Preliminary and incomplete. Comments are welcome.

Are Swedish House Prices Too High?
Why the Price-to-Income Ratio Is a Misleading Indicator*

Lars E.O. Svensson
Stockholm School of Economics, CEPR, and NBER

First draft: March 2022
Revised: January 18, 2023

Abstract

According to ECB (2022) and European Systemic Risk Board (2022), Swedish owner-occupied housing (OOH) was overvalued by about 55% in 2021q2, the largest overvaluation in the EU and EEA; according to European Commission (2021) by at least 30% in 2020q4. These assessments affect warnings and recommendations issued for Swedish economic policy and shocks in EBA stress tests of Swedish banks.

But the large overvaluation assessments are mainly due to the use of misleading indicators: deviations of price-to-income (PTI) and price-to-rent ratios from their historical averages. These disregard mortgage rates and other housing costs and lack scientific support. According to a large housing literature, the *user cost of housing* (*not* the purchase price) is the appropriate measure of cost of living in OOH, the cost of the housing *services* that the OOH delivers.

The user-cost-to-income (UCTI) indicator (the deviation of the UCTI ratio from its historical average) is a natural measure of valuation and affordability and has strong scientific support. New improved estimates of the indicator are constructed, including adjustment for a preference shift during covid in favor of larger and better housing.

For Sweden, the UCTI and PTI indicators are strongly *negatively* correlated and have opposite signs. If the UCTI indicator is right, the PTI indicator is consistently wrong.

According to the UCTI indicator, Swedish owner-occupied houses have since 2010 become increasingly *under*valued (not overvalued), by a maximum of 33% in 2019q4. Due to rising electricity prices and mortgage rates, they have since become less undervalued, but were still undervalued by 17% in 2022q4.

The problem of misleading indicators and overvaluation assessments is not restricted to Sweden but concerns several countries in the European Union. The relevant and informative indicators presented in the paper allow more reliable and appropriate valuation assessments.

Latest version: https://larseosvensson.se/files/papers/are-swedish-house-prices-too-high.pdf

*I thank Ronald Albers, Johan Almenberg, Christophe André, Bo Becker, Robert Boije, Stephen Cecchetti, Alessandro Di Spirito, Peter Englund, Harry Flam, Lucia Fullin, Bernadette Galster, Isabel Grilo, Sten Hansen, Bengt Hansson, Jesper Hansson, Hana Hejlová, Matilda Kilström, Willem Kooi, John Muellbauer, Aurelio Nocera, Ida Peltonen, Tuomas Peltonen, Moreno Roma, Khaled Sakr, Antonio Sánchez Serrano, Rickard Sandberg, Frauke Skudelny, Agnieszka Szczypinska, Alessandro Turrini, Roine Vestman, Stefan Zeugner, and participants in seminars at Norges Bank, the Stockholm School of Economics, and the ECB for helpful recent or previous comments, discussions, and data. I am grateful to Stefan Zeugner for an update of the European Commission's HouseLev database; to Alexander Leodolter for information about the Commission's Housing Taxation Database; to Bengt Hansson and Peter Englund for sharing data and calculations from their work; and to Peter Buvén, Tommy Lindkvist, Malin Sundberg, Maria Wiberg, and Michael Wolf, all of Statistics Sweden, for data and answering questions. Support from the Jan Wallander and Tom Hedelius research foundation and the Tore Browaldh research foundation is gratefully acknowledged. The views expressed are my own and do not represent the views of other members of the ESRB's Advisory Scientific Committee or the official stance of the ESRB or its member organizations. Any errors are my own.

Contents

1 Introduction

Several international organizations that monitor and comment on Swedish economic policy have for many years maintained that Swedish house prices are too high and that Swedish (owner-occupied) housing thus is overvalued. Most recently, the European Systemic Risk Board (ESRB) with the help of estimates provided by the ECB has concluded that Swedish housing was overvalued by about 55% in 2021q2 (ECB, 2022; ESRB, 2022b). This is the largest reported overvaluation in the European Economic Area (the EU as well as Iceland, Liechtenstein, and Norway). Previously, the European Commission concluded that Swedish housing was overvalued by at least 30% in 2020q4 (European Commission, 2021).

These assessments of housing overvaluation affect the warnings and recommendations that these organizations issue for Swedish economic policy (European Commission, 2021; ESRB, 2022a). They also affect the stress tests of the European Banking Authority that Swedish banks are subject to (ESRB, 2021). Because Sweden is considered having the largest overvaluation, Swedish banks are subject to more demanding stress tests than other EU banks. Nevertheless, Swedish banks have managed the tests quite well (FI, 2021).[1]

This paper demonstrates that these large overvaluation assessments are mainly due to the use of unreliable and misleading indicators, more precisely, the deviation of price-to-income (PTI) and price-to-rent (PTR) ratios from their historical averages. These indicators disregard the crucial role of interest rates and other costs of owner-occupied housing and lack any scientific support. A simple and robust indicator that has scientific support in a large housing literature is the so-called *user cost of housing*. It is the actual cost of living in owner-occupied housing and takes into account mortgage interest; the cost of equity; costs of operation, maintenance, repair, and depreciation; taxes; capital gains; and so on.[2]

The deviation of the user-cost-to-income (UCTI) ratio from a benchmark is a natural indicator of the valuation and affordability of owner-occupied housing. The benchmark can be a given fraction of disposable income; an index of the UCTI ratio set at 100 for a given base year, for example, a year at which the housing market is considered to have been appropriately valued; or a historical average. Here, the "UCTI indicator" will refer to a historical average as the benchmark. There will also be a few figures with indices somewhat arbitrarily set to 100 for 2010.

The deviation of the user-cost-to-rent (UCTR) ratio from a benchmark is a natural indicator of the relative affordability of owner-occupied to rental housing. The benchmark can be given ratio, for example, unity for similar owner-occupied and rental dwellings; an index set to 100 for a given base year; or a historical average. Here, the "UCTR indicator" will refer to a historical average as

[1] To provide serious and relevant tests of the resilience of EU banks, the tests need of course assume substantial negative shocks, including negative house-price shocks. But the results of these tests are more informative if the magnitude of these house-price shocks—and any differentiation across countries—beyond a substantial minimum size is determined in the light of *relevant* indicators instead of the deviations of PTI and PTR ratios from their historical averages.

[2] Boije (2019) has previously criticized the overvaluation assessments of European Commission (2019), including its disregard of the downward trend in real mortgage rates and its comparisons with rents that are subject to rent-control and differ from market rents.

the benchmark, but there will also be a few figures with indices set at 100 for 2010. However, for Sweden, the UCTR ratio is less informative and need to be interpreted with special care, because the rental market is deeply dysfunctional due to rent control.

For Sweden, the UCTI and PTI indicators turn out to be strongly negatively correlated and even of opposite signs after 2014q1. Both can therefore not be right. If we accept that the UCTI indicator is the right one, it follows that the PTI indicator is not only irrelevant but after 2014q1 consistently wrong in indicating over- or undervaluation. When the PTI indicator after 2014q1 signals overvaluation, the UCTI indicator signals undervaluation.[3]

According to the UCTI indicator, Swedish owner-occupied houses has since 2010 become increasingly undervalued, not overvalued, with a trough in 2019q4 of −33%. Since then, taking into account a preference shift during covid toward larger and better homes as well rising electricity prices from 2021 and rising interest rates in 2022, the UCTI indicator has risen to reach −17% in 2022q4. Thus, according to the UCTI indicator, in 2022q4 Swedish houses were still undervalued but substantially less so.

The main results of this paper can be summarized with the help of figure 1.1. The solid blue line shows the PTI indicator—the percentage deviation of the PTI ratio from its historical average, where the PTI ratio is Swedish house prices divided by disposable income per capita.[4] The peak value is 48% and occurs in 2022q1. According to the PTI indicator, Swedish houses were thus overvalued by 48% in 2022q1. The PTI indicator has since fallen to 21% in 2022q4, so according to the PTI indicator Swedish houses are less overvalued in 2022q4 than in 2022q1.[5]

Several international organizations use the percentage deviation of the PTI ratio from a benchmark as one of the indicators of overvaluation of (owner-occupied) housing. The benchmark is typically a historical average from the mid 1990s until the latest available observation.[6]

The rationale for the PTI indicator has been expressed as follows:

> Another statistical indicator relates house prices to income. Similar to the house price-to-rent ratio, such indicators are generally related to their long-term average. If the ratio lies above its long-term average, prospective buyers may find purchasing a home, and servicing the associated debt, more difficult, which should reduce demand and lead to downward pressures on house prices. (ECB, 2015b)

We may note that the rationale presented is an affordability argument. A PTI ratio above its historical average would imply that houses are less affordable for prospective buyers, which should reduce demand and lead downward pressure on house prices.

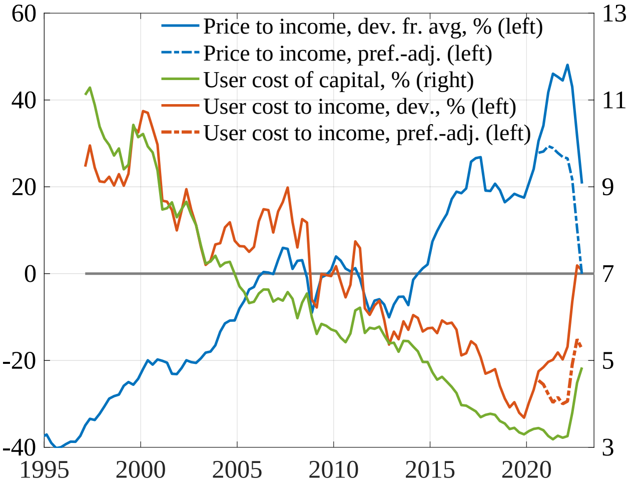
[3] The correlation coefficient for the PTI and UCTI indicators is −0.8.

[4] The house prices are an index of current prices of one- and two-dwelling owner-occupied houses. Disposable income is a 4-quarter trailing moving sum of quarterly net disposable income at current prices, and disposable income per capita is this sum divided by the population in the quarter. The historical average is from 1997q1 to the last available observation. See appendix A for details.

[5] This paper focuses on owner-occupied houses rather than owner-occupied apartments, because the price series on houses is longer. At the end of 2021, houses formed about 70% and apartments about 30% of the value of Swedish owner-occupied housing for permanent living (Statistics Sweden, 2022a).

[6] ECB and ESRB use the historical averages from 1996 until the latest available observation; the European Commission from 1995 until the latest available observation.

Figure 1.1: Price-to-income and user-cost-to-income ratios (percentage deviation from historical averages) and the user cost of capital (percent), Swedish houses.



Source and note: Own calculations. See appendix A and figure 3.5 for the underlying data. The "preference-adjustment" is explained in the text. The user cost of capital is from figure 3.4. The last observation is 2022q4.

However, there is a big problem with the PTI ratio as an indicator of affordability. The price of a dwelling is not at all the same as the annual cost of owning and living in the dwelling (Himmelberg et al., 2005; Mulheirn, 2019). A simple thought experiment is sufficient to prove this statement: Assume that taxes and operation, maintenance, repair, and depreciation costs are zero. Assume also that the house price is constant so there are no capital gains or losses. Assume finally that the buyer of a house can finance the purchase with an interest-only mortgage equal to the purchase price, that is, with a zero down payment and thus a loan-to-value ratio of 100%. Then the purchase of the dwelling results in an annual interest expenditure of just the interest on the mortgage. The relevant cost and the relevant measure of affordability is in this case the annual interest expenditure, not the purchase price. If the purchase price is doubled, but the mortgage rate is halved, the interest expenditure is unchanged.[7]

The last sentence in the quote above is thus misleading. A PTI ratio above its long-term average does not imply that prospective buyers will find purchasing a home, and servicing the associated debt, more difficult and affordability thus less.[8]

More generally, a dwelling is a durable good, an asset, which delivers a flow of services, housing

[7] However, the PTI ratio—preferably expressed in the years of disposable income for the average dwelling—would be most appropriate as measure of housing affordability on the island of Sark in the English Channel, on which mortgages are forbidden (Kelly, 2019). But it is not suitable as such an indicator if mortgages are available.

[8] Interestingly, the rationale for the PTI indicator in the above quote is directly followed by a warning that the interest rate matters:

> Given a strong prevalence of mortgage financing, such indicators are often transformed into "affordability" measures, which are adjusted to reflect the prevailing average interest rate on bank loans for house purchase.
>
> The affordability ratio can be adjusted for interest rate developments in a number of ways. An interest rate variable, derived from a standard annuity formula, can be incorporated directly into the affordability ratio. (ECB, 2015b)

Unfortunately, this warning is apparently easily forgotten.

services. It is the housing services that are consumed by the owner-occupier, not the dwelling.[9] It is therefore important to distinguish between the purchase price of the dwelling and the annual cost of the housing services that the dwelling delivers, that is, the annual cost of living in the dwelling, the *user cost of housing* (services) (UC). It is the latter, by itself or relative to income and rents, that is the relevant metric for valuation assessments, not the purchase price.

For rental housing, it is obvious that it is the rent that is the cost of the housing services consumed and that the rent is the appropriate measure of the cost of living in rental housing. To assess the affordability of rental housing, it is then natural to look at the rent-to-income (RTI) ratio.

For owner-occupied housing, it should be equally obvious that it is the user cost, not the purchase price, that is the appropriate measure of the cost of living in owner-occupied housing. To assess the valuation and affordability of owner-occupied housing, it should then be equally natural to examine the user cost-to-income (UCTI) ratio. And the user-cost-to-rent (UCTR) ratio is a natural measure of the relative affordability of owner-occupied and rented housing. In a hypothetical perfectly functioning market for rented and owner-occupied housing without transactions costs and any differences in taxation, the UCTR ratio should be equal to unity for similar dwellings.

As explained in some detail in section 3, the (annual) user cost equals the sum of the annual operation, maintenance, repair, and depreciation (OMRD) costs; the real after-tax interest on the mortgage; the real cost of the housing equity; the taxes on the property and on imputed rental income; transactions costs; possibly a risk premium; and the negative of the real after-tax annual net capital gains on the house. Positive capital gains reduce the user cost and therefor enter with a negative sign.

The user cost can be calculated for a particular dwelling size or per square meter. It can also be calculated as a percentage of the dwelling value. Then it can be called the *user cost of (housing) capital* (UCC). The UCC_t in quarter t is thus defined as

$$\mathrm{UCC}_t \equiv \mathrm{UC}_t / P_t, \tag{1.1}$$

where UC_t and P_t denote, respectively, the user cost and house price (for a given dwelling size or per sqm) in quarter t.[10]

It follows that the UCTI ratio can be calculated as the product of the UCC and the PTI ratio,

$$\mathrm{UCTI}_t \equiv \mathrm{UCC}_t \, \mathrm{PTI}_t, \tag{1.2}$$

where PTI_t denotes the PTI ratio in quarter t.[11] As we shall see, it is practical to first calculate the UCC and then calculate the UCTI ratio according to (1.2).

The green line in figure 1.1 shows the UCC (measured along the right axis). It falls substantially from about 11% in 1997q1 to a trough of 3.2% in 2021q2. It stays down until 2022q1 and then rises

[9] Conceptually, the owner-occupier combines the two roles of a landlord and renter; the owner-occupier is both a landlord owning the dwelling and renting it to herself and a renter renting from herself (Svensson, 2022b, section 4.2)). Haffner and Heylen (2011) provides a thorough conceptual discussion of the user cost.

[10] What is called the "user cost of capital" here is called the "user cost" or "user cost of (owner-occupied) housing" in some papers, and what is called the "user cost" here may be called the "price of housing services" or "imputed rental price" (Prescott, 1997).

[11] Given the identity (1.1), (1.2) is also an identity.

to 4.8% in 2022q4. As is explained in section 3, the fall and rise in the UCC is explained by the fall and rise in mortgage rates as well as a fall and rise in the OMRD rate, the ratio of OMRD costs to house prices.

The solid red line shows the resulting UCTI indicator—percentage deviation of the UCTI ratio from its historical average. The UCTI ratio is the product of the UCC and PTI ratio as in (1.2). We see that the large fall in the UCC dominates over the substantial rise in the PTI ratio. This makes the UCTI ratio fall from around 25% *above* its historical average in 1997 to a trough of 33% *below* its historical average in 2019q4. It then rises to just 1% above the historical average in 2022q4.[12]

Thus, according to the UCTI indicator, Swedish houses were *undervalued* by 33% in 2019q4, not overvalued by 18% as suggested by the PTI indicator. Furthermore, by the UCTI indicator, in 2022q4 Swedish houses were only slightly overvalued, not overvalued by 21% as suggested by the PTI indicator.

However, figure 1.1 shows that the PTI ratio rose particularly fast during the coronavirus crisis in 2020 and 2021. A similar development can be seen in several comparable countries. As discussed further in section 2, this price rise is best explained by a household preference shift in favor of larger and better homes, due to widespread working from home. That is, this price rise is consistent with fundamental factors and is not by itself any indication of overvaluation (Sveriges Riksbank, 2021).

Given this, for the purpose of assessing over- or undervaluation of housing over time, one may then want to use "preference-adjusted" house prices and user costs, corresponding to approximately unchanged preferences. The dash-dotted blue line in figure 1.1 shows the percentage deviation from the historical average of a PTI ratio for preference-adjusted housing prices. The simple assumption is that 75% of the price increases during 2020q2–2022q1 were due to the preference shift, so the preference-adjusted house prices are simply the observed house prices less those price increases.

The dash-dotted red line shows the corresponding preference-adjusted UCTI indicator, the UCTI ratio's deviation from its historical average. It stays down in 2021 well below the historical average and only rises to 17% below the historical average in 2022q4.

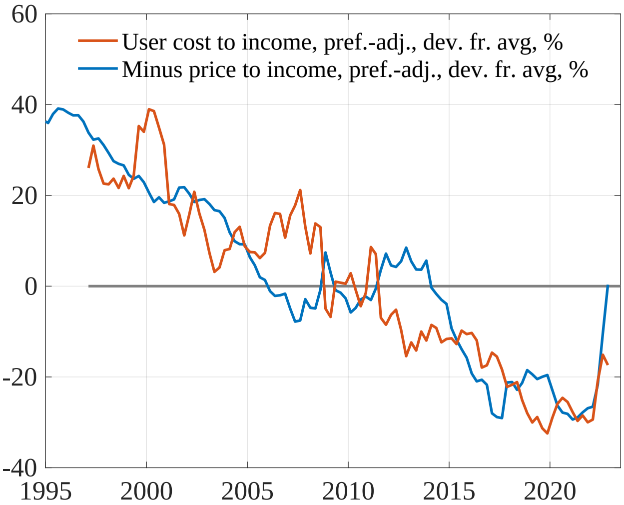
Furthermore, in figure 1.1, the preference-adjusted PTI and UCTI indicators appear to be approximately the mirror image of each other. This is confirmed in figure 1.2, where the PTI indicator is replaced by its negative. That is, the *negative* of the preference-adjusted PTI indicator gives essentially the same message about over- and undervaluation as the preference-adjusted UCTI indicator. If we accept that the UCTI indicator is the relevant indicator, it follows that for Sweden the PTI indicator is not only irrelevant but after 2014q1 consistently wrong. This is a pretty devastating result for the PTI ratio as an indicator of over- and undervaluation.[13]

In summary, the PTI and UCTI indicators deliver opposite messages about housing valuation. According to the preference-adjusted PTI indicator (adjusted from 2020q2), Swedish houses were

[12] The historical average of the UCTI ratio is from 1997q1 to the latest observation, because the mortgage rates used are only available from 1997q1.

