quantify the expected future value of fundamentals are hard to judge, whereas it is hard to justify the existence of a bubble. Another possibility is that explaining has influenced the market by investors just being 'rational' gamblers (Anderson, 1997) or that problems has occurred, which require policy intervention (Shiller, 2000 and IMF, 2003).

3. Theoretical approach - The housing model

To analyze the main factors of the housing market, I have chosen an equilibrium model, which provides us with an academic tool, from which it is possible to incorporate different types of shocks and analyze the impact of each. This type of model is developed and improved by two of the most respected economists in this area: Poterba (1984) and Miles (1994). I have chosen to use the framework of Poterba to achieve the best possible insight into primarily demand shocks and the SR, MR and LR effects of such.

To make the best fit with a fundamental view on house prices I have combined Poterba's model with the Tobin's q presented in general by Summers (1981) and Tobin (1969).

This dissertation will not make a complete description of the model, since the model itself is not my main focus, but it will be analyzed and incorporated into my setup making the model an important stepping-stone for further understanding. A demand shock will be interpreted to analyse the model and relate it to the current situation. After the following section the reader should get the impression that there exists several shocks, which occur at any given time leaving a complex and many-folded picture.

The model

Homeowners are equalizing their marginal cost (ωq_t) and marginal benefit ($R(H_t, y_t, dm_t)$) of housing services, which will be defined below.

User cost

A house is a dual good, whereas it is both an investment and consumption good for the agent. As an investment good the house is not possible to be defined, whereas the consumer in

principle is maximizing the expected utility by solving the inter temporal maximisation problem:

$\max E_0(U_0) = \sum_{t=0}^{T} E_0 \frac{[U(H_t, c_t)]}{(1+\rho)^t}$ under a given budget constraint.

By the choice of the consumer's housing consumption, which is related to the user cost (uc), the consumer maximizes the expected utility of housing consumption (*H*) and non-housing consumption (*c*).

User cost (service cost of holding a housing unit) is defined as:

$UC_t = K_t(\delta + \kappa + (1-\theta)(i+\mu) - \pi^H)$,

where UC is defined as the average market value of houses (*K*) times the after tax depreciation (δ), repair costs (κ), property taxes (θ), mortgage interest payments (i), and the opportunity cost of housing equity (μ), subtracted with the capital gain (π^H). The average market value of houses (*K*) can be assumed as *K*=1, whereas:

$UC_t = \delta + \kappa + (1-\theta)(i+\mu) - \pi^H$

To simplify the expression it is assumed that interest rates are symmetrical for negative and positive capital expenses. Specifying that he one period service cost of holding a housing unit comes as a fraction ω of the price *q*, where the fraction can be defined as $\omega = UC_t$. Equalizing marginal benefit and costs of housing services we get: $R(H_t) = \omega q_t$.

Asset market equilibrium

The expression for the asset market equilibrium condition can be rewritten in terms of real prices by using that

$$\pi_t^p = \frac{\dot{q}_t}{q_t} = \pi_t^H - \pi_t \Rightarrow \pi_t^H = \frac{\dot{q}_t}{q_t} + \pi_t,$$

Stating that the nominal capital gains of houses (π_t^H) equal real house price inflation (π_t^p) and nominal inflation (π_t) in the LR, which can be inserted into the expression for marginal benefit $R(H_t, y_t, dm_t) = [\delta + \kappa + (1-\theta)(i+\mu) - (\frac{\dot{q}_t}{q_t} + \pi_t)]q_t \Leftrightarrow$

$$\frac{R(H_t, y_t, dm_t)}{q_t} = \delta + \kappa + (1-\theta)(i+\mu) - \pi_t - \frac{\dot{q}_t}{q_t}$$

Redefining the expression for housing service costs to $v = \delta + \kappa + (1-\theta)(i+\mu) - \pi_t$ makes the asset market equilibrium

$$\frac{R(H_t, y_t, dm_t)}{q_t} = v_t - \frac{\dot{q}_t}{q_t} \Rightarrow R(H_t, y_t, dm_t) = v_t q_t - \dot{q}_t \Rightarrow$$

$$v_t = \frac{R(H_t, y_t, dm_t) + \dot{q}_t}{q_t} \Leftrightarrow \dot{q}_t = -R(H_t, y_t, dm_t) + vq_t \qquad (1)$$

This equation expresses a non-arbitrage condition, whereas $\dot{q}_t$ express the demanded return on capital if the agent should possess the existing housing market. The demanded return on capital depends on the return on the house $R(H_t, y_t, dm_t)$ and the cost (v_t), which is related to investment of q unit of house.

When $\dot{q}_t = 0$ then the demand curve for houses is stable, because investors do not expect any real capital gains. It is worth noticing that the price of a house must equal the present discounted value of its net future service flow. This relation can be derived from (1).

A house net service value (S_t) is its rental service value subtracted depreciation, tax, and maintenance costs: $S_t = R(H_t, y_t, dm_t) - [(1-\theta)\mu + \delta + \kappa]q_t$, which can be rewritten to:

$$\dot{q}_t = S_t + [(1-\theta)i - \pi]q_t,$$

which is subject to the transversality condition that restricts housing buildings services to grow at a rate less than the discount rate solved by the following differential equation

$$q_t = \int_t^{\infty} S(z) e^{-[(1-\theta)i-\pi](z-t)} dz,$$

which states, assuming that the interest rate is constant, that the real price of a house equals the present value of its future net service flow discounted at the homeowners real after tax interest rate (Miles, 1994 and Poterba, 1984).

Investment equilibrium - Tobin's q

To get find an equilibrium that relates the fundamental view of constant prices in the LR into a theoretical perspective I have incorporated Tobin's q, which will give the wanted tool to analyse the dynamics of house prices. The dynamics of investment and market valuation are considered in a model where the following assumptions are valid; no inflation, houses does not depreciate, investment is financed through retained earning and tax is proportionally on corporate income.

Under these conditions it is reasonable to assume that investment depends on the ratio of the market value of houses to the replacement cost. The following investment equation can therefore be shaped following Tobin (1969) and Summers (1981):

$I = I(\frac{p^H}{p^C})H$, where I represents gross investment and $\frac{p^H}{p^C} = q$ is the q-ratio expressed as the market value of houses p^H relative to the replacement cost p^C.

The average market value of houses (H) can be set to 1 due to the non-existence of inflation, which leads us to the following equation:

$I = I(\frac{p^H}{p^C}) \Leftrightarrow I = I(q)$, where $I(1) = 0$. $I' > 0$

If q=1 then the market value of houses is exactly the same as the replacement cost ($p^H = p^C$).

If an investment of one unit does not pay out more than 1 unit then the investment should not be initiated given the costs of adjustment and lags in recognition and implementation, which leads to no investment in new projects of construction.

The assumption that the I/H-ratio depends on q ensures that the growth rate of the capital stock is independent of the scale of the economy. The equation is a technical relation that depends on the adjustment of the cost function.

It is convenient to examine the dynamics in terms of H whereas the increase in the housing stock will be $\dot{H} = I(q)H$ (2)

(Summers, 1981 and Tobin, 1969)

Equilibrium of model

The equilibrium conditions are therefore in continuous time:

$$\dot{q}_t = -R(\bar{H}_t) + vq_t \quad (3)$$

$$\dot{\bar{H}}_t = I(q)H \quad (4),$$

where $\dot{\bar{H}}_t$ is the rate of change of the aggregate housing stock at time t. But since the housing stock is inelastic in the SR the line has been added. $\dot{q}_t$ is the expected rate of change of house prices at time t.

In Equilibrium there are no expected capital gains $\dot{q}_t$ or increase in housing stock $\dot{\bar{H}}_t$. In equilibrium $\dot{\bar{H}}_t = \dot{q}_t$ =0, which gives the following curves for supply and demand:

$q_t = \frac{R(\bar{H}_t, y_t, dm_t)}{v}$ and $I(q)H = 0 \Leftrightarrow q = 1$

When $\dot{\bar{H}} = 0$ it implies that, the model is in steady state, where q must equal 1 to make the market value of goods equals the replacement cost.

By total differentiating these expressions, it is possible to find the slope of the curve:

$\frac{dq_t}{dH} = \frac{R'(H_t, y_t, dm_t)}{v} < 0$, because $R(H_t)$ is decreasing in H_t

$\frac{dq_t}{dH_t} = 0$, whereas the slope is flat

$R(H_t, y_t, dm_t)$ is the demand curve, which is sloping downwards due to housing consumer's marginal utility $R'(H_t, y_t, dm_t)$ being negative. All else being equal, if an extra unit of house is added by a constant demand then there will be a downward pressure on prices. The supply curve is flat making it positive to perfectly adjust the supply of houses by adjusting investments in the LR.

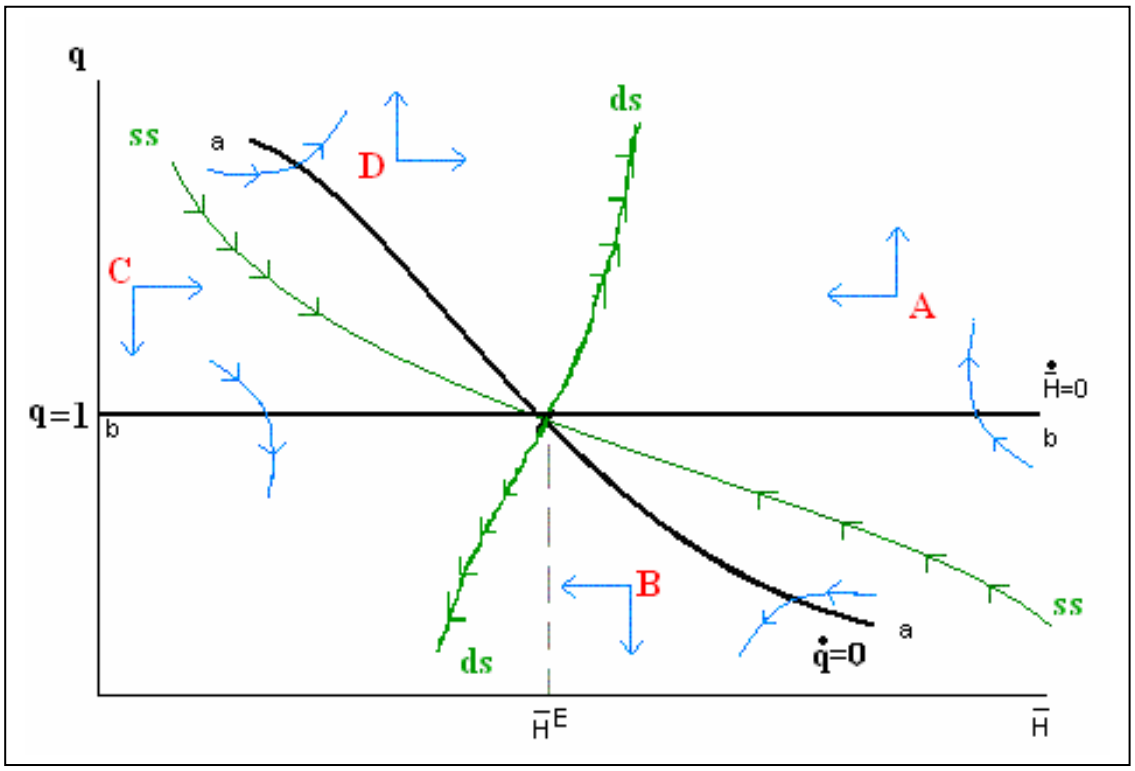
Graphical analysis of equilibrium

The supply of houses is controlled by Tobin's q due to houses being viewed as an investment object. In equilibrium *q*=1, whereas if q>1 then the market price is above the replacement cost making it attractive to build. The increased prices will therefore result in construction of new buildings driving *q* down to *q*=1 as seen in the graph below, which is in contrast to Poterba's model having an increasing LR supply curve and thereby not resulting in stable prices on houses in the LR as fundamentals suggest they should be.

The main point in the system is when equilibrium applies (q^E and $\bar{H}^E$). Exactly at this point where the supply and demand curve crosses is the equilibrium determined by the model and is where the model is most stable. In equilibrium the housing market is in its LR steady state, which I will focus on as following the fundamentals of the housing market.

It can be shown that the equilibrium is a saddle point. This saddle point is stable, because it has exactly one jump variable, q_t and a slow variable, H_t. q_t will adjust to make sure that the economy is always at the stable saddle path (ss). If it is assumed that the economy is consisting of rational utility optimizing individuals (not explicitly modelled) then this is the only possible path. All other combinations of H_t and q_t will follow the alternative diverging path (ds), which is unstable and if assumed that we are positioned in the north-east quadrant then it will be possible for both house prices and the housing stock to increase at the same time. This will be the creation of a rational bubble. However, the individual's transversality condition secures that the diverging path is not feasible with the utility optimization.

The two dynamic equations can be analyzed in a phase diagram as presented beneath



By looking at the dynamics of the model it is possible to understand the reactions of the market. The real estate market is very rarely under such stable conditions, but instead forces influenced by pulling the housing market away from equilibrium. The blue lines indicate how the housing market would react if it was outside the stable path. It becomes clear that house prices will either go to infinity or 0. The different sections describing the dynamics of the system will be analyzed in detail in Appendix A.

3.1. A positive demand shock

House prices are considered highly determined by demand in the SR, making the marginal house buyer extremely important as Poterba and Miles also suggest. Real estate is therefore mostly driven by demand, and the focus will be on such. Demand shocks will influence supply, but because construction of new homes takes time, a lagged stabilization effects through supply of new houses will over time, make the housing market adjust and find a new equilibrium.

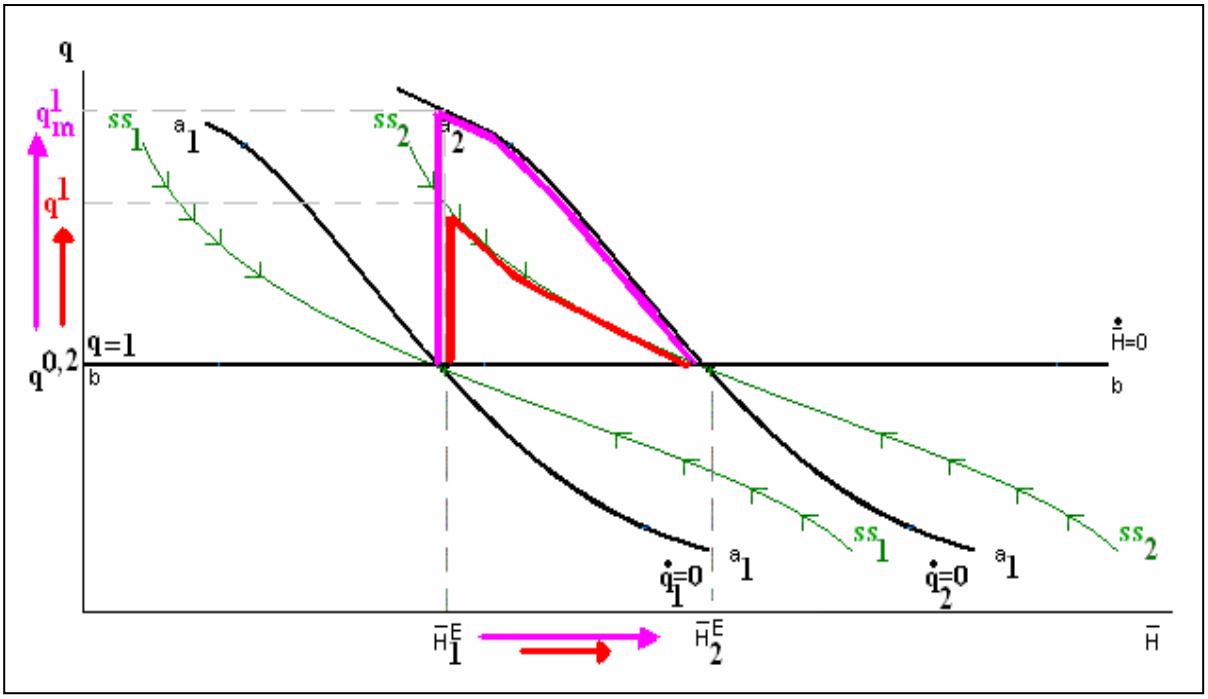
Graphical illustration of a positive demand shock

If a positive (negative) demand shock occurs in the housing market it will put an upward (downward) pressure on demand for houses. In the SR the supply of houses is inelastic, which

forces the house prices to adjust instantaneously and increase (decrease) exactly when the shock occurs. At the time of announcement house prices will therefore have to jump. In practise there is a challenge to the SR instantaneous adjustment, because the extra demand has to be observed (discovering lag), the investment has to be considered (decision lag), the construction has to be completed (construction lag) and the finished product has to be sold (sell and search lag).

It is important to notice the difference between an anticipated and unanticipated shock. If the demand shock is unexpected prices will adjust fully to the new information in the short run and then afterwards over time the extra demand for houses will create a need for construction ($q > 1$), because house prices will be above its replacement costs, whereas construction will over time (MR) secure that prices will be re-established and follow the LR trend. Supply will therefore act as an adjustment process that drive prices back to a new equilibrium over time. It is important to separate between a perfect foresight and a myopic market, which will be explained in the following.

Unanticipated

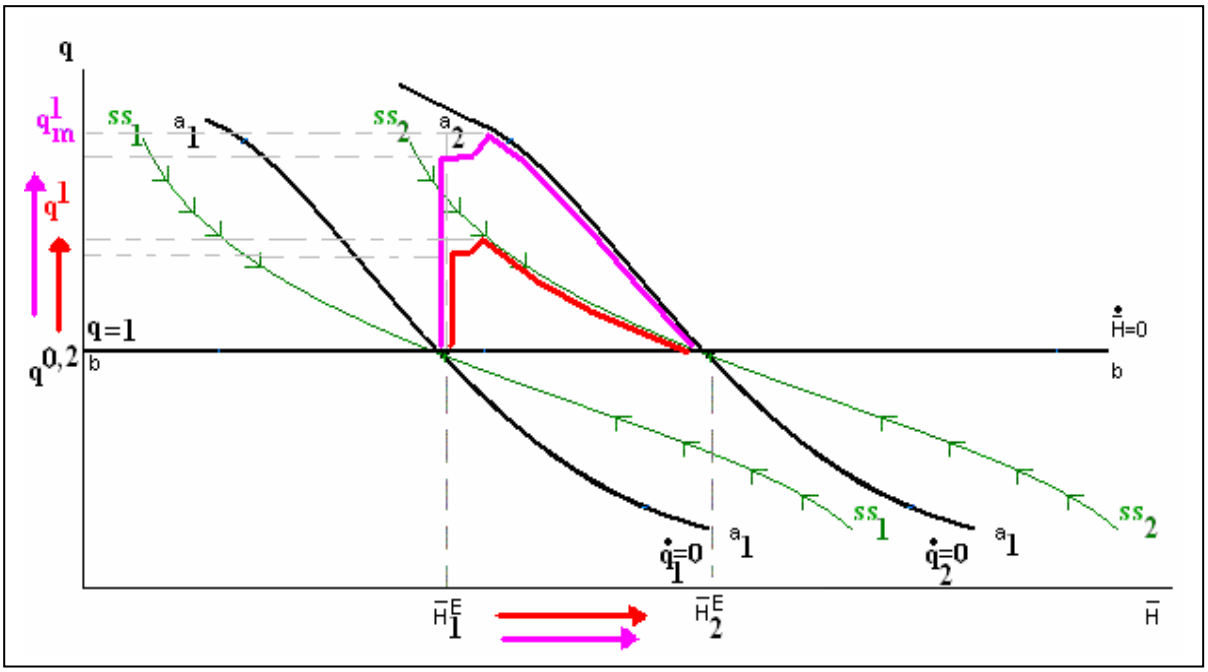


If the shock is unanticipated (e.g. a sudden lowering (raising) of taxes positive (negative) for demand) prices in a perfect foresight market (being able to forecast the change in supply due to the increase in demand) will jump (SR) to the stable path and in the LR bring the housing market to a new equilibrium through the building of new houses. In a myopic market house prices will also jump (SR), but will overshoot the stable path, because of investors not able to

forecast the change in supply of houses in the future. (An expansion in supply due to higher profit in the construction sector would make it more attractive to build).

If the shock is anticipated and thereby having a shock where investors are informed about a coming future change (e.g. when the monetary policy is announced in the near future by cutting (raising) interest rates as for a positive (negative) shock) then the adjustment process will take the discounting into account and therefore in the case of perfect foresight not jump to the stable path, but just beneath. Over time until the implementation of the change in interest rates then the demand will slowly adjust to find the stable path. At the time of implementation the economy would be located at the stable path and over time be driven down to the new equilibrium in the LR by the smooth adjustment of building new houses.

Anticipated



In the case of a myopic market the price would again instantaneously jump to a price above perfect foresight, because of the lack of understanding for the automatic stabilizers in the housing market (it is impossible to tell whether the jump is above or beneath the stable path. Over time, until the date of implementation, prices and the number of houses will increase. When implemented on the overshooting path, again over time through new construction being taken to a new equilibrium, prices are higher and the number of houses has increased.

General observations

From an investor in the housing market perspective, a positive shock to demand makes the prices of existing property above its replacement cost, which gives an incentive for developers

to build more. New properties will take years to complete causing a supply lag, which could encourage a boom in the housing market. An area where the inelasticity of supply in houses is strongest is where home prices are particularly sensitive to changes in demand (e.g. larger cities and highly regulated areas). MR supply is also considered as partly inelastic due to planning control (regulation). Planning control differs globally, as suggested in a study by Malpezzi (1994) that supply is much more responsive in the US than in the UK in the medium term, because of planning regulations in UK being stricter and the land being relatively more scarce. This could probably explain the more common housing booms and bust in the UK as will be shown later. (McCarthy, 2004 and Economist, 05.2003). Regional planning is therefore an important feature of how well a housing market is functioning. Here the LR is considered completely elastic, which will secure that prices will remain constant over time.

There are several other influences such as sociological and psychological factors. Among those are the typical view that living nearby work is positive, because of lower transportation costs. Regional plans will therefore make price adjustment more volatile leaving metropolitan areas with a higher frequency of bubbles and very difficult to avoid. As Glaeser (2003) describes it: 'zoning and other land-use controls are more responsible for high prices' (when a demand shock occurs and supply is fixed). He also finds that measures of zoning strictness are highly correlated with high prices and that these types of government regulation are responsible for high housing costs.

4. Data

I am following Eichholz's (1996) advice by approaching the housing market with LR data. Most studies so far have focused on the post 1970-1995 period where house prices have increased substantially, whereas my research will present 'new' data that has not been used before. The data especially regarding construction costs and house prices have been discovered after thoroughly going through each of the countries yearly books of statistics printed in their home language (e.g. NL and N). This research has taken a substantial effort and made data available, which else would have been kept as a secret. This new data set will be able to contribute in many different aspects of future economical research.

When looking at a LR historic perspective then real house prices LR performance seems to be overstated, because of focusing on a too limited time horizon being only 10-35 years. The statistics in the LR reveal as earlier shown that the real house price is constant over time, but that nominal house prices increase over time.

I have chosen to use annual data from N, NL, UK and USA (Appendix B), because of the best LR statistical data being available for the selected countries. By focusing on annual data it has been possible to find data for the explaining variables at a much longer perspective than any other research have been able to combine with housing market data. Compared to use of quarterly data it does give a smaller number of observation. Quarterly data has however previously given results influenced by seasonal data, which annual data do not. However, this rare LR perspective should strengthen the finding of fundamentals as a result from the analysis. Please refer to Appendix B for data sources.

The data sets concerning the housing market can to a large extent be criticized. There are lots of different housing statistics available (with short time horizon) and over the LR different sources have been used, which makes it necessary to splice the data sets. By using different sources and thereby different techniques to deal with data, the data quality is lowered and restricts the scope of meaningful analysis.

The most important point to note is that no one method of constructing an index or concept of the price of a house is 'right', because all of them will be best possible approximation based on the transactions made. The information from quarterly changes in one 'local' house price indexes should not be overstated, because sampling and estimation error in monthly and quarterly house price inflation rates are substantial. In the SR (with volatile prices) there exist a great deviation between the prices estimated on houses by the different methods, but in the LR these differences are smoothed out. That is the reason why I have used approximations of house prices over time, and to the extent possible I have tested them against other sources to see if they were credible. However, it must be concluded that there is a great need for improvement of the quality of property data and to enhance the comparability of statistics across countries. (Wood, 2005 and Zhu, 2005).

To put these statements into a broader perspective, Arthur (2005) states that more and better data should become publicly available. Currently, private companies are gathering the data depending on their own requirements, which lowers quality for general usage. At best then the following points should be followed to create the best data sets:

Data should become available and be representative for the whole housing market. At the same time comparable data is preferred, because it makes it possible to make comparative analysis. Throughout the different markets there are different ways of collecting house prices making it harder to compare internationally. The series should be continuous and therefore

not spliced as it has been necessary in many of the time series presented here. The length of the series should be as long as possible, which is hard or maybe even not possible because of the need to reconstruct historical data.

It has been troublesome to find data for the reproduction cost. The data only includes the construction prices, but not the prices of land, which means that I have only been able to make an approximation of the complete construction price. The reconstruction costs will therefore be understated if land is scarce (in city areas) where prices of land will increase substantially if a demand shock occurs. Land prices have not been accessible and it would be tricky to get the exact reproduction costs due to a weighting of construction price and price of land will have to be identified (which could easily change over time).

At the same time there could be problems with the statistics because of being affected by regional data, whereas the aggregated data will hide such local differences. My focus is however on the aggregated level and to see a general pattern in house prices in an international perspective.

5. History and house prices

LR and high quality statistical data about the housing market is limited and hard to access, which is partly due to the fact that there is no international standard and there has been a lack of focus. The market participators are therefore primarily left with limited information about the beginning of the 1990´s only. This causes the memory of the market to be shortened and thereby influences expectations of market participators. At the same time most academic research is based on data with a limited history going back to 1970 only. Many of these papers conclude that they have found the LR determination of house prices, which I would like to stress, is not possible for a data set only reaching 35 years. The LR fundamentals have to be found over time series containing several generations to make sure data are not influenced by a temporary trend. The dynamics of house prices should therefore not be determined on the basis of only one generation or even a decade, but rather through several generations.

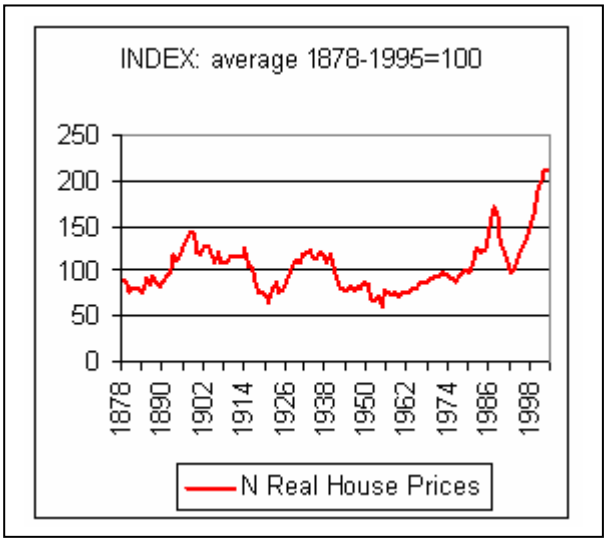
I have been able to obtain housing price data on a much longer time scale (NL back to 1629), which will function as a basis for the LR identification of the dynamics of house prices. Unfortunately it has not been possible for me to retrieve data for all the explaining variables

as far back as the house price data. I will therefore try to use the time series data as far back as possible under the different conditions that I am looking at.

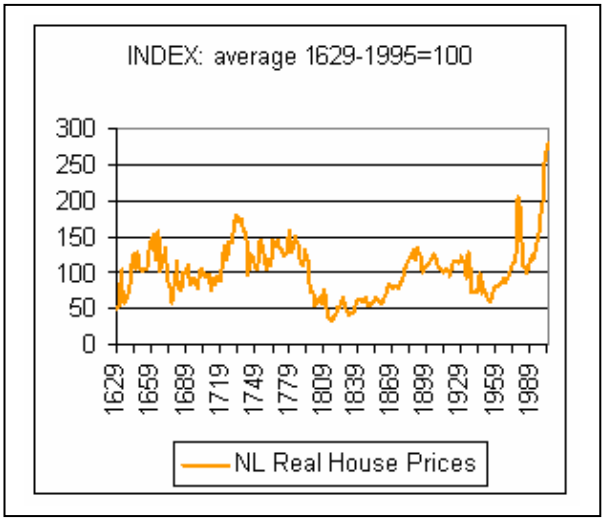
First I will focus on the price movements over time for N and the NL, then I will give a brief introduction of the N and NL history with the aim of explaining the development in house prices over time it is important to use this historical perspective to find reasons why house prices are departing from LR equilibrium and is strengthened by the following advice from Eitrheim (2004), who states: 'house price indices seem to fit well with historical events and available indicators of economic development. The same historic approach will follow for UK and USA as far back as it has been possible.

The best LR statistics available on house prices are from N (1878) and NL (1629). It is clear that N and NL prices have been moving around the index=100 value from respectively 1878 and 1629 until around 1995. During the 116 (N) and 376 (NL) years there has been periods of strong price increases and decreases, but also times when prices find a level above or beneath the LR average and stay around that level for 10-15 years. There is a tendency of a mean reverting force that brings prices departing from the LR average back to equilibrium. There are signs of both under- and overshooting in the adjustment process to the LR average.

Real house prices in Norway



Real house prices in the Netherlands



Historic overview of real house prices in Norway

In the 1870's-80's the international depression made house prices flatten out. This period was followed by a boom in city areas (1890's), because of people moving to the city. An enormous construction initiated shortly afterwards (1900's) made the house prices flatten out and a bust followed in late 1910's because of WWI, the Spanish flu (1918) and insecurity. In

1916 rent control laws were introduced giving the renters more rights and leading to crash in house prices followed by a 1920's bank crisis. The recovery initiated in the 1930's, but the strict regulation and price freeze from 1940's to 1954 and regulation by local boards until 1969 made the prices sore. Credit liberalization and less regulation took over in the late 1970's to mid 1980, which led to increasing house prices. Lending controls being abolished in 1984 and interest rate deregulation in 1985 enforcing the price movements. However in the late 1980's a bust period initiated a national banking crisis, which was strongly influenced by a boom and bust economy. Since the mid 1990's the housing market has been is in its biggest aggregated price increase ever due to primarily further liberalization.

From this overview it becomes clear that the housing market constantly is influenced by shocks pulling it away from equilibrium. Credit liberalization or freeing regulation is confirmed as a positive demand shock, whereas a banking crisis, regulation and insecurity are negative shocks. Evidence from the Norwegian market also shows that there are factors that over time will make the price go back towards equilibrium. Among those is adjustment through construction of new houses (Girouard, 2001).

Historic overview of real house prices in Netherlands

The best available real estate data I have discovered is from NL. It goes back to 1629 and this period is known for the earliest discovered boom and burst of a bubble in history. It is the so-called tulip mania named after the flower, which experienced price booms in the mid 1620's, where the tulip became a symbol of power and prestige during a time of Dutch prosperity. The importance of the tulip was high due to the need for a special tulip when men proposed to women. The more unique, the more popular the tulip was, and the more demand which created higher prices, and ended in a price boom. Tulips became an investment object instead of only being a flower.

During the main boom (1629-1633) house prices increased with approximately 100% in real terms and at the same time share prices doubled from 1630-1639 reflecting a time of extreme wealth. However, when an external shock hit (a plague of pest) house prices they decreased by 46% in real terms in the mid 1630's. Shortly after tulip prices crashed (in February 1637 prices for a Semper Augustus peaking at 6290 Guilder), and returned to normal levels (same tulip trading at 0.1 Guilder), leading to many bankruptcies and the Dutch economy to enter recession (Garber, 2001).

In the later stages of the mania 'windhandel' became possible, which was a chance for people to buy tulip bulbs with paper credit, of which a great fraction was linked to property. Credit expansion made the market unsustainable due to the trade of bulbs that was not yet produced being bought with non-existing money based on expectation of future prices increases. People had leveraged too much and speculated by trying to sell tulips at higher prices than they bought. The collapse happened due to a change in sentiment initiated by rumours saying that there were no more buyers in the market resulting in price decreases. The result was that speculators defaulted and florists were suffering (Chancellor, 2000).

From the data available I have identified the first housing bubble initiated by an external shock that not only ended up having an effect in the housing market, but spread out to other parts of the economy, through the importance of being able to link credit to property. Asset price movements should therefore not be viewed in isolation and instead be compared and related to other assets, the economy in general and especially the availability of credit.

