Swedish house prices in an international perspective

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The paper aims to assess which factors can explain the development of house prices. Can prices be explained by fundamental factors of demand and supply and, if so, which are the most important fundamentals? Or, do house and apartment prices tend to deviate from fundamentals due to irrational expectations or other factors? What is the importance of institutional factors like taxes and credit market conditions? The focus is on understanding the rapid increase of Swedish house prices in recent years. We show that much of the price increase can be explained by the decrease of after-tax capital costs due to falling real interest rates and a reduction of the Swedish taxation of the returns to owner-occupied housing. Further, the value of owner-occupied housing services has increased beyond the increase in rental apartment rents as a result of a lack of new construction. Understanding why housing supply has been so little affected by the increase in house prices remains a challenge for future studies.

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The house price boom that started in the mid 1990s is unprecedented in recent history, both in length and magnitude. Figure 1 illustrates the price development for a selection of countries. In all cases, prices more than doubled between 1995 and the peak in 2007-08. In Great Britain house prices increased more than four-fold and in Spain and Norway more than three-fold. After 2008, prices have come down in some countries but continued to increase in others, including Sweden. This report aims to assess which factors can explain the development of house prices. Can prices be explained by fundamental factors of demand and supply and, if so, which are the most important fundamentals? Or, do house and apartment prices tend to deviate from fundamentals due to irrational expectations or other factors? What is the importance of institutional factors like taxes and credit market conditions? The focus is on understanding the development of Swedish house prices, particularly in recent years, but we will draw on lessons from international research and make comparisons with the development in other countries.

As a background, the first section discusses briefly a number of stylized facts about house prices: (i) house prices tend to increase in real terms over the long run, (ii) house price changes are cyclical and positively correlated with the general business cycle, (iii) house price changes are predictable; price increases above trend tend to be followed by further price increases in the short run but over the longer term house prices tend to revert towards the trend, (iv) house price changes are generally positively correlated across countries, (v) house price changes are positively correlated across different types of dwellings and across regions within a country, (vi) house price changes are positively correlated with market liquidity (the number of sales).

Houses have the double characteristic of being both durable consumption goods and assets. It is crucial to distinguish between the price of the housing services – corresponding to the rent that a renter would pay to his landlord – and the price of the house itself. There are hence two questions to answer. First, what determines the value of housing services? Second, what determines the price of the asset that gives the owner the right to these services, today and in the future? The answer to the latter question depends on the rate of return that the typical home buyer requires on her investment, or expressed differently the costs of funding for a typical home investment. This question will be discussed in Section 2. In section 3, the perspective switches to the fundamental determinants of the price of housing services, that is the factors that affect the supply and demand of housing services.

The market's willingness to pay for a house depends on the capital costs of holding the house and the costs of operating and maintaining the house in order to "produce" housing services. The sum of these costs defines the user cost of housing. Capital costs depend on mortgage interest rates, borrowing opportunities, capital gains expectations and taxes. These costs have fallen dramatically over

the last couple of decades as a result of lower interest rates and easier access to borrowing. In Sweden, reduced housing taxation has further contributed to reducing the user cost of housing. With reduced user costs homebuyers can afford paying higher house prices. The question is how much higher. To provide a benchmark, we measure the value of housing services by apartment rents. We may then compare the ratio of rent to price with the development of user cost. As it turns out the user cost and the rent-to-price ratio in Sweden track each other quite closely from the mid 1980s until today. This suggests that, taking rents as given, the gradual reduction of user cost can explain almost all of the price increase from the trough of the house price cycle in the mid 1990s until today. This conclusion comes with some caveats relating to capital costs, expectations and borrowing constraints. Discussing these factors separately, we still conclude in Section 2 that the development of user cost – essentially the sharp reduction of the real interest rate – can fully explain the sharp increase in the ratio of house prices to rents. This is mainly discussed in the Swedish context, but the decrease of real interest rates has been a world-wide phenomenon.

We next ask, in section 3, what determines the cost of housing services and look at the determinants of demand and supply. The discussion combines a selective survey of the international research literature with a more specific discussion of Swedish developments. On the demand side, the evidence from numerous empirical studies indicates that the demand for housing services increases roughly in proportion to income, i.e. the income elasticity of demand is around unity. In contrast, demand appears to be quite insensitive to variations in rent; the price elasticity seems to be below unity. This means that if supply does not keep track with demand increases due to income and other fundamentals, the price change needed to maintain balance between demand and supply may be substantial. In other words, the price sensitivity of housing supply is a crucial factor that determines the link between fundamentals and housing prices. It is generally agreed that supply, in particular in the short run, is quite inelastic with regard to house prices. Looking at Swedish data, the response of construction to the sharp increase in house prices in recent years has been very modest. Supply has not increased enough to keep pace with demand and this can explain an increase in the shadow rent of owner-occupied housing beyond the modest increase in rental apartment rents. Understanding why there is so little supply response even to quite dramatic price changes is a key issue for a better understanding of housing markets, in Sweden and other countries.

1. Stylized facts about house prices

In this introductory section, we will briefly state and discuss some general features of house prices that are common to most housing markets, across different countries as well as over different time periods. In order to do this, it is necessary to take a longer time perspective. Figures 2a and 2b depict the development of inflation-adjusted prices of owner-occupied homes since the 1970s and 1980s for a number of these countries, and Figure 3 shows the corresponding development across different regions in Sweden. A number of features of house prices are apparent.[1]

Real house prices have been increasing trend-wise over the last 40 years

All countries record an increase in the house price index between the starting and end point of the data series. To take a few examples based on Figure 2, the average rate of yearly price increase over the 30-year period 1978-2008 was 4.1 percent in Great Britain, 3.6 percent in Spain, 3.1 percent in the Netherlands, 2.5 percent in Norway, 2.1 percent in Finland, 1.7 percent in Denmark, 1.2 percent in Sweden and 1.1 percent in the United States. The main underlying reason for this increase is in all likelihood related to urbanization and the growth of population and income levels. With a large and increasing number of ever richer households living in cities, an increased demand for housing will increase the pressure on centrally located land. For the United States, the share of land in the price of the average home increased from 32 percent in 1984 to 50 percent in 2004 (Davis and Palumbo, 2008). Looking across countries, house prices in densely populated countries, where the land component is more important, have generally risen faster than prices in more sparsely populated countries. But that tendency is not without exceptions, with high rates of increase in relatively sparsely populated countries like Spain and Ireland.

The role of land prices is even more apparent when comparing different regions in a single country. Figure 3 shows the development of real house prices across the main Swedish regions. In the major metropolitan areas of Stockholm, Göteborg and Malmö, the 2010 price level is around two and a half time as high as in the early 1980s, whereas prices have hardly increased at all in the sparsely populated parts of the country where population is declining and the cost of land is a negligible part of house prices. Note that Malmö, which is getting more and more integrated with Copenhagen, has had the highest price growth of all regions.

The recent 40 years are special in some respects. In particular, the deregulation of credit markets in most countries have made owner-occupied housing more

1 The price indexes underlying Figures 1 and 2 have been compiled by BIS. The indexes generally refer to owner-occupied one-family houses. The discussion in the paper is perfectly general, however, and applies in principle to all kinds of owner-occupied housing including apartments. In the text, I will use the term houses throughout.

broadly attractive and may have lead to an increase in the price level more as a result of a transition between two regimes than as an expression of a long-run trend. For this reason, a longer time perspective on house prices is warranted. Such data are only available from a few countries: Eichholtz for Amsterdam houses starting in the 17th century, Eitrheim and Erlandsen for Norway starting in the 19th century, Stapledon (2010) for Australia starting in 1880, and Shiller (2005) for US prices from around 1900. Broadly speaking, these studies indicate that real house prices have been close to constant over long periods. It is, for example, striking that U.S. house prices fell by a third during the inter-war period.[2] The problems of constructing a price index, controlling for quality, is particularly serious over the long term (see the appendix for a brief overview of techniques for constructing house price indexes). Hence, these long-term trends need to be taken with a grain of salt.

House prices move in long cycles

For most countries there are well-identified turning points of the house price cycle – for Sweden peaks in 1979 and 1989-91 and troughs in 1985-86 and 1993-96. In a recent study Agnello and Schuknecht (2009) identify such turning points for 18 developed countries covering the period 1970-2007. Peaks and troughs are identified by a sign change in the first difference of data that are filtered in order to remove the trend. Interestingly, the current Swedish boom starting in 1997 stands out as the longest (11 years) of all booms that the authors identify. They also find it to be the severest, with a cumulative price increase of 67 percent above trend counted from start to peak. Whereas the particular definition of severity used by the authors may be discussed, this highlights an important lesson. Due to the strong cyclicality of house prices, the time period considered in any international comparison has a decisive impact on the results. Most comparisons look over a shorter horizon than the three decades covered in Figure 2 and end up with very different rankings. As an example, looking at the period 1995-2008 would yield a yearly rate of real price increase in Sweden of 6.6 percent, second only to Ireland with 7.8 percent per year.

House prices are predictable

The observed cyclicality indicates that house prices are predictable in the short and medium run. Several studies have established a strong autocorrelation in the rate of house price change. The first-order autoregressive coefficient in yearly data may be on the order of 0.4 (see e.g. Englund and Ioannides, 1997), quite high relative to typical financial assets. It is, hence, rational to extrapolate recent price changes

2 Shiller (2007) has taken the long-run constancy of U.S. house prices as an indicator that the post-2000 development – leading to an all-time-high ratio of house prices to income – represents a "bubble".

into the (near) future. On the other hand, there is also a tendency for house prices to revert towards their trendwise development in the longer run. This has been confirmed in numerous studies that will be briefly discussed in section 3.5 below. Hence, while increasing house prices can be expected to continue to increase for a while, the house price level will tend to revert towards trend eventually.

The strong predictability of house price changes may suggest that the housing market is not informationally efficient. It appears that one could make money by buying when prices are rising and when prices are low relative to the long-run trend and selling when prices are falling and when they are high relative to trend. This conclusion does not follow immediately, however. First, the capital gain is only part of the return to housing. The other part is the value of the housing services generated by the dwelling, the rent that the homeowner as a consumer of housing services "pays" to himself in his capacity of the owner of the house. Unfortunately, this implicit rent is hard to measure with any accuracy, in particular in a country like Sweden where access to the rental market is rationed for most households. Second, the potential gains are limited by the absence of a well-developed buy-to-let market in many countries including Sweden. Third, there are large transaction costs associated with exit and entry in the housing market. The most thorough study trying to measure the full return is by Meese and Wallace (1997). Based on observations of rents in the second hand market in San Francisco, they conclude that housing returns are indeed predictable, but that the potential gains from arbitrage transactions are within the bound set by transaction costs.

House prices are correlated across countries

Figures 2 give a clear picture of joint dynamics across countries, in particular after 1995. This may both reflect the influence from common global business cycle components and more direct effects across housing markets. The latter would come from mobility between markets that would tend to equalize house price movements. A recent study by Vansteenkiste and Hiebert (2009) tries to disentangle these two effects. The authors analyze quarterly data from ten euro area countries over the period 1989-2007. They estimate a global vector-autoregression model including three variables: real house prices, real disposable income and real interest rates. They conclude that direct spillover effects from house price shocks in one country to house prices in other countries are small. The correlation of house prices across countries is likely to reflect that macro variables are correlated.