[13] Appendix B provides some cointegration analysis of the logs of the UCC and preference-adjusted house prices and PTI and UCTI ratios. The hypothesis of no cointegration for the log UCC and preference-adjusted PTI ratio is rejected at a significance value of close to 1%, with a p-vale of 1.3%. A linear relation between the demeaned logs of the preference-adjusted log PTI and UCTI ratios is estimated to be $\log \mathrm{PTI} = -0.93 \log \mathrm{UCTI} + \varepsilon_t$, consistent with figure 1.2.

Figure 1.2: The preference-adjusted user-cost-to-income ratio and the negative of the preference-adjusted price-to-income ratio (percentage deviation from historical averages).



Source and note: The deviation from historical averages of the preference-adjusted UCTI and PTI ratios, the latter with opposite sign, from figure 1.1. The correlation coefficient is 0.8. The last observation is 2022q4.

undervalued by about 30% in 1997, neither over- nor undervalued in 2010, overvalued by 27% in 2021q4, and neither over- nor undervalued in 2022q4. According to the UCTI indicator, Swedish houses were *overvalued* by about 25% in 1997, neither over- nor undervalued in 2010, *undervalued* by 30% in 2021q4, and *undervalued* by 17% in 2022q4 (table 1.1).

Table 1.1: Price-price-to-income and user-cost-to-income ratios. Preference-adjusted, percentage deviations from historical means and percentage-point differences.

	PTI	UCTI	PTI−UCTI
1997	≈ −30%	≈ +25%	≈ −55 pp
2010	≈ 0%	≈ 0%	≈ 0 pp
2021q4	+27%	−30%	+57 pp
2022q4	≈ 0%	−17%	+17 pp

Source and note: Figure 1.1, preference-adjusted PTI and UCTI deviations from historical means.

The reason for these different messages is that the PTI indicator ignores movements in the UCC, but these movements are large and negatively correlated with the PTI ratio. This makes the UCTI and PTI indicators negatively correlated in figures 1.1 and 1.2. The international organizations mentioned prefer a valuation indicator that—at least for Sweden—is strongly negatively correlated with the more relevant indicator, the indicator that has scientific support in a large housing literature.[14]

The international organizations also use the percentage deviation of the price-to-rent (PTR) ratio from a historical average as another indicator of overvaluation. The rationale for the PTR indicator is similar to that of the PTI indicator:

> [The price-to-rent indicator] relates house prices to rents based on an arbitrage assumption. Accordingly, if house prices rise beyond what is justified by fundamentals then households will postpone purchasing a house and rent instead, thereby producing down-

[14] See footnote 29 for references.

> ward pressure on house prices. The validity of this assumption rests on households having a viable alternative in the rental market. (ECB, 2015b)

The PTR indicator is subject to the same problem as mentioned above for the PTI indicator, namely, that the price of a dwelling is not at all the same as the annual cost of owning and living in a the dwelling. The same simple thought experiment as above applies. Instead, the user-cost-to-rent ratio and its deviation from a historical average are the appropriate indicators.

As for the UCTI ratio, it is practical to calculate the UCTR ratio as the product of the UCC and the PTR ratio,

$$\mathrm{UCTR}_t \equiv \mathrm{UCC}_t \, \mathrm{PTR}_t. \tag{1.3}$$

Importantly, the UCTR ratio is an appropriate indicator only with a well-functioning rental market, so some arbitrage between renting and owning is possible. In a well-functioning market for rented and owner-occupied housing with moderate transactions costs and differences in taxation, the UCTR ratio should not deviate too much from unity for similar dwellings.[15]

However, Sweden has a dysfunctional rental market for apartments due to rent control, with regulated rents substantially below market rents. Queuing time to get a rent-controlled apartment in the major cities is often ten years or more. Furthermore, there is no functioning rental market for houses.[16] The UCTR ratio is therefore hardly an appropriate indicator of over- or undervaluation of owner-occupied housing in Sweden.[17]

Although the UCTR ratio is hardly an appropriate indicator for valuation purposes, it still conveys some information about the relative affordability of owner-occupied houses and rent-controlled apartments. The deviation of the preference-adjusted UCTR ratio from a historical average fluctuated around zero from 2010 up to 2016 and then fell to a trough of −20% in 2019q4 (figure 4.3, p. 21). It stayed a bit higher at about −14% until 2022q1 and then rose to +4% in 2022q4.[18]

This means that the preference-adjusted user cost has followed the development of regulated rents relatively well except falling substantially below them during 2016-2021. One might have ex-

[15] The equality of the user cost and the rent for similar dwellings is the rationale for the method of Owner Equivalent Rents (OER)—also called the rental-equivalence method. It uses observed rents on similar rented dwellings as an estimate of the user cost of owner-occupied housing in national accounts and consumer price indices. However, we can see in figure 4.3, p. 21, that there can be a substantial difference between rents and user costs, due to inertia, frictions, rent control, and other imperfections in the housing market. This means that the OER method can be quite misleading.

[16] Buy-to-let for houses is very rare or non-existing in Sweden. Buy-to-let for apartments is quite rare, because tenant-owner associations normally restrict subletting. Tenant-ownership is the dominant type of ownership for Swedish owner-occupied apartments.

[17] The rationale in quoted above for the PTR indicator is directly followed by several warnings:

> The validity of this assumption rests on households having a viable alternative in the rental market. The extent to which this holds differs across euro area countries and largely depends on the scale and composition of national rental and owner-occupied markets. . . . Further complicating this, rents may not always be set at market rates given considerable regulation of the sector. Last but not least, the house price-to-rent indicator typically assumes a constant long-term average, but there may be important structural breaks arising from policy changes. For these reasons, the house price-to-rent indicator, although commonly used as a benchmark for house price valuation, may not be a reliable metric for assessing valuations in some euro area countries. (ECB, 2015b)

Again, these warnings seem to be easily forgotten.

[18] There is no rental market to speak of for houses, only owner occupation (including some tenant-ownership also of houses). Therefore, UCTR ratios uses rents of rental apartments in apartment buildings.

pected the cost of living in owner-occupied houses to rise faster than the regulated rents—especially in Sweden with a strong national renters' association, Hyresgästföreningen—but this has not happened. This is consistent with owner-occupied houses having been undervalued rather than overvalued after 2010, as indicated by the UCTI ratio

In 2006, a reform of the Swedish rent-control system was implemented to stimulate the construction of new rental housing, which had been rather limited after the dismantling of construction subsidies in 1990. The reform consisted of introducing a special option for new rental housing, namely, to negotiate and set rents before the construction start. These rents were "presumed" to be exempt for fifteen years from the standard rent-control of the existing housing stock and therefore called "presumption rents" (Lind, 2021). As a result, rents in newly constructed buildings are set at a substantially higher level than rent-controlled rents. The presumption rents are arguably close to free-market levels and may thus be used as indicators of market rents as distinct from rent-controlled rents. Thus, UCTR ratios for presumption rents can arguably be used for assessing valuation of owner-occupied housing, although only small minority of rented housing has presumption rents.

In practice, Swedish presumption rents have increased over time in line with per capita disposable income (figure G.2, p. 47) so the deviation from a historical average of the UCTR ratio for presumption rents looks very similar and provides similar information as the UCTI ratio.

The house price used in this paper is only available in index form. With more specific, data over- and undervaluation can be determined with more precisions. Suppose there is data available so that the user cost can be calculated in SEK for a specific type of owner-occupied dwelling of a given quality. Suppose that there is also data on the rent in SEK on rented dwellings of the same type and quality. Then we can say that the owner-occupied dwelling is over- or undervalued depending on whether the user cost is lower or higher, respectively, than the rent. This is a case when it is possible to make absolute comparisons of the user cost and rent for similar dwellings. It is also possible to express UCTI ratios as percentages of income, providing in this sense absolute measures of affordability.

As an example of such an absolute comparison, Svensson (2020) shows that the monthly user cost for an owner-occupied average studio (an apartment with a single multipurpose room) in Stockholm Municipality 2017 was substantially lower than the monthly rent for a similar rent-controlled apartment: SEK 2,800 vs. SEK 5,300, respectively (about EUR 280 vs. EUR 530 at the time). Furthermore, the queue to get a rent-controlled apartment was about 10 years, and the free-market rent for a secondary rental would be double the rent-controlled rent or more.[19] Another example is presented in Flam (2016). For 2000–20915, he compared owner-occupied user costs to presumption rents in Stockholm's inner city, the hottest housing market in Sweden. He found that presumption rents exceeded the user cost. Thus, there was no indication of overvaluation even in this hot market (see footnote 63).

Even though there is a large literature on various aspects of user costs (see footnote 29 for references), I believe that a few things are special or new in this paper: (1) The UCTI ratio

[19] The user cost is lower despite excluding substantial positive real after-tax capital gains.

relative to its historical average is used as a main indicator of overvaluation.[20] (2) It is shown that the PTI and UCTI indicators are strongly negatively correlated, at least for Sweden. Thus, they cannot both be right. (3) The comparison between the PTI, PTR, UCTI, and UCTR ratios is undertaken in a few informative figures. The reasons why the PTI and PTR ratios are misleading are clearly demonstrated in these figures. (4) A simple and transparent method is used to adjust for the household preference shift during the corona crisis in favor of larger and better homes. (5) A separate companion note (Svensson, 2022b) with a simple frictionless theoretical model shows with a simple rewriting of an owner-occupying household's budget constraint why the user cost is the appropriate measure of the cost of living in owner-occupied housing. Furthermore, with Cobb-Douglas preferences the frictionless equilibrium UCTI ratio may be quite stable over time and therefore a reasonable benchmark. (6) I follow Hansson (2019) in using National Accounts data for operation, maintenance, and repair (OMR) costs and in considering that OMR concerns the structures but not the land. The share of land in house prices has increased substantially in Sweden. This is handled by weighing these costs and the depreciation with the share of structures in the value of housing. I go beyond Hansson in looking at UCTI ratios rather than just user costs and in relying explicitly on the methods of Statistics Sweden and the US Bureau of Economic Analysis to calculate the depreciation of owner-occupied housing (Svensson, 2022a). (7) A convenient and conservative assumption is that the expected real after-tax capital gains on houses are zero. This implies that the calculated user cost is exclusive of any speculation about capital gains. This introduces a bias toward higher user costs. This in turn introduces a bias toward higher UCTI and UCTR ratios and thereby toward overvaluation, thus stacking the cards in favor of finding overvaluation. However, when overvaluation is measured by the deviations of UCTI and UCTR ratios from their historical averages, there is less or no bias, because the historical averages are also higher.[21]

Importantly, the user-cost approach presented here is a method to assess the valuation of housing in terms of the cost of living in owner-occupied housing relative to household incomes and to rents on similar available rental housing. It is not a theory of house-price determination, how house prices depend on fundamentals. The user-cost approach is sometimes used as a simple house-price theory, where the user cost is assumed to be always equal to rents—often referred to as the "rent arbitrage" or "asset pricing" theory of house prices. Alternatively, the UCTI ratio can be assumed to be exogenous or even constant. These simple theories for frictionless and perfect housing markets theory are rejected in this paper by the simple observation that user costs differ from rents for long periods and that UCTI ratios are far from constant. Put differently, a good theory of housing prices

[20] Only a few papers (Office of Policy Development and Research, 2000; Dermani et al., 2016; Svensson, 2019, 2020) have to my knowledge emphasized the role of the user-cost-to-*income* ratio rather than the user-cost-to-rent ratio or the level of the user cost as an indicator of affordability or overvaluation.

[21] The conservative assumption has performed well on US data, in the sense that, with this assumption, Garner and Verbrugge (2009b) found that the resulting user costs tracked market rents rather well. Se the quote from Diewert (2013, appendix, para. 3.67). The assumption is also used in Iceland (Guðnason and Jónsdóttir, 2009).

should explain why and how user costs deviate from rents and why UCTI ratios fluctuate.[22] [23]

The rest of the paper is organized as follows: Section 2 discusses the PTI and PTR indicators and reports what overvaluation they would indicate. Section 3 defines the user cost of housing and the user cost of capital (UCC), which is the user cost dived by price of the dwelling in SEK (or the local currency in another country in focus). It also calculates the UCC and displays its components. Section 4 discusses the UCTI and UCTR ratios and their implication for any overvaluation of Swedish housing, taking into account the household preference shift. Section 5 scrutinizes the calculations of and comments on Swedish housing overvaluation by the ECB and the ESRB, the European Commission, the OECD, and the IMF. It also briefly compares the ECB and Commission model results with those of the staff of the Riksbank and of the National Debt Office. Section 6 concludes.

The companion note Svensson (2022b) and a few appendices present a theoretical background and some details. Appendix A summarizes the data used. Appendix B provides some cointegration analysis of the logs of the UCC and preference-adjusted house prices and PTI and UCTI ratios. Appendix C examines whether Swedish households have overoptimistic mortgage-rate expectations or not. Appendix D provides some details of Riksbank and National Debt Office empirical models of Swedish house prices. Appendix E reports the actual capital gains on owner-occupied houses. Appendix F reports data on housing-expenditure-to-income ratios by tenure. Appendix G includes additional figures.

2 The price-to-income and price-to-rent ratios

The price-to-income (PTI) and price-to-rent (PTR) ratios are defined as $\mathrm{PTI}_t \equiv P_t/\mathrm{DI}_t$ and $\mathrm{PTR}_t \equiv P_t/R_t$, where P_t denotes the price of a dwelling of standardized size (or per sqm) in period t, DI_t denotes net disposable income per capita, and R_t denotes rents.[24] Figure G.1 shows Swedish house prices, disposable income, disposable income per capita, rents, and population.

For house prices, the longest series is a quarterly price index for one- and two-dwelling houses for permanent living of Statistics Sweden (2022h). It excludes apartments. It is also reported with a lag

[22] Almenberg et al. (2022) is an example in which the user cost is assumed to be exogenous and growing with a constant rate when house-price changes are predicted. FI (2022a, In-depth analysis, pp. 22–25, and Appendix 2, pp. 45–47) is an example where the UCTI ratio is assumed to be constant when house-price changes are predicted.

[23] Duca et al. (2021b) have criticized the simple rent-arbitrage (asset-price) theory for being misleading, inconsistent with empirical estimates, and not taking into account inertia, frictions and other imperfections in housing and mortgage markets. These include that fact that rented apartments are imperfect substitutes to houses with more land per occupant, rents are stickier and less cyclical than house prices, different characteristics of renters and owner-occupiers, unobserved costs and benefits of owning versus renting, and the combination of large transactions costs, risk aversion, and house-price volatility making it difficult to arbitrage between renting and buying. Furthermore, credit constraints and entry barriers in the form of affordability tests; limits on debt-service-to-income, loan-to-income and loan-to-value ratios imposed by lenders and macroprudential authorities restrict the demand for owner-occupied housing.

[24] There is a choice between using disposable income or disposable income per capita, and between gross and net disposable income (the latter is net of the depreciation of households' fixed capital. Here I use net disposable income per capita. International organizations often use gross in international comparisons, because countries calculate fixed-capital depreciation differently. Figure G.5 shows that for Sweden the difference between gross and net disposable income is small.

of 2–3 months because it uses the date of the deed rather than the earlier date of the contract. From 2005 a monthly index, the HOX index, is provided for houses and apartments by Valueguard (2022). Figure G.13 shows the different price indices.[25] I use a linked quarterly price index consisting of the Statistics Sweden price index up to 2005q1 and a quarterly mean of the HOX index from 2000q1, shown in figure G.3.

Figure 2.1: Price-to-income and price-to-rent ratios. Index 2010 = 100.

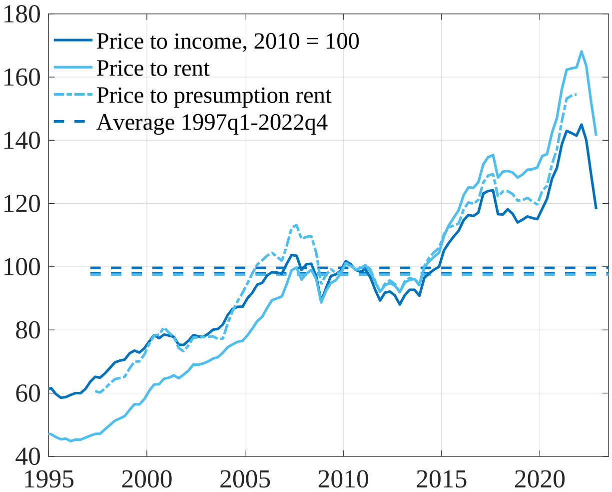
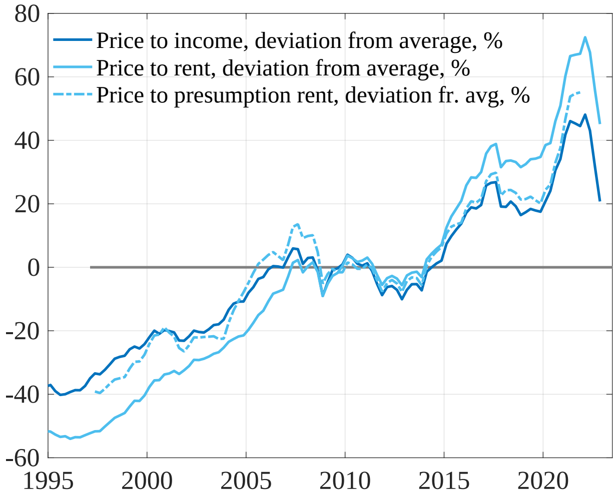


Figure 2.2: Price-to-income and price-to-rent ratios. Deviation from historical average.



Source and note: Statistics Sweden (2022e,h), Valueguard (2022), and own calculations. Income is disposable income per capita. Presumption rents are rents in newly constructed buildings exempt for rent control.

Figure 2.1 shows the PTI and PTR ratios and their averages during 1997q1–2022q4. Figure 2.2 shows their percentage deviations from their averages. According to the PTI indicator, Swedish houses were overvalued by 48% in 2022q1 and 21% in 2022q4.[26] According to the PTR indicator, they were overvalued by 72% in 2022q1 and by 45% in 2022q4. For presumption rents, the PTR ratio is similar to the PTI ratio and thus indicate a similar degree of overvaluation.[27]

In this paper, variables are indexed to 100 for the base year 2010. The percentage deviations from historical averages have the advantage that they do not depend on the indexation base year.

3 User cost and user cost of capital

The (annual) user cost of housing (services) can be defined as the annual cost of buying a dwelling at the beginning of a year; paying operating, maintenance, and depreciation costs as well as taxes during the year; and selling the dwelling at the end of the year, paying any capital-gains tax at the

[25] Booli (2022) has a similar price index for apartments and houses from 2013.