Late 1630's-80's: Volatile house prices because of trade regulation, wars and pest epidemics. During the period 1655-1660 trade flourished and house prices grew with 50%. Amsterdam became a financial centre, which helped prices increase in the 1700's-1785. From then on it lost its status of both trading and financial centre making prices drop. The recovery came after 75 years in 1860 when Holland initiated its industrialization and people moved to the city creating a demand that supply could not match, making house prices increase more than 100%. Shocks like WWI, the Great Depression and WWII flattened the prices out.

House prices recovered post WWII, but then suddenly increased dramatically from 1975 to 1979. Boelhouwer (2000) has found the reasons to be: 'the influence of government measures and other institutions; the development of a number of economic variables; and the dynamics of the market mechanism, specifically the effect of speculation.'

The institutional change was initiated in 1972 where the Central Bank terminated credit controls, which made commercial banks expand mortgage portfolios. In addition mortgage guarantees were expanded in 1973 and banks criteria's on mortgage were extended from 70% to 125% of the market value. The economic conditions were favourable making demand increase; Income increased with prospects of further growth and the mortgage interest rate was low and declining. The price increases made people speculate in further increases and thereby be reinforcing, resulting in an overheated market. The situation changed when the second oil crisis stagnated growth, income decreased and interest rates rose sharply because

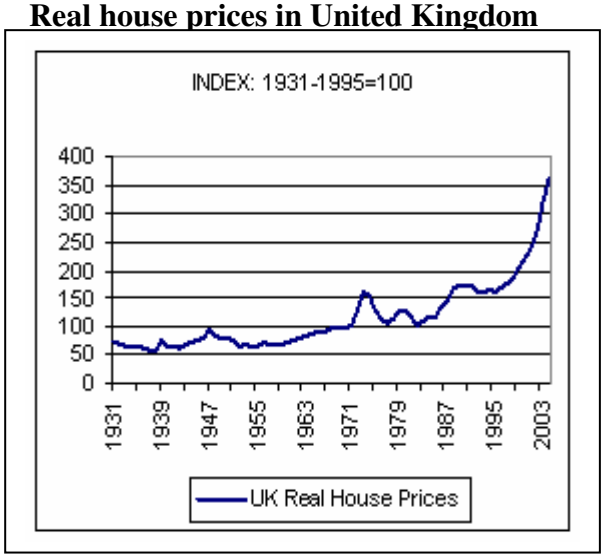
of inflation resulting in banks tightening the conditions for lending (Boelhouwer, 2000). Interest rate deregulation in 1980 did not have a major impact. However, during the last 8 years an even larger bubble has been created in a time of credit liberalization.

This LR perspective on the Dutch housing market makes us realize how much credit, speculation, insecurity, and 'fashion trends' influences the expectations and the dynamics of house prices. Trade, financial prosperity and products affect prices positively.

The latest increases (since 1993) have been exceptionally high reaching values never observed before even when looking at LR data. Boelhouwer (2004) has found that the main reasons are the commercialisation of construction where more than 70% being build by entirely commercial interests instead of previously being subsidised by government, strict local regulation not making building sites available, quality assurance policy on new buildings (e.g. tougher environmental standards, rules on safe building and in many cases municipal standards for architecture), subsidies to owners such as aid to social landlords, direct government spending and tax concessions and not least the rising land prices making a low price to quality ratio of new construction relative to the existing buildings (Eicholtz, 1996, Garber, 2001, Girouard, 2001, Hakfoort, 1997, Smant, 2000 and Steimetz, 1999).

For both N and NL (with the longest time series) there is strong evidence that real house prices are relatively constant in the LR or fluctuating around a constant level, but when focusing on UK and USA (with shorter data that roughly follows N and NL data) then real house prices seem to be fluctuating around an increasing trend. It is therefore very likely that a bubble in house prices in N and NL exist, but that effects as regulation and limited supply of land could be a possible explanation.

Real house prices in United Kingdom



Real house prices in USA

When looking at real house prices for UK and US with statistics from 1931 and 1918 respectively there exist a clear upward trend in real house prices. This is a huge contrast to the findings from N and NL. The problem about the data is that it is not far reaching and that the data is strongly influenced by WWI, the great depression and WWII. However, the latest decade does also appear bubbly.

Historic overview of real house prices in United Kingdom

Up to 1940 house prices decreased due to bad economic conditions and inflationary pressures. During WWII house prices increased dramatically. This is partly due to a damaged and reduced housing stock, which was a result of the bombings, which gave a negative supply shock. At the same time lending possibilities were increased giving a positive demand shock. The boom ended in 1948 followed by an over expanded house building, which was partly due to high credit willingness in the construction sector. At the same time there were not many potential house buyers (casualties in war) giving a negative demand chock.

House prices increased from 1958-69 due to an economic upturn, but in 1970-73 a bubble hit the UK housing market. One explanation can be found in a decrease in mortgage rates incl. tax deductions (interest relief), which dropped from around 0% to -15% for a typical taxpayer making it very favourable to obtain debt. Credit growth and house prices increased dramatically until 1973, when credit was rationed resulting the burst (1976). The real symbol of financial liberalization is when Thatcher eliminated credit controls as liquidity ratios on banks (the 'corset') in 1980 and enlarged international competition leading to higher credit willingness and leverage, This led to a new bubble in the late 1980's (fuelled by building societies allowed to expand credit in 1986, removal of guidelines for lending in 1986, securitization in 1987 and a double mortgage tax relief, which was introduced in early 1988). The bubble peaked (October 1989) and prices reversed after a sharp rise in interest rates from 7.5% to 15%, which was necessary due to inflation pressures and lead the economy into a recession (Ahearne, 2005, Cave, 2005, Girouard, 2001, Holly, 1997, Muellbauer, 1992 and Maclennan, 1998).

It is striking that the UK housing market experienced three periods of price increases during a time span of less than 20 years and all of these were initiated by credit liberalization. The peaks happened due to a tightening of credit or through a monetary tightening leading to lower growth expectations and when the first decreases in prices occurred a tightening of credit by financial institutions strengthening the effect (Muellbauer, 1997).

Today real house prices are at the highest level ever and once again liberalization of credit has been the main factor; new loan types, extended credit willingness and the effects are strengthened by the historic low real mortgage rates.

Historic overview of real house prices in USA

The world's leading economic super power established its position in the beginning of the last century, but that could not prevent a stock market bust in 1929 that led to the Great Depression, which influenced the whole world. It had a great impact on house prices, which dropped substantially and it took 25 years for real estate to recover.

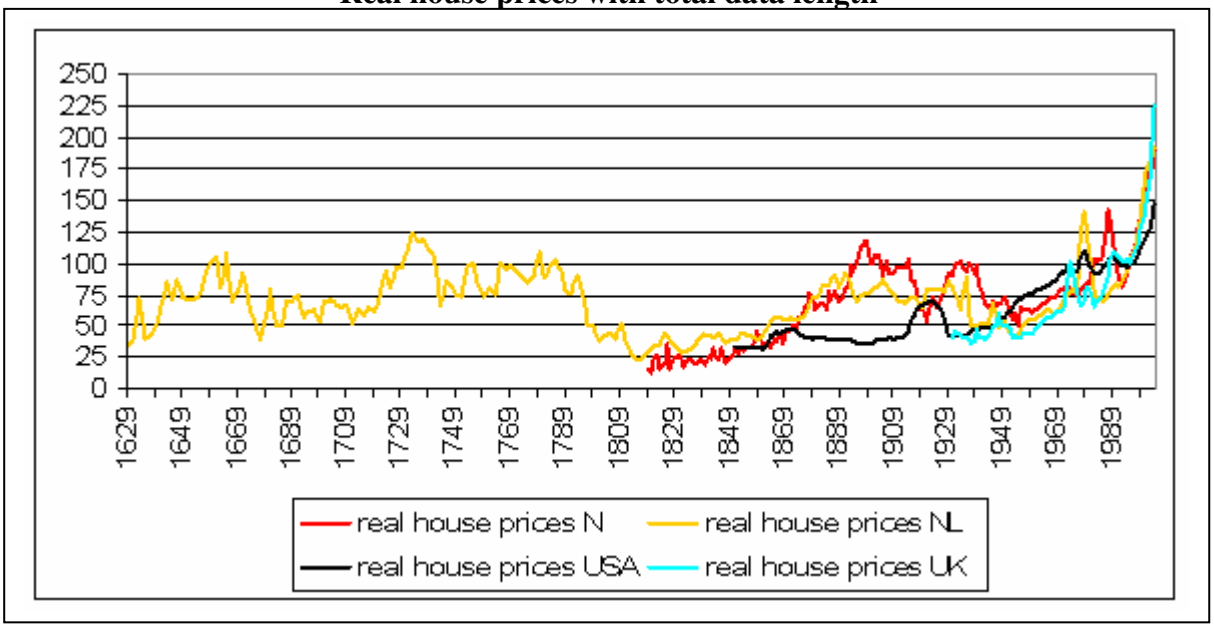
The bust was not only in the share market, but also in house prices, which decreased with almost 50% in real terms and actually occurring (in 1918-19) prior to the stock market bubble and due to the Spanish Flu and the end of WWI. I have discovered that credit growth played a crucial role in the pre 1929 period. House prices had up to then been increasing partly influenced by a credit boom followed being less restrictive on the terms of lending. When the housing market suddenly started to decrease LTV rates became much higher and resulted in a natural limitation of new credit causing the share market and new investments to halt whereas the stop of easy access to credit through the use of houses as loan collateral was not accessible making the share market crash.

Eichengreen (2003) directly links the reasons for the slump in 1930 as because of two factors; the structure of domestic financial systems and the interplay of finance and innovation. The regulation itself being a cause for the banking crisis and that credit is being invested in projects of innovation and housing with too high expectations and thereby not paying off (too easy access to credit creating a building boom resulting in poorly planned investments. The role of credit has therefore to a high extent been neglected as a major factor of a booming economy and instead tight Fed policy is blamed as the reason for the stock market bust in 1929 by being too contractive. The regained credit market had to be helped by the foundation of Federal Housing Administration who successfully reopened the flow of credit to houses making real estate recover (Field, 1992).

The great power of the US was in the post WWII period, when many of the international organizations existing today were established. The housing market gained confidence and experienced a long increase since the great depression all the way up to the oil prices in the 1970's. At the same time securitization was introduced (1971) and interest rate deregulation phased out from 1980, but only having a minor impact on real house prices.

The 1986 Tax Reform Act made it less attractive to invest in real estate, whereas house prices were plummeting until 1991. From then on mortgage rates decreased, which initiated a refinancing boom in 1992. It became possible for mortgage lending companies to operate with improved tools on a larger scale credit enlarged, leading to the longest price increase in US real estate history (Girouard, 2001 and Lereah, 2005).

Real house prices with total data length



When combining the development in the real house prices from the chosen countries as seen in graphs and the tables that will be presented in detail later it becomes obvious that there is a strong correlation in real house prices between the N, NL, UK and USA.

Basically when relating first the UK real house prices (data back to 1931) with the other three nations the starting point and the upward trend in real house prices are roughly the same and the same goes for data from N (1815) and USA (1851). With such a strong tendency of correlation, I therefore conclude that growth rates in real house prices in the LR are constant over time and mean reverting.

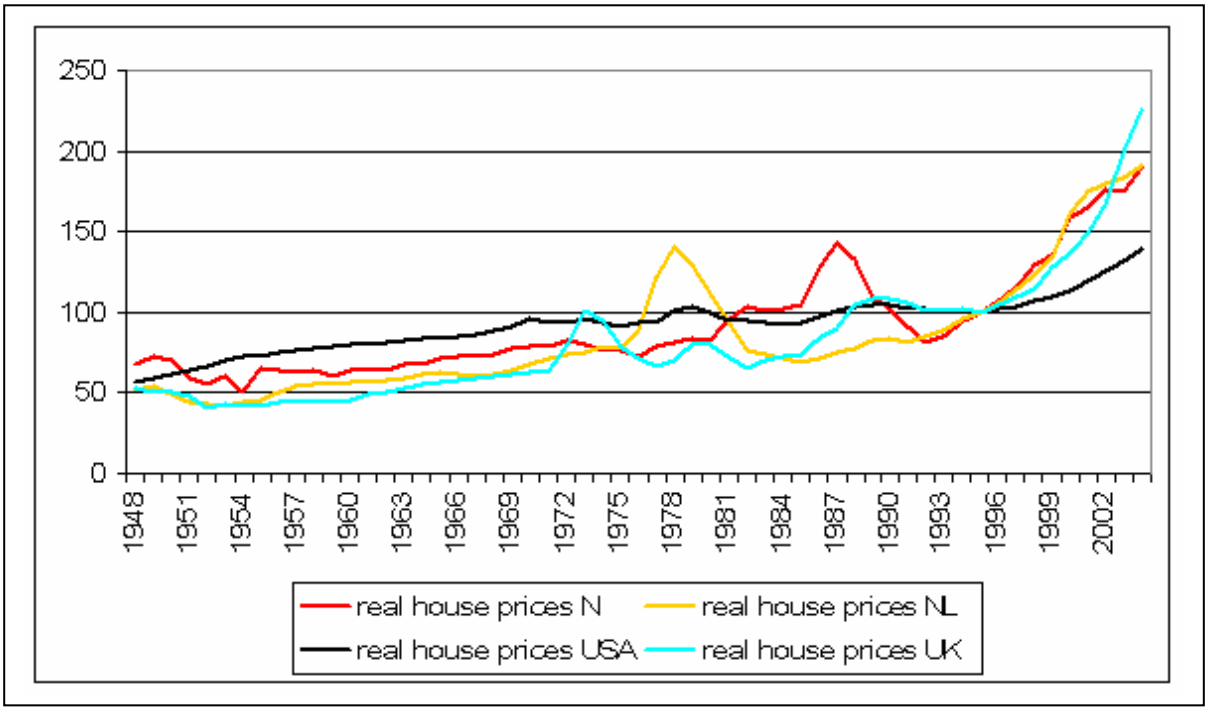
If the data had reached further back it would seem like real house prices would be trending upwards (see graph above and the following graph). I will therefore statistically determine whether real house prices are stationary or not. If real house prices are stationary then it would stand in a contrast to all empirical evidence made by most academics who are only considering data from 1970 and onward from where there would be an upward trend.

Because of the explaining variables not reaching as far back as the data for house prices I have chosen to explain the fundamentals in a comparative view with data from 1948, which is

just post WWII from where data is not so strongly influenced by as many major shocks as in the pre 1948 period.

When choosing comparable data from 1948 as start year (getting out of the times of insecurity), then it is obvious that real house prices have an upwards trend, and that real house prices have increased, especially since 1993. In fact real house prices in UK, NL, N and USA are at the highest level ever.

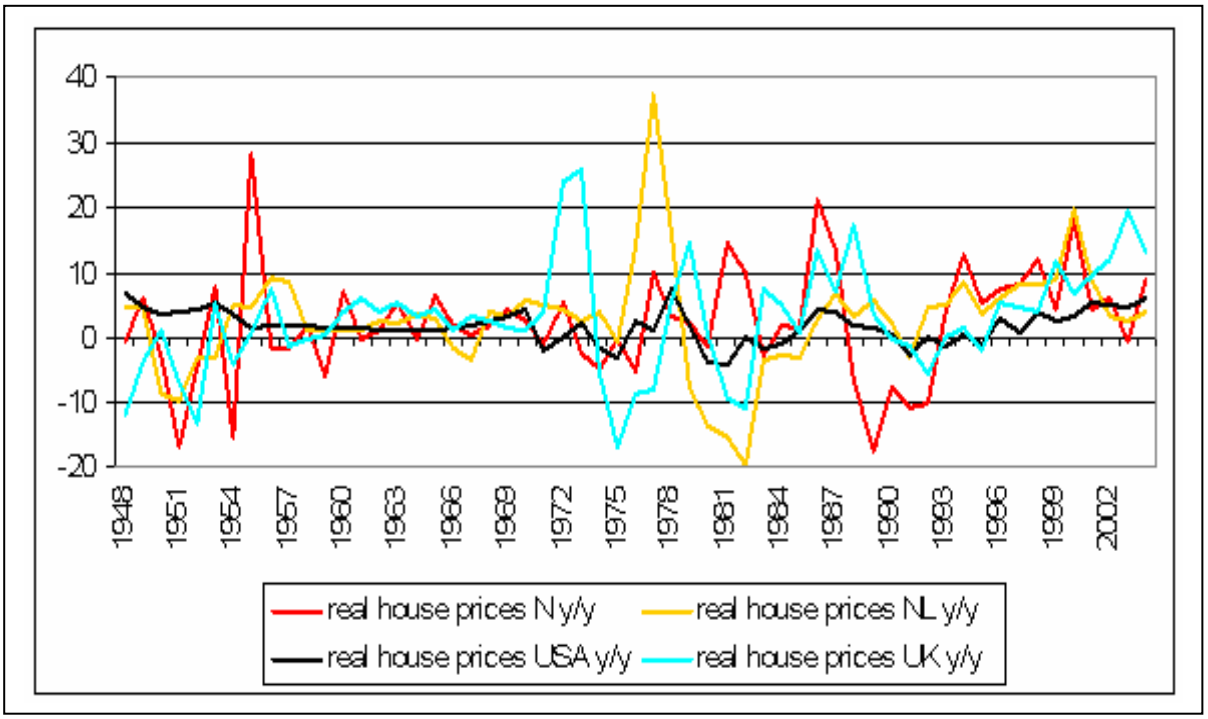
Real house prices 1948-2004



When only being able to focus on the latest 56 years the quality of the dataset is lowered substantially, since there is a strong contrast to the finding that real house prices stay relatively constant over time. The data shows a fluctuations around a clearly upward trend. Since I want to be able to find a LR relation in house prices I will (where LR data exist) start my statistical tests for the respective countries with as much history as possible to gain as much out of the explaining variables. In this way I hope to strenghen the statistical base and be able to present results that are consistent with the LR tendencies of the housing market.

When focusing on the annual movements of house prices then it is clear from a graphical analysis that real house prices are volatile. It is remarkable that since 1995 house prices for all considered countries have increased in real value making it the longest period with the highest increases.

Annual real house price changes 1948-2004



The latest period is therefore unusual when it comes to the size and length, but the dynamics of house prices have been seen several times before in history. I will therefore try to identify the factors, which have influenced house prices in the SR and LR in a search for an explanation.

5.1. Tax and returns

Previous findings showed that housing market should not be viewed in isolation, but should be compared to other assets and the general economic forces. When looking at prices on different asset classes over time, it is interesting to consider which asset class would give the best return.

Those excess returns can be seen in the post 1948 returns by being substantially higher than previously. House prices have historically increased by approximately 1-2% per year with the highest increases in the recent period. The return on houses does not only consist of capital gains but also from rents and there can be substantial effect from taxes and interest relief programs.

Fu (2000) has also discovered that returns are lower in the housing market than the stock market and states: 'Slow price adjustment to news not only induces highly positive auto correlation in real estate excess return, but also dampens their volatility and correlation with stock market returns. The properties of the recovered real estate returns would suggest a

significantly lower allocation to real estate in a mixed-asset portfolio than conventional measures.'

Taxes therefore play an important role by and an analysis of LR data would be too complex to include here, but very interesting, especially if compared to alternative investment possibilities and risk profiles.

It should be stressed that taxes and tax incentives (interest relief) has strong influence on house prices, which is confirmed by Poterba (1984, 1992) who emphasis the importance of taxes and that changes in taxes will have direct effect on consumption and the attractiveness of the given assets and thereby the price.

It is worth noticing that taxes do influence expectations and that a (temporary) gap between expectations driven by ex post returns and actual potential returns measured by the ex ante yield exists (Stapledon, 2004). The housing market is not efficient, which makes it possible for house prices to deviate from equilibrium, which is explained by Cho (1996): 'Real estate markets are not efficient; house prices and excess returns exhibit a positive serial correlation in the SR. Existence of transaction costs makes trading rules non profitable.' Besides that then house price indexes and transactions costs are not good enough and too high to make it possible to trade houses in the SR.

Average real house price increases in percent

%	Years	Houses
Norway	1948-2004	1,80
	1915-2004	0,68
	1831-2004	1,13
	1820-2004	1,38
Netherlands	1948-2004	2,34
	1871-2004	0,93
	1630-2004	0,46
United Kingdom	1948-2004	2,56
	1931-2004	2,30
USA	1948-2004	1,97
	1914-2004	1,43

5.2. Characteristics of price increases and decreases

To identify how returns on real estate are generated over time statistical evidence describing the development of booms and busts in house prices will be presented. (Appendix C).

The housing markets has to a much larger degree become synchronized, and for the first time in history all the considered markets are experiencing an increase in house prices that has lasted the same period of time and at roughly the same size. The synchronization of house prices began with an international peak in 1989-91 followed by a bust in 1993-95. Since then the housing markets have increased in all the considered markets, and the length of the boom and the annual price changes have been above normal.

When looking back in history, it is very rare to have a situation where real estate markets are synchronized. N and NL experienced busts around the same time and size in the late 1820's and 1840's. The European countries experienced a bust in the post WWII period, which can be related to the huge construction during the time and the loss of marginal buyers in the market. The synchronization in Europe stopped even though an international recession occurred in the 1970's (oil crisis). The post WWII period is characterized as the longest period of house price increases for all of the countries (except NL; 2nd longest). However the timing of the peaks were not identical.

The synchronisation of the markets could be due to real estate becoming more integrated into each other and they therefore now to a higher extent than previously being vulnerable to the same external shocks. In addition both the monetary and fiscal response policies are more homogenous than ever before. The markets have also been integrated by construction costs increasing at roughly the same rate since 1999. The reason could be that the markets have opened up, taking part in the globalization, whereas goods, investments, and labour in construction are moving more freely than previously. However, it could also be the natural lag of increasing house prices creating an upward pressure in construction costs. Future research focusing on integration and synchronization of real estate markets and economic policy is definitely an area that deserves more attention.

I have estimated (appendix C) the clusters of house price increase and decreases through the identification of peaks and bottoms in real house prices. I have discovered that there is a strong tendency for longer periods of price increases (reaching 6-11.5 years), whereas price decreases are shorter (5-7.5 years) and the length of the price decrease seems to be correlated with the length of the price increase. Actually it is striking that the price decreases have been

much more aggressive with real price decreases being more negative than the typical price increases are positive. This has been the case especially before 1918, which could be due to the datasets mainly being based on city data. These decreases were an important for the LR trend with constant real house prices to be re-established (many times with overshooting).

Characteristics of price increases and decreases

	N		NL		UK		USA	
	Increase	**Decrease**	**Increase**	**Decrease**	**Increase**	**Decrease**	**Increase**	**Decrease**
# of years								
Mean	11.5	5	8	6	6	5	11	7.5
Y/y price Δ								
Mean	5,95	-6,79	5.18	-7.22	7.14	-5.58	3.12	-2.26
Last wave								
# of years	12		13		10		11	
Y/y price Δ	7.33		6.81		8.27		5.05	
Overall								
Y/y price Δ	1.38		0.46		2.27		1.06	
Interval periods	[5;18]	[1;11]	[2;40]	[2;12]	[2;19]	[2;7]	[3;40]	[2;23]
Interval y/y Δ	[1.26;2.02]	[-38.7;-2.86]	[1.35;6.81]	[-26.9;-1.57]	[1.13;8.27]	[-10.1;-1.35]	[1.02;5.26]	[-4.47;-0.51]

Source: Appendix C

There is a strong tendency for house price increases and decreases to cluster and therefore make price changes be dependent on the previous year. This feature makes the housing market be momentum driven and makes a full ended cycle in real estate prices. The current period of price increases is much longer than the historic mean and the size of the price increases are significantly bigger, especially when comparing to the historic trend for house prices that has been roughly 1.5%. Focusing on the aggregated increases in house prices then the latest increases have been extremely high, which can be specified by being way above the historic mean of aggregated price increases (Appendix D).

It is worth noticing that 83% of aggregated house price increases above 68% since 1888 have been followed by a bust of at least 33,3% with this knowledge it is extremely relevant to see whether the latest boom in real house prices can be explained by economic variables.

6. Fundamentals of the housing market

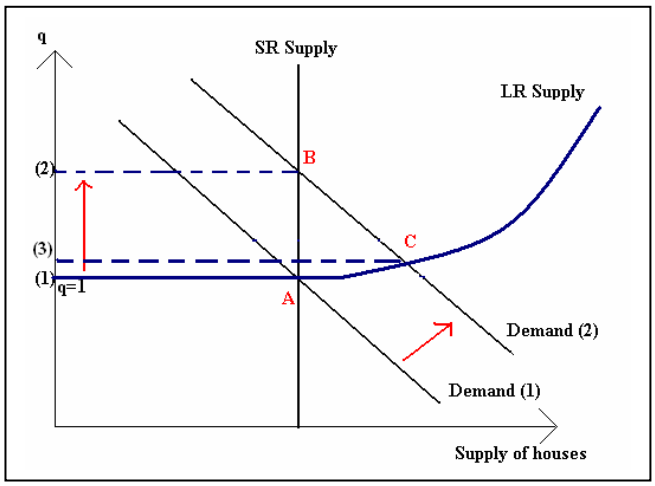
The fundamental approach will be taken with the LR perspective in mind. First of all, then I will present a model that combines the fundamentals into one simple model that combines the knowledge from the previous sections with a more empirical view bases on what my model has found to be the central variables, which will define the LR equilibrium of the housing market. These fundamentals will be presented individually by combining theory, intuition and

then be presented graphically and analyzed. The aim for each of the single contributors of fundamentals is to understate how each variable interact with house prices to get knowledge of the dynamics both regarding SR and LR equilibrium and will be analysed through the coming section of econometrical evidence. Dynamics of house prices will therefore be compared to what could be expected by the model. In this analysis I have included data for 2005, which are mostly based on 2005Q3 data collected from the same sources to give the latest status available and to see how much the most recent data suggest that the housing market is overvalued.

6.1. Price/construction costs (P/CC)

Theory - Tobin's q

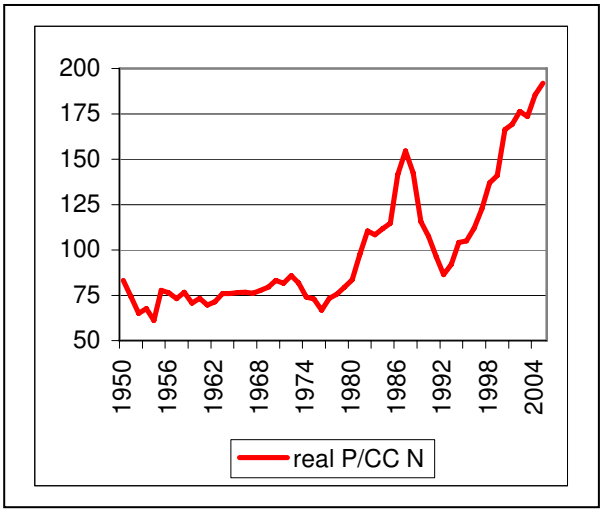
Following Tobin's q defined in the theory section then construction cost is supposed to be one of the fundamentals of the housing market. From the data below I have discovered that in contrast to Tobin's q having a fundamental level and a flat q=1 then the reality is slightly different due to the supply of land being limited from nature. If land is a scarce factor there is a possibility that equilibrium price will be above what a flat q curve can explain.



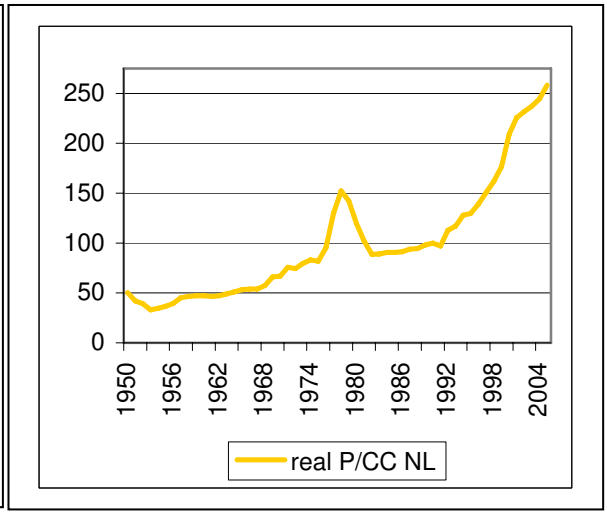
The reason is that the price of land (p^L) (included in p^{new} whereas $p^{new} = p^{cc} + p^L$) will increase relatively more under a demand shock in limited areas making p^{new} have a positive slope when the limits for further construction have been reached. If q>1 then in city areas with limited supply of land will put an upwards pressure on p^L making it less attractive to build. Econometrically it is only possible to model a parallel supply, which does create problems relating empirical data to this fundamental. At the same time then constructions costs as an approximation for p^{new} do not include p^L. It is therefore possible that even though p^H has increased then nothing is build because of increased p^g. A scarce supply of land for construction can therefore explain relative prices increases in houses to construction costs (Miles, 1994 and Summers, 1981).

P/CC

Norway, index ave. 1950-2005=100



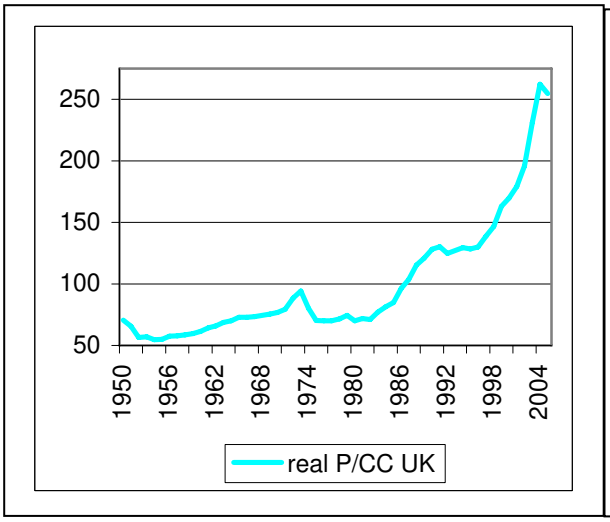
NL, index ave. 1950-2005=100



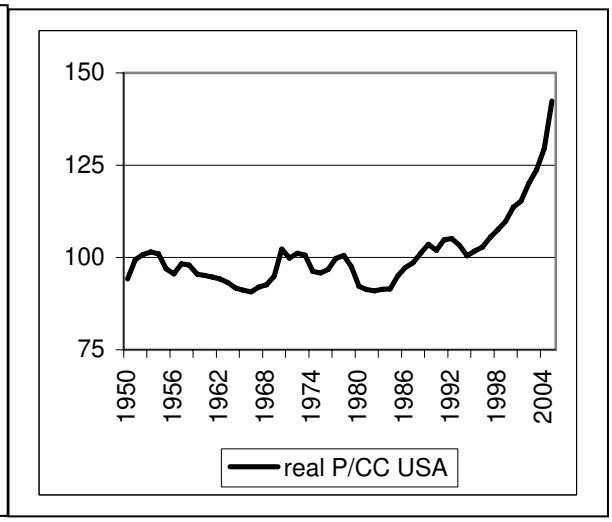
Prices have increased way above general inflation and construction index, but in the LR they are supposed to converge. When house prices increase relatively to construction costs then it becomes more attractive to build whereas demand will tend to drive construction costs upwards and re-establish equilibrium.

As seen below then the P/CC-ratio has been slightly increasing up till around 1992 in N and NL including one bubble on the way in the 1980's. Since 1993 prices have increased tremendously compared to construction costs. The latest price increase has stressed the disfunctionality of the housing market by house prices increasing dramatically, but construction of new homes decreasing (Boelhouwer, 2004), which could be strongly related to the fact that land prices have increased substantially making it less attractive to build.