The correlation between house prices and the business cycle may have different causes. On the one hand, causation runs from macroeconomic variables to house prices. Income and unemployment have a direct influence on the demand for housing services and, hence, on house prices. Likewise, supply factors like building

costs and new construction exert an impact on house prices. On the other hand, causation runs back from house prices onto the components of macroeconomic demand. Most obviously, high house prices stimulate new construction. There also appears to be a link between house prices and consumption. Indeed, several econometric studies (e.g. Case et al., 2005, for the U.S., Slacalek, 2009, for a panel of European countries and Berg and Bergström, 1995, for Sweden) have estimated that the marginal propensity to consume out of housing wealth is about as large as the propensity to consume out of financial wealth. This may seem surprising since a higher house price level also means a higher cost of housing services (i.e, in an aggregate sense housing wealth is not net wealth; Buiter 2008). Hence, in a standard life cycle model an increase in housing wealth should have little or no impact on consumption for the average household. The most likely reason why there nevertheless is an empirical relation between housing wealth and consumption is that a fraction of home owners are credit constrained. Higher house prices will release these constraints and allow the households to take out an extra mortgage, which can be partly used for consumption. Lower house prices on the other hand will further constrain consumption opportunities.

House prices are positively correlated across regions within countries

This correlation is evident in the Swedish data depicted in Figure 3. A basic reason for this pattern is that differences in costs of living (including housing) give incentives for migration. In a world of mobility across regions, differences in housing costs would tend to offset differences in income opportunities so as to equalize real income across regions. If income opportunities are driven by national shocks that affect housing demand more or less simultaneously across the country, we would expect to see positive correlations in house prices across regions. However, as the U.S. experience before 2000 tells us, house price correlations may be low if income shocks are local and there are strong regional business cycles. More recently, of course, all major U.S. regions experienced a coordinated boom as well as a common downturn, although with large differences in magnitude.

In general, the amplitude of the house price cycle tends to be higher in expanding regions where the price level is high. Compare, e.g, the volatility in many high-price coastal areas in the U.S. with the relative stability in low-price Midwest cities. For Sweden, Figure 4 depicts relative price indexes in different regions (expressed as a ratio of the national price index). We see that the relative indexes diverged in the boom of the late 1980s, but had converged almost all the way back to the 1985 situation at the bottom of the cycle in 1995. One explanation is the new construction that occurred in the regions where prices had increased the most. After 1995, dispersion has increased continuously during the boom but with some tendency towards compression as prices started to fall in 2008-2009.

Prices of different types of dwellings move together

Swedish households have access to two types of owner-occupied housing: one-family houses and apartments owned via shares in cooperative housing associations (coops for short). Unfortunately, statistical analysis has to be restricted to one-family homes, since indexes for coop prices are only computed since 2005. Figure 5 compares the coop indexes (3-month averages of the HOX Valueguard monthly indexes) and the indexes for one-family houses for Stockholm. It is hard to draw strong conclusions from a five-year period, but the graph indicates that the two markets are closely related and that coop prices are somewhat more volatile than house prices.

There is a positive correlation between the rate of price change and the number of transactions

When housing markets move from boom to bust, this is usually accompanied by a decreasing market activity. When the market turns downwards, not only do prices stagnate but fewer houses are offered for sale and it takes longer time before transactions are completed. The housing market moves from hot to cold. Hort (2000) has estimated a model on data for Swedish regions and shown that transaction responds before price to shocks to economic fundamentals (interest rates). Figure 6 illustrates the development of price and transaction volume in Sweden. The correlation is particularly strong around the crisis in the early 1990s, where price decreases of more than 10 percent per year were accompanied by sales volumes almost half the normal level. A similar pattern was also apparent in 2008-09 with stagnating prices and sharply reduced volume. At least three different mechanisms have been suggested to account for this pattern. A behavioral story says that sellers are unwilling to reduce their asking prices below their original purchase price. This pattern has been confirmed by Genesove and Mayer (2001) for New York condominiums, but is only relevant in times of falling prices. Another explanation (Stein, 1995, Ortalo-Magné and Rady, 2006) relates to the lock-in effects of borrowing constraints. With increasing prices, those constraints will be released and young households (typically more likely to be credit constrained than older ones) will be able to trade up the housing ladder. A third explanation (Berkovec and Goodman, 1996, Genesove and Han, 2010) emphasizes informational asymmetries. This view builds on the fact that the average buyer inspects many different houses and, hence, may have a better overview of the market than the average seller. For this reason sellers should be quicker to adjust their reservation prices as market conditions change. If demand is generally increasing, then there should be good deals available and sales will go up before buyers have adjusted their asking prices. Conversely, a negative demand shock

should result in fewer transactions during a transition period until sellers have learned about the new market situation. On such a housing market the number of transactions will be a leading indicator of future price changes. Research on Dutch data (de Wit et al., 2010) is consistent with this third explanation of the price-volume correlation.

2. The valuation of housing assets

Basically, houses are like any other asset. They generate income today and in the future, and their value depends on the rate at which this income stream is valued (the discount factor). For rental housing the income and the asset price – the rent and the price of rental apartment buildings – are set in separate markets and observed separately. For owner-occupied homes, the asset market and the market for housing services are integrated and there is only one price set in the market: the asset price. It is nevertheless fruitful to separate the two markets conceptually. This highlights that house prices may change for either of two reasons: due to shocks that affect the balance between the demand and supply for housing services and due to shocks to the rate at which the values of those services are discounted.

2.1 THE RENT-PRICE RATIO AND THE USER COST

A natural benchmark for the price of owner-occupied houses is the cost of rental housing. If there existed a well functioning rental market that offered housing services that were good substitutes for owner-occupied housing, then the cost of housing consumption for the two modes of tenure would have to follow each other closely. For a renter the cost of housing services is simply the rent she is paying to the landlord. For an owner occupant the corresponding cost (the *user cost*) consists of capital costs minus expected value changes plus operation and maintenance costs.

The key component of user cost is the real after-tax interest rate. Its development in Sweden over the last 30 years is depicted in Figure 7 based on the five-year mortgage rate with inflation expectations measured from household surveys. Essentially there are four rather distinct sub-periods with the interest moving from sharply negative (around -5 percent) in the early 1980s to around zero in the latter half of the 1980s to distinctly positive (around 4 percent) during the financial crisis of the early 1990s followed by a gradual descent towards zero until today. Figure 8 decomposes this development into three parts: the nominal interest rate, inflationary expectations and the tax effect (the nominal interest rate times the marginal tax rate). The tax effect was extremely important during the 1980s when it transformed a pre-tax real rate of around 3 percent into a negative after-tax rate of minus 5 percent. After the 1991 reform, which limited the tax rate to 30 percent,

the effect is quite small, however. From the mid 1990s, inflationary expectations have been anchored around the 2-percent target and the gradual reduction of the real rate is almost entirely due to the decrease in nominal interest rates.

The real interest rate graphed in the figures is calculated by deducting the expected inflation of consumer prices in general. What matters for the cost of housing, however, is the house-price inflation. This could deviate from the general inflation expectations both over time and across regions. If, e.g., house prices are thought to reflect a temporary supply shortage, then house prices should be expected to fall in the future. And if growth rates of population and income differ across cities, then house prices in fast growing cities should be expected to increase relative to prices in contracting cities. The role of expectations for user costs, and hence for house price levels, will be discussed more closely in section 3.2.

If rental apartment rents were good measures of the value of owner-occupied housing services and if owner-occupied houses were rationally priced, the costs of housing consumption should be the same in both modes of tenure. Then the ratio of apartment rents to house prices (the yield on a housing investment) should be closely tracked by user cost. User cost would represent the rate at which current rents were capitalized. Hence, taking the rent level as given, this approach would allow one to analyze how the market price level is affected by changes in the cost of capital and the various tax parameters that affect user cost. In the United States, there is a reasonably well functioning rental market that serves as a close substitute for owner-occupied dwellings.[3] Himmelberg et al. (2005) have studied the relation between rents, house prices and user cost across the major metropolitan areas in the United States. They conclude that the boom in U.S. house prices and the consequent decrease of the rent-to-price ratio, at least until 2005, is consistent with the decrease in user cost during the same period. They also find that fast growing cities in general have a lower rent-to-price ratio than stagnating cities, consistent with the differences in user cost.

Decreasing user cost has been a worldwide phenomenon since the mid 1990s. In a study of 17 European economies, Hilbers et al. (2008) estimate that user cost decreased by 3.3 percentage points on average between 1995 and 2000 and by a further 2.6 percentage points between 2000 and 2005. In a panel regression, they find that user cost has a significant negative impact on the price-to-rent ratio.

In looking at the rent-to-price ratio in the Swedish context, one faces the problem that rents are not determined in unregulated markets but set in negotiations where central organizations representing landlords and tenants agree on "fair rents" (*bruksvärde*). In central locations of the major metropolitan regions, rents set in this

3 As Meen (2002) has noted, US studies tend to focus on the rent-to-price ratio, whereas studies of European housing prices directly focus on equilibrium in the market for owner-occupied housing services.

way are significantly lower than market rents. In other parts of the country, rents based on *bruksvärde* may be reasonable approximations of market rents. Ideally, we would like to measure shadow rents that account for queuing time, limited freedom of choice and other frictions that cut a wedge between actual rents and the real value of owner-occupied housing services. Absent such observations, let us make the bold assumption that the wedge between observed rents and shadow rents has remained constant over time. In such case using the available rent index will only result in a measure of the rent-to-price ratio that differs from the "true" measure by a constant.[4]

The development of user cost along with the rent-to-price ratio is depicted in Figure 9. The series are normalized in such a way that they intersect, i.e. one may talk about periods of "over pricing" – when user cost is above rent-to-price – and "under pricing".[5] The reason for using quotation marks should be obvious as there is no way of calibrating rent-to-price for a base year short of having detailed information about the state of the rental market. Still the time variation of the two series gives useful information. In fact, their broad time series patterns are quite similar: an increase from very low starting levels around 1980, stagnation in the latter part of the 1980s, a sharp increase in the first half of the 1990s and a gradual fall thereafter. There are some interesting differences, however. During the first half of the 1980s, the user cost is much lower than the yield. This may reflect borrowing constraints. During this period credit markets were regulated and poorly developed, and many households had limited access to borrowed capital. Measuring the cost of capital by a mortgage interest rate may be more of an under-estimate during this period than later, and the representative cost of capital may have been higher than our measure assumes (see further discussion in Section 2.3 below). A second deviation occurs during the banking crisis in 1992, when user cost temporarily peaks more dramatically than the rent-to-price ratio. With steeply falling prices after 1992, over-pricing is quickly turned into under-pricing. From the mid 1990s there is a trendwise fall in the rent-to-price ratio relative to user cost. After around 2005 the yield is approximately one percentage point below user cost, i.e. the same amount of "over-pricing" as before the banking crisis in 1990-91.

From this simple exercise, we can conclude that if houses were correctly priced relative to regulated rents in the mid or late 1990s as well as in the late 1980s, then they are somewhat over-priced today. An alternative interpretation is that the gap between regulated rents and market rents has increased in recent years.

4 The number of vacant rental apartments gives one indication of the development of regulated rents relative to shadow market rents. Vacancies have decreased gradually since the mid 1990s. This suggests that the gap between the unobserved market rent and the measured rent index has increased over time.