[26] In contrast, ESRB (2022b, table 1, Scoreboard), reproduced as figure G.23, reports that the PTI ratio in 2021q2 exceeds its average during 1996q1–2021q2 by no less than 66%, a number difficult to explain (section 5.1).

[27] The historical average moves with the recent deviation from it. One could consider real-time deviations from a historical average or from the average over a moving constant-length window. See figure G.8 for the PTI deviation from a real-time historical average.

end of the year.[28] More precisely, a simple version of the user cost of housing (UC) equals the sum of the operating, maintenance, repair, and depreciation costs (OMRD), the real after-tax mortgage interest, the real cost of housing equity, property taxes, possibly a risk premium, and the negative of the (expected or realized) real after-tax capital gains.[29]

The note Svensson (2022b) presents a simple frictionless model that explains why the user cost is the appropriate measure of the cost of owner-occupied housing. It also explains why the UCTI and UCTR ratios rather than the PTI and PTR ratios are appropriate indicator of overvaluation. In particular, the model shows that, for an economy with households that have Cobb-Douglas preferences, the equilibrium UCTI ratio is likely to be approximately constant whereas the equilibrium PTI and PTR ratios are not.

The user cost can be calculated for a particular dwelling size or per square meter. It can also be calculated per SEK dwelling value and expressed as percentage of the house price. Then it can be called the user-cost-of-(housing)-capital (UCC) and is given by

$$\mathrm{UCC}_t \equiv \mathrm{UC}_t/P_t, \qquad \text{(1.1 repeated)}$$

where UC_t denotes the (annual) user cost in quarter t and P_t denotes the house price.[30]

It is often practical to first calculate the UCC, and then calculate the user cost as

$$\mathrm{UC}_t = \mathrm{UCC}_t P_t. \tag{3.1}$$

The user-cost-to-income (UCTI) and user-cost-to-rent (UCTR) ratios are defined as $\mathrm{UCTI}_t \equiv \mathrm{UC}_t/\mathrm{DI}_t$ and $\mathrm{UCTR}_t \equiv \mathrm{UC}_t/R_t$, respectively. Given the UCC and the PTI and PTR ratios, the UCTI and UCTR ratios can then conveniently be calculated as

$$\mathrm{UCTI}_t \equiv \mathrm{UCC}_t\,\mathrm{PTI}_t, \qquad \text{(1.2 repeated)}$$

$$\mathrm{UCTR}_t \equiv \mathrm{UCC}_t\,\mathrm{PTR}_t. \qquad \text{(1.3 repeated)}$$

Here, (1.2) and (1.3) (and (3.1)) are actually identities, given the definitions of each variable in them.

Following Poterba (1984), Poterba and Sinai (2008), and Barrios et al. (2019), the UCC can be written as

$$\mathrm{UCC}_t = [\mathrm{LTV}_t(1-\tau_t^M)i_t + (1-\mathrm{LTV}_t)(1-\tau_t^{ci})i_t^{eq}] + m_t + \tau_t^p + \rho_t - (1-\tau_t^{cg})\pi_t^{he}. \tag{3.2}$$

Here, the term in square brackets is the nominal after-tax *financing cost*. The first term within the squared brackets is the LTV-weighted after-tax nominal mortgage rate. The second term is the

[28] Annual average transactions cost associated with the purchase and sale of the dwelling over a typical ownership period can be added.

[29] The user cost of housing is discussed by, for example, Prescott (1997), Dougherty and Van Order (1982), Poterba (1984), Office of Policy Development and Research (2000), Himmelberg et al. (2005), Poterba and Sinai (2008), Díaz and Luengo-Prado (2008), Verbrugge (2008), Garner and Verbrugge (2009a,b), Englund (2011, 2020), Haffner and Heylen (2011), Muellbauer (2012), Diewert (2013, appendix), Fox and Tulip (2014), Duca et al. (2016, 2021a,b), Hansson (2019), Mulheirn (2019), and Svensson (2019, 2020, 2022b).

[30] What is called the "user cost of capital" here is called the "user cost" or "user cost of (owner-occupied) housing" in some papers, and what is called the "user cost" here may be called the "price of housing services" or "imputed rental price" (Prescott, 1997).

housing-equity-to-value-weighted after-tax nominal cost of housing equity. The before-tax mortgage rate, i_t, may differ from the before-tax cost of housing equity, i_t^{eq}, as may the rates of mortgage tax relief, τ_t^M, and capital-income tax, τ_t^{ci}.[31]

The variable $m_t = \text{OMRD}_t/P_t$ (the OMRD rate) denotes the ratio of the operation, maintenance, repair, and depreciation costs to the house price; τ_t^p denotes the property tax rate; and ρ_t denotes a risk premium, representing that housing ownership may be perceived to be risky relative to a safe alternative investment.[32]

Finally, the last term in (3.2) is the negative of the expected rate of nominal after-tax capital gains, where π_t^{he} denotes the expectations held in quarter t of the rate of future nominal house-price appreciation and τ_t^{cg} denotes the nominal capital-gains tax rate.[33] The expected nominal after-tax capital gains reduce the user cost and therefore enter with a negative sign in the UCC.

Let the variable π_t^e denote the homeowner's (not necessarily rational) expectations in quarter t of the rate of future CPI inflation. Following Svensson (2019, 2020) by subtracting and adding this term in (3.2), the UCC can be written as

$$\text{UCC}_t = r_t + m_t + \tau_t^p + \rho_t - [(1 - \tau_t^{cg})\pi_t^{he} - \pi_t^e], \tag{3.3}$$

where

$$r_t = \text{LTV}_t(1 - \tau_t^M)i_t + (1 - \text{LTV}_t)(1 - \tau_t^{ci})i_t^{eq} - \pi_t^e. \tag{3.4}$$

denotes the *real* after-tax financing cost. The term in square brackets in (3.3) is the expected rate of *real* after-tax capital gains.

Under the conservative assumption that the expected real after-tax capital gains are zero, the expression for the UCC simplifies to

$$\text{UCC}_t = r_t + m_t + \tau_t^p + \rho_t. \tag{3.5}$$

This assumption is conservative in the sense that it is biased toward lower capital gains and higher user costs. In the absences of any capital-gains tax, it amounts to assuming that nominal house prices follow the CPI, that is, that expected future real house prices are constant.[34] [35]

More precisely, this assumption is conservative when the actual level in SEK of the user cost is considered, in comparison with rents or as a share of the level of disposable income. It need not affect the percentage deviation from historical averages, since the assumption will affect the level of the historical average.

The European Commission has collected a database, the Housing Taxation Database, of comparable time series of the main features of home ownership taxation and user cost of housing in the

[31] The financing cost can obviously be extended to include the cost of unsecured loans that finance deposits, the return on a diversified portfolio of financial assets as the cost of housing equity, and so on.

[32] Any tax on imputed rental income should be added. Sweden had such a tax before 1991 (Englund, 2020).

[33] According to Barrios et al. (2019), only Cyprus and Sweden have such a capital-gains tax in the EU.

[34] The assumption is quite conservative, given that the average annual rate of the ex-post real after-tax capital gains has been 2.7% during 2010q1–2022q4 and 4.0% during 1997q1–2022q4 (appendix E). These numbers furthermore disregard that the capital-gains tax can be postponed, which increases the effective capital gains.

[35] The conservative assumption has performed well on US data, in the sense that, with this assumption, Garner and Verbrugge (2009b) found that the resulting user costs tracked market rents rather well. Se the quote from Diewert (2013, appendix, para. 3.67). The assumption is also used in Iceland (Guðnason and Jónsdóttir, 2009).

EU and the UK (Barrios et al., 2019; Thiemann et al., 2022a,b). The purpose of the database is not to assess any overvaluation of housing but to display the distortions of housing choices caused by taxation. However, the database is very useful also for estimating user costs of housing and user-cost-to-income ratios for valuation assessments in the EU. Expression (3.3) is a somewhat simplified variant of the expression of the UCC presented there. The database and its results regarding Swedish housing valuation is further discussed in section 5.2 below.[36]

3.1 The components of the UCC

The real after-tax financing cost It remains to determine the components of the UCC in (3.5) and (3.4). I use a mortgage rate with a 5-year fixation period from SBAB (2022) (figure G.16).

Using a 5-year rate implies considering the user cost as being perceived as a longer-run annual average, which seems appropriate given that house purchases are longer-run decisions. Five-year rates are also normally higher than short rates, which implies a bias toward higher UCCs.[37] [38]

For Sweden, the rates of mortgage tax relief and capital-income tax are the same and equal to 30%. Furthermore, for simplicity, for most of the sample, I assume that the cost of housing equity equals the mortgage rate, $i_t^{eq} = i_t$. In this case, the LTV ratio does not matter for the financing cost.

However, the rapid increase in mortgage rates in 2022 from a situation of generally very low interest rates has not been accompanied by increased rate of return of alternative investments. Swedish mortgagors have substantial financial assets, including substantial bank deposits with safe but very small rates of return (FI, 2022a; Statistics Sweden, 2022k). These have not increased in parallel with the mortgage rates. Given this, I assume that the cost of equity is constant starting from 2021q3 and equal to the mortgage rate of that quarter. Furthermore, I assume a constant LTV ratio of 70%, equal to the average LTV ratio for mortgagors that bought a new dwelling in 2021 (FI, 2022a, p. 11). The 5-year mortgage rate, the cost-of-house equity, and the resulting financing cost is shown in figure G.15.

For inflation expectations, I use 5-year inflation expectations collected by Kantar Sifo (2022) and available for downloading from Refinitiv Datastream.

Household expectations of future mortgage rates In this context, it is relevant to consider whether households' expectations of future mortgage rates are realistic or unrealistically low, for example, lower than what is consistent with a 5-year mortgage rate offered by lenders. Any such lower expectations can be considered a separate indicator of overvaluation. However, as shown in

[36] What is called the user cost of capital (UCC) here is called the user cost of owner-occupied housing (UCOH) indicator in Barrios et al. (2019) and Thiemann et al. (2022a).

[37] The SBAB 5-year rate is similar to the average 5+years rate for all mortgage lenders published by Statistics Sweden but available for a longer sample; see figure G.16. Another option would be to use the Statistics Sweden rate from September 1995 and the SBAB rate before. Very few loans would have as long a fixation period as 10 years.

[38] As noted in the introduction, a bias toward higher user costs implies a bias toward higher UCTI and UCTR ratios and thereby toward overvaluation, thus stacking the cards in favor of finding overvaluation. However, when overvaluation is measured by the deviations of UCTI and UCTR ratios from their historical averages, there is less or no bias, because the historical averages are also higher

appendix C, households do not expect higher future mortgage rates than banks. Because banks are likely to be better informed than households, this indicates that households do not have unrealistically low mortgage-rate expectations.

The OMRD rate The OMRD includes nominal operation, maintenance, and repair costs, as well as any remaining depreciation when the maintenance and repair is not full. The OMRD is often for simplicity assumed to be a constant fraction of the house price, but these costs are not directly related to the house price.[39] Some of the operation and maintenance (including repair) are rather real costs that follow the CPI index or wages, or disposable income per capita. Furthermore, any repair and remaining physical depreciation would apply to the structure of the dwelling but not the land it sits on, whereas the house price is the sum of the value of the structure and the value of the land (Diewert, 2013, appendix).[40] One way to deal with this issue would be to assume that the OMRD cost is a fixed share μ of the value of the structure, which implies that the OMRD share of the value of the house, the OMRD rate, is given by

$$m_t = \mu \frac{P_t^{sh}}{P_t}, \tag{3.6}$$

where P_t^{sh} denotes the value of the structure of the house.

However, I follow Hansson (2019) in using National Accounts data in Statistics Sweden (2022g) on operation, maintenance, and repair costs of Swedish owner-occupied houses.[41] Hansson furthermore assumes that the rate of depreciation is 2% of the value of structures. However, as discussed in Svensson (2022a), Statistics Sweden follow a method of the US Bureau of Economic Analysis—described in Katz and Herman (1997)—together with additional assumptions that result in a depreciation rate of approximately 1.5% of the price of the structures. I follow this method.[42]

Figure 3.1 shows the value of the structures of and land under owner-occupied houses in Sweden, as well as the share of structures in the house price, P_t^{sh}/P_t. Land values have risen more rapidly than the value of structures, and the share of the structures in the house price has fallen from almost 80% in the late 1990s to 46% at the end of 2021.

Figure 3.2 shows the OMR together with the value of structures and land. We see that the share of the OMR in the value of structures varies a bit and falls over time. In figure 3.3 the dashed dark red line shows the OMR share of structures. In line with Svensson (2022a), the depreciation rate is assumed to be 1.5% of the value of structures, resulting in an OMRD share of structures given by the solid dark red line. Multiplying this OMRD share by the share of structures in the price of the house results in the OMRD share of the house price—the OMRD rate—given by the solid yellow line in figure 3.2. The OMRD rate drops from 6.6% at the end of 1995 to 2.6% in 2021q2. Assuming a constant OMRD rate is thus a bad approximation, at least for Sweden. Even assuming a constant

[39] Harding et al. (2007) estimate the depreciation rate for US housing during 1983–2001 to 2.5% gross of and 2.0% net of maintenance.

[40] There are of course some operating and maintenance costs associated with the land the dwelling sits on, but they are disregarded relative to the substantial OMR associated with the dwelling.

[41] I thank Peter Buvén of Statistics Sweden for providing updated data, table G.1 and Statistics Sweden (2022g).

[42] I thank Michael Wolf of Statistics Sweden for explaining the methods used.

Figure 3.1: Values of structures and land.

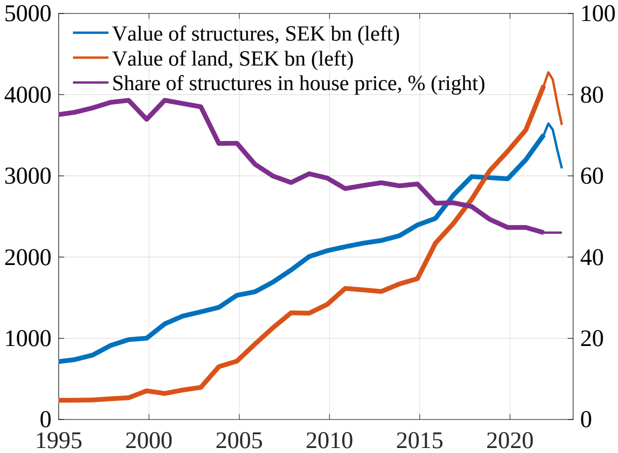
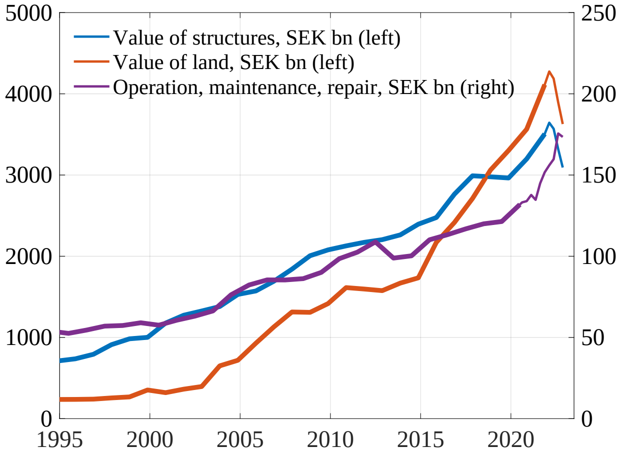


Figure 3.2: Value of structures and land; and operation, maintenance, and repair costs.



Source and note: Statistics Sweden (2022a,g), summarized in table G.1. The values of structures and land are slightly smoothed; see figure G.6. The thick lines are data. Figure 3.1: The thin lines are values extrapolated with the house-price index under the assumption of a constant share of structures in 2022. Figure 3.2: The OMR costs for 2021 and 2022 of heating, insurance, and maintenance and repair are extrapolated with the electricity, insurance, and repair goods prices in figure G.19. The small costs of water and sewage and of waste collection are linearly extrapolated. See figure G.7 for details.

OMRD share of the value of structures, as in (3.6), is only a moderately good approximation, as shown by the solid dark red line in the figure.

Figure 3.3: Operation, maintenance, repair, and maintenance; rates of the value of structures and the house price.

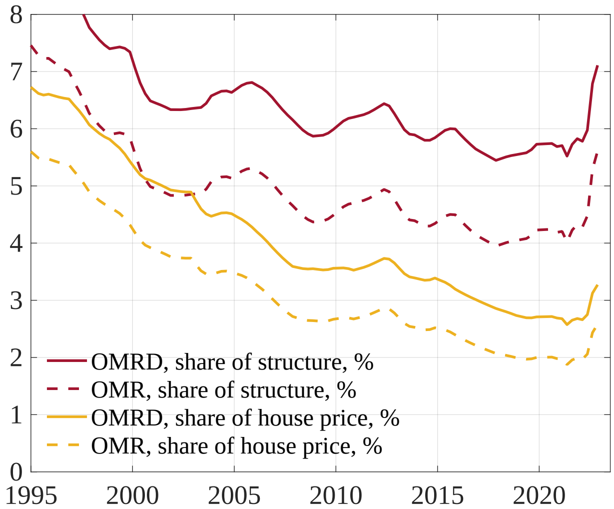
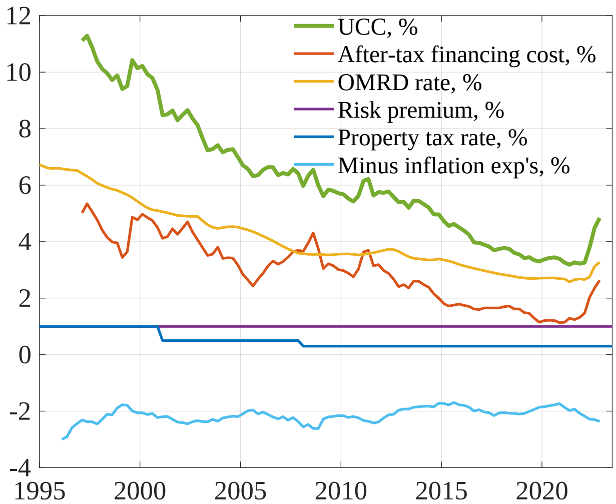


Figure 3.4: The UCC and its components.



Source and note: Figure 3.3: Annual OMR and value of structures and land from figure 3.2. The depreciation rate is in line with Statistics Sweden set to 1.5% of the value of structures (Svensson, 2022a). Figure 3.4: The 5-year mortgage rate is from SBAB (2022); the OMRD rate is a quarterly interpolation of that in figure 3.3, with an extrapolation for 2021 and 2022 of heating as well as maintenance and repair using prices of electricity and repair goods, respectively (see figures G.7 and G.19 and notes for details); the risk premium is 1%, the property tax rate is a piecewise constant approximation of Englund (2020); 5-year inflation expectations are from Kantar Sifo (2022) and Refinitiv Datastream; and own calculations. The last observation is 2022q4.