UK, index ave. 1950-2005=100



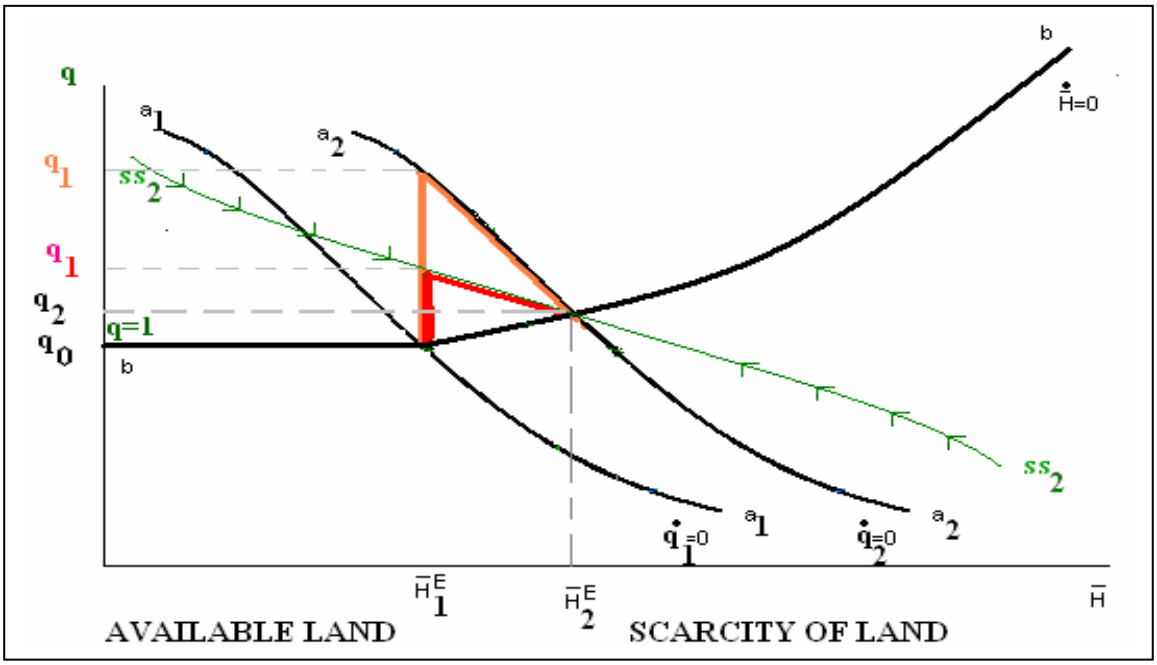
USA, index ave. 1950-2005=100



In the UK house prices have been relatively stable compared to construction costs up to mid 1980's, but afterwards prices have skyrocketed. In the US the relationship has been very stable all the way up till 1993, but again the latest decade shows a steep increase.

In total the P/CC- ratio is stable around the LR average, but the latest decade is very unusual with incredible increases in prices relative to constructions costs. This can be due to the effects coming from Tobin's q where demand in city areas having increased substantially making prices on the limited land increase whereas the more limitations on land the higher possibility of increasing prices of existing homes relative to the core construction costs, which therefore help supporting reinforcing processes during times of positive demand shocks. The analysis of this fundamental is therefore weakened substantially by P/CC not considering the fact of price of land. Over time land becomes scarcer whereas the expression for a new house prices will depend on a time variable. In this way the empirical data supports the basic Tobin's q model as long as arable land is available for construction, but Poterba's model when there is a scarcity of available land and in total the adjusted explanation of Tobin's q.

Unanticipated positive demand shock



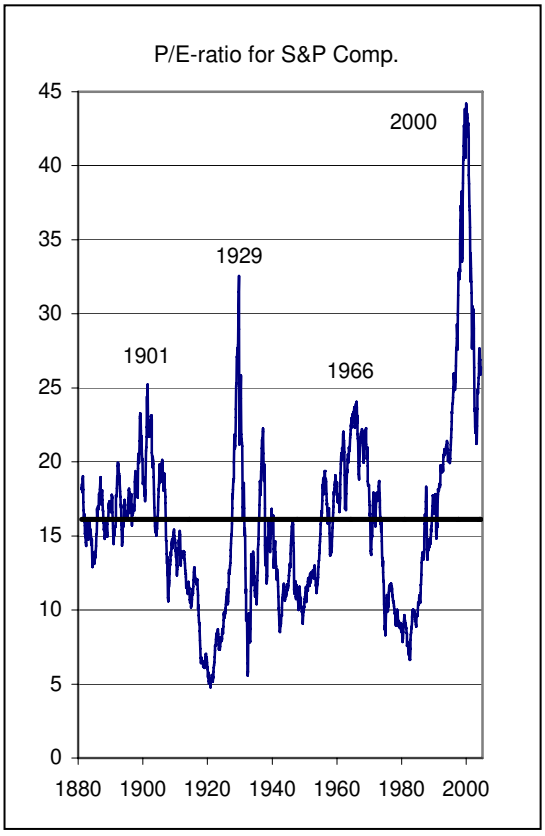
In the above figure the adjusted Tobin's q is presented being influenced by a positive demand shock showing that prices will increase if there is scarcity of available land for construction, but that a negative demand shock also will have the same effect making price volatility in scarce areas higher. If the shock occurred in the left side of the graph then prices would return to an equilibrium price (where q=1) that was identical to previous prices.

6.2. Price/rents (P/E)

Relation to share market

The 2nd fundamental of the housing market is the price earnings ratio defined as P/E, where P is price and E rent. When focusing on the P/E-ratio houses are viewed as an investment, which is meant to give payoffs. When comparing rents to prices you are thereby able to see which type of housing is supposed to be the most favourable investment on an aggregated level in the LR, because the ratio must be constant in the LR.

An introduction to this view can be done through observation of the P/E-ratio for shares. As shown in the graph P/E is mean reverting, because of returning to the LR value around 16.



Source (right): www.econ.yale.edu/~shiller/data.htm

The Greenspan Put has so far been able to keep P/E of shares over the average due to a historic low interest rate. It should be stressed that P/E-values above the historic average, gives a bad outlook for the coming years and a return with overshooting could have serious consequences. (Bordo, 2002, Debelle, 2004 and Shiller, 2001).

When focusing on house prices historically the market has been boom and bust, which is supported by several empirical findings. Compared to the mean reverting process of the share market, the housing market as shown in the graphs below seems to be more stable. Bubbles usually occur in times of credit liberalisation. There seems to be a strong tendency for 5-10 year trends (rather than waves as in a business cycle) and strong overshooting. It is remarkable that P/E of shares and houses today both are at a level, which is much higher than the historic average. (Shiller, 2001 and Smithers, 2002).

The housing market

If we turn our focus on the housing market then the historic low interest rate has given a boost to house prices. When trying to explain the strength of this variable then E has a strong tendency to grow over time because of income growth and increasing population. P grows over time too and in accordance to the increases in E. Today the P/E-ratio for houses is

extremely high, which is not sustainable according to this variable, due to the LR fact that it is mean reverting. The P/E-ratio can be brought back to equilibrium by raising E, but it will happen with a lag due to a long adjustment process. Alternatively P has to grow at a slower rate or even decrease. However P is found to be sticky, in contrast to turnover being volatile (Stephansen, 2005).

The fundamental rental value can be viewed in a formalised setup:

$$NPV_t = X_0 + \frac{X_1}{(1+r)^1} + \frac{X_2}{(1+r)^2} + \frac{X_3}{(1+r)^3} + ... + \frac{X_n}{(1+r)^n},$$

where X_0 is a negative number equal to the down payment and costs. X_n is the net amount received when the house is sold and the mortgage balance (if any) is paid off. The period from X_0 to X_{n-1} are the rent you would otherwise have to pay to live in this house minus the expenses associated with home ownership including the value of non-financial factors. In this perspective investors consider buying and renting as strict alternatives.

Theory – Tobin's q

When introducing the view from a Tobin's q perspective then in the LR where q=1 the following is equilibrium: $p^H = \frac{R(H,Y)}{v}$, where p^H is house prices $R(H,Y)$ are rent determined by housing stock and income and finally v, which is user costs.

Assuming that the user cost v is constant then p^H will only depend on $R(H,Y)$, whereas the relationship between house prices and rent is constant. The problem about this is that the housing market is not a free market and that rent control will make rents sticky, which must result in rents lagging house prices.

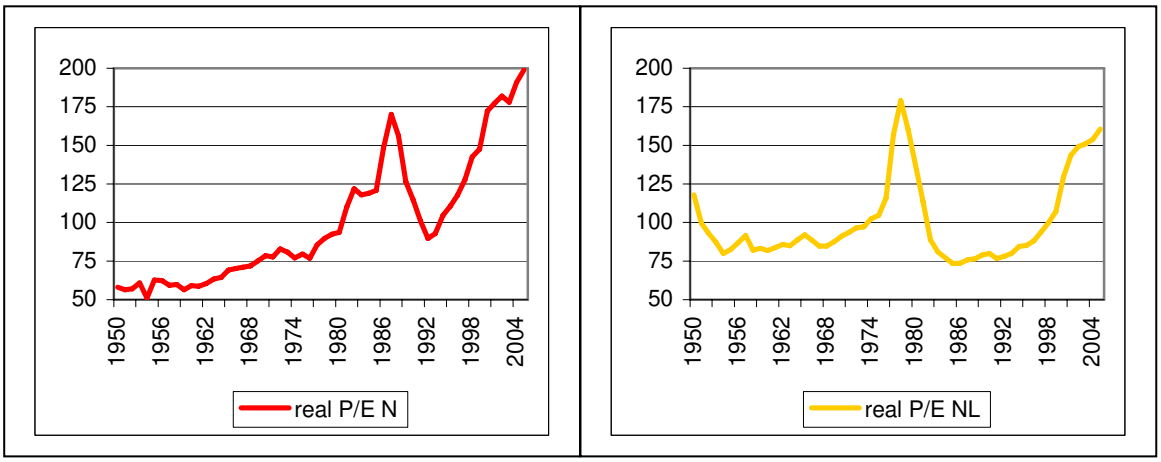
Graphical presentation of P/E

When investing then is should be remembered that the price is what you pay and value is what you get. It is very rarely that price and value are equal, whereas the alternatives as renting or construction should be taking into consideration.

The P/E-ratio for N has during the last 55 years climbed from around 50 to 200, which is a huge increase. The development over time has a clear upward trend, but with a big bubble around 1980's with a big correction down to the LR average. However, since 1992 prices have skyrocketed compared to rents, making the current P/E the highest ever.

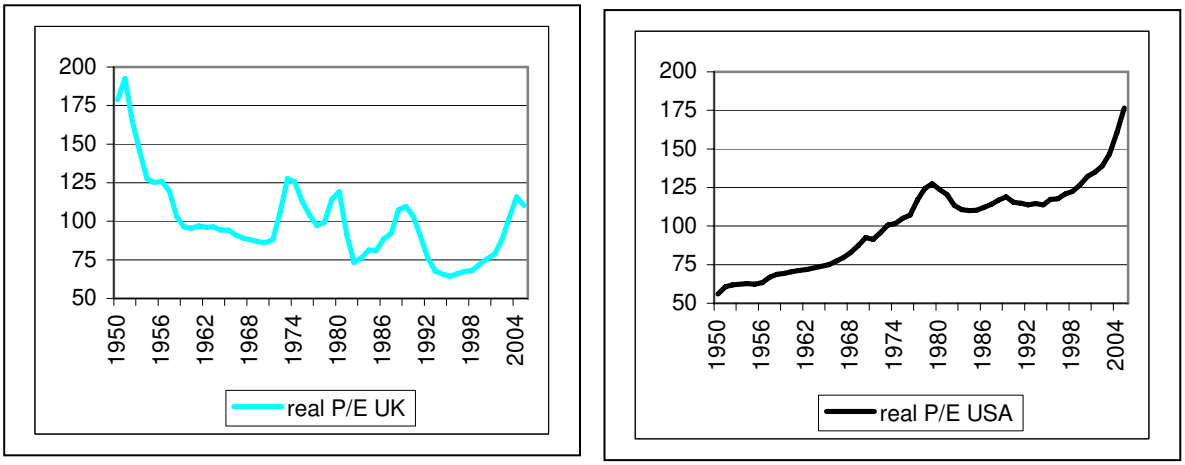
NL the relationship between price and rents are more stable and seems to be relatively constant. There are bumps on the way, especially in the late 1970's and today the ratio is again at a very high level.

Norway, index ave. 1950-2005=100 **NL, index ave. 1950-2005=100**



In The P/E-ratio for UK is relatively stable around the LR average making the relationship be seemingly constant with many bumps on the way. The current ratio is at a peak, which is similar to previous peaks in history. There is a tendency for mean reversion in the data, but also signs of overshooting.

UK, index ave. 1950-2005=100 **USA, index ave. 1950-2005=100**



In the US prices have increased much more than rents making a clear upwards-sloping curve going from 50 in 1950 to 175 today. The latest steep increases in house prices have made the ratio climb to the highest level ever. There is a strong tendency for momentum and only a slight sign of adjustment towards LR average when the boom ended in the late 1970's.

In general then NL and UK seems to be experiencing a mean reverting process in the P/E ratio, whereas N and US has been having an upwards-trending relationship for all countries the ratio has increased dramatically since 1995.

Other research

Rents are one of the fundamentals being discussed the most in academic papers. Theoretically and intuitively the relation is strong making it interesting and logical to examine.

Smith (2005) compares P/E of houses to bonds and stocks: 'Housing prices and rents are tied together by the fact that the fundamental value of a house depends on the anticipated rents, in the same way that the fundamental value of bonds and stocks depends on the present value of the cash flow from these assets. Just as with price-earnings ratios in the stock market, price-rent ratios in the housing market can rise without signalling a bubble if, for example, interest rates fall or there is an increase in the anticipated rate of growth of rents.

The increase in house prices compared to rents in the US has been confirmed by Capozza (1994) stating: 'The quality-adjusted or equilibrium component of the rent/price ratio is a valuable predictor of subsequent house price movements. The rent/price ratios are higher than predicted, subsequent appreciation rates are typically above average.' This problem will be looked at under criticism of fundamentals.

The adjustment of the P/E-ratio is found to be mainly through price changes, which is expressed by Krainer (2004): 'Most variance in P/E is due to changes in future returns and not to changes in rents that tend to remain relatively stable. This tells us that to re-establish the average level then it will probably be through house price changes.' This finding is interesting due to the fact that rent contracts in many cases are made on a LR basis and are therefore much more stable than the volatile prices. The potential households are therefore not considering the two options as perfect alternatives not making a re-establishing force in rents.

However, it is also found by Gallin (2004) that when house prices are high relative to rents, subsequent changes in real rents are larger than usual and subsequent changes in real house prices are smaller than usual rents. The main driver is still prices with a correction process of typically three-years making the process identified as mean reverting. Rents and prices appear to be co-integrated, and although the point estimates from the error-correction models show that rents and prices both correct toward each other, none of the coefficient estimates of the speed of correction were statistically significant.

A simple asset pricing model allows us to incorporate interest rates into the rent-to-price ratio. For example, Poterba (1984) suggests that, in equilibrium, homeowners equalize the marginal cost and benefit of the services derived from the housing assets they own. The marginal benefit is the real implicit rental price from the structure, while the marginal cost is the user cost of the asset. (User cost is the sum of the after-tax opportunity cost of holding the capital asset, after-tax property taxes, and depreciation and repair, minus the expected capital gain of the asset). This arbitrage condition can be expressed as:

$R_t = P_t[(1-\tau_t^y)(i+\tau_t^p)+\delta_t - E(\pi_t^H)]$, where R_t is the implicit rent of the structure, P_t is the home price index, τ_t^y is the income tax rate, i is the SR (three-month Treasury bill) interest rate, τ_t^p is the property tax rate, δ_t is the depreciation (plus repair) rate and $E(\pi_t^H)$ is the expected capital gain on the housing asset. By rearranging the equation we find an expression of the interest rate adjustment to the rent-to-price ratio:

$$\frac{R_t}{P_t} = (1-\tau_t^y)(i+\tau_t^p)+\delta_t - E(\pi_t^H) \Leftrightarrow -E(\pi_t^H) = \frac{R_t}{P_t} - [(1-\tau_t^y)(i+\tau_t^p)+\delta_t],$$

which shows that the expected home price appreciation is inversely related to the rent-to-price ratio adjusted by subtracting the interest rate and property tax rate, both on an after-tax basis, and the depreciation rate. In equilibrium, unusually low levels of the adjusted rent-to-price ratio suggest that housing market participants expect high rates of home price appreciation, which is a key ingredient of an asset bubble (McCarthy, 2004).

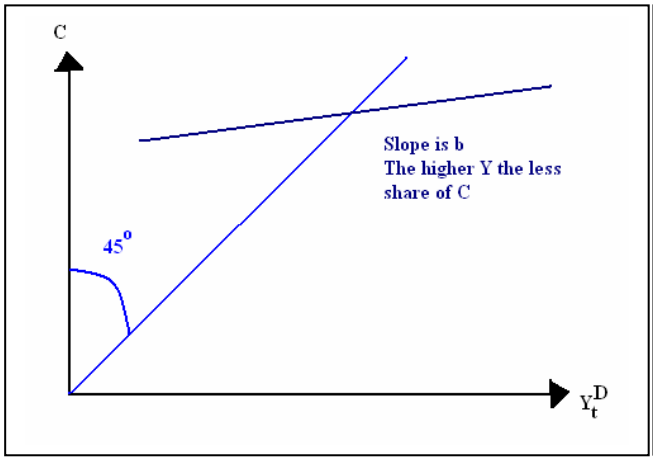
6.3. Price/income (P/Y)

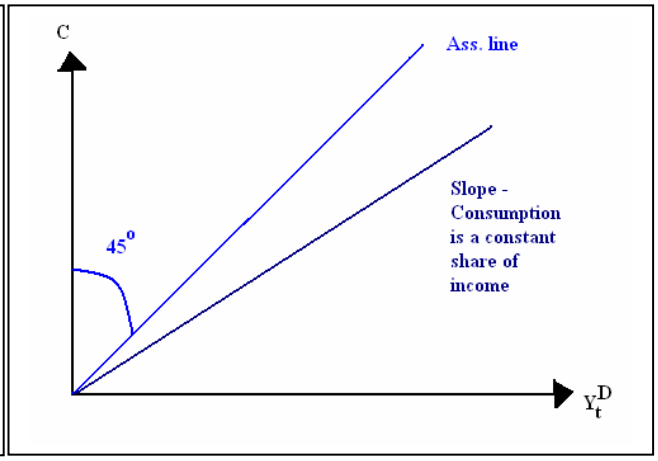
Theory - Keynes

Income is considered as a demand variable included in the expression for return on houses $R(H_t, y_t, dm_t)$. This finding is theoretically linked to the classical Keynesian theory based on the consumer's marginal propensity to consume being constant, positive and less than one and where income is the only determining variable. The following consumption function supports such:

$C_t = a + bY_t^D$, where the marginal propensity to consume is $C_t^{'} = \frac{\partial C_t}{\partial Y_t^D} = b$, where $0 < b < 1$

The average propensity to consume is decreasing in income: $\frac{C_t}{Y_t^D} = \frac{a}{Y_t^D} + b$, where increasing income means lower propensity to consume, which is illustrated below on the left.



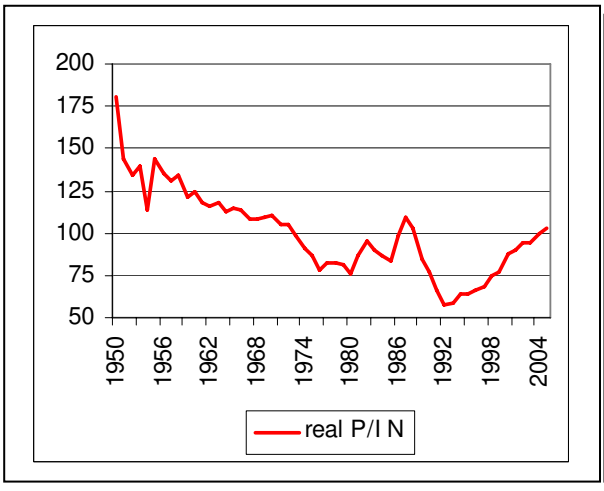


However, in contrast to Keynesian theory then macro economical studies of consumption in USA show that the average propensity to consume is constant even though income is increasing (as shown above on the right). If this tendency is transferred to the housing market then people will raise their consumption of houses the more income they have, whereas an increase in income would lead to higher demand and therefore higher prices. This finding is supported by McCarthy (2004) who suggests that house prices are highly correlated with income leading us to the third fundamental of the housing market (P/Y). The problem about the argument is that the theoretical base is not complete and that it is primarily based on empirical findings.

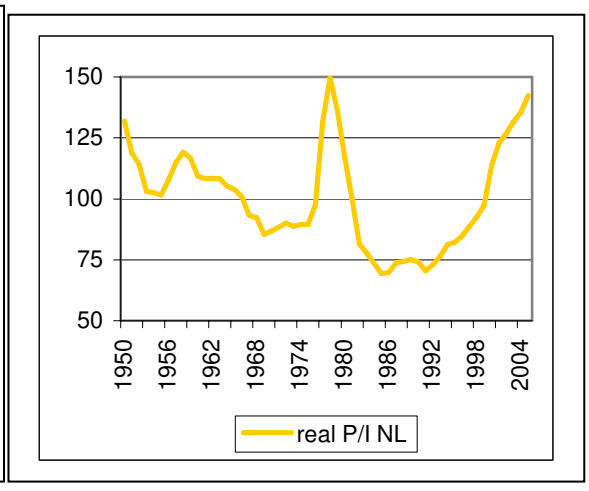
Presentation of P/Y in graphs

As an approximation for income I have used GDP per person, because it gives a broader term, which measures the growth in the economy in general by including factors as unemployment. At the same time population factors do not disturb the setup.

Norway, index ave. 1950-2005=100



NL, index ave. 1950-2005=100



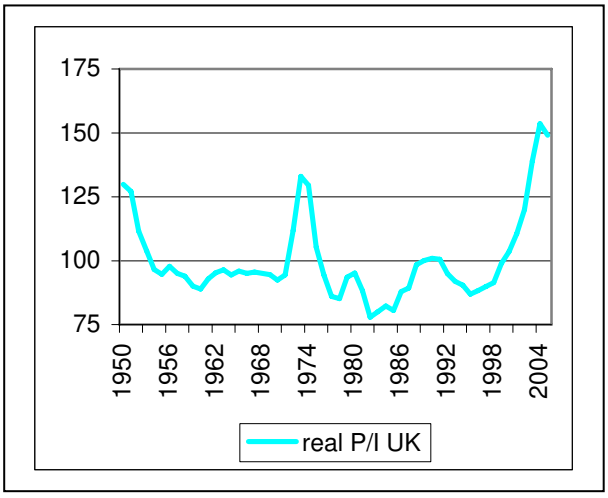
P/Y for N downwards sloping when looking at the considered data length, but if focusing on data since 1970's then the development is relatively more constant, which is supposed to be the relationship between the two variables. There are some major bumps on the way and some long trends in the series (the latest 13 years being one of them). There seem to be some mean reversion in the data, whereas there are forces that keep the relationship relatively stable.

P/Y for the NL is looking constant over the period considered. There are some large deviations from the average and the latest house price boom is one of them. It even originates from a very low level. There is a tendency for mean reversion whereas any deviation must be expected to correct towards LR average.

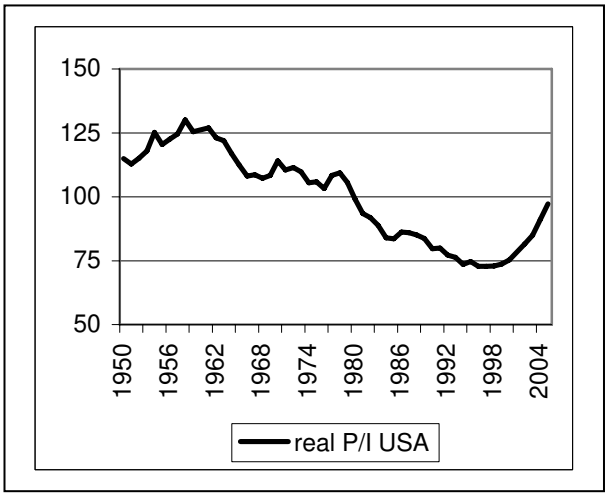
The UK P/Y is moving relatively closely around the LR average. There are some bumps on the way, but in general prices have a strong tendency to be mean reverting. The latest boom is bigger than ever before making the outlook be less favourable.

In the US the data for P/Y supports a wave like movement, which is atypical when relating it to the other markets. The deviation from LR average is however much lower and in the LR the trend seemingly flat.

UK, index ave. 1950-2005=100



USA, index ave. 1950-2005=100



In general the ratio of house prices to income has increased strongly since 1996 in all of the shown countries. There are signs of the housing market being characterised as a market of boom and bust. For NL and UK there is clear evidence that with respect to income, there in the current market exist a bubble, but for N and USA the relation seem to be more stable.

6.4. Price/demographics (P/DM)

Economic theory

The demographic variable is a demand variable, which is included in the expresses for return on houses $R(H_t, y_t, dm_t)$. To specify it more clearly then an increase in population will increase demand for houses and make an upward pressure on prices. Mankiw (1989) who has found that demographic changes could have a strong influence in both the SR and MR. Findings by DiPasquale (1994) suggest that a demographic variable should be included, but the explanation power is only in the SR. The LR price elasticity of supply will dampen off much of a change in demography.

Mixed research results

As Poterba and Miles found then the marginal house buyer is the most important driver of house prices. It is therefore important to identify the characteristics of first time buyers and as many papers find then the baby boomer generation has a major impact (Geanakoplos ,2002, 2004, Bakshi, 1994 and Krainer, 2005).

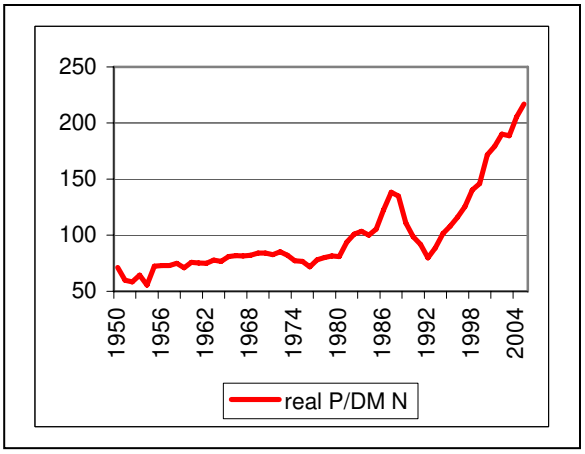
The baby boomer generation own by far largest share of the total housing market and they are approaching retirement age, which due to arguments presented by Mankiw (1989) could make people liquidating the wealth using financial tools or selling their shares and housing stock and adjusting their risk profile due to no income being generated and being depending on a stable return on investment.

However Malpezzi (1994) suggest that in the LR demographics tend to have a relatively modest effect on house prices due to the LR impact of rising demand on prices depends on the supply response. If supply is responsive to changes it will have no effect, but if supply lags then there will be an effect on prices.

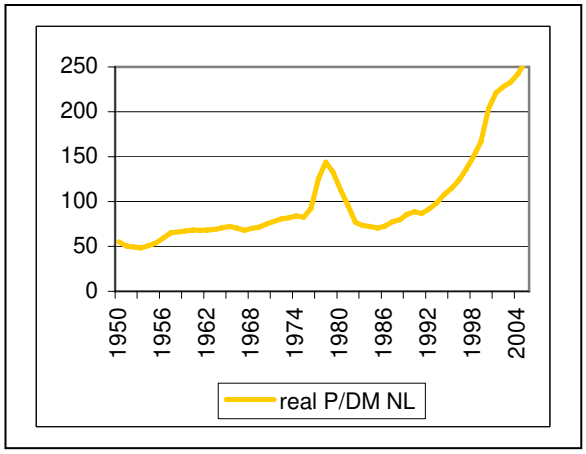
Sociological factors like improved living standards (the number of people in households falling and the space for each person increasing) through economic growth and increased owner occupier rates (28% post WWII to roughly 65% today (Scanlon, 2004)) influenced by interest relief incentives. At the same time then the quality of existing house must usually increase over time through investment and renovation, which therefore can support price increases over time.

For N and NL there is a clear upwards trend when relating house prices to the demographic fundamental. There is a bump on the way in both markets as previously explained. In general then house prices relative to demographics have been relatively stable, but from 1995 house prices increase substantially and are now at all time high.

Norway, index ave. 1950-2005=100

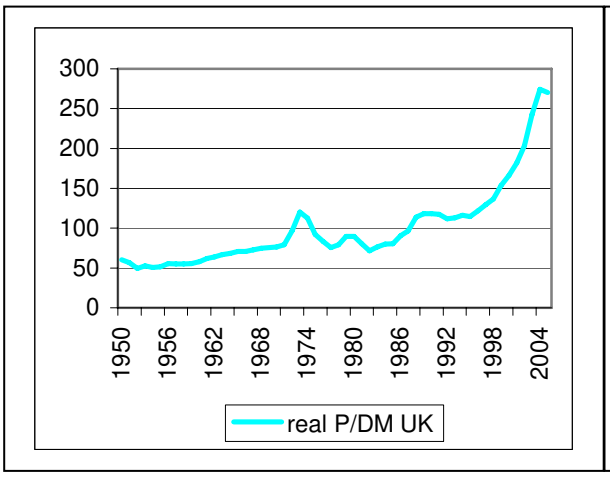


NL, index ave. 1950-2005=100

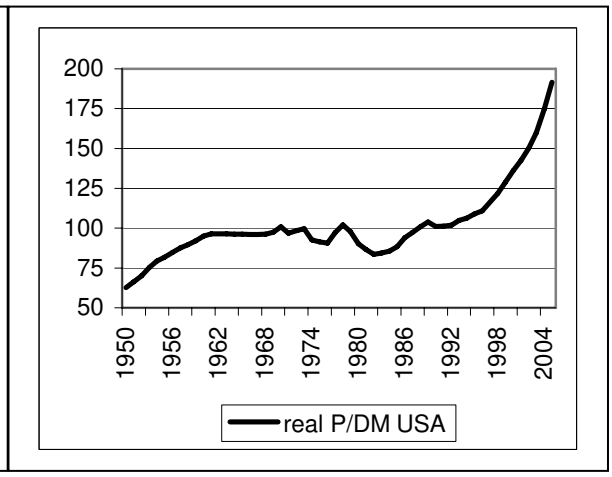


The same goes for UK and USA when relating house prices to the demographic variable. This time there is more of a tendency for a level around the long-term average in both markets for a period of 30 years where the relationship was constant, but since 1996 house prices have skyrocketed compared to the constructed variable and all countries the peak is higher than ever before and extremely high when comparing to the other fundamentals.

UK, index ave. 1950-2005=100



USA, index ave. 1950-2005=100



In total prices have been relatively stable compared to the demographic variable until 1993, but hereafter the prices increase wildly compared to demographics in all of the concerned countries. One reason could be that the marginal buyer has changed from previously being a 25-35 year old to an older person. Evidence from the Danish market shows that financial innovations has made it possible for parents to by apartments as an investment (2nd home) in larger cities as an investment (66% of all apartments sold).

7. Empirical analysis

In this section an econometrical analysis of house prices will be presented. Several researchers have found that house price movements are not following a random walk, but can (at least) partly be explained by determining variables (Malpezzi, 1999). I will use the variables that have influence on Poterba's model, which have therefore been touched upon theoretically and intuitively in the previous sections. I will therefore test to see how well the empirical LR data fits with theory.

In general Abraham's (1996) thoughts will be followed, but I will also include a demographic variable with inspiration from Mankiw (1989) and his baby boomer hypothesis, which can be considered as a demand variable. The model is constructed to estimate how well changes in house prices can be explained by main variables and specify if there exist a bubble term. A bubble is created if the cyclical house prices increase substantially more than what the other variables can explain and it is distorted if real house prices are too far away from the fundamental value.

7.1. The econometrical model

The growth rate in the real house prices at time *t* (growth rates are measured as differences of logarithms) will be explained as the house prices fundamental value p_t^* and the error term θ_t, reflecting adjustment dynamics (e.g. bubbles) as well as random order

$$\Delta \ln (p_t) = \Delta \ln (p_t^*) + \theta_t \quad (6.1)$$

The growth rate in the fundamental value of house prices at time t is constructed as a linear function of the real income (y_t), real construction costs (c_t), real rent (r_t), demographics (d_t) and real interest rate (i_t) and inflation (π_t), which will be explained in detail in the following section.

$$\Delta(p^*_t) = \beta_0+\beta_1 \Delta\ln (y_t) + \beta_2 \Delta\ln(c_t) + \beta_3 \Delta\ln (r_t) + \beta_4 \Delta(d_t) + \beta_5 \Delta(i_t) + \beta_6 \Delta(\pi_t) + \theta_t \quad (6.2)$$

The error term θ_t is specified as:

$$\theta_t = \lambda_0 + \lambda_1 \Delta \ln (p_{t-1}) + \lambda_2 [\ln (p^*_{t-1}) - \ln (p_{t-1})] + \varepsilon_t, \quad (6.3)$$

where p^*_{t-1} and p_{t-1} are respectively, the real price level in equilibrium and the actual real price level at the beginning of time t respectively. ε_t is the standardized normal distributed error term. This equation is a simplified description of the construction of a bubble. The true dynamics may be more complex, which could lead to misperceptions.