5 We measure user cost by adding 7 percent to the real interest rate as calculated in Figure 7 and set the rent-to-price ratio to 5 percent in 1980. The 7 percent added to the real interest rate represent maintenance and operation costs and depreciation as well as a risk premium.

This interpretation is consistent with casual observations on the state of the rental market in the major Swedish cities, with an increasing housing shortage. During this period the number of vacant apartments has been continuously falling, from around 60,000 in the mid 1990s to around 20,000 today. Based on this, we can tentatively conclude that the development of user cost (in practice real after-tax interest rates) seems quite sufficient to explain the development of house prices taking the value of housing services as given. Before we draw any firmer conclusions we should look more closely into the components that determine user cost.

2.2 THE ROLE OF EXPECTATIONS

It is often claimed that the recent house price boom represents a "bubble" in the sense that it is at least partly explained by (overly) optimistic expectations among home buyers. Case and Shiller (2003) report survey evidence indicating that homebuyers tend to extrapolate past price increases during booms, thereby contributing to further price increases. In 2003, when U.S. house prices had already increased by 40 percent in real terms over the past five years, 83 to 95 percent of all home purchasers in the Case-Shiller survey believed that prices would continue to rise by an average of around 9 percent per year over the next decade. Taken literally such expectations would imply a negative user cost, i.e. that housing consumption is for free and that the owner could expect a capital gain on top. Even taken less literally, it is clear that extrapolative expectations have a tendency to be self-fulfilling and can potentially explain prolonged deviations of house prices from fundamentals. User cost is in fact extremely sensitive to expected capital gains. As an example, recall that the average real rate of house-price increase in Sweden during the period 1995-2009 was 6.6 percent, which can be compared with a negative price development during the previous 15 years. If such a difference is fed into price expectations, it could clearly justify almost any amount of price increase. The bottom line of the calculations presented in the previous section, however, is that there is no need to resort to special assumptions about expectations in order to explain the observed price development in Sweden.

Assuming that home buyers expect house prices to rise at the same rate as consumer prices in general may appear to provide a natural benchmark, but it is not consistent with a rational view on the housing market. Rational expectations should incorporate the basic time series pattern of house prices discussed in section 1: short-horizon positive autocorrelation and long-run trend reversion. Since the typical horizon of a housing investment is several years, the trend reversion effect should dominate. This empirical pattern is also backed up by the insight of Poterba (1984) and others that house prices in the long-run are anchored by production costs. Hence, house prices should rationally be expected to go down after a

prolonged period of price increase. Applying this reasoning to today's situation in Sweden would imply a higher value of user cost than assumed above and suggest that houses are after all over-valued relative to rents. Empirically, it may be a moot question whether house prices are overvalued provided that expectations are rational, or if they are correctly valued given that expectations follow consumer prices in general. In any case, survey data on expectations are too scarce to resolve this issue.

2.3 CAPITAL MARKET DEVELOPMENTS

Capital markets have undergone dramatic changes in recent decades and it is widely believed that these developments have had an impact on housing demand and house prices. In Sweden and many other countries, lending ceilings on banks and other credit institutions were removed in the 1980s and more recently various innovations in the mortgage market have improved the borrowing opportunities for many households. The range of mortgage products has been widened including interest-only loans and allowing households to choose between contracts with fixed and flexible rates. In Sweden, the United Kingdom and other countries flexible-rate loans have come to dominate and home-owners have taken advantage of the upward slope of the yield curve during recent years. Intensified competition has narrowed the margin between the lenders' funding costs and mortgage rates. Further, restrictions in terms of minimum downpayment amounts have been relaxed, whether as a result of more risk taking and laxer credit standards among banks or due to improved techniques of credit screening and new methods of bank funding. For all these reasons, calculating user cost based on a single mortgage interest rate may not capture the relevant cost of capital.

As a result of these developments household indebtedness has increased in most countries. A study from ECB (2009) has attempted to measure the amount of loans taken for house purchases in the Euro area, and reports that such loans have increased from 27 percent of GDP in 1999 to 42 percent in 2007. This aggregate number conceals large differences with the Netherlands as high as 90 percent in 2007. In Sweden total household debt as a fraction of disposable income has increased from around 100 percent in the late 1990s to 167 percent by the end of 2009, considerably higher than the previous peak in 1990; see Figure 10. The increase in indebtedness has been accompanied by an increase in household wealth, largely due to rising house prices. As a result, the development of household leverage is less dramatic. Even though, as shown in Figure 11, the ratio of debt to total assets (financial and real) also has increased in recent years, from around 1/4 in the late 1990s to 1/3 today, leverage is still lower today than in the years after the credit market deregulation in the late 1980s.

Aggregate credit volumes may reflect the demand for loans rather than supply restrictions and other institutional factors. A somewhat more direct indicator of supply is the average LTV ratio among first-time home buyers, many of whom would have little equity. According to a survey of US home buyers reported by Duca et al. (2010), this ratio increased from around 85 percent in the early 1990s to 93 percent in 2008. For Sweden, a recent household survey, Finansinspektionen (2010), looks at the average LTV ratio across all new loans to one-family houses (coop shares), including both first-time and repeat-buyers. This average increased from 62 (68) percent in 2005 to 69 (75) percent in 2009. Unfortunately, it is not easy to disentangle demand and supply factors, since the increase coincides with increasing house prices.[6]

Basing user cost on the mortgage interest rate – as in the previous section – would be appropriate if the capital market was "perfect" in the sense that all participants could borrow freely at the same interest rate. This is clearly a strong simplification which makes it impossible to discuss the impact of institutional changes in credit markets. The cost of capital should instead be understood as a weighted average across different sources of funding – the combination of various types of loan and equity with varying opportunity cost. Box 1 provides a derivation of user cost if a fraction of the value of a house has to be financed by equity. Essentially the capital cost is a weighted average of the opportunity cost of equity and the borrowing rate, and the impact of changes in the downpayment requirement depends critically on the cost of equity. If this is not too different from the borrowing cost, then effects are obviously modest, but if the cost of equity is much higher the impact can be substantial. Recently, the Swedish Financial Supervisory Authority mandated a LTV cap on mortgages of 85 percent.[7] If we, as an example, interpret this as changing the downpayment requirement from 5 to 15 percent and assume the cost of equity to be 20 percent, we see from the table in the box that this would lead to a 14 percent price decrease. In practice, the impact is likely to be smaller since the LTV cap only applies to mortgages and the cost of equity should be interpreted as the average across all market participants.

6 Between 2005 and 2009, house prices increased by 26 percent. If household equity (= ability to make a downpayment) was constant in real terms, then a LTV of 70 percent in 2009 would be needed to buy a house that could be bought with 62 percent LTV in 2005.

7 The cap on LTV applies only to mortgages and not to unsecured loans.

Box 1. User cost if a fraction of the value of a house is financed by equity

The value of a house, like that of any other asset, can be seen as the discounted value of the services derived from the house. Assume that a fraction θ of the purchase price of a house has to be financed by equity and that a fraction (1 - θ) is financed by borrowing at the rate *r*. Interest payments are tax deductible at the rate t. We also allow for property and wealth taxes levied as a fraction Ω of the market value of the house P. House prices are assumed to be growing at the constant rate g over the infinite future. To consume housing services the household has to pay operation and maintenance costs of m percent of market value. Discounting future cash flows at the rate ρ, the discounted cash flow associated with owning a house with a current market value of P_t is given by

$$\theta P_t + \sum_{j=1}^{\infty} \left(\frac{1}{1+\rho}\right)^j \left[r(1-t)(1-\theta)P_t + (m+\Omega)(1+g)^{j-1}P_t\right]. \quad (1)$$

The first term is the down-payment and the second is the discounted value of the sum of interest payments (assuming a non-amortizing loan) and maintenance and property tax expenditures. Evaluating the sum, this simplifies to

$$P_t\left[\theta + \frac{r(1-t)(1-\theta)}{\rho} + \frac{m+\Omega}{\rho-g}\right]. \quad (2)$$

Let us now compare this with the value of rental housing services. Assuming that the value of housing services (R) is growing at the same constant rate g, then the present value of these rents discounted at the same discount rate ρ over an infinite future is given by the familiar Gordon valuation formula:

$$\sum_{j=1}^{\infty} \left(\frac{1}{1+\rho}\right)^j R_{t+j-1} = \frac{R_t}{\rho - g}. \quad (3)$$

Equating the cost of owing a house in (2) with the value of housing services in (3) yields[1]

$$\frac{R_t}{P_t} = \theta\rho + (1-\theta)(1-t)r - g + m + \Omega + g\frac{(1-\theta)(\rho-(1-t)r)}{\rho}. \quad (4)$$

1 In a world of uncertainty, variations in R/P would reflect varying expectations about future interest rates and rent growth rates as well as risk premia that would affect discount rates. See Campbell et al. (2009) for a decomposition of R/P variance along these lines.

If the discount rate were equal to the after-tax borrowing rate, i.e. $\rho = (1\text{-}t)r$, this expression would simplify to the familiar formula $R/P = (1\text{-}t)r - g + m + \Omega$. This corresponds to the standard user cost expression noting that in steady-state house prices, rents and maintenance expenditures will all grow at the same rate, and hence that the exogenous growth rate g equals the rate of house price change. Table 1 illustrates the sensitivity of the rent-to-price ratio to variations in the downpayment requirement and the cost of equity capital.

Table 1. R/P for varying cost of equity (ρ) and degree of downpayment (Θ)

		Θ		
ρ	*0.05*	*0.10*	*0.15*	*0.20*
2.1	7.1	7.1	7.1	7.1
3	7.72	7.73	7.75	7.76
5	8.35	8.43	8.52	8.61
10	9.00	9.31	9.63	9.94
20	9.70	10.50	11.31	12.11

Note. The table is based on (4) assuming the following parameter values $r = 3$, $g = 2$, $m+\Omega = 7$, and $t = 0.30$.

The various institutional changes in recent years have provided homeowners throughout the world with a wider menu of loan contracts today than, say, 20 years ago. The ability to tailor funding to the particular needs of the individual borrower should in principle translate into lower borrowing costs and higher house prices, although the magnitude may be difficult to estimate. From a Swedish perspective, the most important dimension may be the choice of maturity of the mortgage loan. Traditionally, the great majority of Swedish mortgages had the interest reset every five years at the prevailing rate, unilaterally determined by the lender. Starting in the 1990s, borrowers have been offered a wider menu of choices and there has been a gradual switch towards shorter maturities. From around 1999 around half of all borrowers have chosen mortgages with the interest rate reset every three months; see Figure 12. To illustrate the impact of this flexibility, Figure 13 calculates the real-interest rate based on both the 3-month and the 5-year mortgage rate. Differences are rather small before the banking crisis in 1992, when the 3-month rate was temporarily 3 percentage points higher than the 5-year rate. From 1995 on, the yield curve has been almost constantly upward sloping and households choosing a flexible rate have faced lower borrowing costs. It follows that if user cost was calculated based on the actual mix of maturities, it would show a larger decline during the post-1995 period than according to either of the interest series. It may be argued, however, that the relevant investment horizon of the typical homeowner is at least 5 years[8] and that the relevant interest rate is the expected rate over this horizon, which may be better captured by a long interest rate. Be that as it may, allowing for flexibility in the choice of loan maturity has only a modest impact on user cost.