The property tax rate Barrios et al. (2019, pp. 48–49) reports property tax rates for EU countries that are implicit and calculated as the revenues from property taxes on households divided by the net stock of dwellings of households. Englund (2020, diagram 14) provides an explicit calculation of property tax rates for Sweden. This results in somewhat lower numbers than for Barrios et al. (2019, pp. 48–49), but the difference is small.

On January 1, 2008, the property tax was reduced substantially. In particular, a low ceiling was introduced, currently about SEK 8,500 per year, about EUR 770 at the time of writing. This is binding for most homeowners, effectively turning the property tax into a small lump-sum tax.[43] I use a piecewise constant approximation to the Englund numbers.

The risk premium Barrios et al. (2019) follow Poterba and Sinai (2008) in assuming a before-tax risk premium β equal to 2%, that is, for Sweden an after-tax risk premium of $(1 - 0.3)2 = 1.4\%$.[44] A risk premium has been derived by Flavin and Yamashita (2002) in a household optimal portfolio setting, but it may be too large (Himmelberg et al., 2005). It ignores that, relative to renting, owner-occupation provides a hedge against future rent increases (Sinai and Souleles, 2005). Also, owner-occupation have benefits in terms of more control over the housing than renting.

Three Swedish additional circumstances have a bearing on the risk-premium assumption. First, there is hardly any buy-to-let of houses and apartments in Sweden. That is, there is hardly any pure investor demand for houses and apartments, where the risk and return on the investment naturally is compared to that of other investments. Thus, there is mainly buy-to-live, in which case the comparison is between owner-occupied housing and other tenure alternatives.

Second, the rental market is dysfunctional due to rent-control. This means that rental housing is not very accessible. In the major cities, ten years or more of queuing is normally required to get a rent-controlled apartment. For those who have got a rented apartment, there is a strong lock-in effect because moving is difficult and require a kind of barter or exchange with other rented apartments, sometimes in complicated multi-apartment chains.[45] Given the high moving costs, renting is therefore quite risky. From this perspective, owner-occupied housing brings considerable flexibility and control, with freedom to sell and move, and is from this point of view less risky than rented housing.

Third, Swedish mortgages to a large extent have variable rates, that is, with a fixation period of 3 months, and many of the remaining ones have relatively short fixation periods of one or two years. The variable rates follow the Riksbank's policy rate with an average lag of 1.5 months and a relatively fixed spread. With floating exchange rates and flexible inflation targeting, policy rates and thus variable mortgage rates generally become procyclical, as do also the mortgage rates with relatively short fixation periods.[46] This means that mortgagors normally get lower interest

[43] This means that the property tax is regressive—the more expensive properties have a lower tax rate. Below the ceiling, the property tax is approximately 0.5% of market value. With a ceiling about EUR 820, the ceiling is then binding for properties with market value exceeding EUR 16,400.

[44] Diewert (2013) does not consider an explicit risk premium.

[45] Side-payments for getting a lease on a rent-controlled apartment occur but are illegal.

[46] In contrast, with fixed exchange rates, during the banking crisis in the 1990s, mortgage rates became very high, when the Riksbank defended a speculative attack on the krona with a policy rate as high as 500%. Thus, with a

payments in recessions and crises, when the marginal utility of the reduced payments is higher. Mortgagors effectively get insurance against bad times. Renters don't get any such insurance. This may actually justify a negative risk premium on owner-occupied housing.[47]

The above insurance against bad times obviously refer to "normal" bad times, which excludes rare shocks such as the recent global supply disturbances after covid and the shocks to inflation and corresponding central-bank responses due to the Russian attack on Ukraine.

Thus, for Sweden, a zero or even negative risk premium on owner-occupied housing may be appropriate. Nevertheless, here I follow the convention and include a positive risk premium, set to 1%, which increases the user costs and its correlation with house prices somewhat. In any case, the results do not seem very sensitive to a modest level of the risk premium.[48]

The UCC and its components Figure 3.4 shows the resulting UCC and its components, namely, the after-tax nominal mortgage rate, the OMRD rate, the risk premium, the property tax, and the negative of inflation expectations. We see that the UCC falls from about 10% in 2000 to about 3.3% in the beginning of 2022. The fall in the UCC is caused by the fall in the after-tax mortgage rate, in the OMRD rate, and in the property tax rate. The subtraction of inflation expectations of about 2% increases the *relative* fall of the UCC. From 2022q2 the UCC quickly rises to 4.5%, due mainly to the rise in the financing cost but also to the rise in the OMRD rate and the fall in inflation expectations.

Hansson (2019, figure 7) calculates a UCC without a risk premium and a depreciation rate of 2%, whereas my UCC is calculated for a 1% risk premium and a 1.5% depreciation rate. Hansson uses other interest rates than those used here, but the difference should be small. The UCC is calculated with and without capital gains. The UCC calculated in this paper is slightly higher than Hansson's UCC without capital gains, as is shown in figure G.20. Englund (2020, diagram 9) provides a calculation of the UCC with a more detailed calculation of the relevant taxes but without any OMRD and risk premium. This results in a lower UCC than the one calculated in this paper, as shown in figure G.20.

3.2 The user cost

Figure 3.5 shows an index of the user cost (2010 = 100), the UCC in percent, and indices of house prices, disposable income (per capita), rents, presumption rents, and the CPI. The user cost

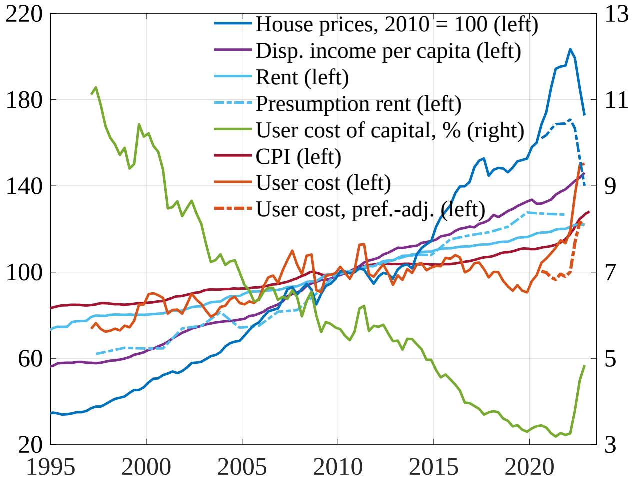
fixed exchange-rate regime with insufficient credibility, interest rates may be countercyclical.

[47] The Riksbank and the National Debt Office have also demonstrated that they have the tools—in particular, purchases of mortgage bonds—to keep the spread down in crises. Furthermore, during most the corona crisis, Finansinspektionen, the Swedish financial supervisory authority, temporarily abolished the mandatory amortization requirements, to further reduce the debt service of mortgagors. Thereby, it has created a precedence to do so again in future crises. This arguably adds to the insurance benefits of mortgages.

[48] Let $\text{UCTI}_t = (\text{UCC}_t + \rho)\text{PTI}_t$, where UCC_t here denotes the UCC for a zero risk premium and ρ denotes a constant risk premium. The covariance between the UCTI and PTI ratios is given by $\text{Cov(UCTI,PTI)} = \text{Cov(UCC,PTI)} + \rho\text{Var(PTI)}$. For the Swedish data, Cov(UCC,PTI) and Cov(UCTI,PTI) are negative. However, a larger ρ increases Cov(UCTI,PTI) and a sufficiently large ρ would make Cov(UCTI,PTI) positive. Thus, a larger risk premium makes the covariance between UCTI and PTI less negative and a sufficiently large risk premium would make the covariance and correlation positive.

is calculated according to (3.1). The figure shows indexed levels instead of the deviations from historical averages shown in figure 1.1.

Figure 3.5: House prices, disposable income per capita, rents, user cost of capital, user cost, and the CPI. User cost of capital in percent; all other series indexed to 100 for 2010.



Source and note: Statistics Sweden (2022b,c,e,h), Valueguard (2022), and own calculations. See note to figure G.2 for details.

Both actual and preference-adjusted house prices and user costs are shown. As briefly discussed in section 1, house prices increased substantially during the coronavirus crisis 2020 and 2021, despite the negative effect of the crisis on the Swedish economy. As discussed in detail in Sveriges Riksbank (2021), a similar development can be seen in many other comparable countries. The price upturn deviates from historical correlations and is difficult to explain with factors traditionally used to shed light on housing demand, such as interest rates and disposable income. Instead, the most important explanations probably have to do with the unusual economic effects of the pandemic. Households being partially forced to save because of restrictions has freed up scope for housing consumption. At the same time, widespread working from home has probably sparked a desire among households for a larger and better homes and a willingness to spend more money on their housing. In addition, the negative effects of the crisis on the labor market have only affected households with permanent employment to a minor extent and these households normally find it easier to obtain a mortgage. This may have helped prices resist the generally weak development in the real economy. In figure G.14, we see that the relative price of houses in terms of apartments increased substantially during 2020 and 2021. The conclusion is that the house price rise during 2020-2021 can be seen as the result of a preference shift toward larger and better homes, with more or less a fixed supply of homes. Thus, it is due to fundamental factors and not in itself an indicator of overvaluation.

The dash-dotted dark blue line shows "preference-adjusted" house prices, for which the 75% of the of the cumulated actual price increases during 2020q2–2022q1 have been deducted from the actual house prices. This reflects the assumption that 75% of the price increases are due to the preference shift. Given the preference shift, for the purpose of assessing over- or undervaluation of housing over time, one may want to use a "preference-adjusted" user cost, corresponding to approximately unchanged preferences. The dash-dotted red line is the corresponding preference-adjusted user cost, calculated using the preference-adjusted housing prices after 2020q2 instead of the actual housing prices.

We see that the dramatic downward trend of the UCC neutralizes the dramatic rise of the house prices and results in a relatively stable user cost until 2020. The preference-adjusted user cost is relatively stable until the spring of 2022, when the UCC starts to rise. As already discussed in section 1, it falls relative to and stays below disposable income. It also falls relative to rents and the CPI, except towards the end where it rises to reach about the same level as the rents and the CPI. Thus, the UCTR ratio and the real user cost is 2022q4 at about the same level as in 2010, and the UCTI ratio is at a significantly lower level. Clearly, Swedish house are by these indicators not overvalued but undervalued relative to 2010.[49]

4 The user-cost-to-income and user-cost-to-rent ratios

Figure 4.1 shows the PTI and UCTI ratios in index form, with 2010 = 100. The UCC is in percent. The UCTI ratio is calculated according to (1.2).

Figure 4.1: Price to income, user cost of capital, and user cost to income. Index 2010 = 100, except user cost of capital in percent.

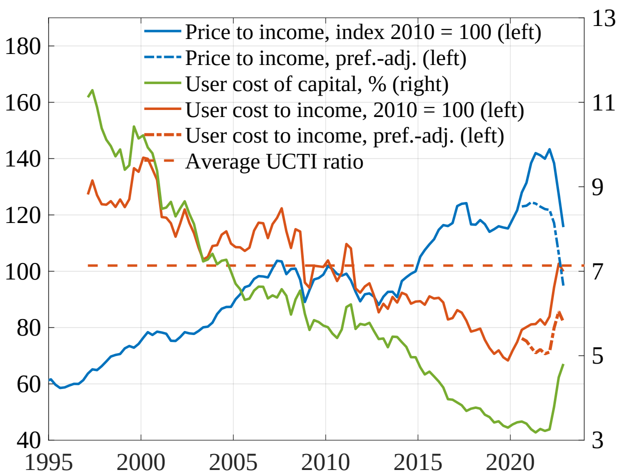
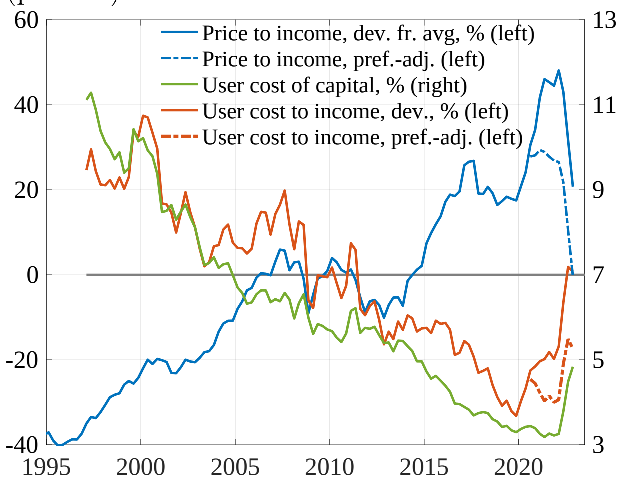


Figure 1.1 (repeated). Price-to-income and user-cost-to-income ratios (percentage deviation from historical averages) and the user cost of capital (percent).



Source and note: Figures 2.1 and 3.4 and own calculations. The "preference-adjustment" is explained the text.

Figure 1.1 (repeated above) shows the corresponding percentage deviation of the PTI and UCTI ratios from their historical averages, which measure is independent of the base year of the indexation. This is discussed in section 1. According to this measure, in 2022q4, the actual and preference-adjusted UCTI ratio are, respectively, 1% above and 17% below their historical average. In 2019q4, the UCTI ratio was 33% below its current historical average.[50]

[49] The estimate of the user cost in figure 3.5 rejects the assumption made in Almenberg et al. (2022) that the user cost is exogenous and grows at a steady rate of 2%.

[50] The variability of the estimated UCTI ratio in figure 4.1 rejects the assumption made in FI (2022a, In-depth

Figure 4.2: Price-to-rent ratio, user cost of capital, and user-cost-to-rent ratio. Index 2010 = 100.

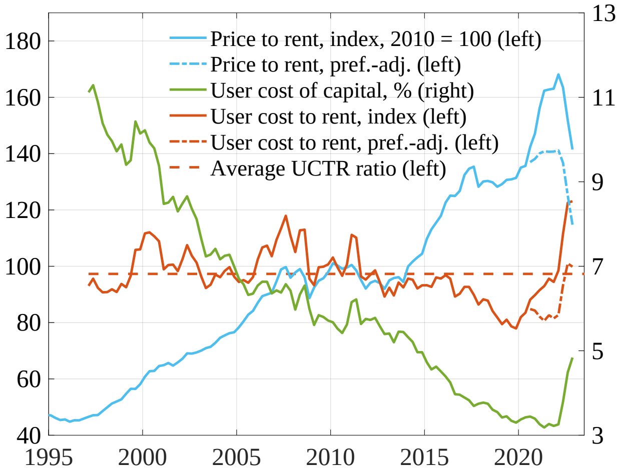
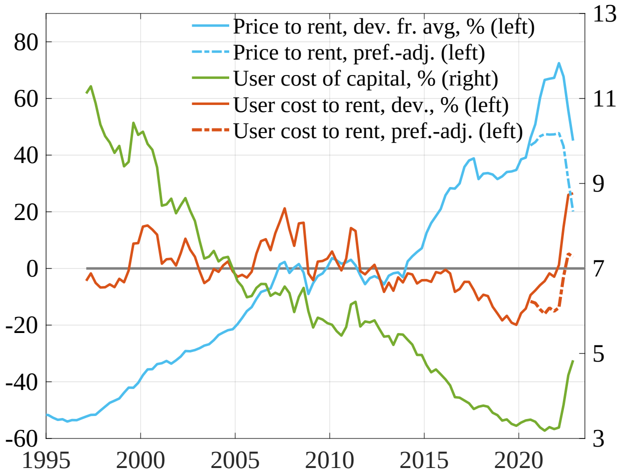


Figure 4.3: Price-to-rent and user-cost-to-rent ratios (percentage deviation from historical averages) and user cost of capital (percent).



Source and note: Figures 2.1 and 3.4 and own calculations. The historical average refers to 1997q1–2022q4. The "preference-adjustment" is explained the text.

Figure 4.2 shows the UCC and indices of the PTR and UCTR ratios for rents—the analog of figure 4.1. Ratios for presumption rents are not shown—they are similar to the UCTI ratios because the presumption rents follow disposable income relatively close. The UCTR ratios are calculated according to (1.3). The contrast between the large overvaluation indicated by the PTR ratio and the lack of any significant overvaluation by the preference-adjusted UCTR ratio is stark.

Figure 4.3 shows the deviation of the UCTR ratios from their historical averages—the analog of figure 1.1. The preference-adjusted UCTR ratio indicates a minor overvaluation of 4% in 2022q4. In 2019q4, the UCTR ratio indicated undervaluation of 20%.

5 International organizations on overvaluation of Swedish housing

Several international organizations that monitor and comment on Swedish economic policy have for many years maintained that Swedish house prices are too high relative to fundamentals and that Swedish (owner-occupied) housing thus is overvalued. This section reports what the ECB and the ESRB, the European Commission, the OECD, and the IMF have said about Swedish housing overvaluation in their previous and latest reports. The assessments of overvaluation by the ECB and the ESRB also affect the magnitude of the negative house-price shocks assumed in the EBA stress tests of Swedish banks.

5.1 The ECB and the ESRB

The ECB calculates four measures of housing overvaluation for several countries. It calculates deviations of the PTI and PTR ratios from benchmarks equal to their historical averages (from

analysis, pp. 22–25, and Appendix 2, pp. 45–47) when price changes are predicited that the UCTI ratio is constant.

1996 to the latest available observation) (ECB, 2015b) and the deviations of current prices from the estimates of two models, an inverted-demand model described in ECB (2015a) and ESRB (2022b, box 2) and a model based on an "asset-pricing" approach (ECB, 2011). The latter has to my knowledge not been published or described in any detail in these references. (Is it a model with unrealistic equality between rents and user costs?) The results are reported in the form of the maximum and minimum valuation, the inverted-demand model valuation, and the average of the four in ECB (2022).[51]

Figure 5.1: ECB estimates of residential property overvaluation: Sweden.

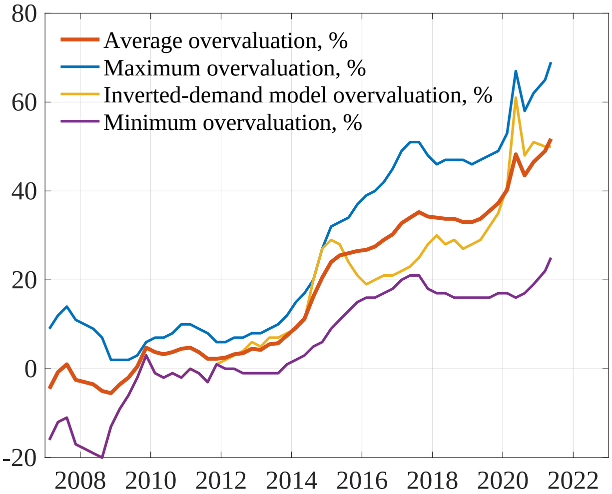
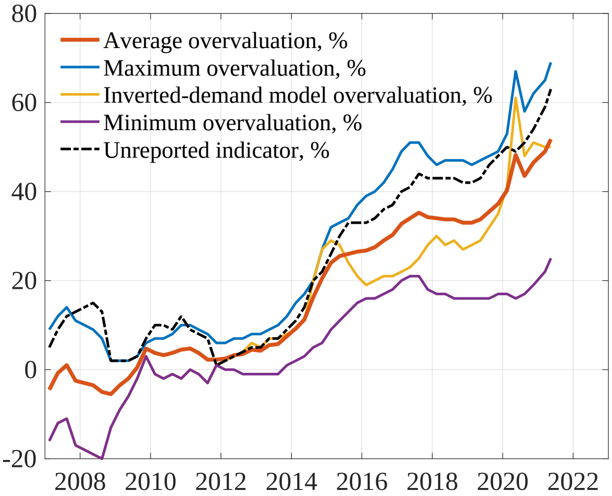


Figure 5.2: ECB estimates of residential property overvaluation: Sweden, including the unreported overvaluation indicator.