Positive (negative) growth in the actual real house prices today correlates, all else being equal, positively (negatively) with growth in the actual house prices the year before, if λ_1 is positive. A part of the growth is then transferred to the next period (perpetuate growth), which gives persistence in house prices. For a positive λ_2 the other part of the equation shows that there is a higher risk of bursting a bubble the further the actual price is greater than the equilibrium price ($p_{t-1} > p^*_{t-1}$ as for a positive bubble). It will cause a negative supply to the growth rate in the actual house prices in 7.1, because of the second part of 7.3. This also means increased risk for a bursting bubble and that the house prices will return to equilibrium.

Substituting 7.2 and 7.3 into 7.1:

$$\Delta \ln(p_t) = [\beta_0 + \lambda_0] + \beta_1 \Delta \ln(y_t) + \beta_2 \Delta \ln(c_t) + \beta_3 \Delta \ln(r_t) + \beta_4 \Delta(d_t) + \beta_5 \Delta(i_t) + \beta_6 \Delta(\pi_t) + \lambda_1 \Delta \ln(p_{t-1}) + \lambda_2 [\ln(p^*_{t-1}) - \ln(p_{t-1})] + \varepsilon_t \quad (7.4)$$

However, it is not possible to estimate the values of 7.4, because p^*_t depends on the result of the equation. The values of p^*_{t-1} from 7.4 has to be consistent with the growth rate in equilibrium prices found by 7.2. To obtain this the dynamic estimation is made by following Abraham (1996). The estimation is done through OLS. The growth rate in real house prices in each individual country will therefore be separately estimated, but the data will first be analyzed to find any special consideration that has to be adjusted for.

7.2. Variables

House prices at a certain time *t* (p_t) has been regressed against the following variables where I have been able to find LR data; income (y_t - real GDP per person), real construction costs (c_t), real rent (r_t), demographics (d_t) and a bubble seed (θ_t). It would have been optimal to include all variables from my model related to Poterba and Tobin, but it has not been possible, whereas I have chosen to simplify and leave it up to future research to include the remaining variables in user cost as investments, interest rates, depreciation and taxes.

Demand variable - Income (y_t)

Income is a demand variable that is measured by GDP per person to make the average citizen income comparable to the average price of a house. The data is indexed and has an upward trend, because of mostly positive growth rates. Income is considered as a demand variable because of the intuitive relation that higher income would lead to higher house prices

assuming that the fraction of income that is used for housing remains stable as previously explained. (Catte, 2004 and OECD, 2004).

Demand variable - Demographics (d_t)

Demographics are a demand variable that I have included to find out if the marginal consumer has an effect on house prices. I have defined the variable as the proportion of people who is expected to be first time buyers, because of the demand effect that it intuitively should give. The variable consists of the fraction of the total population who are 15-35 year olds, which is on average a 25-year-old first time buyer. In times of many potential house buyers (increasing demand) house prices would be expected to increase. The variable is indexed and is therefore relatively stable around 100. There are many different approaches to set up a variable, but first of all we will look at annual changes, which Cerny (2005) supports by stating that demand for owner occupied housing is sensitive to demographics.

User cost variable - Construction cost (c_t)

Construction costs can be seen as an approximation for maintenance. Intuitively works on the supply side as a lagged effect from demand. This variable is considered as an automatic stabilizer that drives house prices back towards the fundamental value. If real house prices are much higher than the alternative to build a house then people will start constructing their own, which will raise demand for goods and construction costs.

User cost variable - Rent (r_t)

Rent can be viewed as the opportunity cost variable, because it is the alternative to owning. It would be considered a lagged variable due the fact that rents are considered sticky compared to house price movements. The variable is considered as an automatic stabilizer that bring real house prices back to fundamentals due to the fact that if it is favourable to rent instead of own then people would start. The problem about rent as a statistical measure is that it is influenced by governmental subsidies and in some markets highly regulated to protect the interests of the renter. Quigley (2004) has found that it is possible to phase universal shelter allowance programs in carefully without driving up rents. However, it is not certain that the rental market gives the same opportunities. Quality and price follow each other and an ongoing concern is whether the renter has the incentive to renovate the house and if the landlord does so, how should the costs be shared.

User cost variable - Lagged house prices (p_t)

Lagged house prices can be considered as the capital gain on houses and the variable is included to discover if house prices are dependent on previous years. The variable is also indirectly touching issues as expectations, since investors would easily observe price information and extrapolate such into the future house price movements with adaptive expectations, whereas momentum driven house prices would be the result.

The error term - The bubble seed (θ_t)

The deviation from the saddle path to the ss line described in Poterba's model is considered the error term. This part of the equation can therefore not be explained by the variables in the model (an error term). When the error term in a period departs one sided then it is said to be creating a bubble. The bubble seed should have a mean at 0, whereas it will in the LR tend to be 0 securing that equilibrium is established. It is possible that due to the lack of data (taxes, investments and depreciation) as described earlier that the error term will be larger than it is would be if the other variables were included.

7.4. Empirical analysis

Descriptive statistics

Correlation matrixes have been calculated (on the basis of statistical Appendix E) and will be presented to confirm LR relationship between real house prices and the intuitive and theoretically approved fundamentals. For each of the markets, correlation matrix of real house prices and the depending variables will be shown: GDP per capita, real construction costs, real rent and the demographic variable.

The Norwegian correlations matrix shows that real GDP per capita is highly correlated with real house prices and that the real construction costs also seem to be correlated with real house prices. However, there is no correlation between real rent or the demographic variables and real house prices, whereas they are not LR determinants of real house prices.

N - Correlation matrix – 1935-2004

	RGDP/POP	RCC	RRENT	DM
RHP	0.80261	0.34490	-0.11536	0.01267
RHP (-1995)	0.63182	0.19142	0.030540	0.35771
RHP (1946-95)	0.80718	0.32577	-0.62449	0.47342

In NL the exact same result seems to be the case when focusing on data from 1870 and onward. However, when looking at data from 1946-1995 only, then the situation is completely different. From this year all variables are highly correlated with real house prices.

NL - Correlation matrix – 1870-2004

	RGDP/POP	RCC	RRENT	DM
RHP	0.62575	0.36687	0.49093	0.49093
RHP (-1995)	0.33081	-0.0075	0.23771	0.41519
RHP (1946-95)	0.74998	0.63356	0.62474	0.62652

United Kingdom has only data back to 1946, but here the highest correlations are again GDP pr capita and real rent. When taking out the price increases since 1995 then all variables become strongly correlated with real house prices. The US data almost replicates the findings from N where real house prices are only correlated with real GDP per capita and real construction costs.

UK - Correlation matrix – 1946-2004

	RGDP/POP	RCC	RRENT	DM
RHP	0.90487	0.22325	0.90086	0.14574
RHP (-1995)	0.91408	0.50896	0.85982	0.68494

USA - Correlation matrix – 1913-2004

	RGDP/POP	RCC	RRENT	DM
RHP	0.91919	0.89468	-0.74657	-0.42938
RHP (-1995)	0.89050	0.90249	-0.76153	-0.23904
RHP (1946-95)	0.90699	0.91664	-0.64938	0.06563

In general it is clear that GDP per capita is strongly correlated with real house prices and that real construction costs in most markets are highly correlated with real house prices, but real rent and the demographic variable are only correlating in certain markets. The reason why the demographic variable is only correlating in a few markets is due to the development since 1995, where house prices have increased and the demographic variable has decreased.

From the above analysis it can be concluded that the empirical data in general support a high correlation between real house prices and the chosen variables, with only some evidence for demographics. This finding supports the idea that the chosen fundamentals in the LR will tend to move in the same direction and thereby be interrelated and depending on each other.

Real house prices Correlation matrix 1946-2004

	N-RHP	NL-RHP	UK-RHP	USA-RHP
N-RHP	1.0000	0.83470	0.90657	0.82692
NL-RHP	0.83470	1.0000	0.88082	0.87706
UK-RHP	0.90657	0.88082	1.0000	0.86987
USA-RHP	0.82692	0.87706	0.86987	1.0000

To confirm that the housing markets are following the same pattern in the LR I have set up a correlation matrix for the considered countries. As seen in the table above then there is a very high correlation between all of the housing markets in real house prices. It is therefore very possible that the housing markets are determined by the same factors and that they roughly will move in the same trend.

Stationarity

As I presented earlier using graphs, there was graphical evidence that real house prices in the LR are constant over time and therefore a great chance of being stationary in first differences. To do so I have used an Augmented Dickey Fuller test (ADF) to test for stationary in real house prices. The reason for doing an augmented version of the DF test is because it is incorporating lagged dependent variables.

ADF without trend: $\Delta p_t = \beta_0 + \beta_1 p_{t-1} + \sum_{i=1}^{n} \beta_{i+1} \Delta p_{t-i} + \mu_t$

ADF with trend: $\Delta p_t = \beta_0 + \gamma t + \beta_1 p_{t-1} + \sum_{i=1}^{n} \beta_{i+1} \Delta p_{t-i} + \mu_t$

$H_0 : \beta_1 = 0$

$H_1 : \beta_1 < 0$

ADF (t-value) ~ DF

To find out how many lags there has to be incorporated into this setup I use AIC (Akaike Information Criterion), which justifies whether a lag should be included or not.

$AIC = \log \frac{1}{N} \sum_{i=1}^{N} e_i^2 + \frac{2K}{N}$, where $\sum_{i=1}^{N} e_i^2$ is goodness-of-fit, K the number of parameters and N the number of observations.

I have used AIC together with ACF (autocorrelation function) and PACF (partial autocorrelation function) to find the number of lags to be included when using the Dickey-Fuller test. By doing so $\mu_t = 0$ is assumed to be white noise when the lag length is specified.

The equation has been tested both with and without trend. The null hypothesis is $H_0 : \beta_1 = 0$; rejection of this hypothesis implies that p_t is I(0). A failure to reject implies that Δp_t is stationary, so p_t is I(1).

Dickey-Fuller values for each country with full data length (Appendix F)

Without	ADF (t-value)	Lags	β_1
N	-11.30**	2	-0.78599
NL	-8.918**	4	0.26939
UK	-6.544**	0	0.24177
USA	-4.983**	2	0.61044

With	ADF (t-value)	Lags	β_1
N	-11.26**	2	-0.78484
NL	-8.934**	4	0.26627
UK	-6.864**	0	0.20084
USA	-5.050**	2	0.60252

Note: Critical values can be found in Appendix F.

From the test results it can be concluded that the null hypothesis of unit roots is rejected. Real house prices in N, NL, UK and US are stationary. The lagged first differences in real house prices are stationary without a constant and trend, because of these being insignificant for all countries using the full data set. This finding supports that real house prices are constant over time. House prices are therefore not dependent on time, which makes the mean and variance independent of time as well. When a data series is stationary it will result in poor estimations and false connections when making econometrical tests. When choosing the explaining variables it will implicitly be assumed that they contain causality.

This finding stand in contrast to what others have found when researching the housing market, since they primarily only look at data from 1970 and onwards.

I have therefore included a test concerning data from 1970. For all the countries included in this test the results conveniently changes. When doing so the null hypothesis of unit roots is accepted stating that house prices are not stationary from 1970 and onwards.

Dickey-Fuller values testing 1970-2004 (Appendix F)

Without 1970-	ADF (t-value)	Lags	β_1
N	-3.148*	2	0.30047
NL	-2.531	4	0.43283
UK	-3.347*	0	0.47979
USA	-2.785	2	0.39043

With 1970-	ADF (t-value)	Lags	β_1
N	-3.286	2	0.25006
NL	-2.566	4	0.40460
UK	-3.461	0	0.44998
USA	-3.036	2	0.33778

Note: Critical values can be found in Appendix F.

Because of not wanting to test in levels, which I would have to do if the data is stationary when using the full data set, I have chosen to convert the real house price data into nominal house price data. By doing so all variables will be increasing over time. After this manoeuvre

I succeeded to get non-stationary data for all countries I have therefore decided to continue my econometrical analysis for all considered markets.

Unit-root tests - ADF test of LHP - (Constant; 5%= -2.89, 1%= -3.50)

1910 – 2004	ADF (t-value)	Lags
N	1.443	2
NL	0.6190	1
UK		
USA	1.265	0

Year – 2004	Year	ADF (t-value)	Lags
N	1822-	1.845	0
NL	1827-	0.9411	2
UK	1933-	0.7494	0
USA	1854-	2.922	0

In the following I will therefore test log nominal house prices as far back as the data that I have discovered allows me. My research will therefore stand in contrast to all other research primarily only considering the post 1970 or 1990 period.

7.5. Guideline: finding the dynamics of LR and SR dynamics of house prices

I have throughout this dissertation taken a LR view and will therefore use OLS regressions to find the variables that are theoretically supported by theory. These variables will determine the LR movements in nominal house prices. When doing such I will compare the four housing markets to see for the longest period of time available how the models respond to each other.

I have used the program Ox including the PcGive package.

First, I discovered that log nominal house prices are non-stationary making me able to get results that are statistically correct. I will therefore be able to estimate the LR determinants of the housing market on the following form:

$$\ln (p_t) = \beta_0 + \beta_1 \ln (y_t) + \beta_2 \ln (c_t) + \beta_3 \ln (r_t) + \beta_4 (d_t) + \beta_5 \ln (p_t) + \theta_t \qquad (7.1),$$

where θ_t is the error term. The statistical measures are defined in Appendix F.

When doing the OLS regressions I have excluded the variables that did not significantly explain nominal house prices. It only happened once that a variable had the wrong sign when relating it to theory whereas I chose to remove that variable and let the remaining factors explain the dynamics. The selection process was done through t-values, t-probability and partial R^2.

In the process DW test results will be uses as a guide to see how great the model is and be combined with R^2 to see the explanation power of the entire model. When running the model and finding the best fit for log nominal house prices the residuals are saved and analysed to be able to discover the deviations and what periods the model cannot explain. The error term will

be analysed through and ADF test telling if the residual is stationary or not. I have discovered that for 3 out of 4 markets that the error term is stationary and thereby considered constant in the LR. The remaining market was highly likely due to being the shortest data set and at the same time a market being well known for its volatility. The ADF tests will be backed up with graphical analysis and the fitted model will be presented and together be the basis of discovering periods where house prices cannot be explained by the theoretically supported variables.

Because of the strong results above the residuals will be used in an Error Correction Model (ECM) to determine the dynamics of SR movements (annual) in real estate. Please notice that the ECM is based on nominal house prices, because of real house prices being economically found to be giving poor results.

$\Delta \ln (p_t) = \phi_0 + \phi_1 \Delta\ln(y_{t-1}) + \phi_2 \Delta\ln(c_{t-1}) + \phi_3 \Delta\ln(r_{t-1}) + \phi_4 \Delta\ln(d_{t-1}) + \phi_5 \Delta\ln(p_{t-1}) + \theta_{t-1}$ (7.2), where the error term is supposed to be between $-1 < \theta_{t-1} < 0$, due to then being following a mean reverting process and therefore supporting the ADF test that the residual is stationary. (all the variables are lagged). I have included all the variables that theory supports as being the determining factors and by using the statistical measurements iteratively excluding the variables that did not give any explanation and thereby finding the equation and the model, which has the best explanation power of the dynamics of annual nominal house prices. Then the fitted model can be viewed towards the actual data and be compared statistically to see how well the fitted model can explain actual annual data.

7.6. Results from the estimation

NORWAY

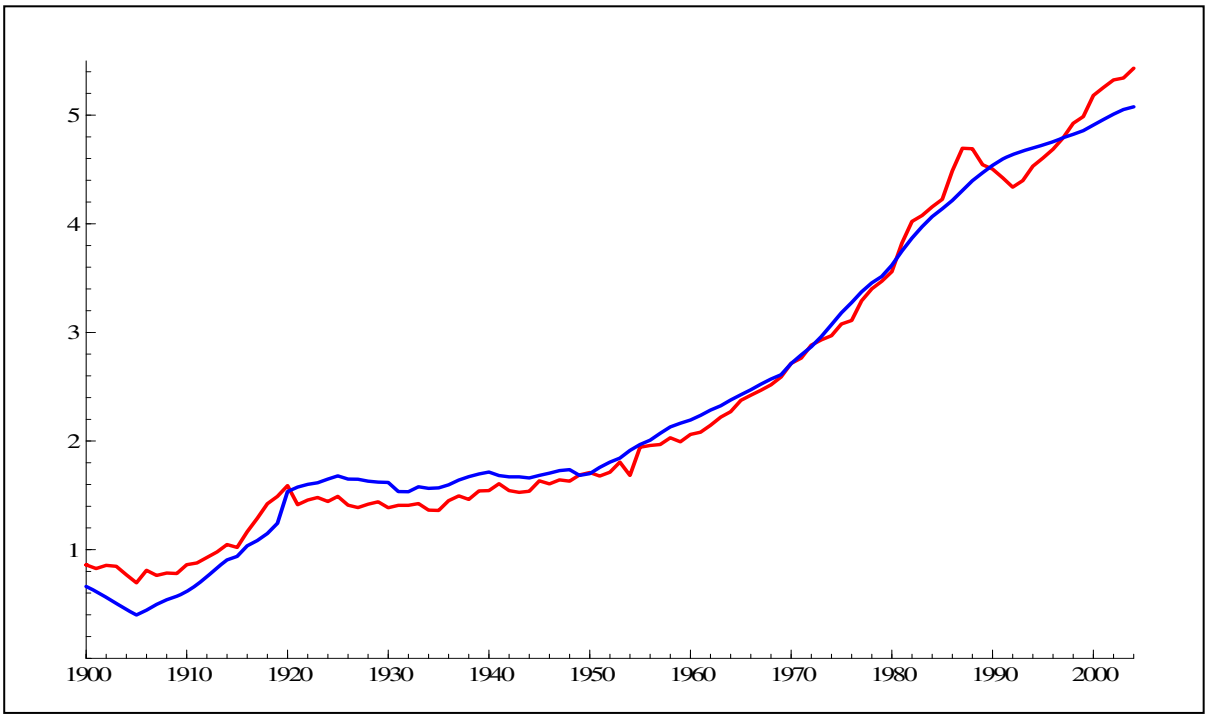
N, Modelling LHP by OLS, 1900-2004

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
Constant	-0.7138	0.1960	-3.64	0.000	0.1150
LRENT	0.9891	0.0857	11.5	0.000	0.5663
LCC	0.1924	0.0408	4.72	0.000	0.1793
R^2	0.9836		F(2,102)	3058	[0.000]**
log-likelihood	32.1976		DW		0.172
mean(LHP)	2.3915		Var(LHP)		1.9329

The LR model for the Norwegian housing market is primarily based on rent (R^2=0.57), but also construction costs (R^2=0.18) with a strong R^2 for the constant. The DW appears to be fairly low (0.17), which lowers the quality of t-values. However, R^2 is very strong (R^2=0.98), whereas the model is highly capable of explaining by the considered variables.

Graphically the empirical data (red) for the housing market fits very well (being highly co-integrated) with the model (blue) except from the early 1900, 1919, late 1980's (peak) followed by a bottom in 1992 and then it does not fit well since 1997.

N, Nominal house prices vs. fitted model, 1900-2004



To investigate into further detail the residuals will be analysed. The graph supports my finding above whereas the following unexplained periods will be combined with history to find the possible causes.

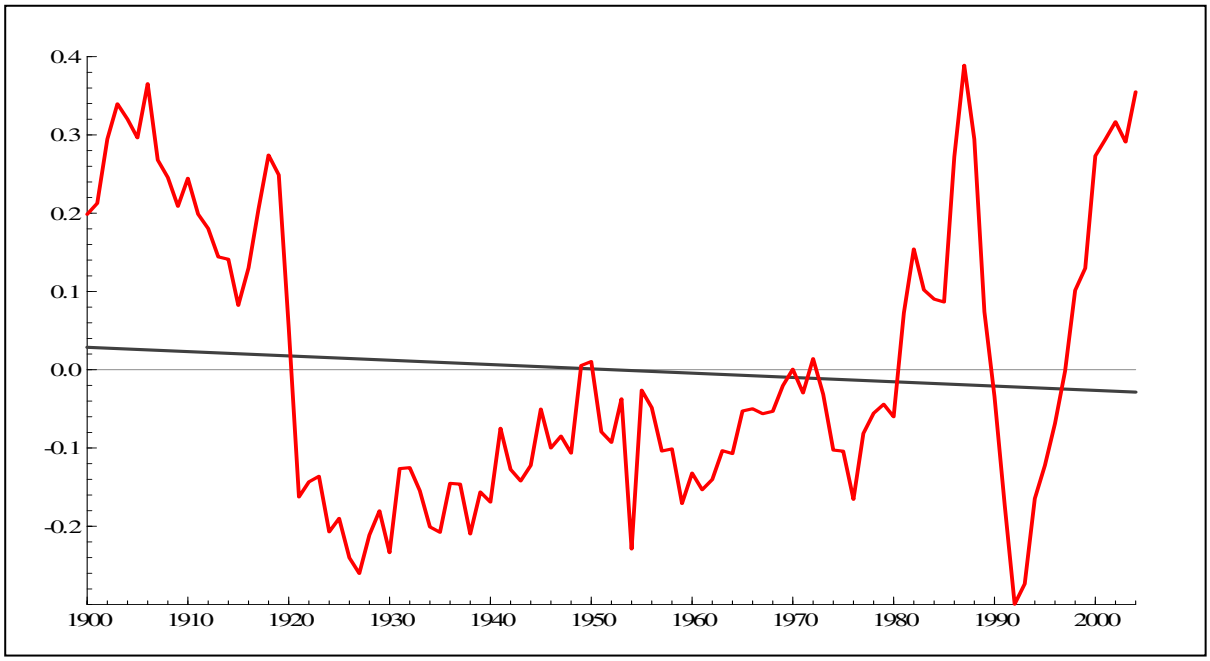
1919: Spanish flu and end of WWI, followed by Great Depression

1980's: Financial liberalisation

Current: Financial liberalisation

It is interesting to see WWII did not influence real estate in N, which perfectly fits with them not being particularly involved in the war and not being bombed or having any major casualties.

N, Residual of LHP, 1900-2004



Unit-root tests - ADF test of error term (Constant; 5%= -2.89, 1%= -3.50)

N	ADF (t-value)	Lags
1903-1995	-2.751	2
1903-2004	-2.502	0

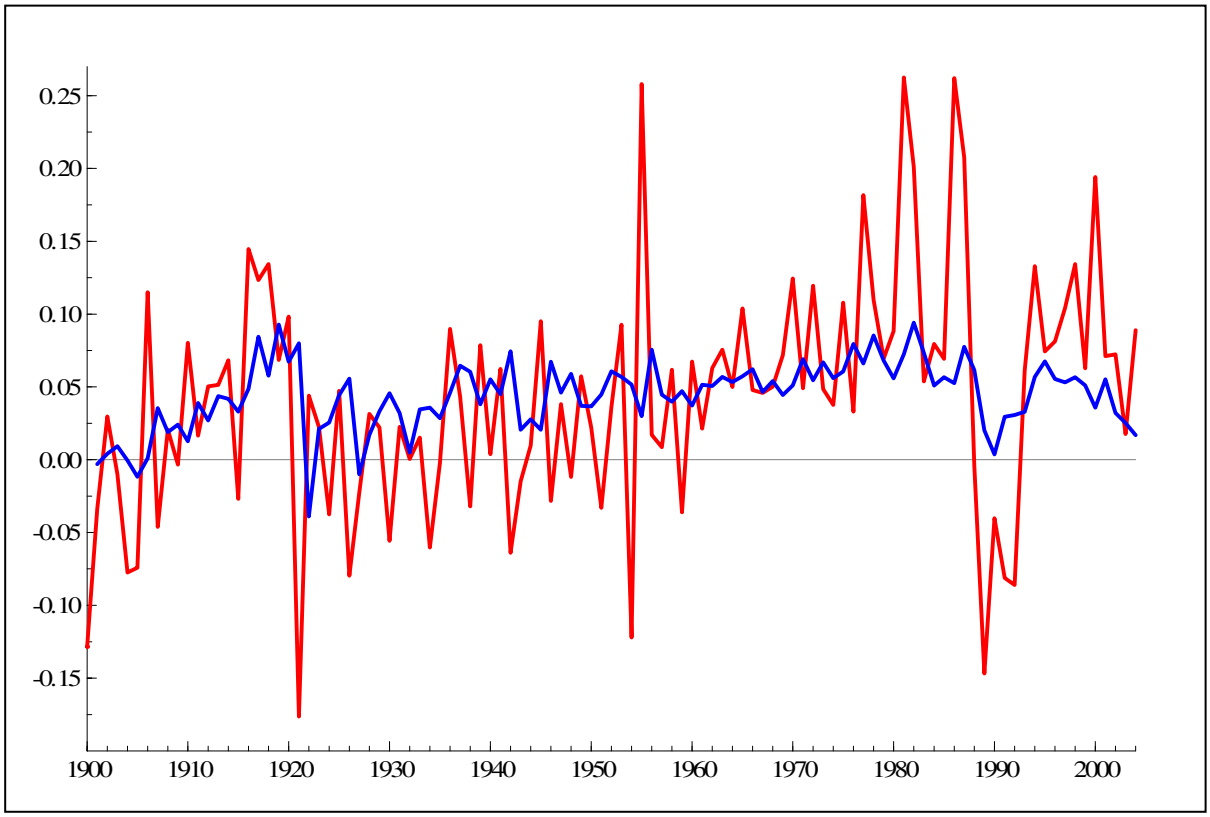
The error term is through ADF tested to be non-stationary when looking at 5% critical values, but if 10% is used instead the variable must be considered stationary. This finding is supported graphically by the trend line almost being flat and only being influenced by the pre 1920 observations. When testing for 1920-96 the residual is stationary using 1% critical values (-3.558**). The error term has therefore been identified as stationary, whereas it will move towards 0 in the LR, which makes it possible to progress to ECM.

N, ECM of DLHP by OLS, 1901-2004

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
Constant	0.0234	0.0103	2.27	0.025	0.0492
RESIDUAL_1	-0.0495	0.04455	-1.11	0.269	0.0122
DLGDP/POP_1	0.2041	0.1166	1.75	0.083	0.0297
DLHP_1	0.1791	0.1052	1.70	0.092	0.0282
R^2	0.0898		F(3,100)	3.287	[0.024]*
log-likelihood	121.462		DW		2.09
mean(LHP)	0.0440		Var(LHP)		0.0062

The ECM shows that income (R^2=0.03) is the only variable influencing the annual house prices but to a very minimal degree. Previous house prices have a similar effect, but there is no variable that has a great significant impact on house prices. DW is 2.09 making the model interdependent, which lowers the quality of the model. However, when testing different time periods DW becomes less and close to 2, but R^2 is extremely low (R^2=0.09) making the model little attractive in the SR. The residual is relatively small (but the highest of the considered markets), which makes the mean reverting take some time to before its effect is incorporated. Even though the ECM (blue) does is not explaining much it still seems to capture the overall trends in the dynamics of the housing market (red), but it is by far not as volatile as the empirical data. This could be due to the influence of the income variable making the model less volatile. Again it is obvious that the SR model cannot explain either the increases in the 1980's or the current. The huge swing in 1950s has not been identified, but wlsethe model fits well with history.

N, Nominal house price increases vs. fitted ECM, 1900-2004



THE NETHERLANDS

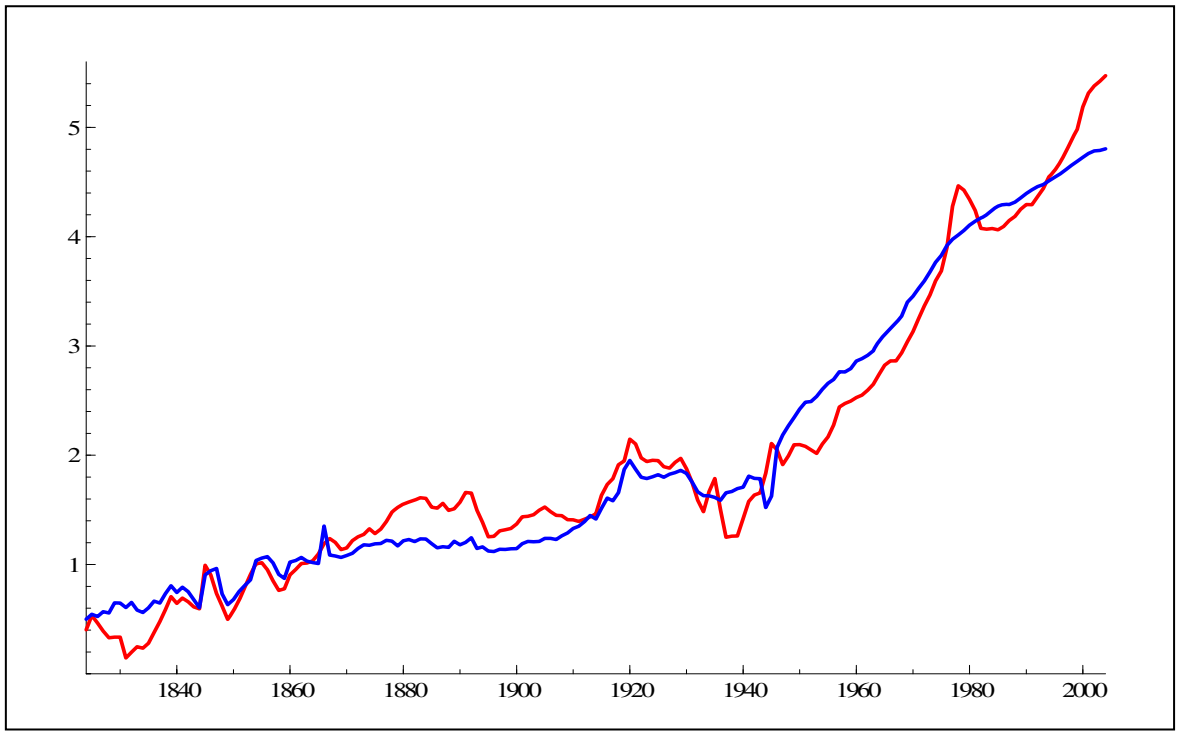
NL, Modelling LHP by OLS, 1824-2004

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
Constant	1.2656	0.0219	57.7	0.000	0.9490
LGDP/POP	0.7116	0.0106	67.3	0.000	0.9620
R^2	0.9620		DW		0.145

The model is fairly weak when looking at the Durbin Watson (DW) test only being 0.145, whereas t-values cannot be used. R^2 is however strong (R^2=0.96) strengthening the model, which purely is income based with income having a great explanation power (R^2=0.96)

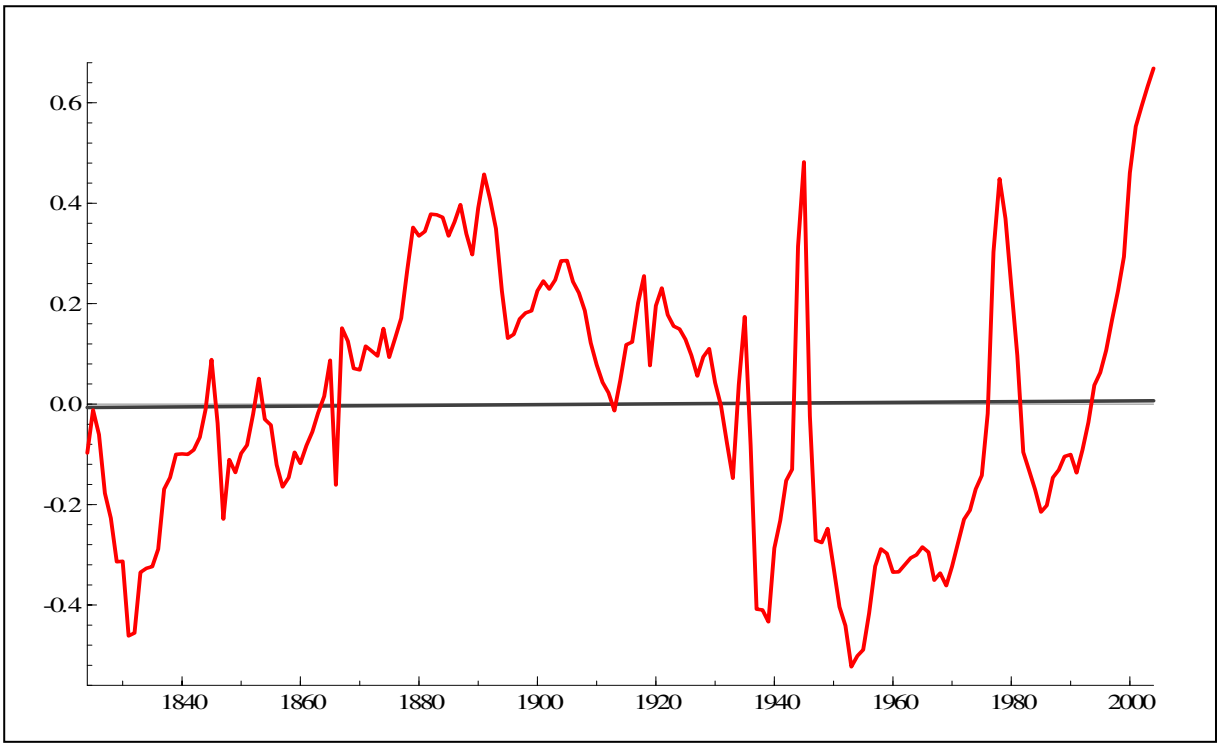
which The graph below shows log nominal house price (red) and the fitted model (blue) consisting of income and rent. The fitted model seem to move in line with the empirical data and thereby be co-integrated. There are four periods being discovered as out of line with fundamentals (the 1880's, early 1940's, late 1970's and the current situation since 1995). To identify the bubbles more clearly the error term can be analysed.