There are only a few empirical studies that explicitly account for the impact of changes in the availability of borrowing on user cost and housing demand in an econometric house price model. The closest example is Duca et al. (2010), where a measure of average LTV for first-time buyers is added as a separate variable in the house price regression. The long run elasticity of house price with respect to LTV is estimated to be between 0.8 and 1.1; i.e. a 10 per cent change in LTV leads to a price increase of 8-11 percent, depending on the exact specification of the model. Taking those results at face value and making the (somewhat heroic) assumption that the simple valuation model in Box 1 is a good description of reality, we may infer the market discount rate. The data of Duca et al. span LTV values ranging from 0.85-0.93. Over that range, an elasticity of around one corresponds to a cost of equity between 15 and 20 percent.

8 Despite this, few homeowners have mortgages with interest fixed for more than five years. Basing the user cost on a ten-year interest rate would make little difference to the time profile of user cost, since the difference between five- and ten-year interest rates has been relatively constant over time.

A more common way of accounting for credit market conditions is to simply include the stock of mortgage debt as a determinant of house prices. One example is a cross-national study by Ganoulis and Giuliodori (2010) based on data covering the period 1970-2004 for 12 European countries. They estimate a panel error-correction model with mortgage debt (normalized by GDP) added to the standard explanatory variables. The long-run elasticity of house price with respect to the debt-to-GDP ratio is found to be on the order of 0.2-0.3. Applied to the increase in debt-to-disposable income that we have seen recently – say 30 percent from the previous peak in 1990 – this would explain a price increase of 6-9 percent.

The comparison between user cost based on the 5-year mortgage rate and the rent-to-price ratio in Figure 9 indicates that houses are somewhat over-valued today relative to 1995. Accounting for the increased variety of mortgage contracts available and the easier access to borrowing during this period suggests that Figure 9 understates the actual fall in user cost. Taking this into account, we may tentatively conclude that the decrease in the rent-to-price ratio could be fully accounted for by a corresponding decrease in user cost.

2.4 USER COST AND TAXES

Housing is affected by a number of taxes, which all have an impact on user cost and on the valuation of housing assets. Tax effects on user cost reflect a lack of symmetry in the tax system: the property owner is allowed to deduct interest expenses but the income received in the form of housing services is taxed very lightly if at all. With high tax rates the effect of this asymmetry can be substantial as illustrated by the Swedish tax system. Before 1985, nominal interest payments were deductible against income at tax rates above 50 percent, while the imputed income was taxed at a low real interest rate. Combined with two-digit interest rates this translates into a negative impact on user cost on the order of 5-10 percent as seen from Figure 8. Following two tax reforms in 1982-1985 and 1991 and the change of monetary regime in the early 1990s, the Swedish tax system has turned more neutral with a dramatic reduction of the tax effect on user cost. Recent changes, however, have made the tax system somewhat less neutral again. In this section we will take a more detailed look at the various components of the tax code.

Ever since the 1950s the Swedish tax system has contained one or several taxes levied in *proportion to market value* as assessed by the tax authority. Prior to 1991 an imputed income calculated as a percentage of the assessed value (3 percent for most houses) was added to taxable income. Assessed values were on average 75 percent of market value at the time of assessment. With infrequent reassessments and rapid house price inflation, the imputed income corresponded to an average of 1-1.5 percent of market value. In 1991-1993, this tax was transformed into a property tax of 1.5 percent of assessed value. Subsequently the property tax

has been relabeled as a property fee (*fastighetsavgift*), currently 0.75 percent of assessed value (roughly 0.5 percent of market value) up to a maximum amount. The cap is set so low that the fee is independent of the market value for the majority of houses. It corresponds to 0.48 percent of the assessed value for the average house in the country and to 0.24 percent for the average house in the county of Stockholm. On top of the property tax, a wealth tax of 1.5-3 percent was previously levied in proportion to net wealth for individuals with wealth above a certain limit. With real estate valued by the assessed value, the wealth tax was 0.75-1.5 percent of market value for those few households with taxable wealth above the limit. The wealth tax was abolished in 2007. The combined impact of the reform of the property tax and the abolishment of the wealth tax has been a reduction from 1-2.25 of market value before 1991 to at most 0.5 per cent of market value today.

Capital gains are taxed at realization. Before 1991 a measure of capital gains was added to taxable income and taxed at 50 percent or more. Today the tax rate on capital gains is a flat 22 percent. Since the tax is only paid at realization, it translates into a lower effective tax rate on the current price appreciation. Agell and Södersten (1982) show that the difference may be sizeable for holding periods of a decade or more, depending on the discount rate. Furthermore, the tax can be rolled forward if the income from selling is reinvested in a more expensive dwelling. In such case, an interest charge is added to the tax credit. In practice, the capital-gains tax matters primarily for households with short holding periods. The impact on house prices in general is likely to be minor, however.

Sweden had an *inheritance tax* until 2004. From the viewpoint of user cost, the inheritance tax worked much like the capital-gains tax, i.e. it was levied in proportion to a market price in the far future. Translated into yearly user cost, it had a minor impact. Further, there is a stamp duty levied when a new title is registered. This is currently 1.5 percent of the sales price, again only with marginal impact on user cost for average holding periods.

The tax reform of 1991 brought housing taxation closer to neutrality, in particular at low rates of inflation and interest rates. Since 1991, the property tax has been cut in more than half and is now effectively zero at the margin for most households. Further, the wealth and inheritance taxes have been abolished. The combined effect of these changes has been to decrease user cost by something like one percentage unit since the mid 1990s, which may translate into a 10 percent increase of house prices, holding the value of housing services fixed. These tax changes were ignored in the user cost calculations presented in Figure 9.

3. Fundamental determinants of the price of housing services

In the previous section, we discussed the asset valuation of houses taking the value of the housing services that come with ownership as given. Let us now switch perspective and ask how the price of owner-occupied housing services (the implicit rent) is determined as a result of the balance between demand and supply. Viewing housing services as any other consumer good, demand should depend on the unit price and on other factors like income and demographics. The price per unit of housing services is simply the user cost as discussed in the previous section, or more precisely the user cost per krona house value multiplied by the price level of houses. It directly follows that changes to a component of the per krona user cost (e.g. a tax rate) should leave the cost of housing services unaffected and hence be offset by a proportionate change in the level of house prices. Expressed differently, the elasticity of house price with respect to per unit user cost should be equal to one; a one percent increase in per unit user cost must be met by a one percent reduction in the house price level.[9]

Taking the demand-supply perspective suggests that estimating a regression equation with the index of house prices as the dependent variable and supply, user cost, and other demand determinants as independent variables would yield estimates of the price and income sensitivity of housing demand.[10] In many cases supply may be difficult to measure. For this reason, some studies do not include a direct measure of supply but instead a variable that affects supply such as construction costs.[11]

A large number of studies have estimated the relation between house prices and fundamentals of demand and supply. Girouard et al. (2006) gives a survey of this literature. Recently a few studies have been based on panels of house prices covering several countries: Hilbers et al. (2008) for a yearly panel of 16 European countries 1985-2006, Ganoulis and Giuliodori (2010) for a yearly panel of 12 European countries 1970-2004, and Adams and Füss (2010) for a quarterly panel of 15 OECD countries (including Australia, Canada and USA) for the period 1975:1-

9 This has to be interpreted with some care, since a change in, e.g., a tax rate could also affect the expectation of future house price changes, which is another component of user cost.

10 A log-linear version of the equilibrium condition may be written $logS = -\beta_1(loguc + logP) + \beta_2 logX$, where S denotes supply, uc user cost, P the house price level, and X is a demand determinant, e.g. income. Inverting yields $logP = \frac{\beta_2}{\beta_1} logX - loguc - \frac{1}{\beta_1} logS$. Hence, the coefficient on supply in this regression equation is the inverse of the price elasticity of demand and the coefficient on income is the ratio of the income and price elasticities.

11 Assume a log-linear supply function, $logS = \gamma_1 \log P + \gamma_1 \log Z$, where Z could be construction costs. Solving for $\log P$ in the condition for market equilibrium gives $logP = -\frac{\beta_1}{\beta_1 + \gamma_1} loguc + \frac{\beta_2}{\beta_1 + \gamma_1} logX - \frac{\gamma_2}{\beta_1 + \gamma_1} logZ$. In this reduced-form model it is not possible to identify the structural coefficients of demand and supply, only their relation to each other.

2007:2. Below we will review some of these studies to see what they tell about the determinants of house prices.

3.1 THE PRICE ELASTICITY OF DEMAND

Estimated price equations usually include a measure related to user cost. In theory, the cost of housing services should not be affected by changes to user cost per krona house value, i.e. the percentage change in user cost should be equal to minus the percentage change in house prices (the elasticity should be minus one). In most studies, however, user cost is simply represented by the real interest rate, where costs of operation are ignored. Almost all studies report significantly negative effects. Among the international panel studies, only Hilbers et al. (2008) pay special attention to the details of user cost and account for separate tax rates on interest deductions and capital gains as well as property taxes. Capital gains are measured by the actual rate of change of the house price index. This measure of user cost comes out insignificant in the regressions, however. In contrast, a simplified version based on the real interest rate (long or short) yields significantly negative coefficients.

The price sensitivity of housing demand can be inferred from studies that include supply among the explanatory variables. According to most of the studies (nine out of eleven) in this category covered by Girouard et al. (2006) price reacts more than proportionately to changes in supply (i.e. the elasticity is larger than one). This implies that housing demand is price inelastic, a one percentage price increase reduces demand by less than one percent. This is in line with recent studies by Meen (2008) for the United Kingdom and by Wilhelmsson (2008) on Swedish data for a panel of local housing markets. The consistent findings that price is sensitive to supply indicate that supply conditions are highly relevant for explaining house prices. We will return to the determinants of supply in Section 3.3 below.

3.2 INCOME

Popular discussions of the housing market often take the price-to-income ratio as an indicator of affordability as well as to gauge whether houses are "correctly" priced. Figure 14 depicts the development of disposable income along with house prices for Sweden. Over the long term, income has increased faster than house prices. The real income in terms of house prices is 30 percent higher today than it was in 1970. Comparing across the recent peaks of the house price cycle, however, the ratio of price to income has returned to approximately the same level today as in 1990.

Since income is a major determinant of housing consumption and supply is constrained by the scarcity of land, one would expect to see a close relation between household disposable income and house prices. Judging from the figure,

however, income and price do not follow each other very closely. A likely partial reason is that consumption in general depends on permanent rather than current income. Since housing choices are more permanent than other consumption choices, this argument applies with particular force to housing. For this reason one should not be surprised that the dynamics of price and current income do not track each other very closely. As an example, the boom in the late 1980s, coincided with modest increases in current disposable income, whereas income growth was relatively strong throughout the crisis until the beginning of 1993, at a point when house prices had already fallen by 25 percent from the peak in 1990.

Nevertheless, most international house price studies find a statistically significant positive relation between house prices and current disposable income or GDP. Among the studies surveyed by Girouard et al. (2006), the implied income elasticities are centered around unity, meaning that a one percent income increase would cause house prices to increase by one percent holding supply fixed. Ganoulis and Giuliodori (2010) estimate a panel error-correction model conditioning on supply and find a long-run elasticity ranging from 0.7 to 1.5 depending on model specification.