Source and note: ECB (2022). For the last observation, 2021q2, the maximum overvaluation is 69%, the model one is 50%, the minimum is 25%, and the reported average is 51.75%. From the three reported indicators and the average of the four indicators, one can infer that the unreported indicator is 63%. It is added in figure 5.2.

The reported overvaluation measures for Sweden are shown in figure 5.1. According to the ECB's measures, in 2021q2, Swedish housing is overvalued on average 52%, with a maximum overvaluation of 69%, a minimum of 25%, and the inverted-model overvaluation of 50%. From the three reported indicators (two of which are unnamed) and the average of the four indicators, one can infer that the unreported indicator is 63%. The inferred unreported indicator is shown as the dash-dotted black line in figure 5.2. Updated data from ECB (2022) is shown in figures G.21 and G.22.

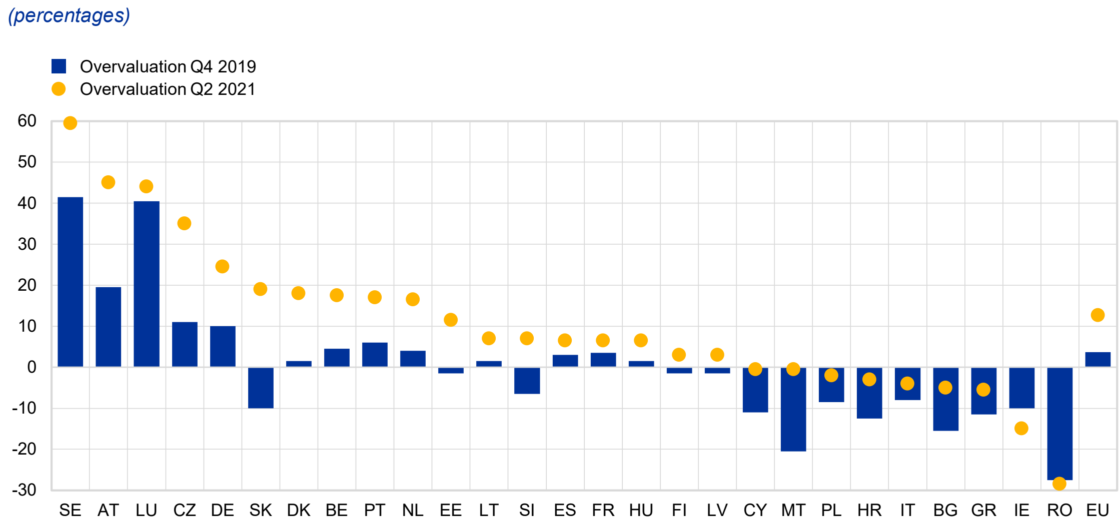
The most recent assessment of the ESRB of the overvaluation of Swedish housing is contained in ESRB (2022b), which assesses RRE vulnerabilities in the EEA countries (the EU27 as well as Iceland, Liechtenstein, and Norway). The ESRB to a considerable extent relies on ECB calculations of overvaluation.

ESRB (2022b, table 1, Scoreboard), reproduced as figure G.23, reports overvaluation measures

[51] Muellbauer and Murphy (1997) provide a detailed discussion of the inverted-demand model. Duca et al. (2021a) provide an extensive discussion and literature review of research on and models of the determination of house prices. In particular, they argue that the "asset pricing approach from finance" with a simple price-to-rent or rent-arbitrage approach in the form of an equality between rent and user cost is misleading (also Duca et al., 2021b) exceeds the sensitivity of house prices to mortgage rates. (What is called the user cost of (housing) capital (UCC) here is called the user cost (of housing) by Duca et al.)

estimated by the ECB, with data of 2021q2. For Sweden, it reports a PTI deviation from its historical average of 66%. How the ECB can arrive at such a large PTI deviation is not explained. In figure 2.2, the deviation of the PTI ratio in 2021q2 from its average 1997q1–2022q4 is 46%, substantially less than the scoreboard number.[52] The scoreboard also reports an econometric model estimate of overvaluation of 51%. The latter is consistent with the yellow line in figure 5.1 from the inverted-demand model. ESRB (2022b, figure 10) (reproduced here as figure 5.3) reports Swedish overvaluation for 2021q2 at 59%, the average of the scoreboard's 66 and 51.[53]

Figure 5.3: ESRB house-price overvaluation (ESRB, 2022b, figure 10).



Source: ECB estimates.
Notes: The last data point is the second quarter of 2021, except for CY (the fourth quarter of 2020), DK, FI, HU, IE (the first quarter of 2021). The overvaluation is the simple average for the price-to-income and an inverted demand-based model estimates. The EU overvaluation is computed as the simple average across all EU countries.

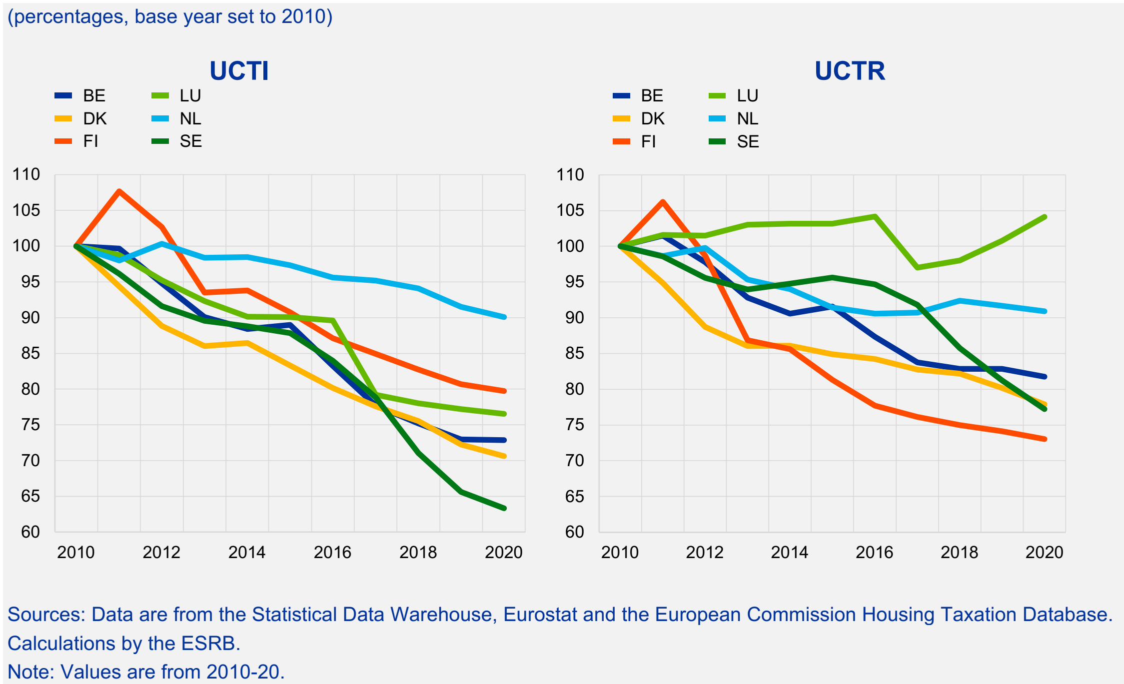
Interestingly, ESRB (2022b, box 4) reports ESRB calculations of the UCTI and UCTR ratios for the six countries (one of which is Sweden) that received ESRB recommendations in 2019. The calculations use the Commission's Housing Taxation Database (Barrios et al., 2019; Thiemann et al., 2022a). The results from these indicators differ substantially from those of the PTI ratio and the other indicators. For Sweden, the dark green lines in the box's figure B (reproduced as figure 5.4) shows that both the UCTI and the UCTR ratio have fallen substantially between 2010 and 2020. This indicates undervaluation rather than overvaluation.[54]

[52] Also, in figure 5.1, for 2020q2, there is a peak in the blue and yellow line but no such peak in figure 2.2, and no big drop in disposable income in figure G.2. This may indicate that the PTI ratios have not been calculated with disposable income per capita but perhaps with GDP per capita.

[53] ESRB (2022b, box 2, figure) reports additional estimates, including external ones, for the EEA countries for 2020q4. For Sweden, the inverted-demand ECB-model here reports 43% overvaluation. The European Commission model of Philiponnet and Turrini (2017) reports -1.9% (consistent with the European Commission (2021, table 2.2) numbers mentioned below in section 5.2). The Commission PTI ratio in terms of years, not much above 10, is also reported. (More on this in section 5.2.)

[54] The ESRB calculation of user costs takes into account that the OMRD need not be a constant share of house prices. It assumes that the OMRD initially is 2.5% of the house price—as in Poterba and Sinai (2008)—but then over time follows the HICP excluding energy and food. This results in the OMRD share falling over time for Sweden (ESRB, 2022b, figure A, panel Sweden).

Figure 5.4: ESRB estimates of user-cost-to-income and user-cost-to-rent ratios (ESRB, 2022b, box 4, figure B).



Figures 5.1 and 5.4 again illustrate the the negative correlation between the PTI and UCTI ratios for Sweden in figure 1.2 (and in figure 5.9 below). The negative correlation is likely to hold for several EU countries. It is easy to check with the help of the Housing Taxation and HouseLev databases (Barrios et al., 2019; Thiemann et al., 2022a; Bricongne et al., 2019).

The mixed results on overvaluation may have somewhat moderated the conclusions about Swedish overvaluation (my emphasis):

> House price growth has been picking up recently and residential property is still significantly overvalued **based on some estimates**, eroding the affordability of housing for households. . . . Rising RRE prices stemming from population and economic growth, supply shortages, tax incentives for home ownership, and a low interest rate environment over an extended period have led to overvalued house prices. . . . The house price-to-income-ratio was 56% above its average in 2020, and model-based evidence suggests that house prices were overvalued by 43% in 2020, although **these estimates are surrounded by uncertainty and will alter in accordance with the underlying assumptions made, the model chosen and the time period, or if the low interest rate environment is taken into account**. (ESRB, 2022b, pp. 77–78)

Indeed, that a "low interest rate environment" and the fall in mortgage rates need to be taken into account in a relevant valuation assessments is demonstrated by the UCC, UCTI, and UCTR calculations in sections 3 and 4—not to speak of ESRB's figure B in figure 5.4.

Overall, the ECB's estimate of the average overvaluation for Sweden is 52% for 2021q2. The ESRB reports several different numbers for different times, but it seems that its estimate of the average overvaluation for 2020 and 2021 is around 55%.

Furthermore, from a comparison of figures 5.3 and 5.4, it is apparent that the problem of misleading overvaluation assessments is not restricted to Sweden. It concerns several countries in the European Union. Of the six countries in figure 5.4, according to figure 5.3 all except Finland have overvalued housing, by between 17% and 60%. But according to figure 5.4, with more reliable and relevant indicators, all six have undervalued housing relative to 2010.

5.1.1 The European Banking Authority EU-wide stress tests

The ECB and ESRB assessment of housing overvaluation have consequences for the EBA stress tests. The stress tests for Sweden have one of the largest negative house-price shocks among the EU countries. The reason is apparently that house-price shocks in the EBA stress tests are set according to the negative of ECB's average overvaluation measure. ESRB (2020, p. 41) provides some details on how the house-price shocks are determined:

> **3.7 Residential real estate price shocks**
>
> The scenario entails an adverse adjustment of residential real estate prices. This assumption is consistent with a narrative where, despite the low level of interest rates, a repricing of assets is envisaged due to both an adverse demand effect and an increase in risk aversion. The calibration of the shocks to residential real estate prices started from a measure of over/undervaluation of residential real estate prices with respect to their fundamentals as evaluated by ECB staff.[39] The main valuation measure is the average of four indicators of house price valuations.[40] These measures were calculated on the basis of models and a comprehensive house price dataset provided by the ECB.[41] This choice is consistent with the ECB's internal assessment of residential real estate risks and it is also aimed at aligning the size of the shocks with the ESRB's risk assessment of the residential real estate market.
>
> [39] The data considered are public and can be found in the Statistical Data Warehouse. Pre-2007 data available at the ECB was also used in the calibration. [This apparently refers to the SDW overvaluation data shown in figure 5.1.]
>
> [40] In a few cases, alternative house price valuations measures, also from ECB (2022), were considered in order to improve the alignment of the house price shock with the ESRB's risk assessment of the residential real estate market.
>
> [41] Further methodological details are given, for instance, in ECB (2018) and further sources cited therein.

According to ESRB (2020, 2021, annex table 1.4), the Swedish house-price shocks for the 2020 and 2021 stress tests were −36.3% and −34.8%, among the largest of all the countries. Nevertheless, Swedish banks managed the stress test quite well (FI, 2021).

If we assume that the reported house-price shocks eliminate the previous overvaluation, we can calculate the corresponding overvaluation as 57% and 53.4% for 2020 and 2021, quite consistent with ESRB's average overvaluation estimate of about 55% mentioned above.[55]

Importantly, to provide serious and relevant tests of the resilience of EU banks, the EBA EU-wide stress tests need of course to assume substantial negative shocks, including negative house-price

[55] If s denotes the negative price shock, the corresponding overvaluation v is the solution to the equation $v/(1+v) = s$.

shocks. But the results of these tests are more informative if, beyond a substantial minimum size, the magnitude of these house-price shocks—and any differentiation across countries—is determined in the light of *relevant* indicators instead of the PTI and PTR ratios from their historical averages.

5.2 The European Commission

In its most recent in-depth review (IDR) for Sweden in its Macroeconomic Imbalance Procedure (IMP), European Commission (2021, table 2.2 and chart 2.2d) maintains that Swedish housing is subject to substantial overvaluation according to the valuation gaps of three indicators. More precisely, the Commission uses the percentage deviation of the current price-to-income (PTI) and price-to-rent (PTR) ratios from benchmarks equal to their historical averages (from 1995 until the latest available observation) as a measure of the valuation gap and degree of overvaluation. A third indicator is a model-based valuation gap, the percentage deviation of the current price from the price estimated by model developed by Philiponnet and Turrini (2017) and improved in European Commission (2020). In contrast to the ECB models, the Commission models are exemplary documented.[56] The average of these three valuation gaps is then a summary measure of the degree of overvaluation.

Figure 5.5: European Commission house-price valuation gaps: Sweden.

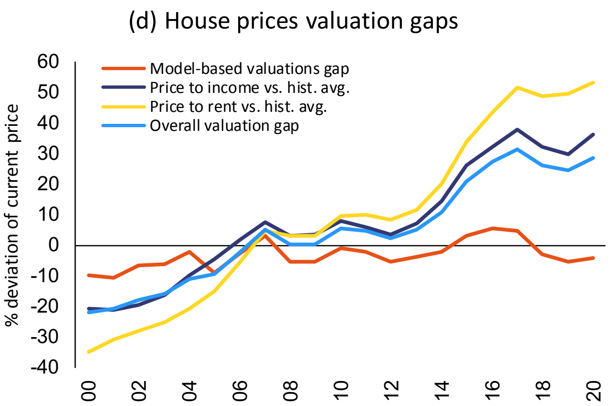
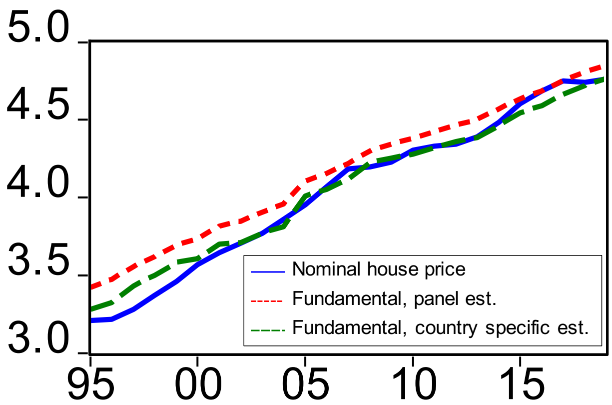


Figure 5.6: Log nominal house prices indexes and Commission model benchmarks (panel and country specific estimate): Sweden.



Source and note: Figure 5.5: European Commission (2021, chart 2.2d and table 2.2). Figure 5.6: European Commission (2020, chart 3, panel SE). The price-to-income and price-to-rent gaps are measured in deviation from the long-term average (from 1995 to the latest available year). The average house price gap is the simple average of the price-to-income, price-to-rent, and model valuation gaps.

Figure 5.5 reproduces European Commission (2021, chart 2.2d) and shows the valuation gaps. For the year 2020, the price-to-income, price-to-rent, and model-based valuation gaps are 36%, 53% and −4%, respectively, giving an average house-price gap of 28%. European Commission (2021, table 2.2) provides quarterly data for 2020. For the last observation, 2020q4, the four gaps are a

[56] The model valuation gap is estimated in a cointegration framework with nominal house prices as the dependent variable and five fundamental explanatory variables: total population, real housing stock, real disposable income per capita, real long-term interest rate and price deflator of final consumption expenditure (Philiponnet and Turrini, 2017; European Commission, 2020).

bit higher, 39%, 55%, −1.7%, and 31%, respectively.[57]

Figure 5.6 reproduces European Commission (2020, chart 3, panel SE) and shows the log of an index of Swedish house prices and the Commission model estimates, for an EU-wide panel estimation and a country-specific estimation. For the country-specific estimation, there is hardly any indication of over- or undervaluation. For the EU-wide estimation, there is an indication of undervaluation.

In European Commission (2021, table 2.2), the Commission also reports the level of the price-to-income ratio in 2020 and 2020q4 as 10.7 and 10.9, respectively. These numbers refer to number of years of income necessary to buy an assumed 100 sqm dwelling, as discussed in Bricongne et al. (2019). In particular, the paper uses a signaling approach to identify a threshold for the PTI ratio, above which there appears to be a significantly increased risk of a downward fall of at least 5% of house prices in the subsequent three years. The estimated threshold is close to 10 years. Sweden is thus not much above this threshold.