NL, Nominal house prices vs. fitted model, 1824-2004



The residuals support the above finding and they become visible and measurable, whereas especially the 1940's, 1970's and 2000 residual is large. The two former being very spiky and the return to equilibrium has been relatively quick. Combining the knowledge from the error term with the historical perspective presented earlier makes it possible to find the main driver for the error term.

NL, Residual, 1824-2004



1940's: NL was hit hard under WWII, where Germany bombed buildings to conquer the country, which gave a negative shock to supply. At the same time construction costs went up due to the high demand for labour and material, because of the war whereas prices adjusted upwards. House prices adjusted downwards with overshooting due to the huge construction programs initiated shortly after the war.

1970's: Financial liberalisation Current: Financial liberalisation

The error term has been tested for being stationary and I have found that the residual in general is non-stationary (but very close to the critical value) using critical values at 5%. However, much of the non-stationary tendency arises from the last the price increases since 1995. Several empirical researchers supports that 10% critical values give more accurate conclusions, whereas this will be used when focusing on error terms. When doing so the error term becomes stationary, which is needed for us to proceed to the ECM. This finding is supported by the trend line (being completely flat), which is inserted in graph for the residual.

Unit-root tests - ADF test of error term - (Constant; 5%= -2.88, 1%= -3.47)

NL	ADF (t-value)	Lags
1827 – 2004	-1.909	0
1827 – 1995	-2.690	0

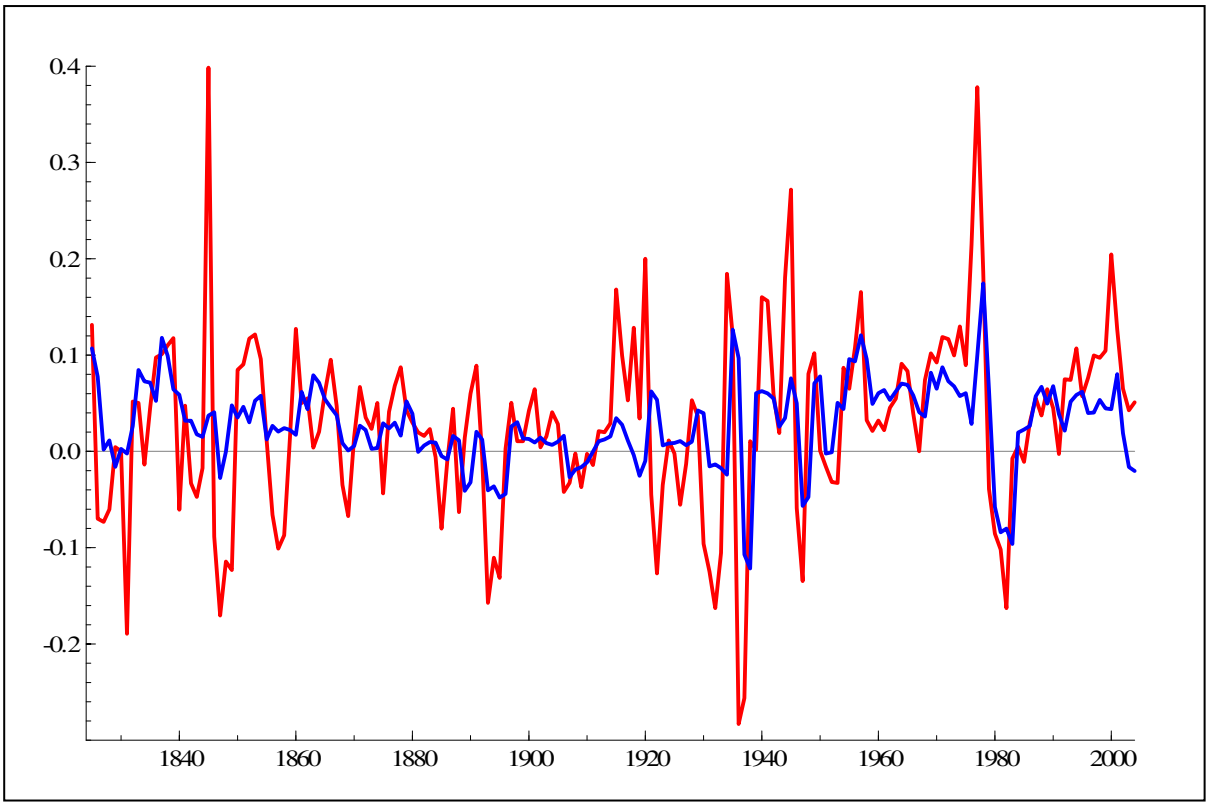
Turning to the SR I will hereby try to identify the drivers of the dynamics of the SR house prices.

NL, ECM of DLHP by OLS, 1825-2004

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
Constant	0.0226	0.0064	3.55	0.001	0.0663
DLHP_1	0.5647	0.0875	6.45	0.000	0.1904
RESIDUAL_1	-0.0924	0.0258	-3.58	0.000	0.0675
R^2	0.2083		DW		1.57

In the SR previous house prices is the only factor having influence (R^2=0.19) and none of the theoretically supported variables explains the SR movements. The negative residual (-0.09) tells that house prices are mean reverting, but also that it would take a long time to adjust.

NL, Annual nominal house prices vs. fitted ECM, 1824-2004



Together these to findings are therefore crucial in the understanding of the SR dynamics of house prices. Adaptive expectation will support the SR movements. The market will therefore be highly influenced by backwards looking agents who would extrapolate previous price changes into the future. The agent's behaviour can therefore initiate reinforcing processes, which builds up momentum. At some point house prices will have to adjust towards the LR path and let the LR determinants rule (fundamentals), but could according to the model take years. The further away from fundamentals and the more years of deviation, the more likely a return is.

To see how well the SR model (blue) fits the data (red) I have printed the development in the graph above. The fitted model seems not to be as volatile as the empirical data, but it does capture the general trends except from the bubbles as previously mentioned. It is obvious that the model does not capture the big increases around 1940's, 1970's and the current. Besides that the time of WWI results in the nominal house price to increase more than supported, but terminated by the Spanish Flu and end of WWI in 1918. The price swings in the 1840's however remains unexplained.

UNITED KINGDOM

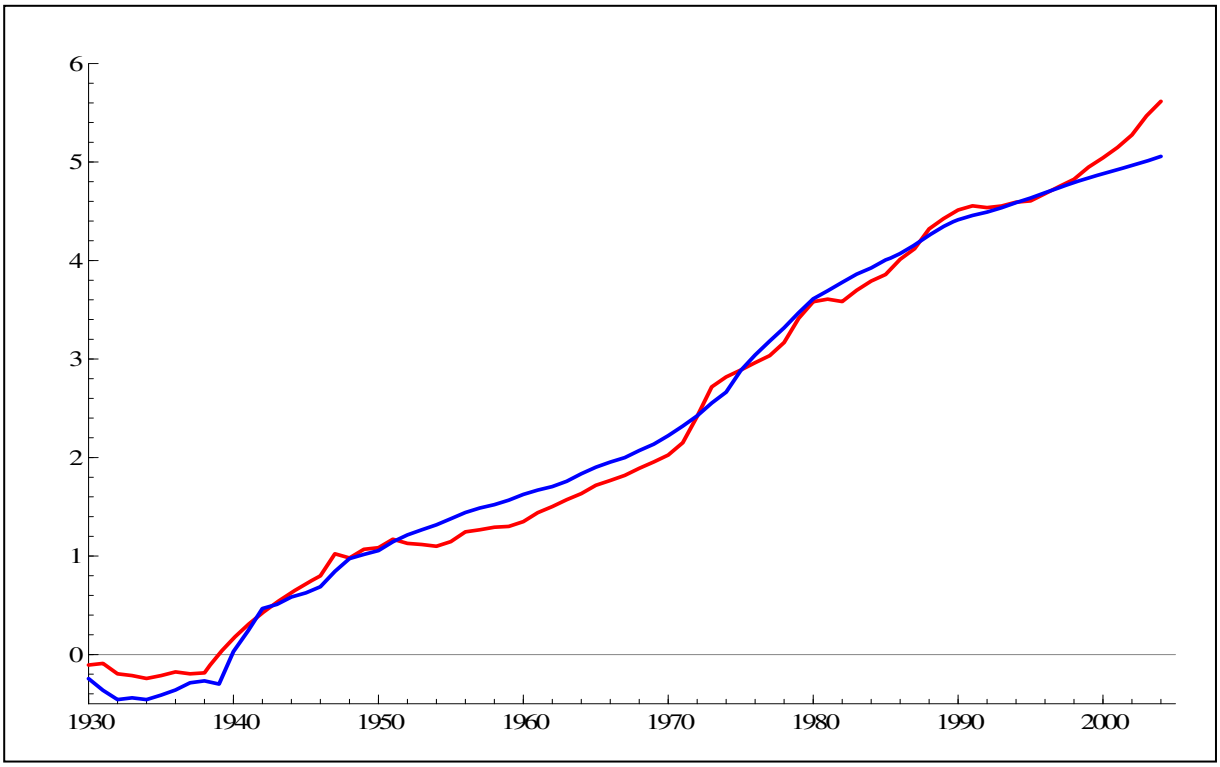
UK, Modelling LHP by OLS, 1930-2004

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
Constant	0.3920	0.0303	12.9	0.000	0.6965
LGDP/POP	0.9211	0.0107	86.1	0.000	0.9903
R^2	0.9903		F(1,73)	7416	[0.000]**
log-likelihood	24.1312		DW		0.169
mean(LHP)	2.3095		Var(LHP)		3.1560

The overall model concerning real estate in nominal prices for UK presented above shows that income (R^2=0.99) is a very strong driver in the LR. DW is low (0.17) weakening the results, but R^2 is high (R^2=0.99), which strengthens the model.

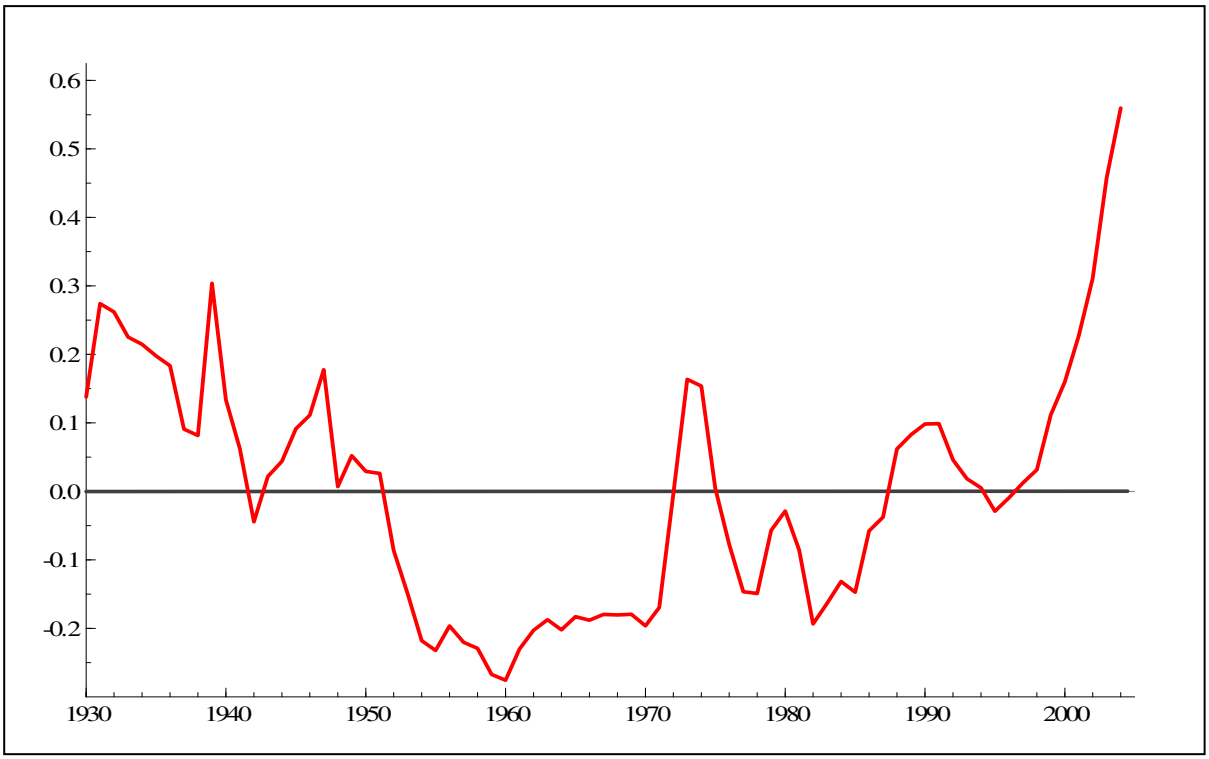
As seen in the graph above then nominal house prices (red) and the estimated model (blue) seems to fit in general and thereby tend to be co-integrated, but some with some bumps in the 1930-40's, 1970-1990's and the today. These findings will be observed in more details by looking at the error term. The 1950's being explained by the huge reconstruction programs followed after WWII.

UK, Nominal house prices vs. fitted model, 1942-2004



From the graph below it becomes evident that there has been at least three in broad term discussed bubbles in recent history of UK real estate (the reason for UK known as a bubble country) and maybe even four if the price increase of the late 1980's is included. The current error term is however, far above all previous peaks.

UK, Residual of LHP, 1930-2004



1930's:	Recovery from GD	1940's:	WWII
1970's:	Financial liberalisation	Late 1980's:	Financial liberalisation
Current:	Financial liberalisation		

I have tested the error term for being stationary. The ADF test appears with non-stationary even when using the 10% critical values. This can be due to the UK housing market only being looked at in short period (the shortest of the four countries considered and that the UK market is well known for being a country with many periods of price increases and decreases (volatile). When looking at the trend line in the graph (completely flat) it is likely that the error term is 0 in the LR. When the latest period from 1999 is taken out the results changes whereas the data will be considered. non-stationary and I will therefore continue to ECM and thereby be able to compare all of the countries.

If the ADF test is based on 1940-1998 the residual will be considered stationary using 5% critical values (-3.008*). ADF test is therefore highly depending on the period considered.

Unit-root tests - ADF test of error term (Constant; 5%= -2.91, 1%= -3.54)

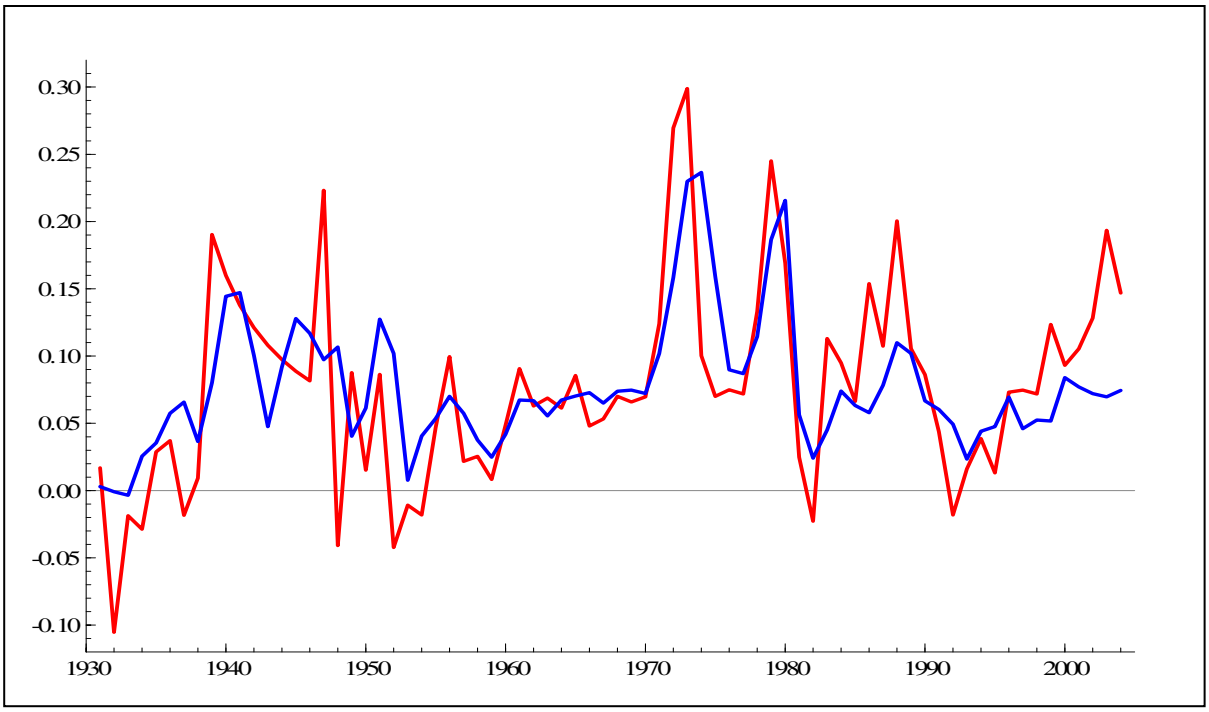
1933 – 2004	ADF (t-value)	Lags
UK	-1.180	2

UK, ECM of DLHP by OLS, 1932-2004

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
Constant	0.0380	0.0111	3.43	0.001	0.1442
DLHP_1	0.5185	0.1046	4.96	0.000	0.2599
RESIDUAL_1	-0.0624	0.04669	-1.34	0.186	0.0249
R^2	0.2614		F(2,70)	12.39	[0.000]**
log-likelihood	106.838		DW		1.68
mean(LHP)	0.0782		Var(LHP)		0.0054

The ECM has a great DW (1.68) and reasonable R^2=0.26 giving us a model that can partly explain SR fluctuations. Previous house price has some (R^2=0.26) explanation power, whereas the model gives reasons for momentum in the SR driven by adaptive expectations, which therefore will create herding behaviour in the market and initiate reinforcing effects. In the LR however the model supports mean reversion (which is slow due to Residual being -0.06) and thereafter being mainly driven by the fundamentals found to be income.

UK, Annual house price increases vs. fitted ECM, 1943-2004



The graph above shows that the model (blue) captures the volatility of the housing market and that it fits well with the general tendencies of the market (red). It should be stressed that the periods of price decreases are 1930-31 (Great Depression) and the periods of 1940's, early and late 1970's, 1980's and the current are the discovered bubbles in the UK housing market. The fitted SR model based on previous house prices is great at explaining the whole period, except from the after 1999 period.

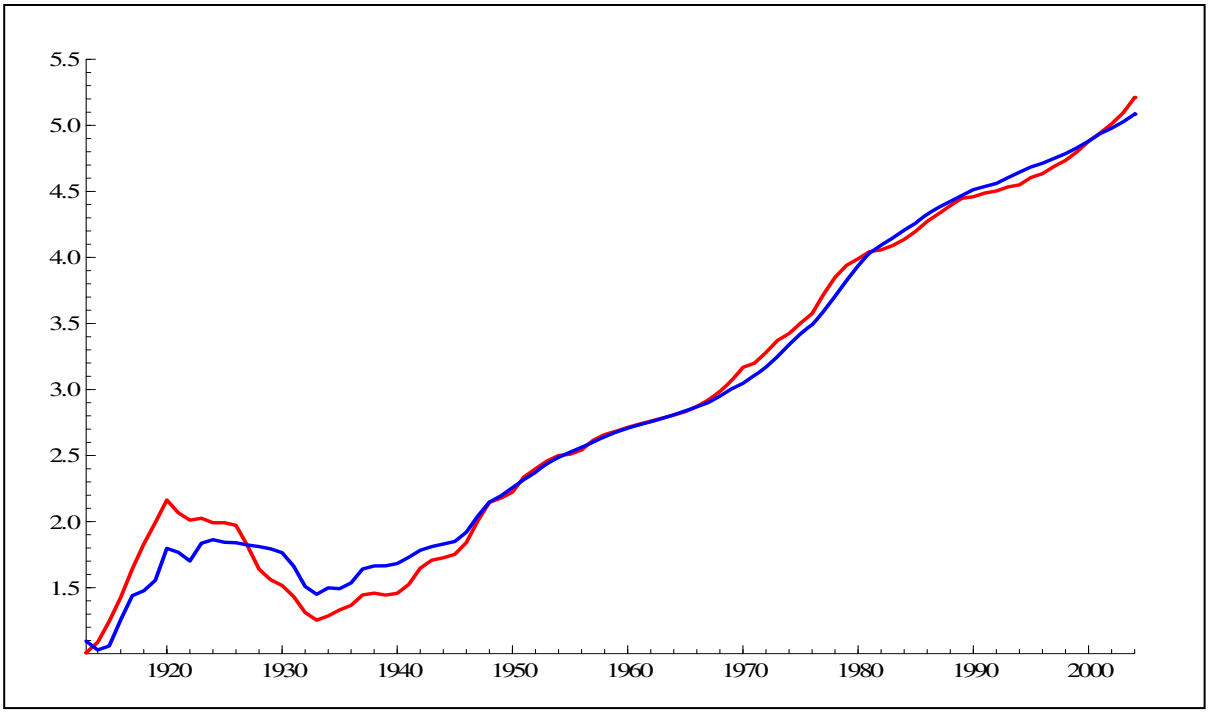
USA

In the LR the US nominal house prices has been found to be dependent on construction costs (R^2=0.74) and rent (R^2=0.55). DW is small (0.12) and therefore not supporting the model, but R^2 is extremely high (0.99) making the explanation power strong.

USA, Modelling LHP by OLS, 1913-2004

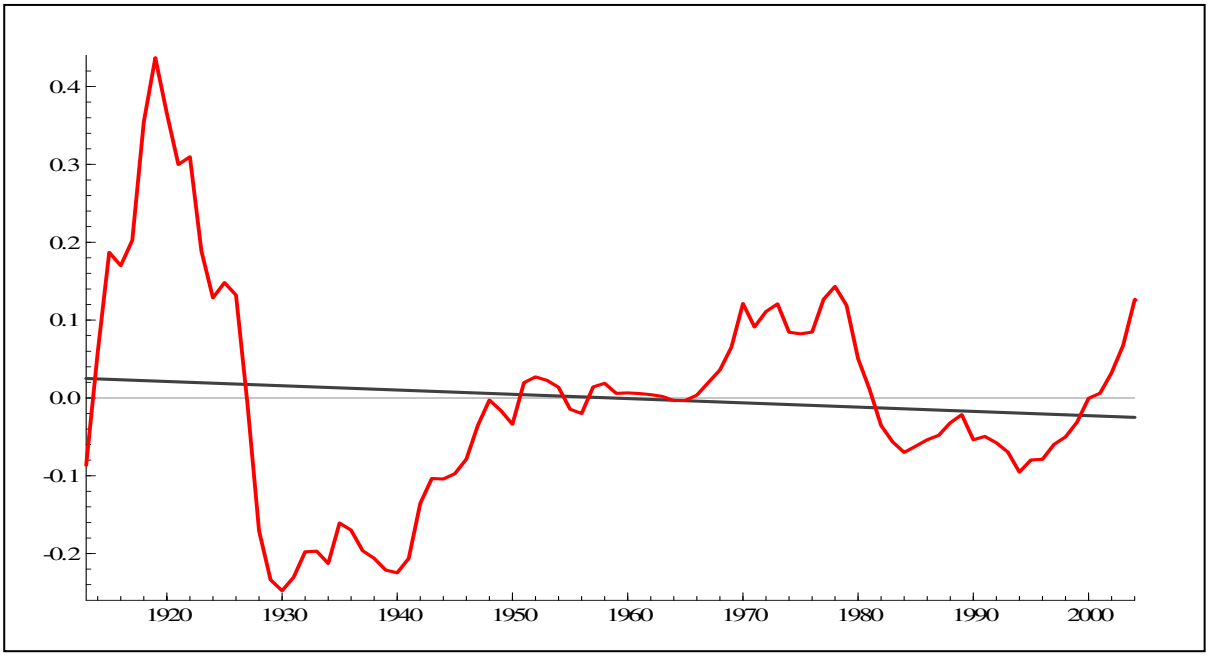
	Coefficient	Std.Error	t-value	t-prob	Part.R^2
Constant	-1.0153	0.1299	-7.82	0.000	0.4071
LCC	0.5696	0.0354	16.1	0.000	0.7446
LRENT	0.6681	0.0638	10.5	0.000	0.5521
R^2	0.9873		F(2,89)	3471	[0.000]**
log-likelihood	52.5707		DW		0.115
mean(LHP)	2.8570		Var(LHP)		1.4752

USA, Nominal house prices vs. fitted model, 1913-2004



From the graph above the development in nominal house prices (red) are strongly moving in the same pattern whereas the fitted model (blue) and thereby co-integrated. The only major period of non-explained increases seem to be around 1919 and the current one, but to identify such periods the residuals will be used. Below it is seen that the error term shows that there have been a few periods of price increases on the way. The first is in 1919 and then ending up in a drop in the late 1920's, but being influenced by fluctuating data. The current price increases have therefore been the period that can be explained the least by the fundamentals.

USA, Residuals for LHP, 1913-2004



1919: Spanish Flu and end of WWI

1920's: Financial liberalisation made easy access to credit, which fuelled the consumer driven economy and created a laissez-faire system of finance. This lead to speculation, which encouraged a boom in house prices followed by a farming crisis initiating the GD. Afterwards credit availability was tightened, because of bad loans initiating a reinforcing process, which resulted in a liquidity crisis leading up to the banking panic of 1933.

1970's: Financial liberalisation

Current: Financial liberalisation

USA, Unit-root tests - ADF test of error term (T=89, Constant; 5%=-2.89 1%=-3.50)

USA	ADF (t-value)	Lags
1916-2000	-1.731	0
1916-2004	-1.630	0

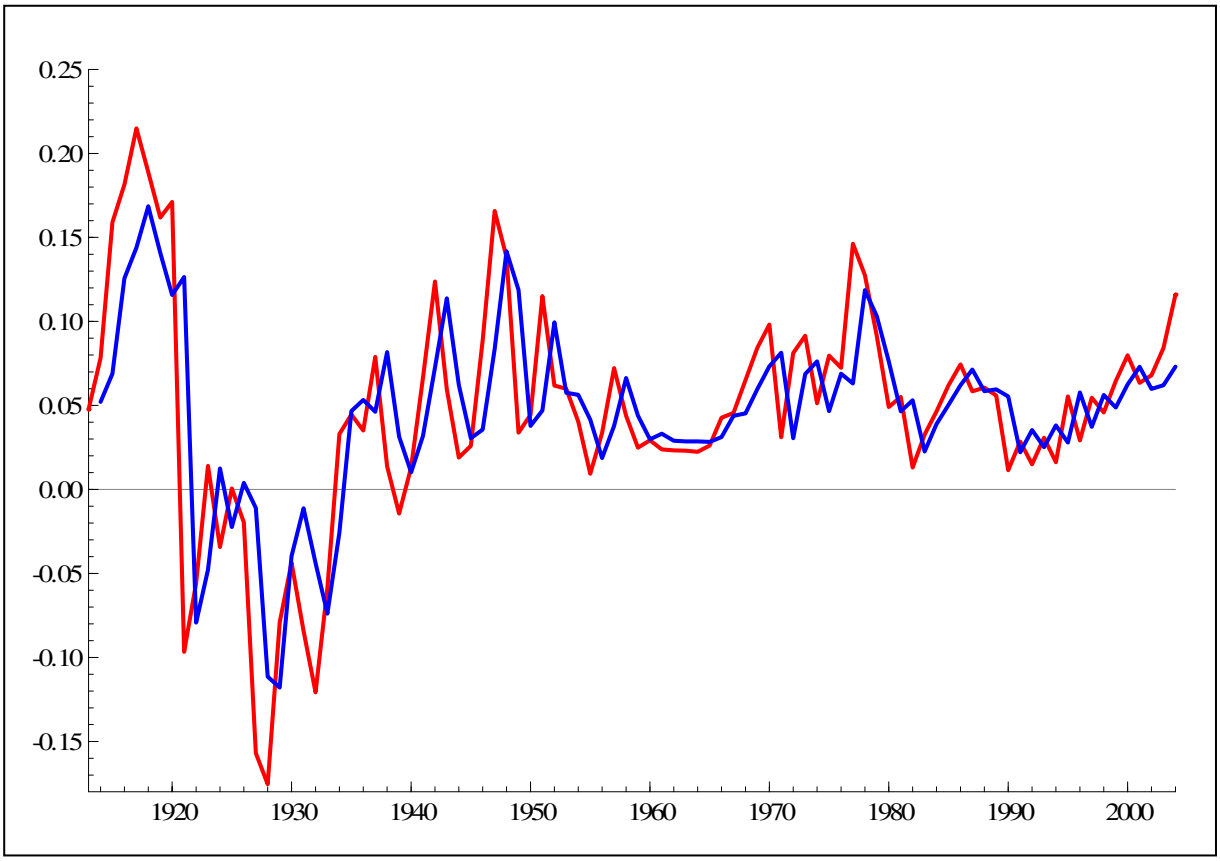
ADF show the error term as non-stationary at both 5% and 10%. However the above graph (the trend line is relatively flat) supports that the error term should be 0 in the LR, which makes it possible to make the ECM. Especially when looking closer at the ADF test, where a test from 1923-2003 shows that the residual is stationary at 5% critical value (ADF: -3.080*).

USA, ECM of DLHP by OLS, 1914-2004

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
Constant	0.0107	0.0061	1.75	0.084	0.0334
DLHP_1	0.7803	0.08046	9.70	0.000	0.5166
RESIDUAL_1	-0.0485	0.0397	-1.22	0.225	0.0167
R^2	0.5449		F(2,88)	52.67	[0.000]**
log-likelihood	151.524		DW		1.89
mean(LHP)	0.0462		Var(LHP)		0.0046

DW test is almost 2 (1.89) indicating that the model is strong and R^2 is 0.54, which makes the model explain a decent part of the dynamics of house prices. The ECM shows that the change in nominal house prices is mostly depending on previous house price changes (R^2=0.52). The residual is negative and relatively small (-0.05) telling that there is a mean reverting process, but that it will take a long time to adjust according to fundamentals.

USA, Annual nominal house prices vs. fitted ECM, 1914-2004



The graph above shows how well the ECM (blue) fits the annual nominal house price changes (red). The ECM is almost identical, but not quite as volatile as what can be observed in the data. There are four periods where the model does not perfectly fit the dynamics: 1918, 1929, 1970's and the current.

7.7. Comparative analysis

This analysis was based on annual data making the perspective of house price data on SR movements in the housing market. The results from the estimations in general give significant variables with the expected signs.

Comparative analysis: LR explaining variables

Country	Variable	Variable
NL	Income (0.96)	
N	Rent (0.57)	Construction costs (0.18)
UK	Income (0.99)	
USA	Rent (0.55)	Construction costs (0.74)

In the LR income has a very strong explanation power if present. Alternatively rent and construction costs gives good explanation for the remaining markets. Three of the four fundamentals are therefore highly supported by the LR data presented here, whereas demographics must be minor.

Comparative analysis: SR explaining variables and residual

Country	Variable	Variable	Residual
NL	Previous house prices (0.19)		(-0.09)
N	Previous house prices (0.03)	Income (0.03)	(-0.05)
UK	Previous house prices (0.26)		(-0.06)
USA	Previous house prices (0.52)		(-0.05)

In the SR none of the variables are present as an explaining factor (income only slightly in one country). Instead previous house prices are present as explaining factor for all countries, which make the results stronger. It is also supported by the residual being small and negative around the same size whereas the features for all markets can be considered similar. It is therefore presented that in the SR house prices are as far as presented here only influenced by previous house prices. There is a strong tendency for momentum driven prices that at some point will have to adjust back to what LR fundamentals can sustain. This process is however proved pinpointed to be slow.

7.8 Empirical results in a historical perspective

By relating the periods where the unexplained residual is large and with fluctuations I have searched for explaining reason for both the price increases and what made prices drop afterwards. The error term can due to the definition made previously and combined with the practical view then be viewed as boom and busts also known in its fairly popular expression as bubbles, which was defined earlier.