Two other international panel studies both estimate a long-run relation not conditioning on supply. Hilbers et al. (2008) find an elasticity of house prices with respect to GDP of 1.75. They split the data based on the rate of house price growth during this period. This puts Spain on top followed by Ireland with Sweden ranked as number seven. Running separate models for three groups ranked according to the growth of house prices (with Sweden in the middle group) they find that the top group has a higher elasticity of price with respect to income (2.4) than the middle group (1.7) and bottom group (0.7). This pattern indicates that the higher rate of price growth in some countries can be explained by a greater sensitivity to income growth. Adams and Füss (2010) construct an "income" measure intended to capture economic activity in a wider sense by taking the first principal component based on five variables: money supply, consumption, industrial production, GDP, and employment. They estimate a panel error-correction model that identifies separate coefficients for each nation. The elasticities of house price with regard to economic activity are in general positive with an average value of 0.34. The coefficient for Sweden is 0.99. Swedish house prices appear to be more sensitive to macroeconomic activity than house prices in most other countries.

For Sweden, Hort (1998) has analyzed a panel of 20 local housing markets during the period 1967-1994. Based on a panel error-correction model not conditioning on supply, she finds an elasticity of house prices with respect to income in the range 0.4-1.0 depending on the specification of the model. More recently, Wilhelmsson (2008) has also looked at local housing markets, now covering a much larger number of markets (281) but over a shorter time period (1991-2006). Conditioning

on supply (measured by the number of housing units), he specifies a model with the ratio of price to income as the dependent variable and including income among the explanatory variables. The estimated income coefficient is negative indicating that the elasticity of house price with respect to income is less than one. Hence, both these studies on Swedish data indicate that house prices increase less than proportionately with income.

Overall, there is strong evidence that house prices are increasing functions of income. The average elasticity across a large number of studies appears to be close to one (in studies that condition on supply). This indicates that the elasticity of housing demand with respect to income is around one.[12] This conclusion is also consistent with micro evidence from demand studies based on household data that generally find income elasticities not too far from one.[13] This means that the in order to meet the increase in demand, the housing stock would have to grow by the same rate as income is growing in society. If not, house prices will have to rise in order to ensure balance between demand and supply.

3.3 DEMOGRAPHICS

The stock of housing has two main dimensions: the number of dwellings and the quality and size ("quantity of housing services") of the average dwelling. An increase in income per capita would primarily increase demand for quality and size, whereas a growing population would demand more units. For this reason, the size and composition of the population should have a separate influence on price beyond that of aggregate income. After all, a main balancing factor is between the number of dwellings and the number of households in different age groups. Differences in population and employment opportunities across regions exert a major influence on local house prices. Referring back to Figure 3 we see very clearly that the rate of price increase has been highest in the three rapidly growing metropolitan areas followed by other parts of southern Sweden where the population has been stable. The northern regions, on the other hand, have been characterized by emigration and stagnating house prices.

Housing demand varies by age. Households typically follow a housing career moving from smaller starter homes to larger dwellings until age 40 or so, and downsizing after age 50 or 60. Younger households are net demanders and older households are net suppliers. Even though household formation is to some extent influenced by economic factors[14], it is mainly driven by factors exogenous to the

12 Recall from note 10 that the elasticity of price with respect to income is the inverse of the income elasticity of demand.

13 See, e.g., Green and Malpezzi (2003) for a brief overview of the U.S. literature.

14 Studies on data for the US (Haurin et al., 1993), UK (Ermisch, 1999) and Sweden (Åsberg, 1998) have shown that the rate of home ownership among young individuals is a decreasing function of housing prices.

housing market. This suggests a positive relation between house prices and the fraction of individuals in household formation age. Girouard et al. (2006) graphs such data across OECD countries for the period 1995-2004 and finds a positive relation. Econometric studies, however, generally fail to find a stable relationship between age structure and house prices.[15] Even if the age structure influences demand, it may not come as a surprise that there is no robust link between age structure and price, since the size and age composition of the population is largely predictable based on birth rates. Hence, new construction has ample time to adapt.

To get a quick look at the potential impact of demographics on Swedish house prices, Figure 15 graphs the ratios of the number of younger (20-29 or 20-39) to older individuals (50-59 or 50-69). These ratios were increasing in the late 1980s and early 1990s as a result of the baby boom after the war, and started to decrease after 2000. While the age structure has some potential to explain house prices in earlier years, in particular the boom in the late 1980s, it cannot be the main explanation of the continued price increase after 2000.

3.4 SUPPLY AND PRODUCTION COSTS

The conclusion from the discussion above is that the demand for housing services is quite sensitive to income (elasticity around one) and rather insensitive to price (elasticity less than one). If the price elasticity is, say, one half, it follows that a one percent income increase would have to be met by a two percent price increase unless there is a matching increase in supply. The conditions for adding to supply by new construction, hence play a crucial role for understanding the evolution of house prices. The profitability of new construction depends on the difference between the market price of a new house and the building cost. Given the long lead times in the building process, it is the expected house price a couple of years in the future rather than the current price that matters.

Figure 16 depicts the development of real construction costs in Sweden (factor price index for residential construction) along with real house prices, both indexes normalized to be one in 1975. In spite of the fact that the construction cost index does not include land costs it has increased continuously in real terms, by a total of more than 60 percent from 1975. This primarily reflects the high labor intensity in the construction industry. Adding land costs, the increase would probably be 10-20 percent larger.[16]

The contrast in volatility between the two series is striking. Construction costs have developed quite smoothly with the exception of a sharp increase in 1992 as a result of the increase in the VAT rate as part of the tax reform. Consequently, house

15 See, e.g., Lindh and Malmberg (2008).

16 The fraction of land costs as a share of total production costs per square meter of new dwellings has increased from 11 percent in 1998 to 20 percent in 2008.

prices have deviated from construction costs over extended periods following the booms and busts of the house price cycle, but with some convergence between the two series over the long term. The relation between cost and price is back at the same level today as in the late 1970s. The difference in building response is striking, however. Between 1975 and 1980, a total of 294,000 new dwellings were completed as compared with a mere 138,000 between 2005 and 2010. From any later starting point, today's house prices are high relative to production costs. Counting from the peak in 1991:1 until 2010:3, the ratio of house prices to production costs increased by as much as 46 percent. It is not clear, however, how comparable these series are in the long run and one should probably resist the temptation to conclude that this discrepancy between two indexes indicates that houses are overvalued today.[17]

The wide and extended deviations between price and cost indicate that supply is slow to adjust. The standard reasoning – Poterba (1984), Rosen and Topel (1988) – distinguishes between short- and long-run supply elasticities as a consequence of costs of adjusting capacity in the building industry. In the short run, production is limited by existing capacity and the inertia of the planning process. Hence, the marginal short-run cost of constructing an extra house is much higher than the average cost (which is what the production cost index measures) when the rate of construction is high and the industry operates at full capacity. In the longer run, capacity is adapted and new projects have time to filter through the planning process. Given this, new construction could be expected to be an increasing function of the price of existing homes and a decreasing function of the cost of producing new houses, sometimes expressed by the ratio ("Tobin's Q"). The more flexible the building industry is, the more elastic is this function in the short run and the faster will price revert towards the long run level determined by production cost.

The elasticity of supply with regard to price and production costs is generally thought to be low, although it has been found difficult to nail down econometrically. A recent example of an econometric supply study is Ball et al. (2010), which presents a simultaneous model of British house prices, construction costs and construction starts. They find an elasticity of starts with respect to the ratio of house price to construction costs of 0.15, suggesting that the adjustment of supply to demand changes would be very slow.

Since demand appears to be quite inelastic with regard to housing prices, any change in fundamentals that is not met by a corresponding change in supply is bound to have a large impact on price. Consistent with this, British and US evidence (Cheshire and Hilber, 2008, Saiz, 2010) show that measures of supply restrictions

17 One reason is that the location of new construction and the stock of existing housing differ. Construction takes place mostly in the periphery of high land price regions, whereas the stock is a mix of centrally located houses in high price regions and housing in regions where the price level is too low for any construction to be profitable.

at the local level are strongly correlated with the level and volatility of house prices. Such measures include both geographical topology and various regulatory constraints.

Two figures illustrate the relation between new construction and Tobin's Q for Sweden according to different dimensions of new construction: the number of completed one-family houses[18] (Figure 17) and the total investment in housing according to the National Accounts (Figure 18). While both measures could be expected to react positively to divergences between price and cost, their long-run trends may differ. The number of dwellings should be closely related to the number of households, whereas total investment in housing also includes renovations and additions and is more closely related to the size and quality of the stock of dwellings. Both measures correlate positively with Q, with peaks and troughs that are slightly lagged relative to the peaks and troughs of the house price cycle. The long-run developments of the two measures of construction differ substantially, however. New completions are well explained by the Q ratio until the mid 1990s, but the subsequent increase in price relative to costs is only accompanied by a modest increase.

The alternative measure of housing investment, which includes renovations and additions, has stood up somewhat better over time. At the peak reached in 2007 it was around 20 percent lower than at the previous peak in 1991. Seen in relation to disposable income, which increased by more than 40 percent over the same period, this is quite a pronounced decrease, however. The amount of construction may also be related to the total housing stock. The value of housing investment (one- and multi-family housing) at the peak in 2007 was 121 billion SEK, corresponding to 3.6 percent of the value of the stock.[19] This would seem enough to cover depreciation and some increase of the stock to match the demand increase due to income and population growth. But this is at the peak of the construction cycle and the total investment since the previous peak in the early 1990s has barely been enough to replace wear and tear.

In an international perspective, Swedish housing supply has been unusually unresponsive to the recent increase in prices. Figure 19 illustrates the development of housing investment as a fraction of GDP in countries that all experienced house price booms. In contrast to Sweden the increase in house prices triggered a building boom in Ireland, Spain and USA. As a result these countries all have experienced falling prices and overbuilding.

Overall, there is strong evidence that the addition to the housing stock in Sweden

18 Instead looking at the total number of new dwellings would give qualitatively the same picture, although with a less dramatic decline in the mid 1990s.

19 In 2007, the assessed value of all one- and multi-family dwellings was 2,548 billion SEK. Multiplying by 4/3, since the average assessed value is 75 percent of market value, yields 3,400 billion.

– whether counting units or value – over the last 15 years has been insufficient to meet the increase in demand due to the growth in population and income levels. Since house prices have been increasing much faster than production costs over this period, it appears that the lack of new construction reflects a very low price elasticity of supply.

3.5 HOUSE PRICE DYNAMICS

Much of the discussion about house prices centers on the distinction between short-run fluctuations and long-run trends – whether phrased in terms of bubbles or in some more neutral language. Short-run price movements can deviate from long-run trends for at least three reasons: supply inertia, expectations formation and credit constraints. First, as previously discussed, supply is much less elastic in the short run than in the long run (and also less elastic downwards than upwards). In the short run, supply change is limited by two factors: (i) the capacity of the construction industry and the costs of adjusting this capacity, and (ii) the supply of factors of production, in particular land. In the longer run, the size of the building industry may be infinitely elastic but the supply of land is not (at least not in urban areas). House prices should react more strongly to demand changes in the short than in the long run. As time goes and supply adjusts, prices should revert back towards a long-run equilibrium level. But due to the shortage of land, the long-run price level will increase with growing income and population.