The Commission concludes:

> In spite of moderation in recent years, Swedish house prices continue to appear significantly overvalued. Price-to-income and price-to-rent ratios were about 36–53 % above their long-term average as of end-2020. A model-based estimate suggests prices are slightly below fundamentally justified levels (but this partly reflects exceptionally low interest rates and population growth). These valuation gaps are among the highest in the EU. The overall valuation gap stood at 28.4% at the end of 2020. (European Commission, 2021, table 1.1)

> Main observations and findings in this IDR analysis are:
>
> - ...
> - ...House prices in Sweden have risen to record highs irrespective of the economic fall-out from the COVID-19 crisis. ...**There is a risk of overvaluation as indicated by house price developments in comparison with disposable income and house rents. The very low interest rate and a growing population have made the overvaluation less visible in the Commission's broader fundamental benchmark.** Interest rates are unlikely to decrease further, though, and population growth has been skewed to those with lower income and, hence, less likely to acquire a house given current prices and banks' lending policies. Land used for construction has become an increasingly valued asset over the year, and prices of (semi-)detached houses have increased notably faster than of flats during the pandemic. (European Commission, 2021, p. 1, my emphasis)

We may note a tendency to put less weight on the Commission's model-based estimate, which does not indicate any overvaluation. Indeed, figure 5.5 shows that the model does not indicate any systematic over- or undervaluation since around 2004. The commission does not indicate whether its down-weighting of the model implies that its overall valuation exceeds the average reported. Also, the average house-price gap in 2020q4 in (European Commission, 2021, table 2.2) is 30.7% rather than the 28.4% mentioned in the quote above.

[57] The corresponding numbers for 2020q4 are 25% and 56% for the deviation of PTI and PTR ratios in figure 2.2, when the average from 1995 is used.

Overall, the Commission's overall valuation gap may perhaps be interpreted to be at least 30%.

In figures 1.1 and 4.3, the unadjusted UCTI and UCTR gaps in 2020q4 are −21.5% and −7.5%, respectively. If they are combined with the Commission's model-based gap of −1.7%, the average gap in 2020q4 would be −10% instead of at least 30%, a difference of at least 40 pp.

5.2.1 The Commission's UCC calculation

Separately, as mentioned in section 3, the Commission has collected a database, the Housing Taxation Database (HTD), of comparable time series on the main features of home ownership taxation and the resulting user cost of capital in the EU and the UK (Barrios et al., 2019; Thiemann et al., 2022a,b).[58] The purpose of the database is not to assess any overvaluation of housing but to display the distortions of housing choices caused by taxation.

However, the database can directly be used for estimation of the user cost and the UCTI ratios for valuation assessments in the EU. For example, the UCTI ratios can be constructed by multiplying the UCC estimates with the PTI ratios in the Commission's HouseLev database (Bricongne et al., 2019). Indeed, the calculations of the UCTI ratios in ESRB (2022b, box 4) and figure 5.5 use these two Commission databases.

Figure 5.7: The European Commission's user cost of capital for Sweden.

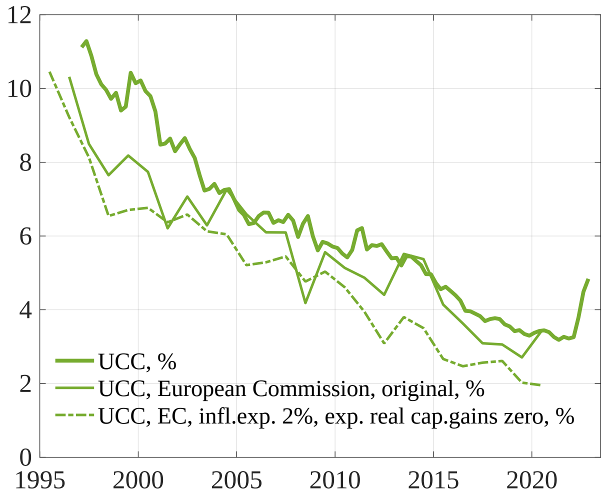
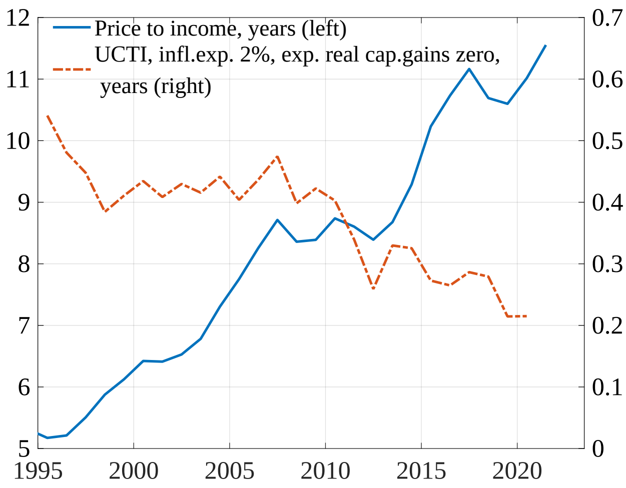


Figure 5.8: The Commission price-to-income and user-cost-to-income ratios for Sweden. Years.



Source and note: Barrios et al. (2019), Thiemann et al. (2022a), Bricongne et al. (2019), and own calculations. Figure 5.7: The thick solid green line is the UCC from figure 3.4. The dash-dotted line is the Commission UCC for Sweden calculated with 2% inflation expectations and zero expected real after-tax capital gains. Figure 5.8: The PTI ratio is from HouseLev. The UCTI ratio is the product of the PTI ratio and the UCC with 2% inflation expectations and zero expected real after-tax capital gains.

Figure 5.7 shows the HTD's original estimate for Sweden of the UCC (thin solid green line) and a modified HTD UCC, for which I assume that inflation expectations are 2% and that the expected real after-tax real capital gains are zero (dash-dotted green line). The figure also shows the UCC

[58] What is here called the user cost of capital (UCC) is in Barrios et al. (2019) and Thiemann et al. (2022a) called the user cost of owner-occupied housing (UCOH) indicator. As mentioned, expression (3.3) above is a somewhat simplified variant of the expression of the UCC presented in Barrios et al. (2019).

estimated in this paper (thick solid green line).[59]

There is a similarity between the HTD estimates of the UCC and the estimate used in this paper. This means that, if the Commission would use these UCC estimates to calculate the user cost and the UCTI and UCTR ratios to assess the valuation of housing in Sweden, it would get results similar to the ones I get in this paper. Thus, the Commission results would contradict its conclusions from figure 5.5.

Figure 5.9: The Commission user-cost-to-income ratio and negative price-to-income ratio for Sweden, % deviation from average.

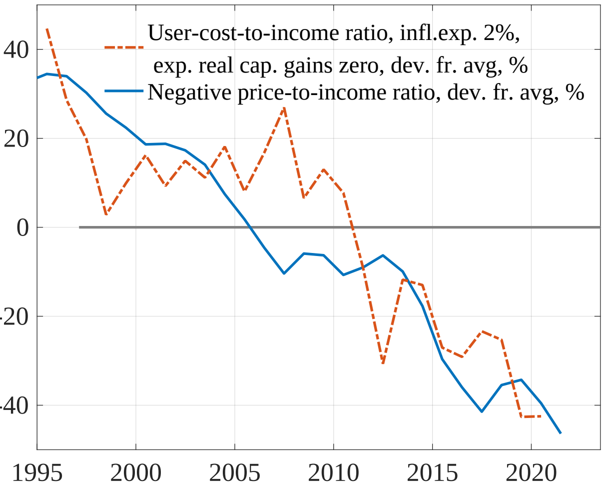
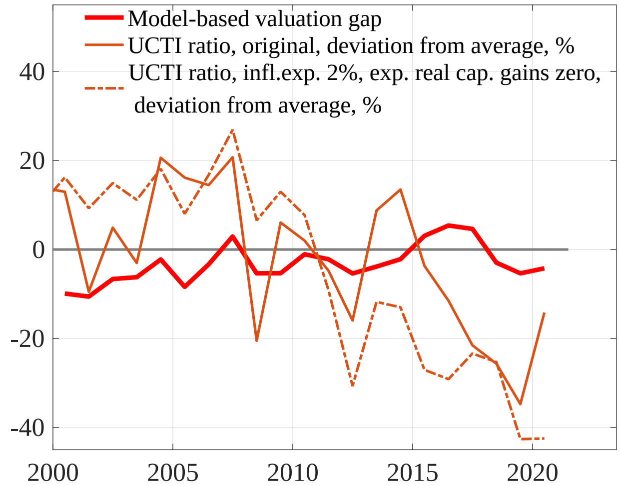


Figure 5.10: The Commission model-based valuation gap and user-cost-to-income ratios for Sweden, % deviation from average.



Source and note: Barrios et al. (2019), Thiemann et al. (2022a), Bricongne et al. (2019), and own calculations. Figure 5.9: The negative PTI ratio is from HouseLev. The UCTI ratio is the product of the PTI ratio and the Commission UCC for 2% inflation expectations and zero real capital gains in figure 5.7. Percentage deviations from averages. Figure 5.10: The model-based valuation gap has been extracted from figure 5.5 with the help of Rohatgi (2021).

Figure 5.8 shows the PTI ratio for Sweden from the HouseLev database, measured in the number of years of (per capita gross) disposable income needed to buy a 100 sqm dwelling (for more detail, see Bricongne et al., 2019). The dash-dotted red line shows the UCTI ratio for such a dwelling measured in years of disposable income. It is the product of the PTI ratio and the modified HTD UCC in figure 5.7. We see that by 2020 the UCTI ratio had fallen to only about a 0.2 years. That is, the annual user cost of such a dwelling was only about 20% of annual disposable income.

Figure 5.9 shows the same negative correlation between the Commission PTI and UCTI ratios as figure 1.2. If the UCTI indicator is right, the PTI indicator is completely wrong, at least for Sweden.

Figure 5.10 shows the percentage deviations from their historical averages of the two UCTI ratios resulting from the two Commission UCCs in figure 5.7. They indicate undervaluation of

[59] I interpret Barrios et al. (2019, pp. 13–14) to assume that housing-price inflation in year $t + 1$ equals HICP inflation in year t. This is equivalent to assuming that inflation expectations are equal to current HICP inflation and that expected real nominal capital gains are zero. This makes for a volatile real interest rate, equal to the interest rate minus current HICP inflation, and thus a volatile UCC. The reasons for instead using 5-year inflation expectations or constant 2% expectations are discussed in section 3.1.

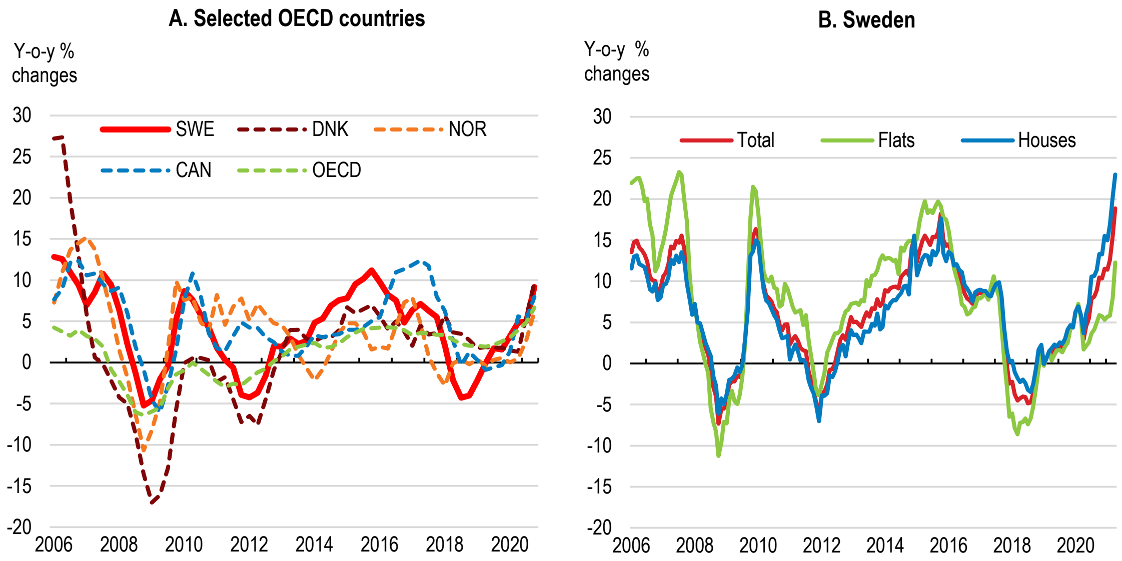
14% and 42% for the original and modified UCC calculation, respectively.[60] The figure also shows the Commission's model-based valuation gap. The figure can be compared to the Commission's overvaluation measures in figure 5.5.

5.3 The OECD

Previously, the OECD has warned about overvaluation of Swedish housing. For example:

> **Buoyant house prices in some economies raise concerns about financial stability**
>
> ...Some advanced economies have experienced rapid house price growth, including Canada, Sweden, Australia and the United Kingdom. In these countries, house prices are elevated relative to rents (i.e. rental yields are low), suggesting overvaluation. As past experience has shown, rapid house price gains can be a precursor of an economic downturn, especially when they occur simultaneously in a large number of economies. (OECD, 2017, pp. 43–44)

Figure 5.11: House prices have been rising at a fast pace (OECD, 2021b, figure 1.13).



Note: Panel A displays quarterly data adjusted for inflation using the private consumption deflator, up to 2020q4. Panel B displays nominal monthly data, up to April 2021. Source: OECD, House Price database and Valueguard.

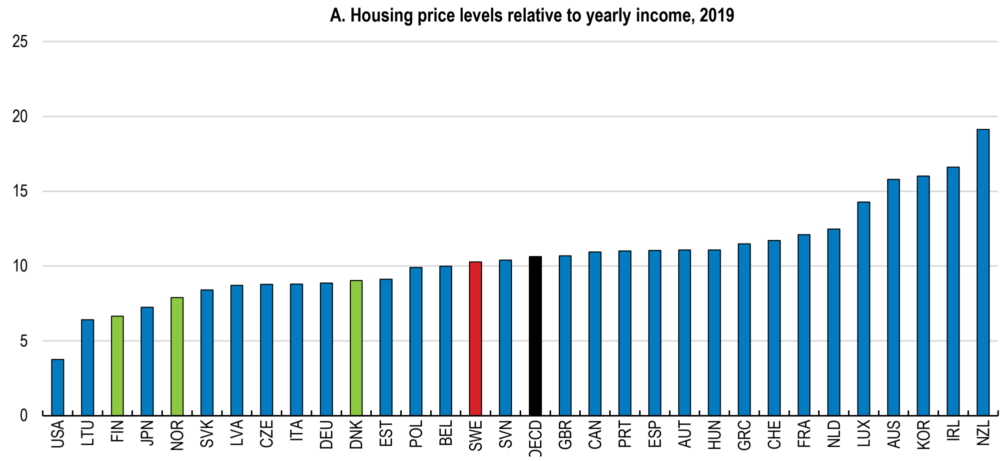
However, in the recent OECD economic survey of Sweden, OECD (2021b), I have not found any discussion of overvaluation of housing. About house prices, the report only says:

> Like in several other OECD countries, easy financing conditions and changing preferences have pushed up housing prices sharply during the pandemic (Figure 1.13, Panel A) [reproduced as figure 5.11]. In contrast with previous recent upswings, houses have gained more value than apartments in 2020, likely reflecting demand for space, as people spend more time at home than before the pandemic (Panel B). Average housing prices

[60] A UCTR ratio would also indicate undervaluation, but smaller because rents have risen less than disposable income, see figure G.2.

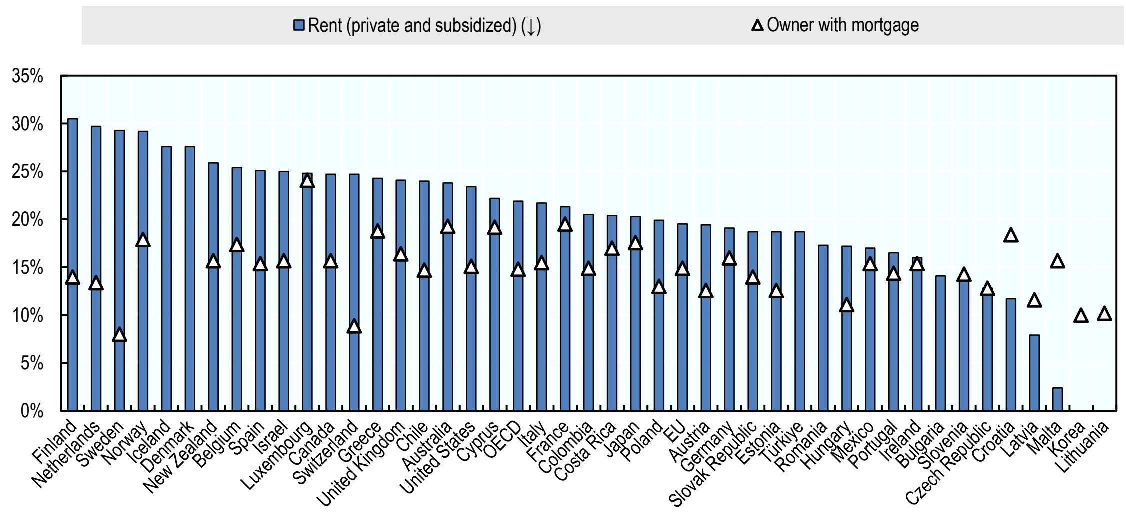
relative to income are close to the OECD average, but higher than in the other Nordics (Figure 1.14, Panel A) [reproduced as figure 5.12].

Figure 5.12: The Swedish house-price-to-income ratio is close to the OECD average . . . (OECD, 2021b, figure 1.14A).



Note: The number of years of per capita gross disposable income needed to buy a 100 sqm dwelling (for more detail, see Bricongne et al., 2019). . . . Source: HouseLev; OECD, House price database and OECD, National Accounts database.

Figure 5.13: Households' housing cost burden (mortgage and rent cost) as a share of disposable income (OECD, 2022a, figure HC1.2.1).



Note: Median mortgage burden (principal repayment and interest payments) or rent burden (private market and subsidized rent) as a share of disposable income, in percent, 2020 or latest year available. See (OECD, 2022a, figure HC1.2.1) for extensive notes.

The OECD has done considerable work on housing affordability and constructed the OECD Affordable Housing Database (OECD, 2022c,b), with several indicators of housing affordability (OECD, 2021a), summarized in OECD (2021a, table HC.1.5.1). Interestingly—and much justified, in my opinion—in this work there is some skepticism against the use of price-to-income ratios.

> However, from a policy perspective, price-to-income ratios have their limits. Because they are calculated at the aggregate level, they say little about the distribution of hous-

> ing costs and housing affordability. **They do not take into account household borrowing costs to acquire housing**. They do not provide information on who does and does not have access to affordable housing, or why, nor do they provide any indication of the quality of housing that households are paying for. Because these measures provide only a general indication of the extent to which housing is (un)affordable for a (median) household, they are ill suited to support policy makers in targeting housing supports to different groups. (OECD, 2021a, p. 1, my emphasis)

Instead, OECD (2021a) suggests expenditure-to-income ratios, for example, with a threshold of 30% of gross income, below which housing is considered "affordable". A related measure is the housing overburden rate, which captures the share of households spending an unacceptably large share of income on housing (that is, above a given threshold); both Eurostat and the OECD set the overburden threshold at 40% of household disposable income (net of housing allowances). Residual-income measures are also discussed.[61]

Figure 5.14: Housing cost overburden rate for owners (with mortgage) and tenants (private rent and subsidized rent) (OECD, 2022a, figure HC1.2.3b).