As the table below presents then I have identified 23 house price bubbles in my data. 6 of these are related to wars with different ways of influencing the pricing of houses and 3 of them is because of a deadly illness spreading quickly world wide combined with war. If these 9 bubbles are excluded and instead be considered as special occasions due to them being very rare, then the remaining 14 price bubbles should be thoroughly investigated. One of these is a price boom due to the removal of taxes on land making it more attractive to possess land and

property. The remaining 13 (93%) house price bubbles can all be related to financial liberalization and if the GD excluded as a special consideration 9/10 (90%).

Historical overview of price increases and decreases

	NL	N	UK	USA
1630's	FL, Tulipmania			
1650- 80's	3: Wars			
1715-30's	War			
1880-90's		Tax		
1918-19	Pandemic, WWI	Pandemic, WWI		Pandemic, WWI
1920's	FL, GD	FL, GD	FL, GD	FL, GD
1940's	WWII		WWII	
1970's	FL		2 FL: Early and late	FL
1980's		FL	FL	
Current	FL	FL	FL	FL

Turning back to the wars making bubbles in real estate there is an interesting finding, because the impact of wars has changed. In Netherlands from 1650-1680 there were 3 wars between Netherlands and England named the 1st (1652-54), 2nd (1665-67) and 3rd (1672-78) Anglo-Dutch wars and originated as conflicts because of trade. During periods of peace certainty ruled whereas house prices increased, but when wars arose insecurity and uncertainty made house prices decrease. The same effect can be seen in the data for 1715-30 where the European war again made prices decline together with decreasing credit.

In the more recent history there has been two major wars, where prices decreased right after the wars ended and typically increased during. WWI ended in 1918, but at the same time a pandemic crisis occurred from which 50-100 million died (primarily young) of H1N1 (Spanish Flu), which is an influenza virus, similar to the bird flu today (H5N1). It spread quickly to the rest of the world and by 1919 nearly one billion people throughout the world had become infected (world population was 1.8 billion). I will therefore highly expect this bubble to be demand side related.

WWII is more clearly observed as negative supply shock, because it only exists in NL and UK, which were the countries being hit the hardest by German forces. The decrease in supply due to bombs and demolishment made prices increase and the post war price decreases can be related to the huge reconstruction program that occurred.

Taxes have only once had a visible impact on house prices, which was in N during 1880's and 1890's. Norway was under Swedish occupation but was starting to get more influence before its final independence in 1905. A tax reform removed a 30% remission on land taxes, which would make it more attractive to own land and property.

When it comes to financial liberalisation the first known bubble is as previously argued the pre tulipmania bubble in Holland in the 1630's, where both the initiation and the halt was the reason for the fluctuations volatile prices. The next major financial liberalisation I have discovered is in the late 1920's, which ended when entering the Great Depression again with financial aspects having severe effects on borrowing. During the 1970's and 1980's I have identified 6 bubbles related to financial liberalisation and if they are not reversed or limited then economic growth and income will lead to the same effects on banks credit willingness. In fact the only type of bubble in the post WWII period has been bubbles related to financial liberalisation.

When analyzing the current house price increases it has become evident that prices are now above what fundamentals can sustain and that the latest decade has been highly influenced by financial innovation and liberalisation. It is therefore highly likely that the markets will experience a peak when the reality is discovered. For the first time there would then be an international housing bubble all caused by the same factor.

7.9. Discussion

Intuitive variables such as income, rent and construction costs were the variables represented the most important explanatory factors giving an idea that the same fundamentals do exist for all of the markets considered. There are however local differences in the respective importance of the variables in the determination, and their influence on changes of house prices.

This model specified here does not give theoretical insight in time lags as how long time it will take for construction costs and rent to adjust to changes in house prices. It is problematic that the previous real estate changes have such a great explanatory power in the SR, because it makes it impossible to explain house price movements in the SR. However, it does also say that static expectations could have an influence in the market and that herding behaviour is highly possible, which results in overshooting.

In all countries the credit growth led to price increases that were reinforced by adaptive expectations among people leading to speculation in a fundamentally overpriced asset whereas herding was the result. The size of the bubble is related to the inelasticity of supply in the SR and therefore depending on the responsiveness of the housing market to changes in market conditions.

It is extremely interesting that all separate housing markets cannot explain the latest, increases in house prices. Every single time when there has been a big unexplained residual, which in this term is called the bubble element, then the house prices have corrected towards equilibrium usually with overshooting.

The housing market in all the considered countries therefore from this analysis view looks bubbly and from previous experience and theory then the probability of a peak increases the larger the deviation.

The reversal factor has several times been a limit on credit such as a credit constraint, which has limited households to buy property making price increases stall and because of the lagged supply in the construction process (new houses will enter the market because construction time) a downward pressure on houses will initiate shortly after. The effects being strengthened, because of the wealth effect being stopped the lack of increases and thereby no more usage as a loan collateral credit will be limited, which will lower consumption and have a negative impact on the economy.

If it is not the credit being tightened by regulation then the tightening of credit will occur automatically: First, the interest rate has to be raised or a shock has to occur making it relatively more expensive to buy, income growth to halt or the outlook for the economy being worsened. In such a situation banks will be more reluctant to expand credit whereas the reinforcing process will be initiated.

When looking at the current situation of the market then during the last decade real house prices have increased substantially more than ever before and none of the fundamentals can explain such movements. Once again credit have been liberalised, financial innovations has made new loans available where house owners have been able to leverage their investment in houses and loan takers have to a certain extent been able to afford more at the same monthly payment at the same time as banks have relaxed the LTV-ratio (Appendix H).

It does not seem like the governments are willing to restrict access to credit whereas the adjustment will take a longer time to occur due to the lag of market efficiency and the natural

stabilizers taking a longer time to be initiated. The possible outcome is that the current economic growth will result in inflationary pressures and interest rates to increase, which will initiate the path described above to re-establish LR equilibrium.

7.10. Critique

The problem with the model is that it is not possible to know if the defined fundamental value is correct. There may be other variables that have to be taken into consideration and not only the few that I have included in this analysis. The main driver of SR house prices is financial liberalization and thereby credit willingness and new loan types due to most bubbles being related. However data concerning finance is not easily interpreted in a model and will demand a major historical study to be fully covering this issue.

If a credit variable was incorporated I would strongly expect it to remove large parts of the volatility in especially the post WWII period, but it would also lead to a discussion about acceleration effects bringing house prices further away from equilibrium. This is due to the influence that lending has on house prices and the psychological effects connected, starting a self-encouraging effect. However a credit variable would increase the risk of multicollinarity, because of house price increases would make it possible to lend more and not only cover the marginal effect from new buyers.

The model shows that real house prices follow a bubble dynamic. It hereby incorporates the markets expectations, but it does not include how the expectations are developed. The lagged house prices that represents the speculative pressure on the market obtains a large effect of the volatility in the real house prices, but it still does not give us an explanation of why they are necessary. The expectations can therefore clearly be defined as backward looking and it is then obvious that there is a strong tendency for adaptive expectations.

In the LR fundamentals explain to a large extent the movements and they are consistent over time, however there are deviations between the markets, which I have not been able to relate to the setup of the different markets, whereas future research could be beneficial.

Returning to the main problem that real house prices are stationary in the LR, which is emphasized by Gallin (2003), who states that there is only very little sign of co-integration. This is however due to the fact that real house prices are constant in the LR whereas statistical tests searching for co-integration are regarded as statistically incorrect. I chose to test in nominal terms, whereas I managed to escape the failure of co-integration.

There is a statistical problem when comparing rents with house prices, there is a danger that apples and oranges are being compared. The reason is that most apartments available for rent are characterised as being smaller, cheaper and in less desirable neighbourhoods, whereas other more desirable areas would tend to have a different pattern of movements due to the attractiveness factor. Under an economic boom it must be expected that the upward pressure on P is stronger than on E and the opposite when a recession is present. The P/E-ratio would therefore, even though it in some markets has mean reversion properties be cyclical. At the same time this fundamental would be dependent on the existence of a well-established alternative to owning and thereby the degree, to which a free and well-established market for rental houses exist. This could explain why NL and UK with a relatively well functioning rental market with the same attributes as owner houses makes the P/E-ratio be relatively more mean reverting. This is especially so when comparing N and USA, where N is characterized by a barely existing rental market with lots of regulation making it hard to access the homes being primarily in less attractive areas, whereas the US rental market is relatively well established, but being characterised by having other attributes than the comparable owner houses. Another possibility of the increases in P/E-ratio is that it is desired by politicians to have a larger fraction of owner occupiers, because they are proven to be more responsible taxpaying citizens, whereas policies would make it more attractive to buy than rent making the homeowner ship rates increase.

The unexplained last decade could be a due to a structural change or a variable that has been overlooked. The most plausible variable would be to have a variable stating the degree of financial innovations and use of such.

7.11. Other research

The recent massive academic interest in the housing market leading to a number of econometrical analyses. Almost all of them look at the post 1970 period and get very similar results depending on how many variables they include in their analysis and making them conclude more or less the same.

Some of these explaining factors are suggested to be low mortgage rates, financial innovations lowering homeownership cost, technological advances lowering the cost of selling the good, and making search costs decline. In addition the demand has been increased by baby-boomers, their children and immigrants, together prioritizing of home ownership,

whereas the fraction has increased (Appendix H). Sociological factors as divorces, youngsters moving out earlier and people living longer also drive up demand. Houses are being seen as a safe haven for household wealth, especially in times of insecurity (terror and stock market crash) (Lereah, 2005).

Because of other research with very limited historical data being able to explain most of the house price increases it is still a discussion whether or not there exists a bubble. Some researchers like Jacobsen (2005) believes that the latest house price increases can be explained by interest rate, wages, housing stock and unemployment.

My results about demographics is supported by Green (1996) who stresses that house prices will not be due to demographics by saying: 'If substantial changes in real house prices occur in the next 30 years, they are likely to be due to shifts in non-demographic variables such as real construction costs and real after-tax interest rates. Demographic changes of the magnitude deemed to be likely are simply not large enough to matter a great deal. If anything, the partial effect of age on housing demand is positive.'

An analysis by Tsatsaronis (2004) separates the explanations into SR and LR saying that house prices are determined by the factors presented in the following tables:

LR influence on house prices

Income	Population	Demographics (relative age)
Taxes	Interest rates (related to inflation)	Construction costs
Availability of land	Investments in old houses to improve quality	

SR influence on house prices

Length of planning	Construction phases	Uncertainty (investment cant be undone)
Transaction costs	Inertia of existing land planning schemes (local regulation)	

The most important factor has been found to be inflation (90% explanation power in the SR), which helps explain why real house prices are constant. To explain the latest 10 years then Tsatsaronis finds that the yield curve, bank credit and SR interest rate has become increasingly more important due to the invention and use of new loan types.

Tsatsaronis can not explain the latest house price increases and warns: 'The link between interest rate, inflation and house prices suggests that long periods of elevated inflation followed by a sharp deceleration of price growth may, in the SR, breed misalignments between house prices and LR determinants of residential real estate values. Situations like this might call for greater caution on the part of monetary authorities.'

My findings about finance is backed by discovering Tsatsaronis finds a clear link between credit growth and house prices: 'Feedback from property prices to credit growth is strongest in countries with a greater prevalence of variable rate mortgages and more market-based property valuation build-up of mutually reinforcing imbalances in the real estate market and the financial sector is more pronounced, indicating that prudential authorities should closely monitor developments in property values.'

Other researchers who mainly focus on quarterly data have come up with mostly the same determining variables as mentioned above. In a more fundamentalist based view, Sutton (2002) finds income, interest rates and stock prices (lag between share prices and equity increases). He confirms that house prices lately have increased more than the chosen fundamentals. The same is the case for Zhu (2005), who however finds the most important variables to be; lagged house prices (60%), equity (10%), GDP (10%), credit (10%) and real interest rate (10%). In an analysis made by Jacobsen (2005) it is found that the interest rate is the most important factor when explaining house prices and that the reaction to a change in interest rates is strong and quick. The problem about such analysis is that it only considers the data from 1990, which weakens the result.

Verbruggen (2005) makes it clear that income is the main variable to explain house prices, but that construction costs also have explanation power. However, SR inelasticity makes the relationship weaker, which must be the same as the existence of a lag. He stresses the key point that real interest rate has become increasingly important and can explain some of the latest development.

What most of the research does is to try and get the most explanation out of their data as possible in the hope of finding the one true relation between house prices and explaining variables. The problem is that researches then get tempted to limit their time series to only consider the post 1990 period where house prices have only experienced an upward trend making it econometrically easy to get strong results. The problem is that such research totally neglects cyclicality in the market for real estate and the LR house price dynamics, whereas prices are not constantly increasing over time, but instead stationary. An extrapolation of such research would lead to ever growing house prices, which would be to extrapolate on a SR tendency in the believe that such will be everlasting (LR).

Other research do go back to 1970, but then most of their findings are adjusted with dummy variables only for certain time periods or by fitting the residuals to get econometrically strong

enough results. They are again totally ignoring the most important finding in this paper that real and nominal house prices are constant in the LR and that if demand shock occurs then scarcity of land will be the only factor supporting a higher post shock house price.

7.12 Overvaluation

In the search for reasons why some markets are more volatile and thereby experience larger price movements than others then it must be because of the structure of the individual housing markets. Especially the supply of new houses and the rigidity of building new homes could be a very important factor to explain why house prices can divert from the LR fundamentals and not be pulled back by the automatic stabilizers. The inelasticity of the supply of houses is of course due to the political structure as previously explained, but I have also found that it could be because of these markets having less possible land to build on making the pressure on the available land greater and thereby stressing the regulation process and taking longer for the adjustment process to initiate.

Overvaluation, volatility and scarcity of land

	N	NL	UK	USA
Current overvaluation (%)	35	67	56	20
Mortgage Debt / GDP (2004)	63	105	75	69
Residents per arable land (million per km^2)	520	1752	1057	167

Source: Appendix G and H

The statistics above show that there is a tight link between the current overvaluation with the number of residents per arable land and credit. The countries that have the largest bubbles are also the ones having the most residents per arable land. If the ratio of residents per arable land is high, it means that in times of high demand, there would be an extreme pressure on the relatively scarce land being available for construction, and therefore whereas prices on land would increase, which therefore makes a perfect link to the Tobin's q and the fundamental perspective presented under of P/CC.

8. Market efficiency

The share market is known for its instantaneous price adjustments to new information, which eliminates the possibility of arbitrage opportunities. The housing market is different. Due to inefficiencies it is possible for the housing market to divert from an equilibrium price level sustained by fundamentals. These inefficiencies include a lack of quick adjustment on the

supply side, because of a construction lag in the process of building houses. The SR and MR time lag means that the adjustment will occur through prices.

At the same time information is not fully available, which complicates the search and decision process resulting in longer trade effectuation times. First of all houses are rarely traded, secondly there does not exist houses with the same attributes making it hard to compare investments, third the seller has a strong incentive not to give all available information, whereas it is likely that there exist asymmetry in knowledge between buyer and seller.

On the demand side a substantial search time must be expected making the individuals take longer time to adjust to their best suitable homes. This can be influenced by transaction costs and moving costs, making people moves less frequently. The real estate market is mostly consisting of small investors (private people) who rarely trade the good (low transaction frequency) making them inexperienced and amateurs having to make their biggest investment depending on limited and asymmetric information. They have little or no experience in what the fundamental value of the houses they are buying and selling are, and they very rarely calculate present value of their investment. At the same time investors rarely consider their alternatives, which include renting a similar house or constructing their own. In addition then the investment in a house is a lumpy investment giving credit restraints on the buyer who usually would have to sell the former residence.

Unlike the share market, the absence of short selling and derivatives concerning houses prevent informed traders from exploiting the mistakes of noise traders to be able to re-establish equilibrium. Compared to stocks, house prices tend to get relatively further away from the fundamental value, making the housing market relatively unstable and more likely to be bubbly (Smith, 2005).

The housing market is therefore not perfectly efficient, but that does not mean that the market for real estate is completely inefficient. To be so there would have to be serial correlation in house prices. As earlier presented then there was some evidence of serial correlation in the SR, but in the LR it did not seem to be the case. Therefore I will describe to which degree the housing market is efficient.

A perfectly efficient market is defined as where a security's price equals its investment value at all times. However, we have already seen that this is not the case for the housing market. Instead the term strongly efficient market regarding a market where asset price changes should be unpredictable since they only respond to new information, which by definition is

unpredictable. Price changes should therefore follow a random walk, which makes it impossible to forecast the returns on real estate. Expectations of returns are mathematically done through available information at time t, whereas a test could justify the predictability of house prices.

If it was possible to predict house prices then it would be able to make arbitrage in the market, whereas the housing market must be said to be only partly efficient. However, being an investor in the housing market is not without risk and since short selling is not possible and a house being a big investment then the arbitrage possibilities are limited. For the arbitrage to work people would have to know that other investors would be effective in doing the same and thereby on aggregated terms bring the market to its fundamental path. Combining that housing investors cannot expect others to arbitrage in the market they will hesitate to do so themselves. At the same time mortgage bankers have strong incentives typically influenced by bonuses and are under competitive pressure to keep lending, whereas there is a much stronger effect of using momentum and expecting others to follow.

There is therefore asymmetry in the psychological aspect of agents in the market making it impossible to arbitrage and a creation of reinforcing processes are very likely making the SR serial correlation lead to a possibility of forecasting SR returns. However, because of being away from the fundamental level, it must be expected that the correction will come at some point. The mean reverting process supports that the further away from equilibrium the riskier the market. This is due to the probability of decreases will increase the further away from fundamentals that house prices get.

8.1. Risks and instruments

The housing market includes risk and it grows with the size of the unexplained residual also known as the bubble element. Investing in houses is thought to be much riskier than to invest in many other assets due to the fact that houses to a much larger extent are financed by borrowed money, making the investment relatively more risky than stocks. It is therefore very important to have instruments that can manage risk. These tools are not present today, which makes an urgent need for diversification of the portfolio, which would make short selling and risk adjustment possible (Eichhiolz, 1998).

An alternative would be to develop a futures market, which would reduce the volatility of real house prices. Investors could then buy or sell real estate with much lower transactions cost

and be able to do arbitrage and making the housing market more efficient. Financial instruments would then to a larger extent be able to prevent housing bubbles and take out a major risk element for individuals (Capozza, 2002 and Farlow, 2004b).

9. Marginal consumer, behaviourism and rationality

One extremely important finding by Miles (1994) is that the marginal house buyer is crucial in the understanding of the dynamics of the market. The marginal buyers is the one who sets the level of house prices from what is possible through conditions for financing house purchases. The importance of young households and their income level is supported by findings by Ortalo-Magné (1998 and 2005) and found to be crucial for turning points.

The marginal house buyer is usually considered as the first time buyers that enter the housing market to buy their first home. This stream of new people entering and their level of welfare will determine how much they can pay. The age group is usually considered to be 25-35 years old making them relatively young and facing one of their biggest and most leveraged transactions ever. They are less experienced in the market and will have a tendency to follow the signals and tendency of the market and thereby support the re-enforcing process.

As a first time buyer in a highly priced market the monthly payment has become the main focus, because of new loan types. There is therefore a risk that new homeowners will put themselves into a difficult situation having too much debt and be forced to use the new loan types making them fragile to both interest rate and house price falls. I have tried to incorporate a variable that should have included the influence of first time buyers in the housing market. It seems like it does not have the wanted explanation power, which could be due to the marginal house buyer changing to a different group. Instead the key point is to research how marginal buyers and new financial loan types fit. Lately it has been made possible for people to borrow more at lower monthly payments, whereas people find the financing attractive. The variable and interest only loans do not include the benefits of the fixed mortgages where debt is lowered if the interest rate increases. With the popularity of the new loan types the risk is that the market pushed house prices up to what is possible in respect to monthly payments, but overlooked that the new loan types do not have a safety net build in when interest rates rises. As previously explained then the variable cannot explain annual house prices, but has a stronger influence in the LR.

9.1. Elasticity

Krainer (2005) has found that the responsiveness of housing supply to house prices is 1, which means that if house prices increase by 1% then the housing stock increases by 1% in the LR meaning that housing supply is unit elastic. This finding is supported by DiPasquale (1994) who finds that the LR elasticity of construction is 1-1.2% (supply) and that the adjustment of housing stock is very slow. Other researchers have found the elasticity to be around 1.5-3%, which then would make the housing supply more elastic to changes in house prices (and demand). The elasticity has changed during the last 30 years, which could be due to local regulation and limitations on physical geography.

Farlow (2004a) and Giroard (2006) have found that the real house price elasticity of supply has been very small and falling, which makes the house prices almost entirely demand determined. It is specified to be -0.5 to -7.9, which means that a 1% increase in the housing stock per year would put a downward pressure on the real house prices.

Farlow also the income elasticity is 1.3-3.2 in an international comparison, where UK and USA has the highest and N and NL the lowest, which again supports my finding that income is an important driver for house prices.

The elasticity has in Giroard (2006) been analysed to be -0.6 to -9.4 with a high impact in especially NL and UK and low in USA. These are also the countries where new financing methods are being used whereas it gives good meaning that the effects are larger here. This finding supports that increasing interest rates will create a downward pressure on house prices. The above facts support my finding that there is a clear link between income, demand and house prices. For households it becomes clear that income growth expectations and wealth effects are significant, and that people will have to carefully consider what they can afford buying.

9.2. Speculation

Many researchers have lately found evidence that there exist a great extent of speculation in the current housing market. I will hereby present their arguments and use them in the context of finding reasons for now re-enforcing processes can take prices away from fundamentals in the SR.

Schnurre (2005) has identified that there is a speculative pressure on house prices, where some market participators are purchasing their 2nd home for investment purposes only. It has

been made possible through the use of interest-only mortgages that have allowed a more expensive purchase for a given monthly payment, especially if the 1st home can be used as a loan collateral. Surveys and anecdotal evidence suggest homebuyers have extrapolated past gains into their expectations for future appreciation. Cutler (1991) supports this by observing that returns are mostly positively serially correlated. He also finds that if asset values deviate from the fundamental value then it has predictive power for excess returns in the SR. However, in the LR then returns tend to be (weakly) negatively serially correlated.

Malpezzi (2002) shows that a lagged response to price changes and speculation by it self leads to housing cycles. Further he has found that speculation is highly related to the supply side and it mostly happens in markets where the supply is relatively inelastic. It therefore becomes important to have a smoothly regulated way to make construction of new real estate as responsive as possible and thereby make the housing market more efficient and less speculative. If the marginal buyer in the housing market tends to be speculating in gains from trading the asset instead of using it for its purposes, then the housing market must be considered as non-healthy.

Case (2003) has discovered some elements of speculative bubble behaviour in the current market. He concludes that declines in real home prices probably would come in cities that have been frothy, notably cities on both coasts of US and thereby mostly be a local phenomenon. The consequences of such decreases in home prices would be severe for some individuals, especially the ones who are highly in debt relative to their personal income, whereas they could be declared bankrupt. On an aggregated level it threatens the whole economy, because it is possible that personal consumption that has driven the economy could drop resulting in a time of low growth.

At the same time then speculation is encouraged by the Federal Reserve by the willingness to consistently bail out and rescue investors and thereby desensitizing investors to take risk as Thornton (2004) would state it and at the same time interest relief makes it attractive to obtain debt. Baddely (2005) sums up by stating that herding, bubbles, frenzies and imbalance between supply and demand can explain instability in the housing market, whereas there is great support for speculation in the housing market.

9.3. Information cascades and herding

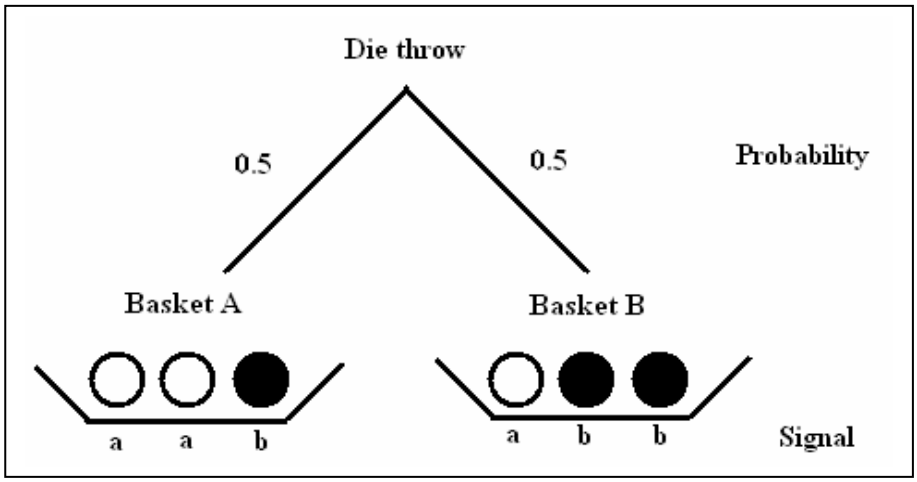
By knowing that speculation is possible in the market for real estate it is important to know how people use the information available to them when deciding if they should invest or not.

It is usually theoretically correct to assume that people are rational in their decisions, which is the base of Anderson's (1997) model. The model considers information cascades as when individual decisions are independent from private information and that the agents rationally will follow the crowd, the action itself is named herding.

Anderson's experiment is based on the idea that agents continuously will take decisions in the market depending on the information available to them, which is very similar to the conditions of the housing market. The agents observe signals from the market and by seeing such (the actions of other agents) they are indirectly able to identify the other agent's private information, since the agents actions reveal the conclusion of the other agents made on their private information. In the case of the housing market then increasing demand combined with price increases is the current basis for the expectations of the market.

The model

Individuals are symmetrically only being able to observe public information about two equally likely events that occurred. The events are named A and B and the signals a and b. An instructor throws a dice. If 1-3 is rolled then the instructor takes Basket A and if 4-6 is rolled then the instructor takes Basket B (cannot be observed). Basket A includes black and white balls with a distribution 2:1 and basket B the distribution 1:2, which makes them ex ante equally likely. The first agent draws a ball from the basket that the instructor has determined by rolling the dice. The agent will then guess, which basket the ball has been pulled out of (A or B).



The colour of the ball is considered private information and will not be revealed to the other agents, but the choice of the agent will be published and will therefore function as a signal to the market. The next agent will now make his choice depending on the information available.

It is assumed that all of the agents expect that the other agents use the Bayes' rule from which it is therefore possible to calculate the probability of an event (here A):

$$\Pr(A \mid n,m) = \frac{\Pr(n,m \mid A)\Pr(A)}{\Pr(n,m \mid A)\Pr(A) + \Pr(n,m \mid B)\Pr(B)} = \frac{(2/3)^n (1/3)^m (1/2)}{(2/3)^n (1/3)^m (1/2) + (1/3)^n (2/3)^m (1/2)} = \frac{2^n}{2^n + 2^m}$$

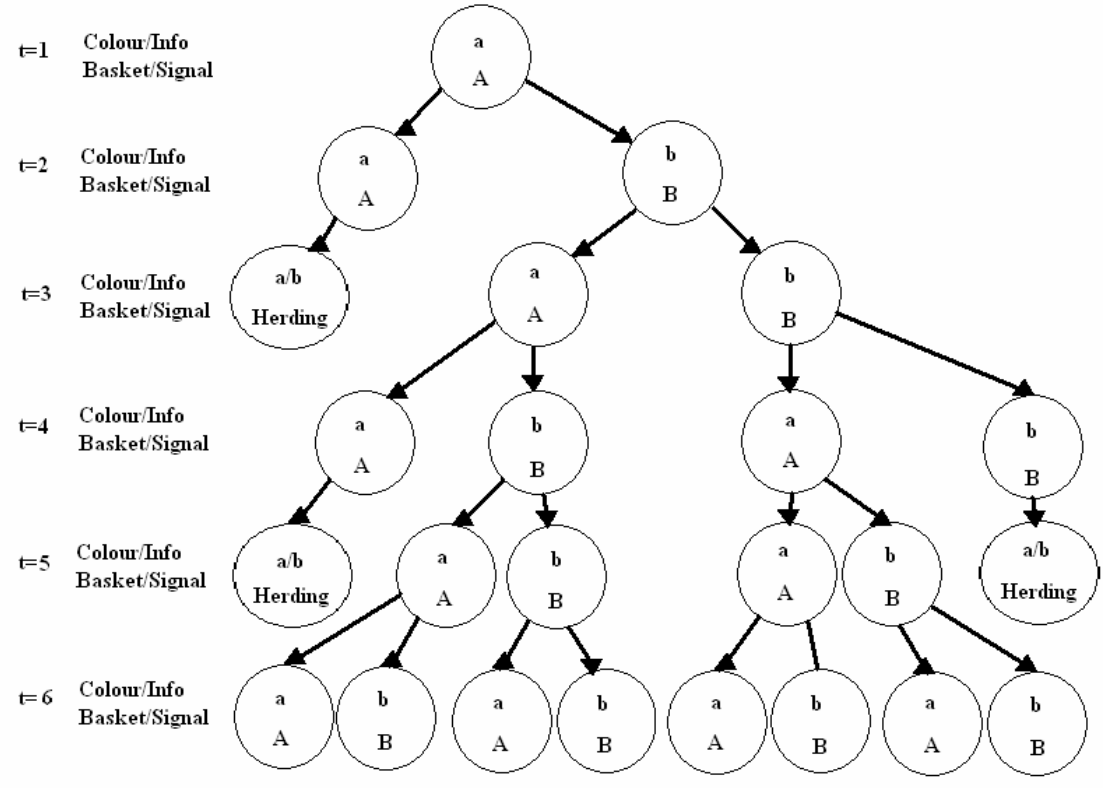
, where *n* and *m* are the number of relevant signals from a and b respectively.

The expected answers – probability that A is in the basket

		Number of b – signals, m			
	%	0	1	2	3
Number of a –signals, n	0	50	33	20	11
	1	67	50	33	20
	2	80	67	50	33
	3	89	80	67	50

According to Bayes' rule and following the above table then if the first agent pulls a white ball (signal a) then the agent would chose Basket A, (Pr(A|a)=2/3). If the next agent pulls out a white ball (signal a), then the probability of Basket A is 80% (Pr(A|aa=4/5). If the agent would have pulled a black ball (signal b), then the probability of Basket A is 50% (Pr(A|ab)=1/2) etc.

Graphical illustration of the model



Each agent received $2 for a correct answer and nothing if wrong. The experiment made by Anderson was done over 15 periods and was repeated three times.

Results

The experiment showed that in 73% of the periods it was rational to turn down the private information and follow the signal of the public and thereby follow the crowd. Herding behaviour is therefore highly possible result. The model can therefore illustrate that the existence of large publicly available information can result in agents discarding private information and thereby turning down their own judgement of the market to follow the majority of the agents (signals) in the market. It will therefore be possible that rational agents well knowing that the housing market is not following the fundamentals to rationally follow the crowd.

10. Initiation of price decreases

Throughout this paper I have presented clear evidence that the reason for the boom in house prices have primarily been caused by increasing credit. The most effective way to initiate a price decrease will therefore be to constraint credit or to follow a more contractive monetary policy, which will hit households directly, especially due to the increased sensitivity among households after new finance methods being introduced. Evidence show that there is strong SR effects in countries with the highest fraction of variable loans, but that LR effects are limited (EC, 2005).

Research has shown that housing equity withdrawal through new financial products has made consumption more reliant on house prices changes, whereas the price increases have contributed substantially to private consumption growth in some countries. These products include variable and interest only loans, increased borrowing by existing mortgage holders against their housing equity to finance consumption and new investments. This has helped to maintain consumption throughout the global slowdown after the stock market crash in 2000 (Debelle, 2004).

The problem arises when house prices no longer increase. First of all it will not be possible to use house equity withdrawal to the same extent and secondly banks will be less willing to lend to households and thereby constrain the credit supply. This possibly could initiate a downward reinforcing process.

House prices and household debt (and thereby credit willingness) are highly correlated, and when expectations suddenly change it could very well lead to the formation of bubbles and imbalances in households, and banks balance sheets. Both households and the banking sector have therefore increased the sensitivity to changes in interest rates, income (GDP) and asset prices. Any slowing or reversal of credit willingness could result in a deceleration in house price growth, which will have a substantial negative impact on the macro economy. It is worth noticing from previous sections that booms and busts in the housing market are not uncommon, and that booms tend to be related to periods of high credit willingness (Aherne 2005, Catte, 2004, Debelle, 2004 and Girouard, 2001).

If a bust occurs, then the LR adjustment in capital goods must come from a change in price, which will entail large losses and possible bankruptcies by the owners of these capital goods. To the extent that these types of adjustments are widespread, they are a threat to capital markets and the banking system. (Thornton, 2003).

Actually Thornton (2003) has made an interesting finding that the timing of a bubble usually occurs when skyscrapers are constructed, which is due to the interest rate effect on the value of land and the cost of capital. A lower rate of interest tends to increase the value of land, especially in city areas due to the reduction in opportunity costs of owning land and the raised demand.