Second, the exact nature of the dynamic adjustment towards equilibrium depends crucially on how market participants form their expectations. With rational expectations, they should realize that the price level is trend-reverting. Compared to the case of static or extrapolative expectations, rational expectations would reduce the immediate price impact of a shock to fundamentals and dampen price fluctuations more generally. As Poterba (1984) has demonstrated, there is a unique perfect foresight path for the adjustment of house prices to a shock to fundamentals. The more elastic supply is in the longer run (even if it is completely inelastic in the short run) the smaller is the initial price impact due to the feedback from expectations. As discussed above, there is some evidence that the expectations of home buyers may not be rational in certain market situations but rather tend to extrapolate past price trends (e.g. the US market in the early 2000s). Whether such deviations from rationality follow a general pattern is another and more difficult question.

Third, credit market constraints may give rise to short-run fluctuations away from fundamentals. A fraction of all home buyers, in particular first-time buyers, borrow up to the limit allowed by the bank and have negligible assets beyond their home. Effectively, their housing demand is restricted by the credit constraint imposed by the bank. Under normal circumstances the credit constraint is gradually released

as households save from their income and house values increase over time. As a result, homeowners can afford to climb up the housing ladder and move to a more expensive house. The dynamics of this process is sensitive to the development of house prices. A price increase will by itself release extra demand and hence lead to a multiplier effect on prices. Likewise, a negative price shock will lock in potential movers into their current homes and lead to a further downward price pressure.[20]

For all these reasons we would expect house-price dynamics to be cyclical. Initial price shocks could be amplified by extrapolative expectations and credit constraints. But in the longer run new construction should lead prices back towards an equilibrium level determined by fundamentals. The vast majority of econometric house price studies employ an error-correction framework to capture this interplay between the short and the long run. In such a model there is a long-run relation embedded within a short-run dynamic model. In the long-run, the *level* of the variable of interest, in this case the real price of owner-occupied homes, is related to the *levels* of a set of explanatory variables, in this case income, demographics, user cost etc. In the short run, the rate of price *change* is driven by the (current and lagged) *changes* of those explanatory variables and by the lagged *deviation* of price from its long-run level. The regression coefficient on the latter variable indicates the rate at which prices are approaching long-run equilibrium.

Error-correction models of house prices have a particularly long tradition in Britain, starting with Hendry (1984). As shown by Meen (2008), such a model originally estimated on quarterly UK data for the period 1969:3-1996:1 has remained stable through 2005. Meen's model, which includes the housing stock as an explanatory variable, exhibits a mean-reversion rate of 13 percent. This means that it will take five quarters to reduce an initial deviation from equilibrium by half. Since the model is conditioned on supply, the interpretation is that this inertia is related to expectations formation and/or the dynamics of credit constraints.

Preliminary estimates of an error- correction model of Swedish house prices, not conditioning on supply, indicates a quarterly mean-reversion rate of 8 percent and a first-order autocorrelation coefficient of 0.4. This means that there is considerable momentum in house prices; knowing that prices increased faster last quarter than warranted by fundamentals signals that they are likely to continue to increase the next quarter. Borrowing terminology from Abraham and Hendershott (1996), one can talk about this as a "bubble builder". The combination of the two dynamic mechanisms means that a disturbance to fundamentals leads to over-shooting in the short-run with a cyclical adjustment towards equilibrium. As an illustration of this interaction, consider a one-shot price increase of 10 percent

20 Models of such price-credit cycles have been developed by Stein (1995) and Ortalo-Magné and Rady (2006) among others. They have recently been successfully built into general equilibrium models, e.g. by Iacoviello and Neri (2010).

holding the fundamental long-run equilibrium price unchanged. This will, according to the model, lead to a "bubble" with further price increases by 3.2 percent in the next two quarters and the price level reaching a peak at 13.2 percent above equilibrium. Nine quarters after the shock the "bubble" is burst and house prices are back at 5 percent above equilibrium, which is almost exactly the same as in the absence of the short run feedback. Expressed differently, the "bubble burster" is more important than the "bubble builder" except in the very short run. Broadly speaking, the collective evidence from models in the error-correction tradition is that housing markets are generally relatively stable and that prolonged deviations from equilibrium are exceptions rather than the norm.

4. Summing up

Swedish house prices increased by 144 percent in real terms between the first quarter of 1995 and the third quarter of 2010. During the same period, real apartment rents increased by a mere 13 percent and real construction costs increased by only 33 percent. Does this mean that 2010 house prices are seriously overvalued? We have tried to answer this question in two steps. First, we have suggested that the user cost of housing has fallen sufficiently during this period – as a result of a general reduction of real interest rates in the world economy and a reduction of the Swedish taxation of the returns to owner-occupied housing – to warrant a substantial decrease in the rent-to-price ratio. Second, we have conjectured that the value of owner-occupied housing services has increased beyond the increase in rental apartment rents as a result of a lack of new construction. Housing supply has been very inelastic in response to increased house prices and the housing shortage has increased in main metropolitan areas. Combining these two factors, today's elevated house price levels appear to be warranted by fundamentals.

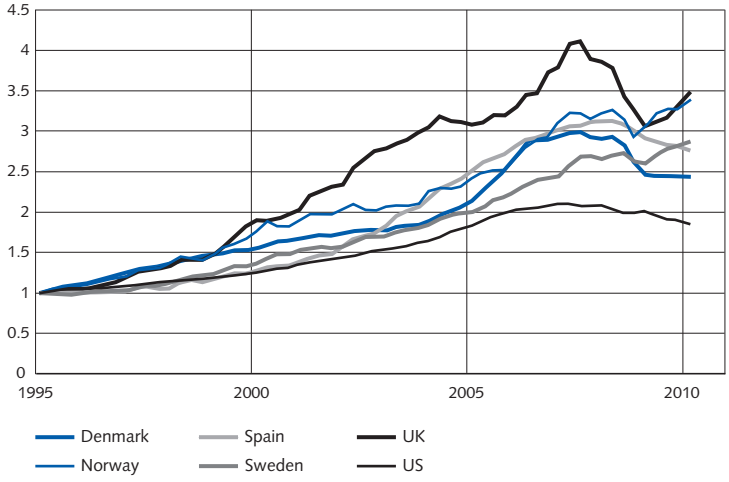
This conclusion comes with two caveats, however. The first relates to the lack of supply response. This stands in sharp contrast to the building boom in some other countries in recent years as well as the Swedish experience in the late 1980s. In part, the lack of new construction may be a legacy of the over-building in the early 1990s. But this cannot explain why there is so little new housing investment today despite the fact that the ratio of house prices to building costs appears to be at an all-time high. It may be that available cost indexes are misleading. If so, it is urgent to dig behind these numbers and sort out why it is not profitable to build despite the explosion of real house prices. Research in other countries has pointed to the role of planning processes and building restrictions.

A second caveat relates to the role of expectations. When suggesting that the current rent-to-price ratio is warranted, we have presumed that the cost of capital is well captured by the five-year after-tax mortgage rate minus expected general

consumption-goods inflation. In other words, we have assumed that households value houses based on zero after-tax capital costs. Sweden has experienced zero and even large negative real interest rates before, but that was in the 1970s and 1980s when borrowing opportunities were restricted. It could be argued that a negative real interest rate after tax would be unsustainable in today's deregulated environment and that rational pricing of long-lived assets should always be based on a positive discount rate. Further, it could be argued that capital-gains expectations should rationally anticipate that high house prices will sooner or later stimulate more new construction with falling prices as a consequence. This should rationally induce today's home buyers to expect decreasing prices in the future and, hence, to assign a higher level of user cost. In this way the two caveats are related. Today's price level is only warranted presuming that supply is permanently inelastic.

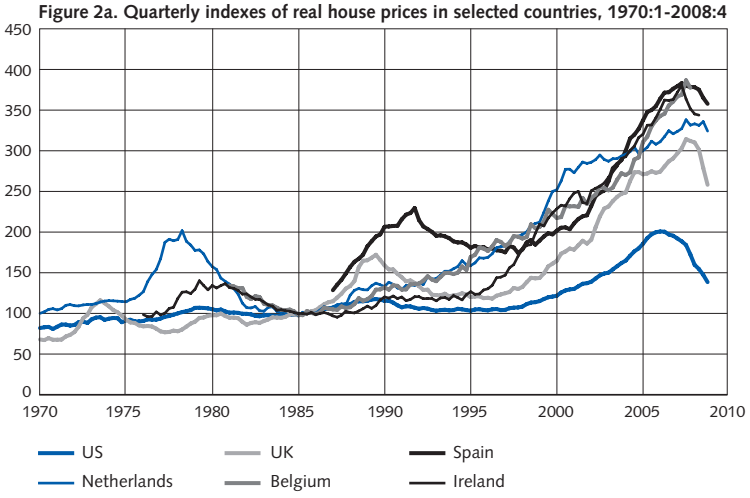
The discussion above points to two areas where we are particularly short of knowledge: the determinants of supply and the formation of expectations. Research in those two areas promises to have high returns.

Figure 1. Quarterly indexes of nominal house prices in selected countries, 1995:1-2010:1



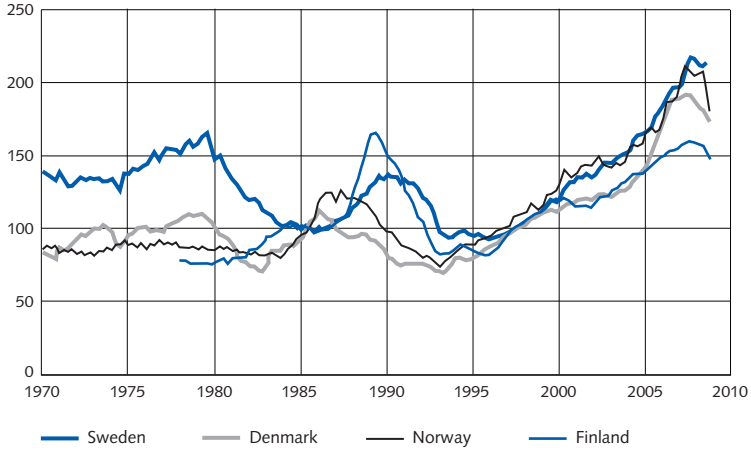
Source: BIS (http://www.bis.org/statistics/pp.htm).

Figure 2a. Quarterly indexes of real house prices in selected countries, 1970:1-2008:4



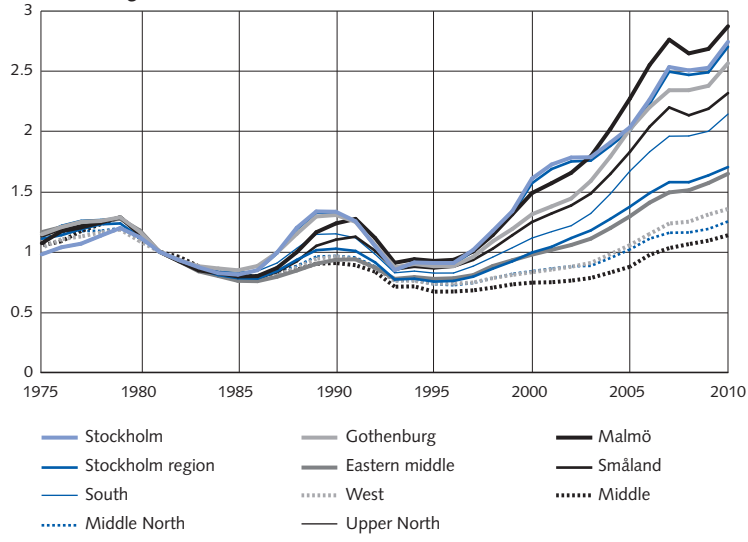
Source: BIS.