Note: Share of population spending more than 40% of disposable income on mortgage and rent, by tenure, in percent, 2020 or latest year. In Denmark, the Netherlands, New Zealand and Sweden tenants at subsidized rate are included into the private market rent category due to data limitations. See (OECD, 2022a, figure HC1.2.3b) for extensive notes.

Regarding Sweden, the owner-occupiers' median mortgage burden (principal repayment and interest payments) as a share of disposable income, it was at 8% the lowest in OECD in 2020 (OECD, 2022a, figure HC1.2.1, reproduced as figure 5.13). As for the owner-occupiers' housing overburden rate, that of Sweden and Finland was at 0.9% the lowest in OECD in 2020 (OECD, 2022a, figure HC1.2.3b, reproduced as figure 5.14). See also appendix F and figures F.1 and F.2 on Swedish housing expenditure shares and disposable income by tenure.

[61] The OECD housing costs (OECD, 2022a) can refer to: (1) a narrow definition based on rent and mortgage costs (principal repayment and mortgage interest); or (2) a wider definition that also includes the costs of mandatory services and charges, regular maintenance and repair, taxes and utilities, which are referred to "total housing costs". They differ from user costs and rather represent households' cash payments for housing.

It is difficult to see that these low numbers would be consistent with considerable overvaluation of Swedish housing. Rather they are consistent with some undervaluation.[62]

5.4 IMF

Previous IMF Article-IV reports have warned about Swedish house prices being too high. For example, in the 2019 report:

> **24. High housing prices and high market rents increase vulnerabilities and inequality.** Despite their recent moderation, house prices have tripled in real terms since the mid-1990s, lifting the price-to-income (PTI) ratio to almost 30 percent above its 20-year average, with Stockholm's PTI nearly twice the national average and among the highest worldwide. New purchasers must take on high debts relative to income (DTI), typically at floating rates, a macrofinancial vulnerability. (IMF, 2019, pp. 13–14)

However, the most recent Article-IV report of the IMF on Sweden, IMF (2021), does not mention any overvaluation of Swedish housing:

> 19. **As in many countries, residential housing prices continued to strengthen, potentially raising some risks**. Easing of macroprudential regulation and monetary policy, coupled with fiscal support and likely changes in housing preferences, have contributed to rising demand. Although the 2020 price increase was higher than in most countries, it was relatively mild compared to the experience over the past decade. Recent stress tests suggest that most households have sufficient buffers to service their debt in case of income loss or mortgage rate increases, and the loan-to-value ratio is quite low (at below 70 percent, an average). However, with continued price increases, a slow recovery, and the recent acceleration of consumer credit, the number of highly indebted borrowers could increase. Staff advised that more comprehensive data collection on households' balance sheets would help improve monitoring these risks and welcomed the recently launched government inquiry on household balance sheet statistics. (IMF, 2021, p. 17)

5.5 Model estimates: The Riksbank and the National Debt Office

As noted, in addition to the statistical indicator PTI and PTR ratios, the ECB uses two empirical models. The ESRB reports the results of one of those models, the inverted-demand model, in its valuation assessment. This model indicates an overvaluation of 50% in 2021 (figure 5.1). The inverted-demand model and its coefficient estimates are not documented in any detail. The "asset-pricing model" is not documented at all. It is therefore difficult to assess the models' relevance and the appropriate weight on their results.

[62] A recent European Commission discussion paper, Frayne, Szczypińska, Vašíček, and Zeugner (2022), discusses housing developments in the euro area with a focus on housing affordability, thus not including Sweden. It suggests three different indicators of housing affordability, namely, the price-to-income ratio, the housing-cost overburden rate, and a measures the household borrowing capacity. It presents and appears to give equal weight to PTI ratios as to the other indicators, without commenting on the fact that the PTI ratios may give opposite messages from the other more relevant indicators.

The Commission uses the model of Philiponnet and Turrini (2017), which is improved in European Commission (2020). This model is exemplarily documented. It indicates an overvaluation of −1.7% in 2020q4 (European Commission, 2021, table 2.2) (figures 5.5 and 5.6).

It is relevant to compare with the results of two other relatively recent, well-documented models of house prices in Sweden. They are constructed by Riksbank staff (Dermani et al., 2016) and National Debt Office staff (Bjellerup and Majtorp, 2019). The models and their results are discussed in appendix D. The models do not find any indication of overvaluation.[63]

It makes sense to put more weight on the results of models that are well documented. With such weighting, the average model results do not indicate any significant overvaluation.

6 Conclusions

The concluding section summarizes a main but simple methodological point and some factual points made in this paper. It also suggests some improvements of valuation assessments and mentions some qualifications.

The **methodological point** is, first, that the user-cost-to-income ratio is a natural indicator of valuation and affordability of owner-occupied housing. The user-cost-to-rent ratio is a natural indicator of the relative affordability of owner-occupied housing and rental housing—but it is less informative for Sweden, given rent control and a dysfunctional rental market. The user cost has scientific support in a large housing literature as a measure of the cost of living in owner-occupied housing. The UCTI and UCTR indicators may be expressed as percentage deviations of the respective ratios from their historical averages.

The UCTI and UCTR ratios are the product of the user cost of capital and, respectively, the price-to-income and price-to-rent ratios. The UCC is the user cost as a percentage of the house price. It summarizes crucial information about the housing costs: the financing cost (mortgage and equity); the operation, maintenance, repair and depreciation costs; taxes; any risk premium; and expected capital gains.

Second, the PTI and PTR ratios on their own are misleading indicators of valuation and affordability. This is because house prices do not at all represent the cost of living in owner-occupied housing. The PTI and PTR ratios disregard the crucial information in the UCC and the resulting considerable variability in the UCC.

More precisely, if the elasticity of the PTI ratio with respect to the UCC would be −1, the product, the UCTI ratio, would be constant. Empirically, the elasticity is negative but the magnitude is less than one, because of inertia, frictions, and other market imperfections. As a result the

[63] Flam (2016) has undertaken a detailed survey of previous studies of Swedish housing prices, including Englund (2011), Claussen (2013), Bergman and Sørensen (2013), Sørensen (2013), and Turk (2015). Considering limitations and problems with the methods and data used, he concludes that the studies do not indicate any significant housing bubble or overvaluation. A major problem is the lack of data on free market rents. However, the special system of "presumption rents," which excepts newly constructed rentals from rent control for a period of 15 years, allows negotiated rents to better reflect market levels. Comparing owner-occupied user costs to presumption rents in Stockholm's inner city, the hottest housing market in Sweden, Flam finds that presumption rents exceed the user cost and thus do not indicate overvaluation even in this hot market.

correlation between the UCTI and PTI ratios is negative. For Sweden, the UCTI and PTI ratios are strongly negatively correlated, with a correlation coefficient of −0.8. Their larger percentage deviations from historical averages have opposite signs (figure 1.2). Then they give completely opposite messages about housing affordability and valuation. And the UCTI ratio has strong scientific support, whereas the PTI ratio has none.

This simple methodological point should be obvious and uncontroversial.

Regarding the **factual points**, according to ECB (2022) and the ESRB (2022b), Swedish owner-occupied housing (OOH) was overvalued by about 55% in 2021q2, the largest overvaluation in EU and EEA; according to the European Commission (2021), by at least 30% in 2020q4. These assessments affect warnings and recommendations issued for Swedish economic policy and shocks in EBA stress tests of Swedish banks.

However, this paper demonstrates that these large overvaluation assessments are mainly due to the use of the PTI and PTR valuation indicators. According to the UCTI indicator, Swedish owner-occupied houses has since 2010 become increasingly undervalued, not overvalued, with a trough in 2019q4 of −33%. Since then, taking into account a preference shift during covid toward larger and better homes as well rising electricity prices from 2021 and rising interest rates in 2022, the UCTI indicator has risen to reach −17% in 2022q4. Thus, according to the UCTI indicator, in 2022q4 Swedish houses were still undervalued but substantially less so.

As demonstrated in the paper, the user-cost approach can be used both at the time of writing, when mortgage rates and electricity prices rise and house prices fall, and previously, when for many years mortgage rates fell and house prices rose.

If the ESRB and the Commission would be right about Swedish housing prices having been overvalued by 30–55%, one might think that a mortgage-rate rise of several percentage points in 2022 would trigger a correction of at least a similar magnitude as the proposed overvaluation, plus an additional adjustment due to the higher mortgage rates and user cost of capital. What has happened and will happen to house prices can thus be seen as a separate test and natural experiment of the ESRB's and the Commission's overvaluation thesis. So far, by monthly data, from a peak in February-Mars 2022, house prices have fallen steadily and by November 2022 fallen by a total of about 15%, far from a crash of 30–50% or more (figure G.4).

From the ESRB's own calculation of the UCTI and UCTR ratios for five other countries than Sweden (figure 5.4), it is clear that misleading assessments of overvaluation from the use of the PTI and PTR indicators is a problem that concerns several other countries in the EU than Sweden. Any misleading assessments will distort ESRB's decisions about which countries should receive warnings and recommendations regarding real estate vulnerabilities (ESRB, 2022a); they will also distort the Commission's decisions about which countries may have macroeconomic imbalances and need special monitoring in the so-called macroeconomic imbalance procedure (European Commission, 2022).

Dwellings are unique in their location and the land they sit on. Dwelling prices are to a large extent determined by the location and other conditions in the local housing market. There is considerable heterogeneity between the housing market in large cities and in the countryside, in

Sweden and in other countries, and the difference in prices between similar structures in different local housing markets can be large. The user-cost approach can easily be applied to local markets, such as, for Sweden, the Stockholm inner city, Municipality, or County. It can also be applied to quite specific types of dwellings, such as the owner-occupied and rent-controlled studios in Stockholm Municipality and County examined in Svensson (2020, 2021a,b). Studying critical local markets provides more precise information about affordability and any overvaluation, as well as more precise and relevant comparisons between user costs and rents in SEK rather than indices for similar dwellings.[64]

Regarding **improvements in housing valuation assessments**, the obvious (and now hopefully uncontroversial) suggestion is to use UCTI and UCTR indicators rather than the PTI and PTR ones, with the qualification that the relevance in informativeness of the UCTR indicator depends on the functioning of the rental market. It is easy to improve the housing valuation assessments this way. Figures such as 1.1, 4.3 (with a functioning rental market), and 3.4 (as well as the ESRB's figure B reproduced as figure 5.4) provide substantial information. The Commission's existing Housing Taxation and HouseLev databases make it simple to replicate these valuation assessments for most of the EU countries (Barrios et al., 2019; Thiemann et al., 2022a; Bricongne et al., 2019). These databases could be revised and extended to explicitly include UCTI and UCTR ratios for the EU countries. The OECD Housing Affordability database (OECD, 2022c) could be extended to explicitly include user costs and UCTI ratios as a complement to the current housing expenditure measures for OECD countries. These databases would be even more useful if they included quarterly data and were more frequently updated.

The international organizations also use various econometric models of house prices for valuation purposes. To assess their reliability and appropriateness, external scrutiny is necessary. To allow external scrutiny, the models need to be publicly documented in detail and ideally be accompanied by replication kits, as has become standard in many scientific journals. Such replication kits need to include both code and data, or links to public databases. Then researchers, other organizations, and interested parties can reproduce the results as well as update the results with new data. The use of publicly undocumented models prevents external scrutiny and risks prolonging the use of inappropriate or erroneous models.

Some simple "asset pricing" models assume that UCTR ratios (or UCTI ratios) are constant. These simple models are rejected by the findings that UCTR and UCTI ratios are far from constant but fluctuate substantially due to inertia, frictions, and other market imperfections (Duca et al., 2021b; Svensson, 2022b).

Regarding **qualifications** of the analysis and results in present paper, the simple user-cost approach applied here is appropriate for assessing whether a given combination of current and past house prices, user costs of capital, disposable incomes, and rents indicate that owner-occupied housing is overvalued or undervalued—in which case over- or undervaluation is measured in terms of the cost of living in owner-occupied housing relative to disposable incomes and to rents. But it is not a precise theory of how house prices depend on all the relevant fundamentals, and how house

[64] See also Flam (2016) and footnote 63.

prices may change when those fundamentals change. Such a theory needs to take into account the supply of housing, the liquidity and credit constraints facing households, the role of housing cash payments as distinct from user costs for liquidity-constrained households, and other frictions and imperfections in the housing and mortgage markets.

Furthermore, the UCTI and UCTR indicators constructed depend on the assumptions made. But the assumptions are transparent and simple and can easily be modified for sensitivity and robustness tests, or to other assumptions considered more appropriate, depending on the country and housing and mortgage market being examined.

Appendix

A Data appendix

For Swedish house prices, the longest series is a quarterly price index for one- and two-dwelling houses for permanent living of Statistics Sweden (2022h). It excludes apartments. It is also reported with a lag of 2–3 months because it uses the date of the deed rather than the earlier date of the contract. From 2005, a monthly index, the HOX index, is provided for houses and apartments by Valueguard (2022). Figure G.13 shows the different price indices.[65] I use a linked quarterly price index consisting of the Statistics Sweden price index up to 2005q1 (adjusted for the lag in reporting) and a quarterly mean of the HOX index from 2005q1, shown in figure G.3.[66]

Income is net disposable income per capita, that is, net disposable income divided by the population (Statistics Sweden, 2022e). Net disposable income is a 4-quarter trailing moving sum of quarterly net disposable income. Data for 2022q4 is a prediction using the forecast of NIER (2022a) and the projection of Statistics Sweden (2019).

There is a choice between using disposable income or disposable income per capita, and between gross and net disposable income (the latter is net of the depreciation of households' fixed capital. Here I use net disposable income per capita. International organizations often use gross in international comparisons because countries calculate fixed-capital depreciation differently. Figure G.5 shows that for Sweden the difference between gross and net disposable income is small.

In the national accounts, Ukrainian refugees are included in Swedish households and population according to the European Union's activated Temporary Protection Directive (Council of the European Union, 2001).

The mortgage rate is a quarterly mean of a 5-year monthly rate from SBAB (2022).

The CPI is from Statistics Sweden (2022c) and inflation expectations are from Kantar Sifo (2022) and Refinitiv.

Rents are from Statistics Sweden (2022b, 4103 Main rental). Presumption rents (rents in newly constructed buildings) are from Statistics Sweden (2022i,j).

Values of structures and land are from Statistics Sweden (2022a,g). Operation, maintenance, and repair costs are from Statistics Sweden (2022g). They are summarized in table G.1. The values of structures and land are slightly smoothed; see figure G.6. Prices of electricity, insurance, and repair goods are Statistics Sweden (2022b, codes 4605, 4606, and 4703) (figure G.19).

Some additional data are reported in notes to figures.

B Cointegration and elasticities

Logs of the series PTI, PTR, P, and UCC are nonstationary (with and without the preference adjustment shown in figure 1.1). That is, augmented Dickey-Fuller tests do not reject the hypothesis of a unit root. The first-difference of the logs of the series are stationary. If the levels are nonstationary and the first-differences are stationary, the logs of the series are integrated of order one, I(1). The rest of appendix B uses the preference-adjusted PTI, PTR, and P series.

If the logs of the series are I(1) and have a stationary linear combination, they are cointegrated. The demeaned logs of the series PTI, PTR, and P are cointegrated with the demeaned logs of

[65] Booli (2022) has a similar price index for apartments and houses from 2013.

[66] At the time of writing, the 2022q4 quarterly mean is the mean of the observations of October and November only, as the December observation is not yet available.

the series UCC, with p-values for Engle-Granger cointegration tests (1 lag, no contant) equal to, respectively, 1.3%, 1.5%, and 1,4%.[67]

If the series log PTI and log UCC are cointegrated, there is a stationary linear combination,

$$u_t = \log \mathrm{PTI}_t - \beta \log \mathrm{UCC}_t, \tag{B.1}$$

where u_t equals the residual from a linear regression of log PTI on log UCC. Furthermore, the estimate of the coefficient, β, is superconsistent, meaning that it converges faster than OLS estimates with increasing number of observations (Engle and Granger, 1987; Rajbhandari, 2016).

Table B.1 shows the estimated coefficients for regressions of logs of PTI and PTR on the log of UCC. These can be interpreted as long-run elasticities with respect to UCC.

Table B.1: The elasticities of preference-adjusted PTI and PTR ratios and house prices P w.r.t. the UCC.

	PTI	PTR	P
UCC	−0.48	−0.84	-1.21
	(0.015)	(0.020)	(0.024)
Obs	103	103	103
R^2	0.91	0.95	0.96

Source and note: OLS regressions of demeaned logs of preference-adjusted PTI and PTR ratios and house prices P on the demeaned log of UCC. OLS standard errors in parenthesis. The constant is zero for demeaned series. Sample 1997q1–2022q3.

Figure B.1: The deviations of the preference-adjusted log PTI and UCTI ratios and the stationary linear combination, the residual u_t.

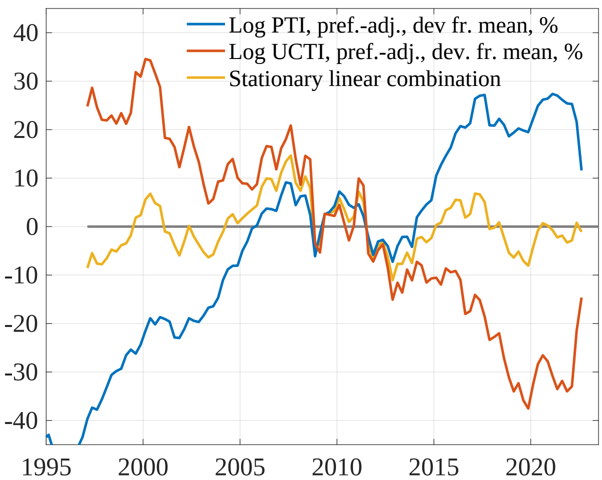
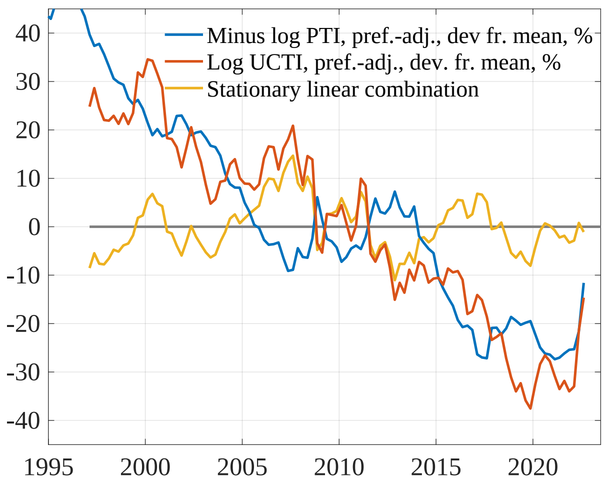


Figure B.2: The devation of the log UCTI ratio, the negative of the deviation of the log PTI ratio, and the stationary linear combination, the residual u_t.



Source and note: Own calculations. The ratios are preference-adjusted. The stationary linear combination is the u_t in (B.3).