When the cost of land increases then it becomes more attractive use the available land more efficient and thereby build taller buildings in order to spread the land cost over a larger number of floors. At the same time then a lower cost of capital encourage firms to grow in size, to become more capital intensive and to take advantages of economies of scale, which creates a higher demand and increasing house prices. Finally, then taller buildings will require new untried technology and thereby demand new innovations. All three Cantillon effects resulting from lower rates of interest are, of course, interrelated and reinforcing and emphasizes the importance of monetary policy.

Lags between equity bust and housing bust are usually much less than what we are experiencing now. Borio (2003) shows that housing prices peak 1-3 years after equity peaks with a probability of 65%. He also stresses that housing booms are highly likely if financial imbalances have been built up through credit expansion and equity booms. In fact he even concludes that especially the nominal SR interest rate is the key issue to the timing of a bubble. The size of the bubble is to be found through the fact that there is strong correlation

between the size of interest rate increase and the size of the bust, which is supported by Debelle (2004) showing that the most important factor when focusing on the lag between equity bust and a house market bust is the short interest rate. Actually evidence from the yield curve appears to be even more important than the interest rate it self. After periods of increased interest rates, up to flat or inverse yield curve, the probability of a slowdown in economic growth is 3/3, since 1977 (100% for the three last downturns in 1982, 1990 and 2001) for USA since 1975. Bernard (1996), Elliott (1977) and Ang (2003) supports this finding by stating that the SR interest rate is crucial when determining GDP and that especially the slope of the yield curve is a leading indicator for economic growth (explaining more than any other factor) and that the effects will be strengthened by the span between long and short interest rates. The reason is where central banks decide their policy to be either contractive or expansive in the SR related to the markets determination of the LR interest rate. When monetary policy effects hit existing households and investors then in case of a contractive policy (interest rate increases) will slow down the economy, which will have negative income effects leading to less demand for real estate and downwards pressure on house prices.

10.1. Expectations, behaviourism and change in sentiment

There is a risk that house prices, because of the inefficiencies more easily tend to be driven by adaptive expectations, which create inertia in price movements and thereby more easily tend to deviate from fundamentals. Among those factors that help explain the significant deviation from the competitive general equilibrium model is behaviourism. Akerlof (2002) have found some of these factors to be money illusion (people thinking in nominal rather than real terms) and herding and thereby supports my previous finding.

Shiller (2002) argues that markets need not to be efficient and that expectations and behaviourism is playing a strong role when assets are valued. When prices are far away from a fundamental value he suggests that it is due to irrational exuberance, human foibles and arbitrary feedback relations. Ordinary peoples expectations are highly influenced by feedback mechanism from changes in prices, which is likely to be spread through their network, the media etc. It makes human patterns less-than-perfectly rational and all it takes for a bubble to change is just a change in sentiment (Case, 1988 and Shiller, 2000, 2000ie and 2001). The process could be strengthened if the housing market is non-rising, which could make investors

sell, as their expectation of capital gains disappear and their 2nd homes not being necessary and the realisation that it is possible to loose money. (Economist, 11.2003). The above finding is supported by earlier work from Shiller (1998) where investor's expectations may be driven substantially by lagged price changes, which is also known as adaptive expectation. In this way a trend is reinforced and the feedback mechanism starts that would take prices away from fundamental value (Shiller, 2000).

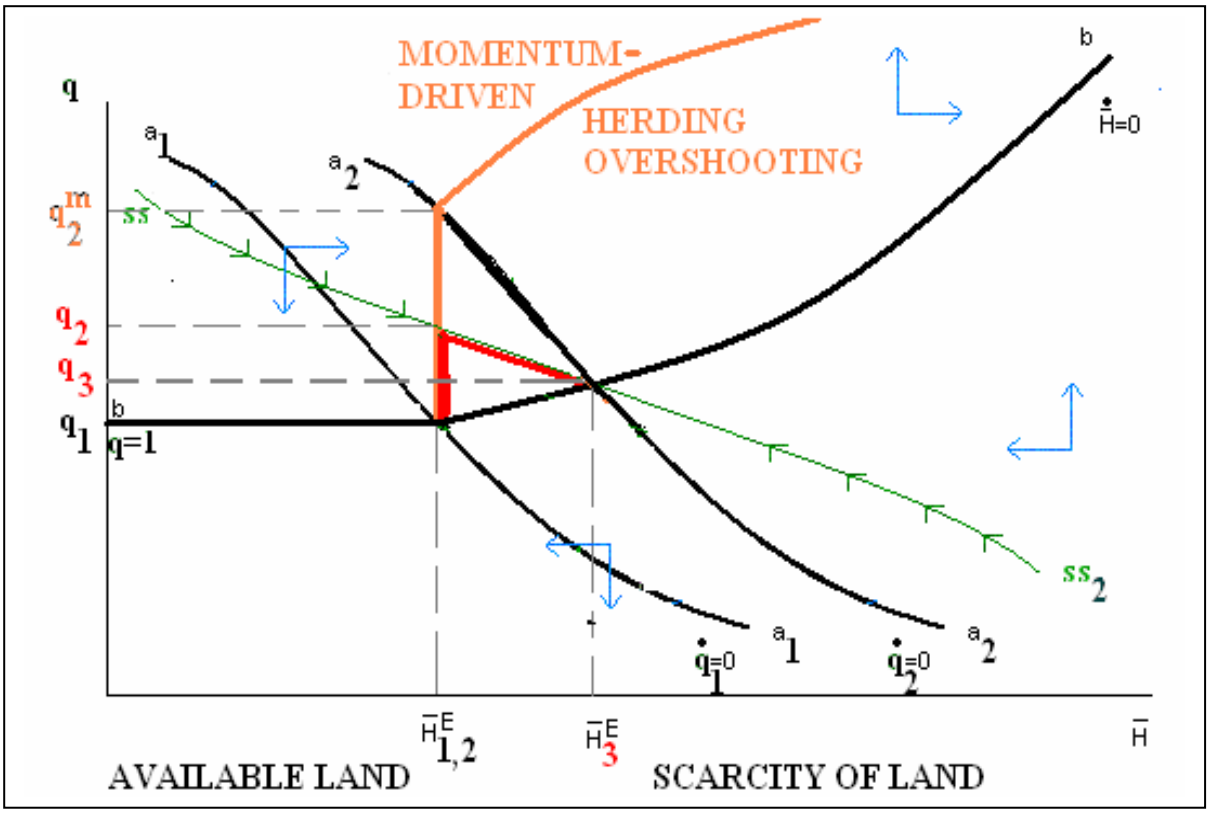
However, an interesting finding by Miller (2002) shows that the latest bubble just as well could have been an exaggerated faith in the stabilising power of Greenspan and the Greenspan Put, and it will be very interesting to see whether Bernanke will follow Greenspan's advice to increase interest rates more (Baker, 2002).

Homebuyers in general have been shown to have unrealistic expectations about future prices, because of static expectations making them believe that past house price increases will continue in the future, whereas momentum to a large extent explains house prices. Trades are even done by people holding private information expecting prices to fall. Instead they follow the information made publicly available. House buyers therefore believe that they can always sell their house in the future to someone else who will be prepared to hold it at an even higher price (Farlow, 2004a and Smith, 2005).

As momentum being a key driver for house prices in the SR then the graphical presentation of a positive demand shock will be shown in my combined model of Poterba and Tobin's q. The finding of momentum driven prices in the short run are supported by findings that expectations tends to be adaptive making investors speculate and create herding effects that reinforces each other.

As presented in the graph then under myopic market conditions people will first overshoot the normal rational agent at the time of the shock, but because of adaptive expectations people will believe in further price increases making them speculate and increase demand leading to more price increases. Herding behaviour will be initiated and reinforce the process creating a momentum effect that due to the setup of the model will continue indefinitely and will follow the unstable path. A reversed effect will have to stop the illusion of ever increasing prices, which will result in price drops and the further away prices have been driven the larger the price revaluation will have to be.

Unanticipated positive demand shock with momentum, speculative forces and herding



10.2. Overvaluation

The overvaluation of the current market condition is according to the fundamentals previously specified in the econometrical analysis identified as the error term in the model that had explanation power for the LR. The unexplained deviation according to the bubble definition will be named overvaluation.

Overvaluation of N, NK, UK, US housing market

	N	NL	UK	US
Overvaluation today in %	35	67	56	20
Decrease to re-establish equilibrium today in %	20	39	36	13
Nominal 5 year increase needed to re-establish equilibrium	-17	-33	-27	-5
Annual nominal increase to re-establish equilibrium (5 years)	-3.7	-7.7	-6.2	-0.9
Nominal 10 year increase needed to re-establish equilibrium	-7	-25	-19	9
Annual nominal increase to re-establish equilibrium (10 years)	-0.8	-2.9	-2.1	0.9

Note: Inflation rate in Europe is set to 2.25 % whereas it is set to 2.75 % in the US.

From the table above it is seen that the overvaluation in the chosen countries are quite high, but that especially NL and UK would need to have very strong decline in house prices and or a long period of falls to re-establish equilibrium. As evidence showed earlier then the length of the boom is correlated with the length of the bust, and the recent long boom would indicate that a coming bust would be likely to have duration at roughly 10 years. The yearly decreases become much lower when following such and even allows US house prices to increase slightly in nominal terms.

The problem about the need for a long adjustment period and the economy being dependent on real estate increases the probability of poor economic growth and maybe even a recession. The calculations above have been made with a fixed inflation rate. If central banks allow the inflation rate to increase, then the time of adjustment would be shorter and thereby more rapidly re-establish the economy to its equilibrium.

Even though the US market in general seems not to be as bubbly as the other countries then some cities are experiencing very high prices. At the present stage most commentators argue that there is no national US housing bubble, but that there are strong signs of local ones, which are harder to deal with on a national basis. (Labonte, 2003 and Laing, 2005). The same problem exists in EU where German house prices have decreased making it difficult to use the interest rate to inflate the bubble. However, it should be noted that the above definition of a bubble does not include the fact of scarcity of land that can make prices find an equilibrium price at a higher level.

11. Consequences of price decreases

IMF (2003) has compared busts in the share and housing market, and they have found that the real price declines in the housing market are not as large (30%) as in the share market, but house crashes last for a longer period (4-5 years). Evidence shows that economic performance will be influenced more and for a longer period if house prices bust relative to a share market bust, because of more value being linked to houses (Appendix I).

Housing price busts are likely to be lagging and overlapping equity bust. Nevertheless all findings show that the larger a boom has been, the larger the bust will be. IMF (2003) finds that housing market busts are less common than equity crashes, because 20 housing price crashes have been observed between 1970 and 2002 in 14 countries compared to 25 equity price crashes. On average there tends to be a bust in each country every 20 years. In the

period most housing busts clustered around 1980-82 and 1989-92, while equity crashes were more spread. Equity and real estate busts tend to be synchronized, which makes them cluster and when they occur then recessions are highly likely. (IMF, 2003, Debelle, 2004 and Smithers, 2002).

This time the housing boom is synchronised, which makes it likely that a country will not experience a separate bust and not influencing the other. Himmelberg (2005) has however found bubbles to be very local, but he does also recognize the spill over effects between markets whereas the fundamentals that influence the market must be similar. The synchronization of housing market bubbles is from my analysis something that has happened only very recently, which means that in this period of bubbles in all the considered countries they are more likely to be fragile to the same shocks.

Historically a banking crisis has been highly correlated with real estate bubbles, which is likely to be connected to a serious credit expansion, and also because both households and financial institutions today own a larger value in houses than in shares. The latest larger housing market bust occurred in Japan, where the economy and the housing market experienced a time of excessively optimistic expectations with respect to the future (euphoria) ending up in a bust initiated just a couple of years after a stock market crash. This bust has been partly responsible for a decade of economic stagnation and it shows how bad the consequences can be. The German economy has also been in trouble, partly due to decreasing house prices after the huge construction following the reunion. UK is another example on how liberalization and easing of credit expansion created a bubble in the 1980's, which came to an end around 1990. (Herring, 2002, Debelle, 2004, Helbling, 2005 and Shiratsuka, 2005).

There is evidence from IMF (2003) that housing price busts are associated with stronger and faster adverse effects on the banking system together with decreases in consumption, than equity price busts. In fact real private consumption and investment in construction and machineries all experienced larger and faster falls in their growth rates during housing price busts. Housing price busts were more likely to be preceded by a boom so that there were larger imbalances to be unwound, which are costly for the society to unwind through a recession. (IMF 2003 and Helbling, 2005).

However, Helbling (2005) has found that only 40%-67% of all house price booms in the sample ended in a bust, whereas Helbling suggest that large house price increases over several years do not necessarily need to be a good indicator of a forthcoming bust. Instead Helbling

finds that relatively rapid increases over a short period of two years or less would be a better, but imperfect indicator. Besides poor economic performance there should be no doubt that crashes in asset prices generate real and substantial misallocation of resources both during the creation of the bubble and after. E.g. people only living ½ the time in their homes (from 15 to 7 years), which enlarge transaction and movement cost that are misallocating resources in society (Shiller, 2002).

11.1. International housing bubble

The effect of a single isolated bubble itself has a great impact on the local economy and of course influences the economies nearby. This time the bubble is not isolated in one country only. The phenomenon is now for the first time in history international making the importance of the housing market crucial for the world economy. To some extent the market has also converged by freeing up trade for construction costs and at least internally in Europe by the free movement of labour making the housing market highly correlated as shown earlier. Busts are also stated by Otrok (2005) to be synchronized and if one major market collapses then there is a high probability of others to follow.

Stephansen (2005) also pinpoints that house prices have converged and thereby become more synchronised. This is mainly attributable to the convergence in per capita disposable income, but is also the result of the convergence in real interest rates, following the European monetary union. If a major housing market correction occurs then it is very likely to be preceded by a sharp rise in interest rates and/or labour market shock.

There exists a risk that the economies have become too reliant on the housing market and the increasing prices. The latest examples are found in UK and Australia where UK house prices have stopped increasing making the growth rates halt. As Blumen (2005) states; 'the US economy is undergoing a secular shift to a housing-based economy'. Such an economy where wealth creation is manly originated in real estate is known as 'The New Housing Economy'. The consumption has been driven by tremendous amounts of debt and house prices walking hand in hand in a seemingly never-ending process. People have changed their behaviour by not paying down on their loans, but instead issuing debt to be able to acquire more debt in the future (in the belief of rising house prices). The danger is that if the debt and house prices have been used to fund current consumption, this could make it troublesome if prices no longer increase. (Otrok, 2005).

11.2. Moral Hazard

A housing market bust will have a strong adverse effect on capacity and the willingness of financial institutions to lend, which partly can explain the severity in real economic terms of a bust. If households are constrained, they will be likely to save more and become more risk adverse. By making households less risk tolerant, and having to accept lower payoffs on housing investment, people save even more and this initiates a reinforcing process. Besides this maintenance of houses is less likely when house prices fall, because of a lower payoff giving a lower incentive. However, when house prices increase, then they are likely to use the 'free value' to finance luxury improvements and keep on renovating.

The new and popular loan types might be a moral hazard for loan takers, banks and credit givers. The forces of competition make the financial companies go into the business of risky loan types or else they will loose market share. This situation creates 'the perverse incentives of lenders'. When property prises are rising financial institutions have an incentive to lend as much as possible, but if prices fall they will be likely to pull out before they accumulate too many losses. Today most banks have a huge property holding and because of higher house prices capital is racing upwards. This encourages them to relax their lending standards and lend more to gain market share from their competitors, which all together push prices up. Because of the credit growth, there is perverse support for the boom and bust, which financial institutions seem not to focus on. (IMF, 2003 and Herring, 2002).

Evidence shows that banks are far more vulnerable to housing busts than a share market crash. However some financial institutions may be subject to perverse incentives, because they might ignore the risk of a bust and believe they are protected if the tragedy occurs. Almost every country has put up a safety net, which functions as e.g. a government guarantee. If a bank is declared bankrupt then it will have consequences for the whole economy. To prevent such a lender of last resort usually exist, who would then save their existence. The knowledge of support during a crisis encourages financial institutions to abandon potential market discipline and lend out money.

To support this finding Herring (2002) has observed that if a real estate boom begins to collapse, financial institutions may hasten the decline in real estate prices by withdrawal of credit. In this sense it is important to stress that a decapitalized banking system is highly vulnerable to external shocks and can severely damage the real economy. Decline in house prices might, as explained, trigger problems in the financial institutions, which were observed

in 1929, where widespread defaults (bad loans) contributed to the biggest banking crisis in US history. In this light it is surprising that there does not yet exist a hedging instrument for real estate and the lack of such instruments makes participants in the housing market vulnerable (Shiller, 2004, Shiller, 1998 and IMF, 2003).

As Case (2005) expresses it: 'Banks are exposed to cyclicality in real estate markets, and because banks incentive structures may lead them to exacerbate boom-bust cycles in real estate markets, fluctuations in real estate prices have the potential to strain financial stability and even to jeopardize entire financial systems.'

11.3. Financial stability

Heath (2005) explains the situation quite well: 'Real estate has been a neglected area because it has always been treated as an independent sector. Now, the real estate sector is viewed as a significant contributor to the financial position of financial institutions in terms of mortgage loans as well as asset holdings'. Thus, real estate prices are critical for the financial sector and in terms of measuring the wealth of the country. Monitoring real estate prices is important for financial stability analysis. There can be large exposures (both direct and indirect) to an asset whose price can be volatile not least because of the actions of lenders themselves to deposit-takers, and other sectors.

The primary source of real estate funding comes from lending and it is not surprising that there is a close connection between real estate prices and bank credit. VAR analysis made by Zhu (2005) shows that increases in property prices lead to an expansion of bank credit and that bank credit and property prices are highly positively correlated.

The real estate market is therefore very reluctant on debt and as the recent period where the increased indebtedness has built up financial imbalances, especially if times of optimism make asset prices increase and get fuelled by issuance of new debt. The level of debt is now the highest ever compared to disposable income and GDP, which increases the probability of less financial stability.

Evidence from Nakamura (2002) shows that liberalization of the banking sectors and credit lead to a credit growth. E.g. the limits of lending were completely removed by 1985 and free capital movements were made available by 1989 in Sweden. The easy access to credit had strong effects on behaviour and because of liberalization occurring at a time of high growth then firms and households increase their loans rapidly (Finland in the 1980's: Lending

increased from 50% to 100% of GDP, Japan: credits tripled in 1986-89) strengthened by interest relief and the possibility to loan in foreign currency (e.g. Sweden and Finland: relatively high inflation and at the same time fixed exchange rate). The liberalization lead to loan-financed consumption and investment patterns that made house prices increase and initiate speculation causing prices to rise even further and above what was sustainable, whereas new loans were granted on the increasing and over valuated assets (primarily real estate) with relatively low assessment (due to competition in the banking sector and increases). When house prices revaluated in the late 1980's the banking sector was suddenly facing bad loans (Sweden in 1990: 75% of bad loans were related to real estate investment) and leading to a debt crisis where the solvency of the whole financial systems where under threat (Nakamura, 2002).

Research by Riiser (2005) shows that a credit span (the deviation of debt from the LR trend) to a high degree can explain former bank crises. Today it is even more worrying that the span of house prices and share prices are big adding to the risk of a possible bank crisis.

At the same time Zhu (2005) is warning that a fall in property prices can lead to a large-scale deterioration in asset quality and in the profitability of the banking industry, particularly for those banks that are involved in property or property-related lending businesses. The economy will be challenged if the debt issuance process is reversed. This could possibly happen if people start to not pay their loans, whereas credit givers will be more reluctant to expand credit, because of the higher risk. If the lending attitude changes it would have important implications for property prices. Bank credit to property buyers and constructors can change the balance between the demand and the supply side and cause property prices to fluctuate.

The most dangerous situation for the economy would happen if a reinforcing process initiates. Such has happened several times before when looking at the history of real estate. The most recent of these is the credit liberalization and deregulation of the 1970's and 1980's, which in NL and UK created bubbles by blowing in air (credit) into the market. As observed earlier then at some point the housing market is overheated and too far away from the fundamentals. The automatic stabilizers (construction, rent adjustment) take time to act, but they will ensure a mean reversion of house prices to return to an equilibrium decided by fundamental value.

To secure financial stability it is therefore important that the supply of credit and especially mortgage finance is relatively stable. However, the problem is that financial stability is not

considered a general objective of the central bank and monetary policy aims at maintaining the objective of price stability. Price stability would usually foster financial stability, but it is not sufficient to secure it. A conflict between SR and MR is therefore possible; a situation where it would be optimal to deviate from the desired rate of inflation in the SR to maintain price stability over the medium run. (Issing, 2003 and Schnurre, 2005).

It will be crucial to distinguish between macroeconomic (MS) and financial (FS) stability, where MS focuses on output and inflation and FS on asset prices and loan losses. Usually MS and FS happen at the same time, they can cause each other, but they need not. (Von Peter, 2004). Evidence from Borio (2004) suggests that pro cyclicality of the financial system may cause financial instability. Bank capital, provisioning, profits and risk assessments all move over the cycle in a way that encourages pro cyclical lending, which may feed boom-bust cycles in credit and asset prices. Especially in 1980's and 1990's.

11.4. Aftermath of the crisis

When house prices initiate a decline the economic activity usually drops and these are as previously shown correlated with stock markets decreasing leading to less consumption and an increase in savings. These effects will strengthen each other and be reinforcing and therefore be making a momentum of decreasing prices. Severe effects on the financial sector has been described where it can be necessary to find a national lender of last resort that will ensure that the system will not fail.

Mergers can be forced to make better balance sheets, financial supervision and advisory can be created, asset management institutions can be founded, banks can be taken over by the government or make commitment and give out loans. There are many ways that the government can prevent a financial crisis, but they do not come without a cost. The more promptly, the more political support and the better signal of the actions taken by the governments the lower costs to society and the faster it is possible to get out of the trouble (Nakamura, 2002).

A banking crisis does not occur in isolation. Unemployment must be expected to increase and a recession is very likely to be the result of the laissez faire attitude towards the credit growth, which is untameable during an upturn if it is let alone without restrictions. It therefore crucial that credit restraints are only loosened during downturns and tightened during upturns to help stabilizing the economy and not getting out of control.

12. Conclusion

Evidence in this paper show that the housing market is a crucial part of the economy and that economic growth is highly dependent on real estate. At the same time households are highly dependent on houses, because real estate is the largest asset. There can be and liability from making houses important when households decide their spending and saving pattern.

I have through a thorough statistical research found and analyzed LR data never presented before from Norway, Netherlands, United Kingdom and USA. Data appears graphically as relatively stable, except from a few bubbles on the way. The data has been put into a historical context and the bubbles seem to fit well with the major historic events like tulipmania, Anglo-Dutch wars, European war, WWI, Spanish Flu, Great Depression, WWII and financial liberalisation. Returns on house investments have lately been abnormally high compared to historic averages, which has initiated a broad discussion about existence of a bubble.

House prices are in the SR characterised as highly momentum driven and explained by the last house price change making prices persistent in the SR and the adaptive expectations being a base for inertia. In the MR the adjustment factors will usually limit the deviation from equilibrium where the timing will depend on the inelasticity of supply. In the LR mean reverting forces will secure that the further away from equilibrium prices get, the higher the probability correction towards LR average.

The data has been analyzed econometrically where it is discovered that real house price data are stationary, whereas they are constant in the LR. Most other research is only considering a very limited period and at most back to 1970. I have discovered that by limiting the research to this period then, because of the latest increases in house prices they are no longer statistically stationary whereas they are not constant. Limiting the data to 1970 or later there is a high risk that the results will lead to wrong conclusions unless a structural change has occurred in the housing market, which then has to be identified first. It is therefore advised that research should rather than focusing on small periods of a single boom where it is easy to find correlation and statistical relations in upward trends, but instead focus on determining on if or what has made a structural change in the housing markets in the 1970's.

I suggest that the structural change is could be the liberalization of credit (lately through new innovations as interest only and variable loans), which several other times in history have had a major impact on house prices and created price bubbles several times in all of the housing

markets. History does however also show that real house prices have returned to the LR average, whereas it would be likely to occur for this boom too and thereby indicate that a structural change has not occurred.

I have transformed the data into log nominal house prices, which are increasing over time and making it econometrically correct to make further analysis. The most important variables for the housing market in the LR are; Income (GDP), rent and construction costs, which is supported by my presented model combined by Poterba and Tobin's q. The fitted models for all market appear to be great at explaining the house prices. In fact the fitted appear as highly co-integrated with the empirical data. From the econometrical tests the residual is given, which tells us what the model cannot explain. The residual for the fitted model consistently has given results that can be related to major historic events very plausible to have affected the housing market as wars and the Great Depression. If these two are discarded due to the special circumstances then (excl. the current) 93% of the remaining is due to financial liberalisation.

The error term is when following the definition described earlier then a bubble term. This bubble has increased in size over the latest period and is found to be the first international housing bubble. The markets have been identified as synchronized for the first time in history, whereas they are highly likely to be influenced by the same factors and if a negative shock occurs then it will have a stronger and broader effect.

When the housing market is above its fundamental value the market at some point will have to adjust and follow the LR trend defined by theory and supported by historical data. The timing of such an adjustment is only dependent on a change in sentiment. Bursting the bubble has previously and will have severe impact on the world economy and may even result in a recession. The bursting of a bubble and our findings about credit institutions having moral hazard problems about credit willingness is a key factor to the initiation of a reinforcing process.

The reinforcing processes have, through theoretical insight in a model made by Hurst, been found to be possible, even if investors are rational agents, by discarding private information and instead focusing on signals of the market, and herding behaviour is established as a self-reinforcing process.

The many price bubbles can also be related to the many market inefficiencies that exist in the housing market: real estate is a necessary good being rarely traded by inexperienced market

participators; the existence of inelasticity in house supply; the lack of high quality statistics, information problems between buyer and seller; moral hazards; the lack of short selling and financial instruments for hedging.

These effects have been strengthened by monetary policy not focusing on real estate even though the major effect from interest rate changes is through the housing market known as the wealth effect. At the same time policy changes as regulation of both financial innovations (lack of control over credit growth and no LR authority to approve new financial tools) and supply conditions (mostly at state level not being responsive to changes in demand) has made the market much more volatile.

All of the above factors have been involved in the creation of the bubble we are now experiencing in the housing market. Through a discussion I have presented my suggestions on the basis of existing theories for policy makers.

The most important lesson is that policy changes now could stop the mania and herding behaviour before the problem gets even bigger. Stopping the housing market from continuing its reinforcing process until an even bigger and less controllable bust would occur would therefore be advisable, whereas a gentle policy response should be incorporated.

The myopic housing market will sooner or later return to its fundamental, the most likely way is through the price of credit, which is the interest rate, where households and especially first time buyers have become more sensitive to changes in interest rates by being forced to finance through interest only or variable loans. SR interest rates have already increased in all of the countries and research has found that the yield curve is crucial in the determination of economic slowdown functioning as a leading indicator. A flat or inverse yield curve would make it relatively more expensive to consume and invest today, whereas demand for houses will decrease and put a downward pressure on prices.

To make the housing market healthier it is a cornerstone to have a flexible renters market, which makes the alternative to owning feasible at all times. Flexibility is a key word, and there is nothing that could hinder a market creation for changing in between owning and renting the same house, whereas it would be possible to change the status of your home freely depending the households expectations without having to move. At the same time local authorities should be given more power to make supply more responsive to demand. At the same time speculation should be prevented as much as possible through taxation of 2nd home ownership per person, cutting interest relief and thereby make it less attractive to increase

leverage in investments (households and the economy would become less fragile). Debt needs to be overviewed by an independent enforcing international organisations that can make standardised rules and make sure that credit growth does not get out of control.

Another way to make the housing market less inefficient is to create financial tools as futures, which would make expectations of future house prices much more visible and make it possible for people to go short in real estate. In this way it would be possible to adjust the risk that individuals are facing in the housing market. At the same time better portfolio solutions should be made available, which could take some of the local market risk out of individual households.

13. Literature

Abraham, J.M. and Hendershott, P.H., (1996), Bubbles in Metropolitan Housing Markets, Journal of Housing Research, vol. 7, no. 2, 1996, pp.191-207, http://www.fanniemaefoundation.org/programs/jhr/pdf/jhr_0702_abraham.pdf

Ahearne, A.G., Ammer, J., Doyle, B.M., Kole, L.S. and Martin, R.F., (2005), Monetary Policy and House Prices: A Cross-Country Study, http://www.federalreserve.gov/pubs/ifdp/2005/841/ifdp841.pdf

Akerlof, G.A., (2002), Behavioural Macroeconomics and Macroeconomics Behaviour, The American Economic Review, Vol. 92, No. 3, 411-433

Anderson, L.R. and Holt, A., (1997), Information Cascades in the laboratory, American Economic Review, Vol. 87, Issue 5, 47-862.