Figure 2b. Quarterly indexes of real house prices in the Nordic countries, 1970:1-2008:4



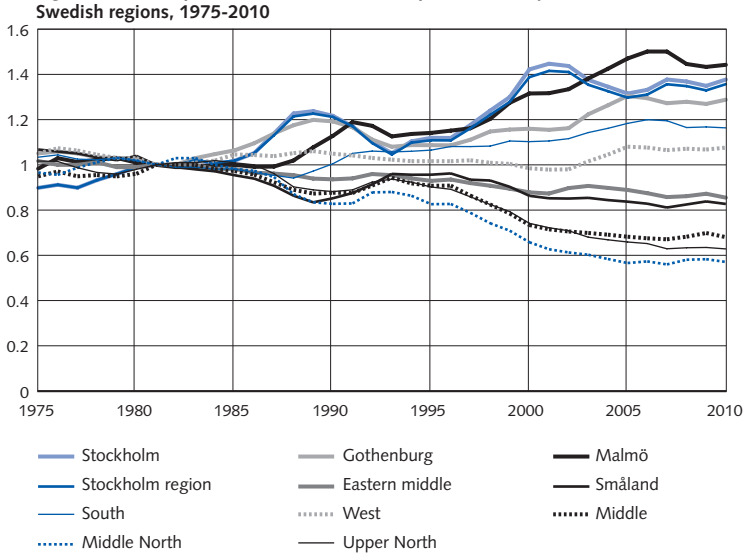
Source: BIS.

Figure 3. Yearly indexes of real prices for owner-occupied one-family houses, Swedish regions, 1975-2010



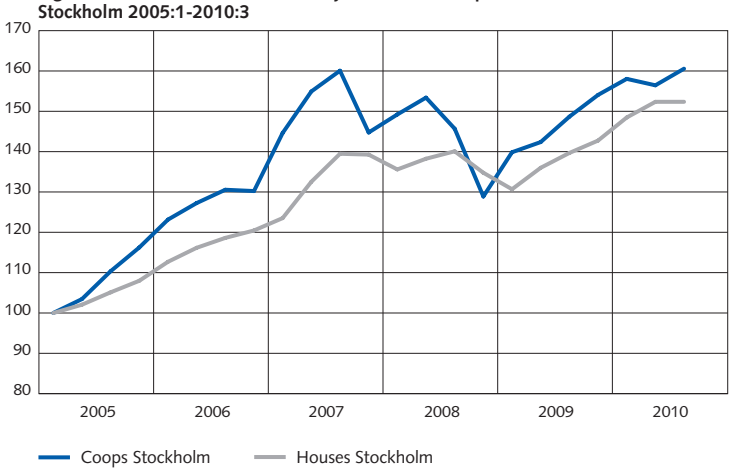
Source: Statistics Sweden.

Figure 4. Relative price indexes for owner-occupied one-family houses, Swedish regions, 1975-2010



Source: Same data as Figure 3.

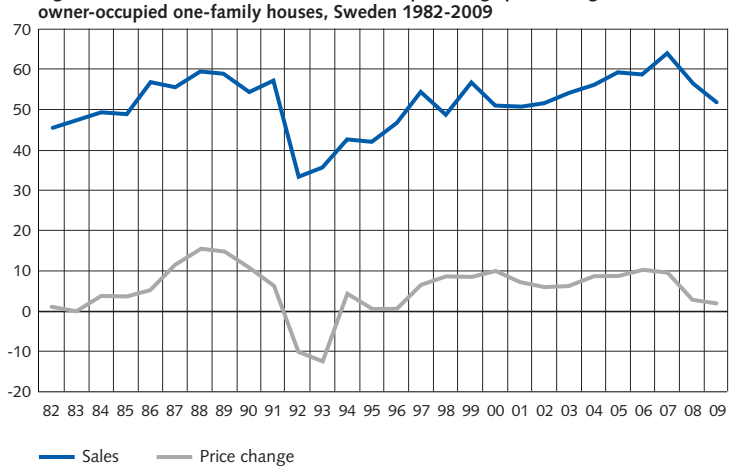
Figure 5. Price indexes for one-family houses and coop shares, Stockholm 2005:1-2010:3



Note: Coop index refers to contract date, house price to registration date.

Sources: Statistics Sweden and Valueguard.

Figure 6. Number of sales (in thousands) and percentage price change, owner-occupied one-family houses, Sweden 1982-2009



Source: Statistics Sweden.

Figure 7. The real after-tax interest rate, Sweden 1980:1-2010:4

Note. The real interest rate is defined as $i(1\text{-}t) - \pi$, where i is the 5-year mortgage rate (from ECOWIN), t is the median tax rate applicable for interest deductions and π is the expected CPI-inflation based on survey data.

Figure 8. Components of the real interest rate, 1979:1-2009:4

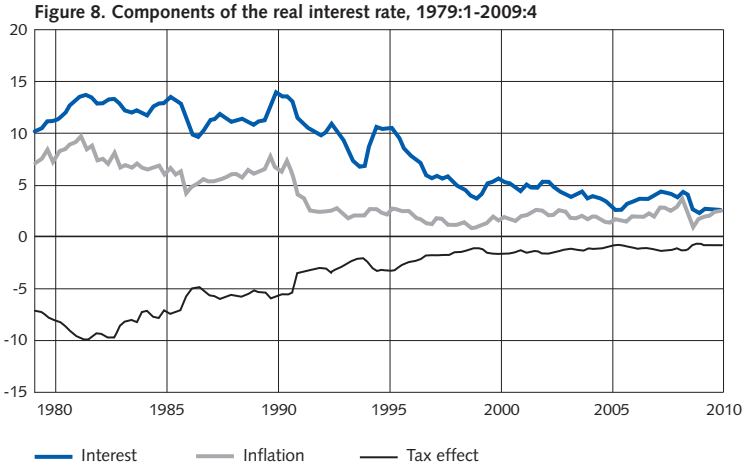
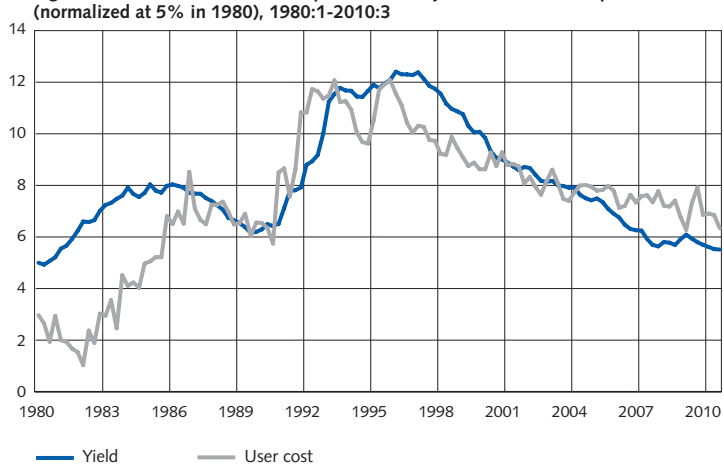
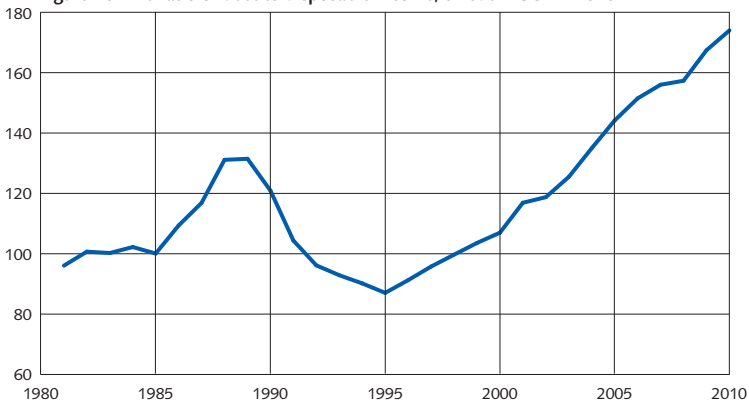


Figure 9. User cost for owner-occupied one-family house and rent-to-price ratio (normalized at 5% in 1980), 1980:1-2010:3



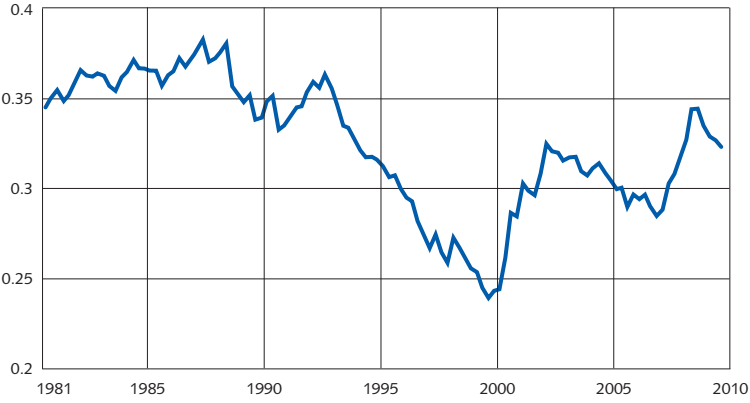
Note. Rent-to-price ratio defined as the ratio of the rent component of the consumer price index to the price index for owner-occupied houses, normalized at 5 percent in 1980. User cost defined as defined as the real interest rate from Figure 7 plus 7 percent.

Figure 10. The ratio of debt to disposable income, Sweden 1981:1-2010:1



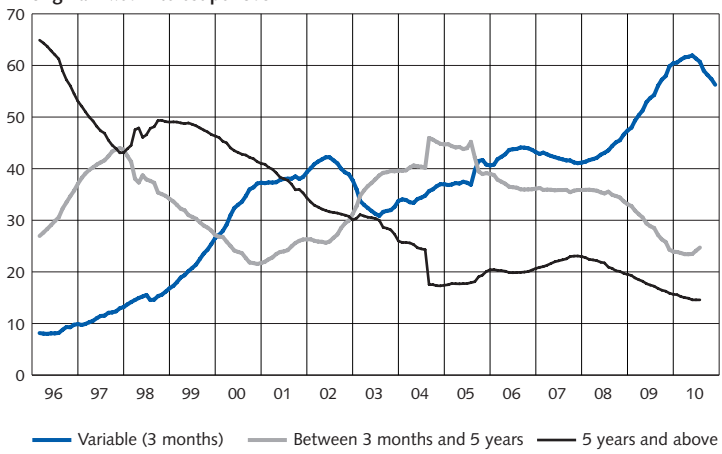
Source: Diagram 2:11, *Financial Stability* 2010:2, Sveriges Riksbank.

Figure 11. The ratio of debt to assets, Sweden 1981-2010



Source: Diagram 2:9, *Financial Stability* 2010:2, Sveriges Riksbank.

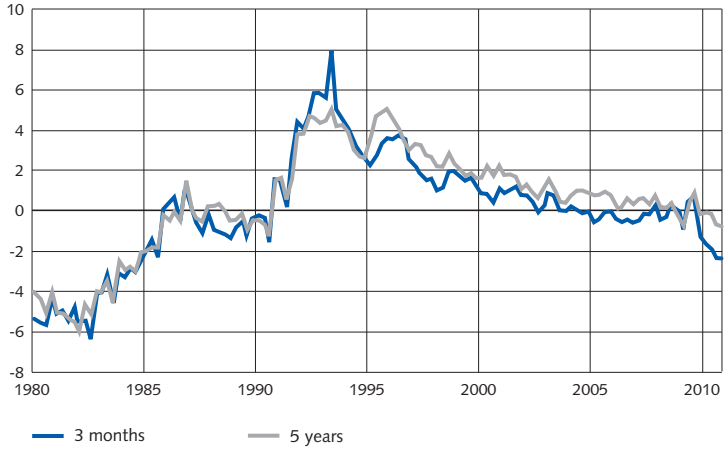
Figure 12. Breakdown of Swedish mortgage institutions' outstanding stock by original fixed interest periods



Note. Due to a change how the statistics are reported, data up to August 2010 uses the categories "Between 3 months and 5 years" and "5 years or more". This distribution of categories is not available after August 2010, at which time the statistics of outstanding loans only show "variable rate" and "fixed rate".

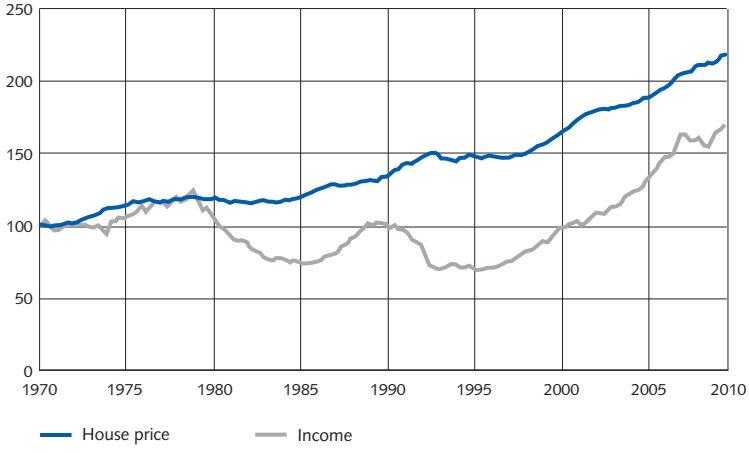
Sources: The Riksbank and Statistics Sweden.

Figure 13. Real interest rates based on-month and 5-year mortgage rates, Sweden 1980:1-2010:4



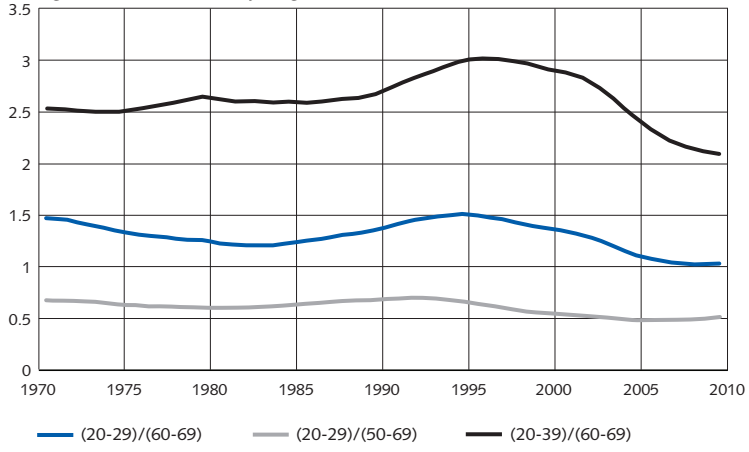
Note. Sources and definitions as Figure 7.

Figure 14. Indexes of real house price and real disposable income, Sweden 1970:1-2009:2



Note. Four-quarter moving average of disposable income (from National Accounts).

Figure 15. The number of young relative to old individuals, Sweden 1970-2009



Source: Statistics Sweden.

Figure 16. House price and factor cost, indexes (deflated by CPI), Sweden 1975:1-2010:3

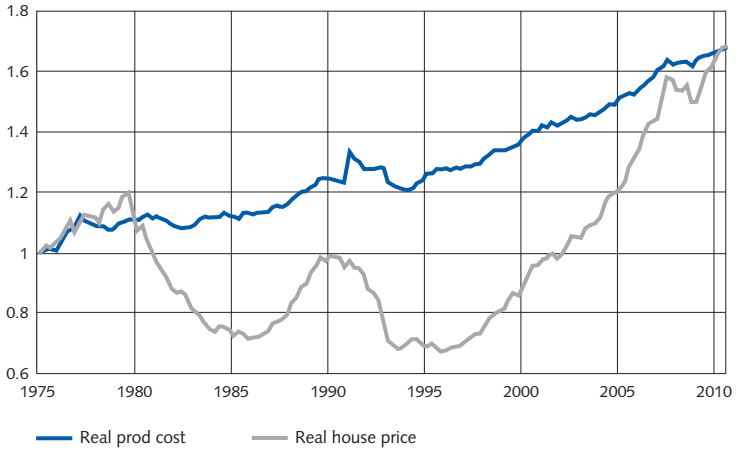
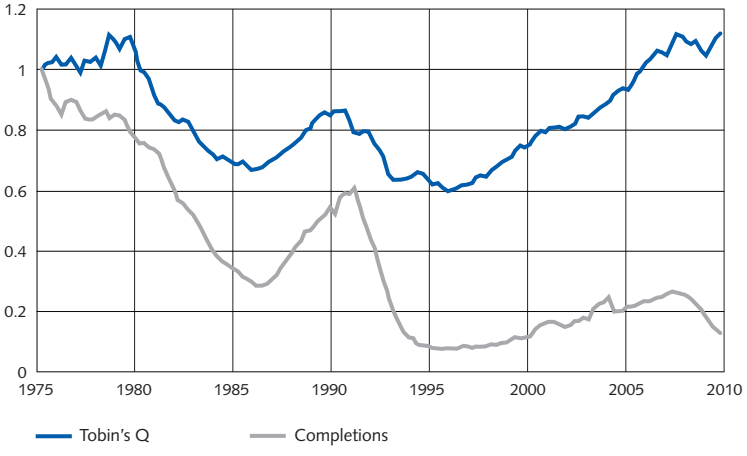


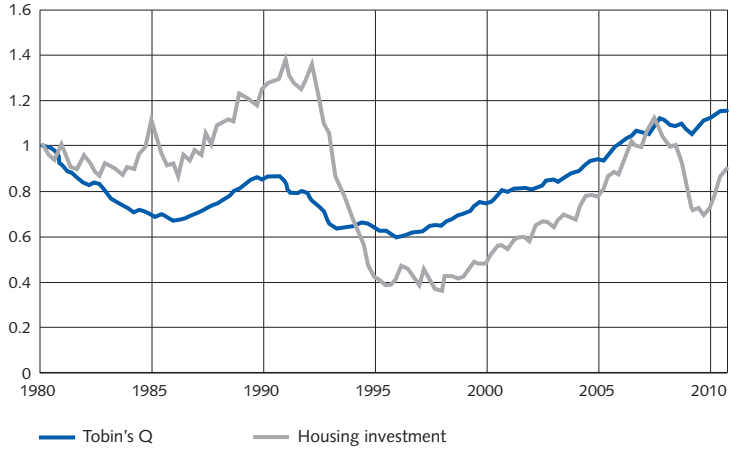
Figure 17. Tobin's Q and number of new one-family houses, indexes, Sweden 1975:1-2009:4



Note. Q defined as the ration of the price index to the construction index (from Figure 16). The index for completions is a four-quarter weighted average.

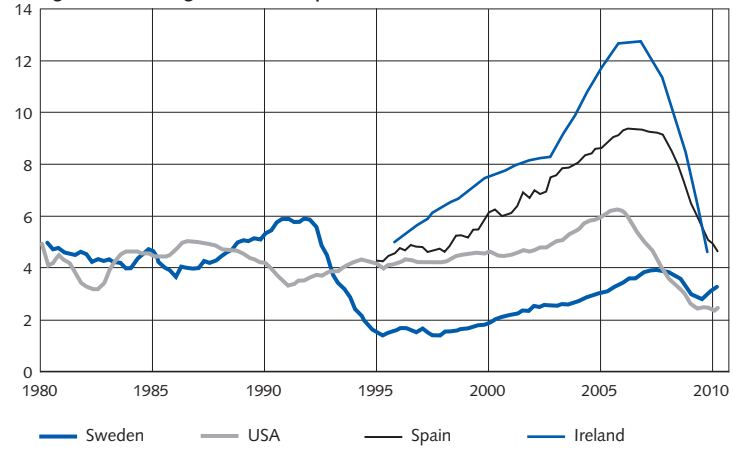
Source: Statistics Sweden.

Figure 18. Tobin's Q and housing investment (index, fixed prices), Sweden 1980:1-2010:3



Source: National Accounts. Two chained series for housing investment.

Figure 19. Housing investment in percent of GDP, selected countries 1980:1-2010:1



Source: *Monetary Policy Report*, October 2010, Sveriges Riksbank.

Appendix: Measuring house prices

Houses are heterogeneous and only a small fraction of the housing stock is transacted in any shorter time period. This creates difficult problems in measuring "the" price level of houses, in particular at a frequency that is high enough to be relevant for economic analysis. A widely accepted framework for analyzing house prices starts from the notion that a house can be described by a number of characteristics and that the price of a particular house is the price of that bundle. Denoting the characteristics by the vector X, the price of a particular house is $f(X)$. Estimating this function for different time periods, a price index can be constructed based on a house with a particular set of characteristics. In practical applications it is common to assume that $f(X)$ is constant over time and that the price of house i at time t may be written $P_{it} = \pi_t \cdot f(X_t)$. Here π_t is the price per unit of housing $f(X)$ and has the natural interpretation of a price index. Taking logs of this equation gives a standard linear regression equation. This is the *hedonic method* which is used in several countries to estimate price indexes. With access to a rich set of characteristics this is the favored method of index construction. It underlies the HOX Valueguard Index for coop shares (http://www.valueguard.se/index).
A related method is based on external valuations of $f(X)$ in a base year. Holding $f(X)$ constant, the mean of the ratio $P_{it}/f(X_i)$ can be taken as an estimate of a price index. This is essentially the method used by Statistics Sweden to construct an index of owner-occupied one-family houses. This method is only as good as the valuations that it is based on, in the Swedish case the point system that is the basis for the tax assessments. An advantage is that it allows the analyst to take account of special conditions of an individual house that are not easily entered into a regression framework.

The hedonic method requires a rich set of data on hedonic characteristics. If such data are not available a simple alternative would be to only look at median and mean sales prices, not controlling for the heterogeneity of houses. With a representative and large sample of sales the difference between the median sales price and a hedonic index may be quite small (see e.g. Englund et al. 1998 for Sweden). Another alternative is to construct a data base of paired sales of the same house sold at different points in time. Presuming that the characteristics of the houses have not changed between sales, calculating a price index based on such *repeat sales* would give an accurate price index. Such indexes are the only ones available in the United States. An advantage is that the method controls for idiosyncratic characteristics of an individual house that would go unmeasured in the hedonic approach, but a serious disadvantage is that quality changes due to renovations and additions are not taken into account.

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