Ang, A., Piazzesi, M. and Wei, M., (2003), What does the Yield Curve Tell us about GDP Growth?, http://ssrn.com/abstract=579208

Arthur, S.V., (2005), Obtaining real estate data: criteria, difficulties and limitations, BIS papers No. 21, http://www.bis.org/publ/bppdf/bispap21f.pdf

Baddely, M., (2005), Housing bubbles and frenzies: evidence from British housing markets, http://www.landecon.cam.ac.uk/real_estate_grp/econ_and_public_polic/PUBLICATIONS_CCEPP_files/pb0205.pdf

Baker, D., (2002), The run-up in housing prices: Is it real or is it another Bubble?, http://www.cepr.net/publications/housing_2002_08.htm

Bakshi, G. and Chen, Z., (1994), Baby boom, Population Aging and Capital Markets

Bernard, H. and Gerlach, S., (1996), Does the term structure predict recessions? The international evidence, BIS working paper No. 37, http://www.bis.org/publ/work37.pdf

Blumen, R., (2005), The United States of Real Estate, http://www.gloomboomdoom.com/marketcoms/mcdownloads/050904_robert_blumen.pdf

Bordo, M and Jeanne, O., (2002), Boom-Busts in Asset Prices, Economist Instability, and Monetary Policy

Borio, C. English, W. and Filardo, A., (2003), A tale of two perspectives: old or new challenges for monetary policy?, BIS Working Papers No. 127, http://www.bis.org/publ/work127.pdf

Boulhouwer, J., (2000), Development of house price in the Netherlands: An International Perspective, Journal of housing and built environment 15, 11-28,

http://www.darenet.nl/nl/page/repository.item/show?identifier=oai:tudelft.nl:K_11145428581078958426&repository=tudkeur
Boulhouwer, J., (2004), House-price fluctuations and the disfunctionality of the Dutch Housing market: exploding house prices versus falling housing production, http://www.enhr2004.org/files/papers/boelhouwer,%20P.pdf

Capozza, D.R, (1994), Expectations, efficiency, and euphoria in the housing market, Regional Science & Urban Economics, vol. 26, no. 3-4, pp. 369-386, June 1996
Capozza, D.R, Hendershott, P.H., Mack, C. and Mayer, C.J., (2002), Determinants of real house price dynamics, NBER working paper 9261, http://www.nber.org/papers/w9262

Case, K. and Shiller, R., (1988), The Behaviour of Home Buyers in Boom and Post-Boom Markets, http://cowles.econ.yale.edu/P/cd/d08b/d0890.pdf
Case, K. and Shiller, R., (2003), Is There a Bubble in the Housing Market? http://cowles.econ.yale.edu/P/cp/p10b/p1089.pdf
Case, B. and Wachter, S., (2005), Residential real estate price indices as financial soundness indicators: methodological issues, BIS Paper No. 21, http://www.bis.org/publ/bppdf/bispap21o.pdf

Catte, P.N., Miles, D. and Schmidt, L., (2004), Housing Markets, Wealth and the Business Cycle, OECD Economic Outlook, http://www.oecd.org/dataoecd/4/60/31920338.pdf

Cave, F., and Giles, C., (2005), House prices wobble and have a long way to fall, Financial Times, http://www.economics.ox.ac.uk/members/andrew.farlow/Newspaper%20articles/FarlowFT30Aug2005.mht

Cerny, A., D. Miles and Schmidt, (2005), The Impact of Changing demographics and pensions on the demand for housing and financial assets, CEPR Discussion paper series, No. 5143, http://ssrn.com/abstract=750604

Chancellor, E., (2000), Devil take the hindmost - A History of Financial Speculation, Papermac

Cho, M., (1996), House Price Dynamics: A Survey of Theoretical and Empirical Issues, Journal of Housing Research Vol. 7 Issue 2, http://www.fanniemaefoundation.org/programs/jhr/pdf/jhr_0702_cho.pdf

Cutler, D.M., Poterba, J.M. and Summers, L.H., (1991), Speculative Dynamics, NBER working paper No. 3242 , Review of Economic Studies 58(3): 529-546

Debelle, G., (2004), Household debt and the macro economy, BIS Quaterly Review, http://www.bis.org/publ/qtrpdf/r_qt0403e.pdf

DiPasquale, D. and Wheaton, W.C., (1994), Housing Market Dynamics ad the Future of Housing Prices, Journal of Urban Economics 35, 1-27

Economist, (03.2002 and 11.2003), Surveys about property, www.economist.com

Eichengreen, B. and Mitchener, K., (2003), The Great Deperssion as a Credit Boom Gone Wrong, BIS Conference on Monetary stability, financial stability and the business cycle, http://www.bis.org/events/conf0303/eichmitch.pdf

Eicholtz, P.M.A, (1996), A Long Run House Price Index: The Herengracht Index 1628-1973, University of Limburg, Maastricht, NL and University of Amsterdam, NL, http://homepage.mac.com/rabbel/.Public/PDF's%20and%20Doc's/The%20Herengracht%20Index.pdf
Eicholtz, P. and Huisman, R., (1998), Busts in House Prices, http://ssrn.com/abstract=97288

Eitrham, Ø. And Erlandsen, S.K., (2004), House price indices for Norway 1819-2003, Norges Bank Occasional Papers No 35, http://www.norges-bank.no/stat/historiske_data/en/hms/c9.pdf

EC (European Commission), (2005), Focus: III. Housing markets and the business cycle in the euro area, Quaterly Report on the Euro Area, http://europa.eu.int/comm/economy_finance/publications/quarterly_report_on_the_euro_area/2005/report0205en.pdf

Elliott, J.W. and Echols, M.E., (1977), Expected Yield Curve Movements and Rational Term Structure Expectations: An Empirical Note: Comment, Journal of Money, Credit and Banking, Vol. 9, No. 1, Part 1, 90-96

Farlow, A., (2004a), UK house prices: A critical assessment (part 1), University of Oxford, http://www.economics.ox.ac.uk/members/andrew.farlow/Part2UKHousing.pdf
Farlow, A., (2004b), The UK house price bubble (part 2), University of Oxford, http://www.economics.ox.ac.uk/members/andrew.farlow/Part2UKHousing.pdf

Field, A.J., (1992). Uncontrolled Land Development and the Duration of the Depression in the United States, The Journal of Economic History, Vol. 52, No. 4, 785-805

Fu, Y. and Ng., L.K., (2000), Market Efficiency and Return Statistics: Evidence from Real Estate and Stock Markets Using a Present-Value Approach

Gallin, J., (2003), The Long-run relationship between house prices and incomes: evidence from local housing markets, Finance and Economics Discussion Series, No. 2003-17, Board of Governors of The Federal Reserve Systems, http://ssrn.com/abstract=410808
Gallin, J., (2004), The Long-Run Relationship between House Prices and Rents, FEDS Working Paper No. 2004-50, http://ssrn.com/abstract=633082

Garber, P.M., (2001), Famous First Bubbles, The Fundamentals of Early Manias, The MIT Press, Massachusetts Institute of Technology

Geanakoplos, J., Magill, M. and Quinzii, M., (2002 and revised edition 2004), Demography and the Long-Run Predictability of the Stock Market, http://ssrn.com/abstract=329840 and http://cowles.econ.yale.edu/P/cd/d13b/d1380-r.pdf

Girouard, N. and Price, R., (2001), House prices and economic activity, OECD Economics Department Working Papers, No. 279, http://www.olis.oecd.org/olis/2001doc.nsf/43bb6130e5e86e5fc12569fa005d004c/c1256985004c66e3c12569e00040f49a/$FILE/JT00101870.PDF
Girouard, N., Kennedy, M., Van den Noord, P. and André, C., (2006), Recent house price developments: The role of fundamentals, OECD Economics Department Working Papers, No. 475, http://www.olis.oecd.org/olis/2006doc.nsf/43bb6130e5e86e5fc12569fa005d004c/857e92111575744fc1257106002d97b6/$FILE/JT00197301.PDF

Glaeser, E. and Gyorko, J., (2003), The impact of building restrictions on housing affordability, Federal reserve Bank of New York Economic Policy Review, http://www.newyorkfed.org/research/epr/03v09n2/0306glae.pdf
Green, R. and Henderhott, P.H., (1996), Age, housing demand, and real house prices, Regional and Urban Economics 26 Issue 5, 465-480

Greenspan, A. (9.6.2005), Testimony of Alan Greenspan, The Federal Reserve Board, http://www.federalreserve.gov/boarddocs/testimony/2005/200506092/default.htm
Greenspan, A., (26.9.2005), Remarks by Chairman Alan Greenspan, The Federal Reserve Board, http://www.federalreserve.gov/boarddocs/speeches/2005/200509262/default.htm

Hakfoort, J and Matysia, G. (1997), Housing Investment in the Netherlands, Economic Modelling 14, p. 501-516.

Heath, R., (2005), Real estate prices as financial soundness indicators, BIS Papers No. 21, http://www.bis.org/publ/bppdf/bispap21b.pdf

Helbling, T., (2005), Housing Price Bubbles – A tale base don Housing Price Booms and Busts, BIS Papers, No. 21, Real Estate indicators and Financial Stability, http://www.bis.org/publ/bppdf/bispap21d.pdf

Herring, R. and Wachter, S., (2002), Bubbles in Real Estate Markets, http://realestate.wharton.upenn.edu/newsletter/bubbles.pdf

Himmelberg, C.P., Mayer, C.J. and Sinai, T.M., (2005), Assessing High House Prices: Bubbles, Fundamentals, and Misperceptions, NBER Working Paper No. W11643, http://ssrn.com/abstract=812017

Holly, S. and Jones, N. (1997), House prices since 1940's: Cointegration, demography and assymetrics, Economic modelling 14, p. 549-565

IMF, (2003), When bubbles burst, World Economic Outlook, http://www.imf.org/External/Pubs/FT/weo/2003/01/pdf/chapter2.pdf

Issing, O. (2003), Monetary and Financial stability: Is there a trade off?, Address at the Conference on Monetary stability, Financial stability and the Business Cycle, Bank for International Settlements, Basle, http://www.bis.org/publ/bispap18.pdf

Jacobsen, D. and Naug, B., (2005), What drives house prices?, Norges Bank Economic Bulletin, No. 05 Q1, http://www.norges-bank.no/english/publications/economic_bulletin/2005-01/jacobsen.pdf

Kindleberger, C., (1987), Bubbles, The New Palgrave: A Dictionary of Economics, John Eatwell, Murray Milgate, and Peter Newman, eds., New York: Stockton Press

Krainer, J. and Wei, C., (2004), House Prices and Fundamental Value, FRBSF Economics Letter, http://www.frbsf.org/publications/economics/letter/2004/el2004-27.pdf
Krainer, J., (2005), Housing Markets and Demographics, FRBSF Economics Letter, http://www.frbsf.org/publications/economics/letter/2005/el2005-21.pdf

Labonte, M., (2003), Is There a Bubble in Housing? New Evidence from 210 Housing Markets, Report for Congress, OFHEO (Office of Federal Housing Enterprise Oversight)

Laing, J.R., (2005), The Bubble's New Home, Barons online, http://online.barrons.com/article/SB111905372884363176.html

Lereah, D., (2005), Are you missing the real estate boom?, Doubleday

Maclennan, D., Muellbauer, J. and Stephens, M., (1998), Asymmetries in housing and financial market institutions and EMU, Oxford review of economic policy, Vol. 14. 3

Malpezzi, S. and Maclennan, D., (1994), The price elasticity of supply of new housing in the US and the United Kingdom
Malpezzi, S., (1999), A Simple Error Correction Model of House Prices, Journal of Housing Economics Vol. 8, issue 1 27-62
Malpezzi, S. and Wachter, S.M., (2002), The Role of Speculation in Real Estate Cycles, http://www.bus.wisc.edu/realestate/pdf/pdf/Speculation%20in%20Real%20Estate%20and%20Cycles%20June%2026%202002.pdf
Mankiw, N.G and Weil, D.N., (1989), The Baby Boom, the Baby Bust, and the Housing Market, Regional Science and Urban Economics 19, 235-258.

McCarthy, J. and Peach, R.W., (2004), Are Home Prices the Next "Bubble"?, http://www.newyorkfed.org/research/epr/04v10n3/0412mcca.pdf

Miles, D., (1994), Housing, financial markets and the wider economy, John Wiley & Sons

Miller, M.H., Weller, P.A. and Zhang, L., (2002), Moral Hazard And The U.S. Stock Market: Analyzing The 'Greenspan Put'?, Institute for International Economics Working Paper No. 02-01. http://ssrn.com/abstract=300896

Muellbauer, J., (1992), Anglo-German differences in housing market dynamics, European economic review 36, p. 539-548
Muellbauer, J. and Murphy, A., (1997), Booms and busts in the UK housing market, The Economic Journal, 107, http://www.housingoutlook.co.uk/Papers/boomsandbusts.pdf

Nakamura, R., (2002), The big cleanse: The Japanese response to the financial crisis of 1990's seen from a Nordic perspective, The European Institute of Japanese Studies, Working paper No. 149, http://web.hhs.se/eijswp/149.pdf

National Association of Home Builders, (2004), Housing Facts, Figures and Trends 2004, http://www.nahb.org/fileUpload_details.aspx?contentTypeID=7&contentID=20

Nielsen, H.B., (2005), Cointegration and common trends, http://www.econ.ku.dk/metrics/Econometrics2_05_II/LectureNotes/Cointegration.pdf

OECD, (2004), Housing Markets, Wealth and the Business Cycle, Economic Outlook, No. 75, http://www.oecd.org/dataoecd/4/60/31920338.pdf

Ortalo-Magné, F. and Rady, S., (1998), Boom In, Bust Out: Young Households and the Housing Price Cycle, http://ssrn.com/abstract=137961
Ortalo-Magné, F. and Rady, S., (2005), Housing market dynamics: On the contribution of income shocks and credit constraints, http://www.restud.org.uk/PDF/10_2005/8413finalversion.pdf

Otrok, C. and Terrones, M., (2005), House Prices, Interest Rates and Macroeconomic fluctuations, IMF, http://europa.eu.int/comm/economy_finance/events/2005/bxlworkshop2111/contributions/terrones_en.pdf

Poterba, J., (1984), Tax Subsidies to Owner-Occupied Housing: An Asset-Market Approach., The Quarterly Journal of Economics, Vol. 99, No. 4, 729-752
Poterba, J., (1992), Taxation and housing: Old questions, new answers, American Economic Review, Vol. 82, No. 2.

Quigley, J. and Raphael, S., (2004), Is housing unaffordable? Why isn't it more affordable?, Journal of Economic Perspective, Vol. 18., No.1, http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1047&context=iber/bphup

Riiser, M.D., (2005), Boligpriser, aksjekurser, investeringer og kredit – hva sier de om bankkriser? En historisk analyse på norske data, Norges Bank, Penger og kreditt, http://www.norges-bank.no/publikasjoner/penger_og_kreditt/2005-02/riiser.pdf

Scanlon, K. and Whitehead, C., (2004), International trends in housing tenure and mortgage finance, Council of Mortgage Lenders Research, London School of Economics, http://www.cml.org.uk/cml/media/press/94

Schnurre, C., (2005), Boom-bust Cycles in Housing: The changing role of financial structure http://www.imf.org/external/pubs/ft/wp/2005/wp05200.pdf

Shiller, R., (2000), Measuring Bubble Expectations and Investor Confidence, http://cowles.econ.yale.edu/P/cp/p10a/p1004.pdf
Shiller, R., (2000ie), Irrational Exuberance and www.irrationalexuberance.com
Shiller, R., (2001), Bubbles, Human Judgement, and Expert Opinion, http://cowles.econ.yale.edu/P/cd/d13a/d1303.pdf

Shiller, R., (2002), From Efficient Market Theory to Behavioural Finance, http://cowles.econ.yale.edu/P/cd/d13b/d1385.pdf
Shiller, R., (2004), Household Reaction to Changes in Housing Wealth, http://cowles.econ.yale.edu/P/cd/d14b/d1459.pdf
Shiller, R. and Weiss, A., (1998), Moral Hazard in Home Equity Conversion, http://cowles.econ.yale.edu/P/cd/d11b/d1177.pdf

Shiratsuka, S., (2005), Asset Price Bubble in Japan in the 1980's: Lessons for Financial and Macroeconomic Stability, IMES (Institute for Monetary ad Economic Studies), http://www.imes.boj.or.jp/english/publication/edps/2003/03-E-15.pdf

Smant, D.J.C., (2000), Famous First Bubbles, Erasmus School of Economics Rotterdam, http://www.few.eur.nl/few/people/smant/m-economics/tulipmania.htm

Smith, M.H., Smith, G. and Thompson, C., (2005), When is a housing bubble not a housing bubble?, http://www.economics.pomona.edu/GarySmith/SoCalHousingBubble.pdf

Smithers, A. and Wright, S., (2002), Stock Markets and Central Bankers: The Economic Consequences of Alan Greenspan, http://www.econ.bbk.ac.uk/faculty/wright/pdf/The%20Economic%20Consequences%20of%20Alan%20Greenspan.PDF

Stapledon, N.D., (2004), Long run yields in residential property: structural decline or cyclical overshoot? A question of tax?, http://www.nzae.org.nz/conferences/2004/33_Stapledon.pdf

Steimetz, S., (1999), Bubbles, Bulps, Bytes & Bonds, San José State University, USA, http://www.ags.uci.edu/~ssteimet/bubbles.htm

Stephansen, K. and Koster, M., (2005), Housing valuations: no bubble apparent, BIS Paper No. 21, http://www.bis.org/publ/bppdf/bispap21i.pdf

Stiglitz, J.E, (1990), Symposium on Bubbles, The Journal of Economic Perspectives, Vol. 4, No. 2, 13-18

Summers, L.H., Bosworth, B.P., Tobin, J. and White, P.M., (1981), Taxation and Corporate Investment: A q-Theory Approach, Brookings Papers on Economic Activity, Vol. 1981, No. 1, 67-140

Sutton, G., (2002), Explaining changes in house prices, BIS Quaterly Review, http://www.bis.org/publ/qtrpdf/r_qt0209f.pdf

Thornton, M., (2003), Skyscrapers and Business Cycles http://www.mises.org/journals/scholar/Thornton4.pdf
Thornton, M., (2004), Who Predicted the Bubble? Who Predicted the Crash?, http://www.mises.org/journals/scholar/Thornton6.pdf

Tobin, J., (1969), A General Equilibrium Approach To Monetary Theory, Journal of Money, Credit and Banking, vol. 1, pp. 15-29

Tsatsaronis, K. and Zhu, H., (2004), What drives housing price dynamics: Cross country evidence, BIS Quaterly Review, Bank for International Settlements, http://www.bis.org/publ/qtrpdf/r_qt0403f.pdf

Verbeek, M., (2005), A guide to Modern Econometrics, John Wiley & Sons, Ltd

Verbruggen, J. and Kranendonk, H., (2005), Welke factoren bepalen de ontwikkeling van de huizenprijs in Nederland? (including english summary), Central Planbureau, http://www.cpb.nl/nl/pub/cpbreeksen/document/81/doc81.pdf

Von Peter, G., (2004), Asset prices and banking distress: a macroeconomic approach, BIS Working Papers No. 167, http://www.bis.org/publ/work167.htm

Wood, R., (2005), A comparison of UK residential house price indices, BIS Papers No. 21, http://www.bis.org/publ/bppdf/bispap21p.pdf

Zhu, H., (2005), The importance of property markets for monetary policy and financial stability, BIS paper No. 21, http://www.bis.org/publ/bppdf/bispap21c.pdf

Appendix

Appendix A – Explanation of the dynamics in the face diagram

$$\dot{q}_t = -R(\bar{H}_t) + vq_t \qquad (3)$$

$$\dot{\bar{H}}_t = I(q)H \qquad (4)$$

Above $\dot{q}_t$ =0

At any point above $\dot{q}_t$ =0 indicated by the line aa and the arrows A and D.

Equation (3) secures that $\dot{q}_t$ for any given value of H_t will be larger than 0. An investor would be willing to take over the full give housing stock $\bar{H}_t$ if he expects that the prices will increase more, whereas the investor would buy the asset today with the expectation of increasing prices tomorrow. This is the case of a speculative housing bubble where prices will go towards infinity.

At any point below $\dot{q}_t$ =0 indicated by the line aa and the arrows B and C.

Equation (3) secures that $\dot{q}_t$ for any given value of H_t will be smaller than 0. Investors expect capital losses tomorrow, whereas the demand for housing stock $\bar{H}_t$ would decrease. Prices will fall and this will initiate a reinforcing process with prices going towards 0.

Below H_t =0

At any point below H_t =0 indicated by the line bb and the arrows A and B.

Equation (4) secures that H_t for any given value of q_t will be smaller than 0. The aggregated investment is smaller than what is needed to keep up the existing housing stock, which makes the housing stock H_t fall.

At any point above H_t =0 indicated by the line bb and the arrows C and D.

Equation (4) secures that H_t for any given value of $\dot{q}_t$ will be larger than 0. Very similar to the case above then the aggregated investment, because of the high $\dot{q}_t$ on the existing housing stock, is larger than what is needed to keep up the existing housing stock, which makes the housing stock H_t increase (capital is accumulated).

Appendix B – Overview of data

Norway

Variable	Year	Details	Source	Link
House Prices	-1995	Price indices, compiled, Property registers (4 cities)	Norges Bank	http://www.norgesbank.no/ Historical Statistics, Chapter 9
	1995-	House Price index for 'borettslagsboliger'	Statistics Norway, StatBank	www.ssb.no
GDP	-2003		Norges Bank	http://www.norgesbank.no/ Historical Statistics, Chapter 6
	2003-		Statistics Norway, StatBank	www.ssb.no
Rent	-1995		JBM	
	1995-	Konsumprisindeks, Husleie, inkl. Fritidsbolig	Statistics Norway, StatBank	www.ssb.no
Construction Costs	-1950	'Enebolig av tre Detached houses of wood' Lineary Interpolation (every 5. years)	Statistics Norway, 'Historisk statistikk' 1994, (17)	www.ssb.no
	1950-	'Byggekostnadsindeks for enebolig av tre'	Statistics Norway, StatBank	www.ssb.no
CPI			Norges Bank	http://www.norgesbank.no/ Historical Statistics, Chapter 3
Interest rate	-1945	Hypoteksbank long bond		
	1946-2003	S10-15 Government long bond with maturity y		
	Except 1989-1992, 95, 97	S8 Government long bond with maturity y		
	2004	S10 Government long bond with maturity y		

The Netherlands

Variabel	Year	Details	Source	Link
House Prices	-1959	City center of Amsterdam.	Herengracht index	ssrn.com/abstract=598
	1960-1969		JBM, BIS	
	1970-		OECD, JBM	www.oecd.org
GDP	-2004	Tweehondred jaar statistiek in tijdreeksen	Statistics Netherlands	www.cbs.nl
Rent	-1958	CPI	Statistics Netherlands	www.cbs.nl
	1958-		JBM	
Construction Costs	-1939	Bouwnijverheid en bouwinstallatiebedr. Toegevoegde waarde (bruto, marktprijzen)		
	1940-1980	CPI	Statistics Netherlands	www.cbs.nl
	1981-1994	Housing construction total output price index; Index	UNECE United Nations Economic Commission for Europe	http://w3.unece.org/stat/ Human Settlements, Catalog, Netherlands
	1995-	New dwellings; Input indices Total building costs	Statistics Netherlands	www.cbs.nl
CPI	-2004	Tweehondred jaar statistik in Tijdreeksen	Statistics Netherlands	www.cbs.nl
Interest rate	-1991	Governmental Bonds, Rentestanden, Lange Rente		
	1992-2003	Governmental Bonds, Five longest term	Nederlandsche Bank	www.dnb.nl Statistics, interest rates, market interest rates
	2004	Governmental Bonds, Latest ten year	Nederlandsche Bank	www.dnb.nl Statistics, interest rates, market interest rates

For all countries it has been necessary to splice time series data together when combining different sources over time. The data has been indexed using 1995 as base year.

United Kingdom

Variabel	Year	Details	Source	Link
House Prices	-2004	Simple average house prices	Office of the Deputy Prime Minister	www.odpm.gov.uk
GDP	-2004	IHYP – GDP	National Statistics UK	www.statistics.gov.uk Statbase
Rent	-1962	CPI	Economic History Services website	http://eh.net/hmit
	1963-2004	ADFT – Actual rentals for housing	National Statistics UK	www.statistics.gov.uk Statbase
Construction Costs	-2004	An index of Building Costs in the United Kingdom-2004	K. Mayweld, (second series) VII, 2 (1954)	www.dti.gov.uk
CPI	-2004	Inflation Rate	Economic History Services website	http://eh.net/hmit
Interest rate	-1980	U.K. Long-Term Interest Rate, Consistent Series	Economic History Services website	http://eh.net/hmit
	1981-2004	Annual average of Bank of Englands Repo rate	Bank of England	www.bankofengland.co.uk Statistics, Interest rates, Wholesale

USA

Variabel	Year	Details	Source	Link
House Prices	-1880	Chapter E, Prices and Price Indexes	Historical Statistics of the USA	
	1881-1912	Chapter E, Prices and Price Indexes	Historical Statistics of the USA	
	1913--1969	Chapter E, Prices and Price Indexes	Historical Statistics of the USA	
	1970-2004	CHMPI - Conventional Mortgage Home Price Index		http://www.freddiemac.com/finance/cmhpi/
GDP		Real GDP	Economic History Services website	http://eh.net/hmit/
Rent	-1958	Annual averages for housing	Statistical Abstract of the US, '59	http://www.census.gov/ Table 433, p. 336
	1959-1994	CPI Rent	JBM	
	1995-2004	Rent of primary residence, City average	US Department of Labor,	www.bls.gov/data Bureau of Labor statistics
Construction Costs	1908-1963	Construction Cost Index History	ENR – Engineering news record	www.enr.com
	1964-2004	Price Index of New One-Family Houses	Construction Price Indexes	www.census.gov
CPI	CPI	Chapter E, Prices and Price Indexes	Historical Statistics of the USA, JBM	
Interest rate	-2004	Long Government bond, 10y	Robert Shiller	http://www.econ.yale.edu/~shiller/data.htm

Appendix C– Overview of price increases and decreases

Detailed overview of price increases and decreases

	N		NL		UK		USA	
	Increase	**Decrease**	**Increase**	**Decrease**	**Increase**	**Decrease**	**Increase**	**Decrease**
Year	1993-2005		1992-2005		1995-2005		1994-2005	
Length	12		13		10,00		11,00	
Annual change	7,33		6,81		8,27		5,05	
Year	1977-1988	1988-1993	1986-1991	1991-1992	1982-1989	1989-1995	1982-1989	1989-1994
Length	11	5	5	1	7	6	7	5
Annual change	6,42	-10,67	3,99	-3,24	7,61	-1,35	2,02	-1,52
Year	1955-1973	1973-1977	1954-1979	1979-1986	1977-1980	1980-1982	1975-1978	1978-1982
Length	18	4	25	7	3	2	3	4
Annual change	2,72	-3,29	4,98	-9,66	6,66	-10,12	5,26	-4,47
Year					1954-1973	1973-1977	1933-1973	1973-1975
Length					19	4	40	2
Annual change					4,77	-9,92	1,02	-3
Year	1945-1950	1950-1955	1940-1946	1946-1954	1942-1947	1947-1954		
Length	5	5	6	8	5	7		
Annual change	2,2	-6,79	5,18	-5,91	8,87	-4,98		
Year	1922-1934	1934-1945	1914-1930	1930-1940	1937-1939	1939-1942		
Length	12	11	16	10	2	3		
Annual change	5,43	-4,04	1,35	-5,15	1,13	-6,17		
Year						1931-1937		1922-1933
Length						6		11
Annual change						-3,56		-4,44
Year	1906-1915	1915-1922	1896-1906	1906-1914			1895-1922	
Length	9	7	10	8			27	
Annual change	1,41	-8,8	2,26	-2,83			2,44	
Year	1885-1899	1899-1906	1848-1888	1888-1896				1872-1895
Length	14	7	40	8				23
Annual change	4,5	-3,62	2,26	3,31				-1,18
Year	1865-1879	1879-1885					1861-1872	
Length	14	6					11	
Annual change	5,96	-2,86					3,79	
Year	1848-1860	1860-1865						1851-1861
Length	12	5						10
Annual change	7,25	-6,32						-0,51
Year	1841-1847	1847-1848	1832-1846	1846-1848				
Length	6	1	14	2				
Annual change	9,02	-38,68	3,2	-8,85				
Year	1833-1839	1839-1841						
Length	6	2						
Annual change	5,93	-9,68						
Year	1820-1827	1827-1833	1816-1826	1826-1832				
Length	7	6	10	6				
Annual change	13,22	-11,71	6,8	-7,24				

Year			1802-1810	1810-1816				
Length			8	6				
Annual change			3,99	-12,47				
Year			1792-1794	1794-1802				
Length			2	8				
Annual change			9,35	-10,36				
Year			1776-1780	1780-1792				
Length			4	12				
Annual change			6,5	-2,95				
Year			1760-1766	1766-1776				
Length			6	10				
Annual change			5,39	-1,57				
Year			1744-1757	1757-1760				
Length			13	3				
Annual change			2,48	-7,19				
Year			1726-1734	1734-1744				
Length			8	10				
Annual change			5,3	-6,05				
Year			1712-1724	1724-1726				
Length			12	2				
Annual change			5,02	-6,66				
Year			1694-1704	1704-1712				
Length			10	8				
Annual change			2,21	-3,95				
Year			1686-1692	1692-1694				
Length			6	2				
Annual change			6,53	-12,45				
Year			1678-1682	1682-1686				
Length			4	4				
Annual change			18,28	-10,17				
Year			1668-1672	1672-1678				
Length			4	6				
Annual change			7,24	-12,87				
Year			1664-1666	1666-1668				
Length			2	2				
Annual change			15,78	-19,63				
Year			1652-1662	1662-1664				
Length			10	2				
Annual change			4,05	-12,56				
Year			1646-1648	1648-1652				
Length			2	4				
Annual change			10,34	-5,27				
Year			1636-1644	1644-1646				
Length			8	2				
Annual change			10,54	-8,84				
Year			1630-1634	1634-1636				
Length			4	2				
Annual change			2,08	-26,94				

Appendix D – Size of price increases and decreases

Aggregated real house prices changes

	N		NL		UK		USA	
	Increase	**Decrease**	**Increase**	**Decrease**	**Increase**	**Decrease**	**Increase**	**Decrease**
			112,7	-46,6				
			120,3	-15,9				
			21,7	-19,5				
			48,7	-23,5				
			34,0	-35,4				
			32,3	-56,2				
			95,7	-34,8				
			46,1	-23,4				
			24,4	-27,6				
			79,9	-12,9				
			51,2	-46,4				
			37,5	-20,1				
			37,0	-14,6				
	137,0	-52,6	28,7	-30,2				
	41,2	-18,4	19,6	-58,3				
	67,9	-38,7	36,8	-55,0				
	131,5	-27,8	93,1	-36,3				
	125,1	-16,0	55,7	-16,9				
	85,2	-22,8	144,0	-23,6	11,8	-19,5		-5,0
	13,5	-47,6	25,0	-20,5	27,3	-17,4	51,6	-24,0
	88,7	-36,4	24,0	-41,1	52,9	-30,1	91,7	-39,4
	11,5	-29,6	35,5	-38,6	142,3	-34,2	137,9	-5,9
	62,2	-12,5	236,9	-50,9	21,3	-19,2	16,6	-16,7
	98,2	-43,1	21,6	-3,2	67,1	-7,8	15,0	-7,4
	133,6		125,5		121,4		72,1	
Mean	83,0	-31,4	63,5	-31,3	63,5	-21,4	64,1	-16,4
Interval	[11,5;137,0]	[-52,6;12,5]	[19,6;236,9]	[-58,3;-3,2]	[11,8;142,3]	[-34,2;-7,8]	[15,1;137,9]	[-39,4;-5,0]

Appendix E - Statistical measures

Correlation coefficient

The correlation coefficient between *x* and *y* is given by: $r_{xy} = \frac{\sum_{t=1}^{T}(x_t - \bar{x})(y_t - \bar{y})}{\left[\sum_{t=1}^{T}(x_t - \bar{x})^2 \sum_{t=1}^{T}(y_t - \bar{y})^2\right]^{½}}$

It describes how well to variables follow each other and will in this thesis be considered as a base of the LR equilibrium.

R^2 - Squared multiple correlation coefficient

R^2 is the proportion of the variance of the dependent variable which is explained by the variables in the regression. By adding more variables to a regression, R^2 will never decrease, and it may increase even if nonsense variables are added. Hence, R^2 may be misleading. Also, R^2 is dependent on the choice of transformation of the dependent variable (for example, p versus Δp) -- as is the F-statistic below. The equation standard error, σ, however, provides a better comparative statistic because it is adjusted by the degrees of freedom.

Residual sum of squares (RSS)

$$RSS = \sum_{t=1}^{T} \hat{u}_t^2$$

F-test

$$F(k-1, T-k) \sim \frac{R^2/(k-1)}{(1-R^2)/(T-k)} = \eta_\beta$$

The null hypothesis is that the population R^2 is zero, or that all the regression coefficients are zero (excluding the intercept). The value for the F-statistic is followed by its probability value between square brackets. F-tests are shown as: F(num,denom) = Value [Probability] /*/**, where the test statistic has an F-distribution with x degree of freedom in the numerator and y in the denominator. The probability of getting a value or larger is printed beside. Significant outcomes at a 1%-level are shown by two stars. 5% will appear with one star.

Log-likelihood

$l_c(\beta \mid y, X) = K_c - T/2 \log RSS/T$, where $K_c = -T/2(1 + \log 2\pi)$

Durbin Watson test (DW)

This is a test for autocorrelated residuals and is calculated as:

$$DW = \frac{\sum_{t=2}^{T} (\hat{u}_t - \hat{u}_{t-1})^2}{\sum_{t=1}^{T} \hat{u}_t^{\,2}}$$

DW is most powerful as a test of (u_t) being white noise against:

$u_t = \rho u_{t-1} + \varepsilon_t$, where $\varepsilon_t \sim IID(0, \sigma_z^2)$

If 0<DW<2, then the null hypothesis is H_0: ρ =0, that is, zero autocorrelation (so DW=2) and the alternative is H_1: ρ >0, that is, positive first-order autocorrelation.

If 2<DW<4, then H_0: ρ =0 and H_1: ρ <0, in which case DW*=4-DW should be computed.

The significance values of DW are widely recorded in econometrics' textbooks. However, DW is a valid statistic only if all the x_t variables are non-stochastic, or at least strongly exogenous. If the model includes a lagged dependent variable, then DW is biased towards 2, that is, towards not detecting autocorrelation.

(Nielsen, 2005 and Verbeek, 2005).

Appendix F – Dickey-Fuller tests

Critical Dickey-Fuller values for each country depending on number of observations

Country	Level	Without trend	With trend
N	1% - level	-3.47	-4.01
(182 obs)	5% - level	-2.88	-3.44
NL	1% - level	-3.45	-3.99
(370 obs)	5% - level	-2.87	-3.42
UK	1% - level	-3.52	-4.09
(73 obs)	5% - level	-2.90	-3.47
USA	1% - level	-3.47	-4.02
(149 obs)	5% - level	-2.88	-3.44

Critical Dickey-Fuller values for all countries 1970-2004

	Level	Without trend	With trend
N, NL, UK and USA	1% - level	-3.63	-4.24
(35 obs)	5% - level	-2.95	-3.54

Appendix G – Residents and arable land

	N	NL	UK	US
Residents (mio.)	4593041	16407491	60441457	295734134
Land (km_2)	307860	33833	241590	9161923
Residents per land (mio. per km_2)	15	485	250	32
Share of arable land (%)	3	28	24	19
Arable land (km_2)	8836	9365	57184	1771000
Residents per arable land (mio. per km_2)	520	1752	1057	167

http://www.cia.gov/cia/publications/factbook/geos

Appendix H – Characteristics of the housing market

Homeownership rates and characteristics of debt

	Homeownership rate	Average LTV of new loans (%)	Typical amortization period	Mortgage Debt / GDP 2004
N	77	70	15-20	63
NL	53	87	30	105
UK	70	75	25	75
USA	69	80	30	69

Source. Aherne (2005)

Appendix I – Stock market vs. Housing market

Size of the housing market relative to the stock market

	Number of Banks with data	Total	Multiple of Market Cap	Multiple of Equity
NL	3	405	3.6	7.3
UK	21	237	1.8	2.7

Source: Aherne (2005)