In order to show that in this case that the deviation of the UCTI ratio from its average is approximately the negative of the deviation of the PTI ratio from its average, we note that from (1.2)

[67] The test is done with the Matlab function `egcitest`, which uses the correct critical values, different from the standard critical values of the augmented Dickey-Fuller test.

the log of the UCTI ratio for preference-adjusted house prices satisfies

$$\log \mathrm{UCTI}_t \equiv \log \mathrm{UCC}_t + \log \mathrm{PTI}_t. \tag{B.2}$$

This can be used to eliminate $\log \mathrm{UCC}_t$ in the linear combination (B.1). This results in the following stationary linear combination,

$$u_t = (1+\beta)\log \mathrm{PTI}_t - \beta\,\mathrm{UCTI}_t = 0.52\,\log \mathrm{PTI}_t + 0.48\,\log \mathrm{UCTI}_t. \tag{B.3}$$

That is, the stationary residual u_t is (approximately) the mean of log PTI and log UCTI.

We can rewrite this as

$$\log \mathrm{PTI}_t = \frac{\beta}{1+\beta}\log \mathrm{UCTI}_t + \frac{1}{1+\beta}u_t = -0.93\,\log \mathrm{UCTI}_t + \varepsilon_t, \tag{B.4}$$

with $\varepsilon_t \equiv 1.93\,u_t$.

Figure B.1 shows $\log \mathrm{PTI}_t$ (blue) and $\log \mathrm{UCTI}_t$ (red). The linear combination, the residuals u_t (yellow), is the (approximately) the average of the blue and red lines. Figure B.2 shows $\log \mathrm{UCTI}_t$ and the *negative* of $\log \mathrm{PTI}_t$, to illustrate their negative relation and (B.4). The linear combination u_t is (approximately) half the difference between the red and blue curve.

C Households' expectations of future mortgage rates[68]

What are Swedish households' expectations of future mortgage rates? Could households have overoptimistic expectations of future mortgage rates?

Figure C.1 shows, for December 2022, Swedish households' expected future 3-month mortgage rates (dash-dotted red), their expected *average* future 3-month mortgage rates (the households' implied "yield curve") with and without an added term premium (solid thick and thin red, respectively), and the SBAB lending rates for different fixation periods up to five years (the SBAB "yield curve," solid blue). The households' implied yield curve represents the households' expectations of average future 3-month rates; the SBAB yield curve represents the SBAB expectations of average future 3-month rates.

We see that, in December 2022, households expected similar future mortgage rates as SBAB, which is considered representative of other Swedish banks in this paper. Because banks are likely to be better informed that households, this indicates that households do not have overoptimistic mortgage-rate expectations.

Figure C.2 plots a time series of the households' expected 5-year average of future 3-month rates with and without an added term premium, the SBAB 5-year mortgage rate, and the spread with and without a term premium between them. The spreads indicate that since 2011 (except perhaps for the winter 2013–2014) Swedish households' expectations of future mortgage rates have been substantially higher than SBAB's up to the early spring 2022. More recently, the spread has closed.

Altogether, there is no evidence that households would have overoptimistic expectations of low future mortgage rates, at least not compared to banks. Personally, I think the SBAB has overdone their 5-year rate increases, and I think it very likely that average mortgage rates in the next 5 years will be substantially lower than the SBAB December rate of 4.4%.[69]

[68] This is an update of Svensson (2019, section 2.4).

[69] Previously, Hjalmarsson and Österholm (2017) and Österholm (2017)—by examining the time series and forecast errors, respectively, of the households' mortgage-rate expectations—have not found any evidence of Swedish households' mortgage-rate expectation being unrealistically low.

Figure C.1: Swedish households' expected future 3-month mortgage rates, expected average future 3-month mortgage rates with and without term premium, and SBAB lending rates for different fixation periods, December 2022.

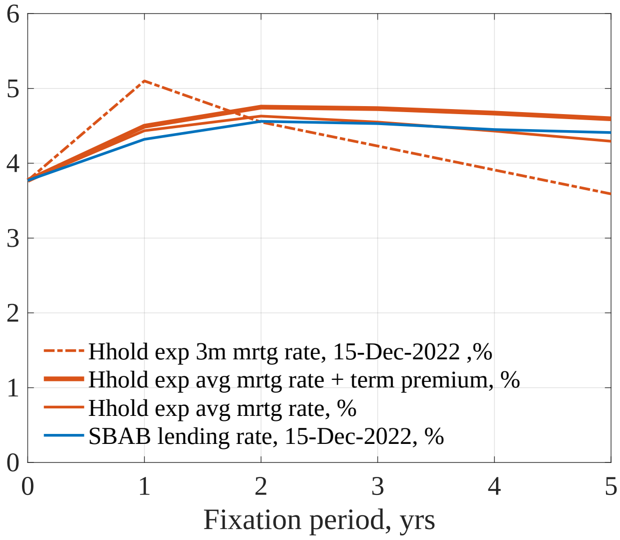
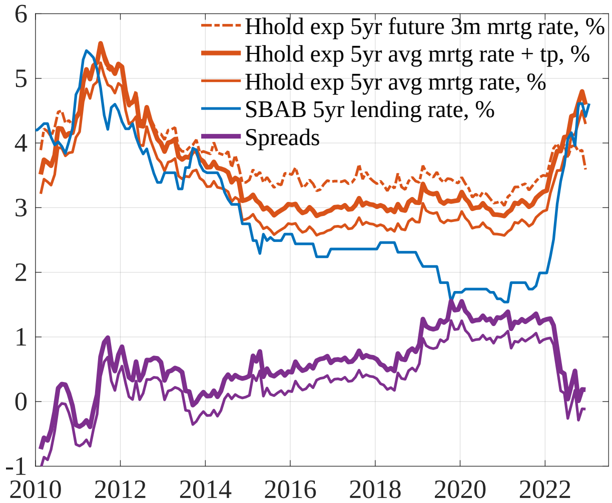


Figure C.2: Swedish households' expected 5-year average of future 3-month mortgage rates with and without term premium, the SBAB 5-year lending rate, and spreads, 2010–December 2022.



Source and note: NIER (2022b), SBAB (2022), and own calculations. The term premium is assumed to be 0.5 basis points (bp) per month fixation period, so it is 30 bp for a 5-year fixation period.

Figure C.3: Household expectations of the 3-month mortgage rate 1 year ahead, 2 years ahead, and 5 years ahead.

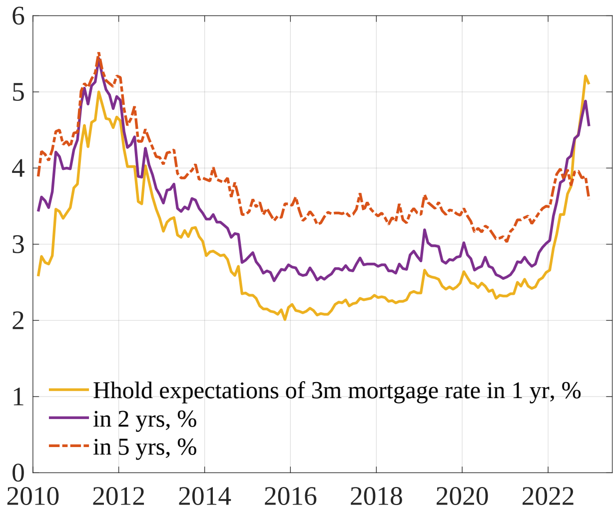
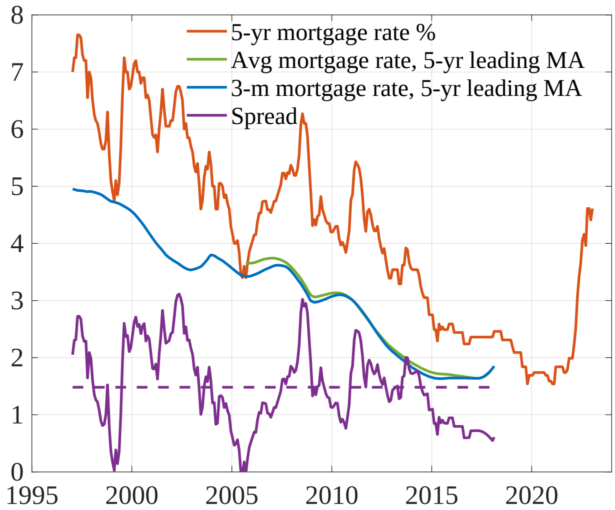


Figure C.4: The SBAB 5-year mortgage rate, 5-year leading moving averages of the average and 3-month mortgage rates, and the spread between the first and third of the rates.



Source and note: Figure C.3: NIER (2022b). Figure C.4: NIER (2022b), SBAB (2022) and Statistics Sweden (2022f). The mortgage rates refer to new and renegotiated loans. The last observation is December 2022.

Figure C.4 shows that the SBAB 5-year mortgage rate has substantially exceeded the 5-year average of future 3-month mortgage rates. The read line shows the 5-year mortgage rate. The blue line shows a 5-year *leading* moving average of the 3-month mortgage rate, that is, the average over the 5 future years of 3-month rates. The solid purple line shows the spread, the 5-year rate less the

5-year average of future 3-month rates. The dashed-purple line shows the average of the spread.

The green line shows a 5-year leading moving average of the volume-weighted average mortgage rate for all lenders and fixation periods. The SBAB 3-month rate is rather representative of the average of all mortgage rates.

D Model-based measures of overvaluation from the Riksbank and the National Debt Office

D.1 Riksbank staff analysis

Dermani, Lindé, and Walentin (2016) of the Riksbank examine whether Swedish house prices can be explained by fundamentals. In an international comparison, they estimate real house prices on data for a panel of seven countries: Denmark, Finland, Germany, Norway, Sweden, the UK, and the US. The explanatory variables are real disposable income per capita, real financial wealth, the real mortgage rate, annual CPI inflation, annual population growth, and residential investment as a fraction of GDP. They assume that the coefficients are the same across countries and make assumptions that allow individual countries to be over- or undervalued throughout the sample.[70]

Figure D.1: Actual and estimated house prices: Sweden.

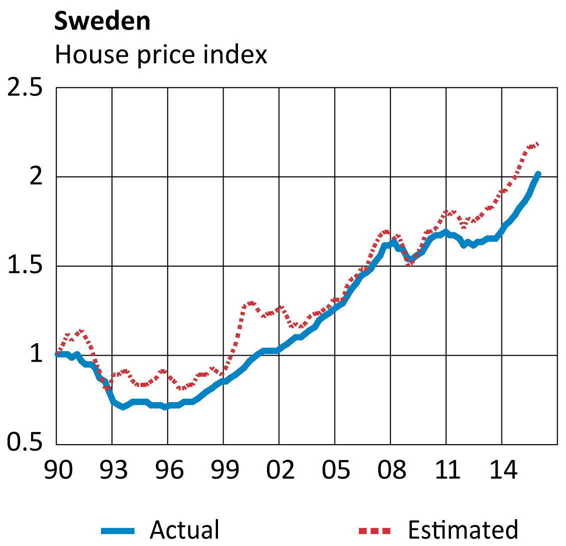
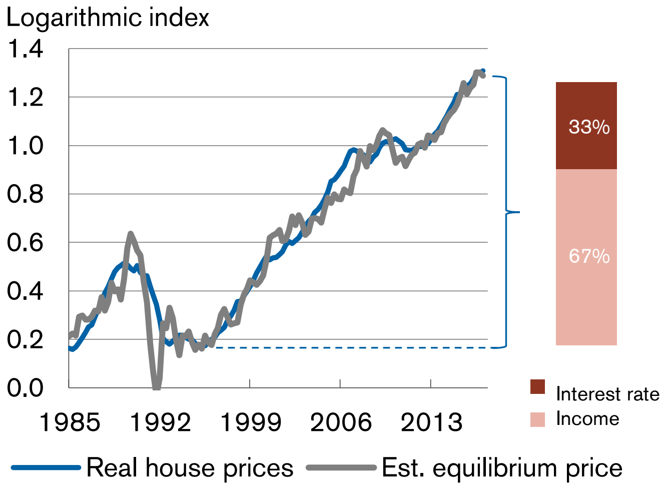


Figure D.2: Driving forces behind the rise in Swedish house prices 1996–2017.



Source and note: Figure D.1: Dermani et al. (2016, figure 5, panel for Sweden). Actual and estimated single-family house prices from the regression model without indebtedness (Dermani et al., 2016, regression in equation (1)). Figure D.2: Bjellerup and Majtorp (2019, figure 31). The calculated driving forces—real after-tax interest rate 33%, real disposable income 67%—relate to the change in the estimated equilibrium price between 1996q1 and 2017q4.

Figure D.1 shows results for Sweden. On average over the sample, Swedish housing has been

[70] They disregard differences in levels of variables that grow over time by converting the relevant variables into index series that are normalized to 1 for the start period in the empirical analysis (1990q1). Specifically, this normalization is done for house prices, disposable income, and financial net wealth. Had they not done this, they would have been forced to allow for a country-specific constant term in the model. A country-specific constant had, however, involved an assumption that house prices in each individual country had been correctly valued on average over the estimation period, something which they wish to avoid in advance in their analysis. The normalization does mean, however, that the average residual for each country contains the deviation in the cointegrating vector between housing prices and the other normalized variables in the first quarter of 1990. Turk (2015) shows that this deviation is small for Sweden. Their results may therefore be interpreted in terms of over- and undervaluation of prices in levels for Sweden.

somewhat undervalued. More recently, it is undervalued after 2011.

Dermani et al. (2016) also examine possible over- or undervaluation in Swedish municipalities, with a different method, namely. by examining the UCTI ratios over time. They thus use the municipality user cost share of median income as an indicator of overvaluation.[71]

Their summary conclusion is:

> According to the methods we have used, there is no evident overvaluation of houses in Sweden, either in the country as a whole or in the municipalities for which we have data (Dermani et al., 2016, p. 42).

More recently, Sveriges Riksbank (2021) discusses the reasons behind the rapidly rising housing prices during the corona crisis (see figures G.13 and G.14). It suggests that the price rise is due to a preference shift in favor of larger housing and location outside the large cities. That is, the price rise is considered due to fundamental factors and not any indication of overvaluation.

D.2 National Debt Office staff analysis

Bjellerup and Majtorp (2019) of the National Debt Office present a thorough and granular analysis of the data and development of Swedish housing prices. In particular, they estimate a simple cointegrating vector of real house prices as a function of real disposable income and the real after-tax interest rate, with a dummy for the introduction of the 85% LTV cap in 2010q4.

Figure D.2 shows actual real house prices and the equilibrium house price predicted by the cointegration vector. It shows that there is no evidence of overvaluation since 2011. Furthermore, the rise in real house prices during 1996–2017 is well explained by the fall in the real after-tax interest rate and the rise in real disposable income.

E Capital gains on owner-occupied houses

The UCC in section 3 is calculated under the assumption that expected real after-tax capital gains are zero. This is a conservative assumption in the sense that average ex-post real after-tax capital gains on Swedish housing have been substantial. The average is 4.0% for 1997q1–2022q4 and 2.7% for 2010q1–2022q4. It is also conservative in the sense of assuming that house buyers do not speculate in high capital gains. With on average positive actual capital gains, assuming they are zero introduces un upward bias in absolute user costs and UCTI and UCTR ratios and in that sense toward overvaluation. Thus, the cards are somewhat stacked in favor of finding overvaluation. However, percentage deviations from historical averages are less or not affected, so there is less or no bias when overvaluation is measured in terms of such deviations.[72]

Figure E.1 shows nominal housing prices, the tax rate on nominal capital gains, and the resulting ex-post nominal 4-quarter after-tax capital-gains rate and its average from 1997 and 2010.[73] Figure E.2 shows the CPI inflation rate and the corresponding ex-post real 4-quarter after-tax

[71] The user cost in year t and municipality j is calculated as the approximation $(r_t + \tau_t)P_{jt}$, where r_t is the real after-tax long mortgage rate, τ_t is the property tax rate, and P_{jt} is the aggregate real purchase price for a house in municipality j. Thus, the measure of user cost excludes the OMRD and any expected capital gains.

[72] For simplicity, it is assumed that the capital gains tax is paid every year. In practice, it can be postponed until the sale of the house, which reduces the present value of the tax (Englund, 2020).

[73] The capital-gains tax rate was 15% during 1994–2001 and 20% during 2001–2007, and is 22% from 2008 (Englund, 2020).

Figure E.1: Housing prices, the capital-gains tax, and ex-post nominal after-tax capital-gains rates and averages 1997q1–2022q4 and 2010q1–2022q4.

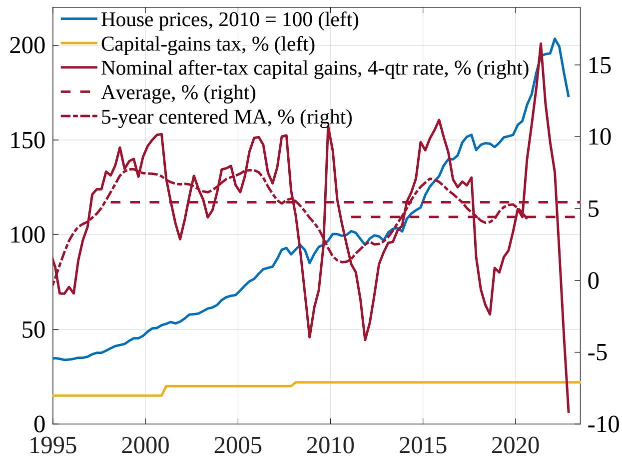
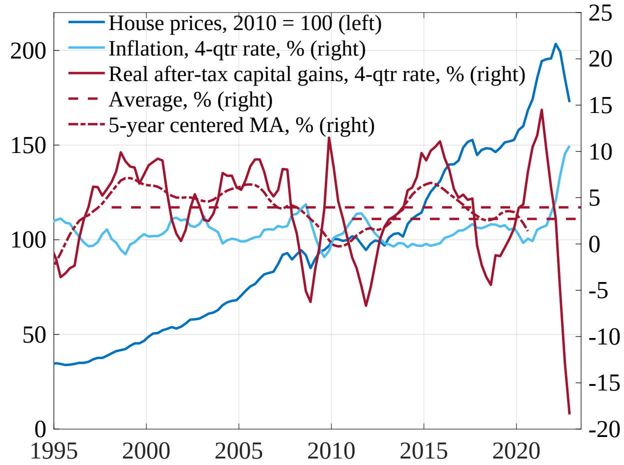


Figure E.2: Housing prices, inflation, and ex-post real after-tax capital-gains rates and averages 1997q1–2022q4 and 2010q1–2022q4.



Source and note: Englund (2020), Statistics Sweden (2022c,h), and own calculations.

capital-gains rates and their averages.[74] We see that, whereas the ex-post real 4-quarter after-tax capital-gains rate has fluctuated substantially and taken both positive and negative values, the 5-year moving averages have never been negative since 1997.

Figure E.3: The UCC and its components, and average real aft22q4er-tax capital-gains rates during 1997q1–2022q4 and 2010q1–2022q4.

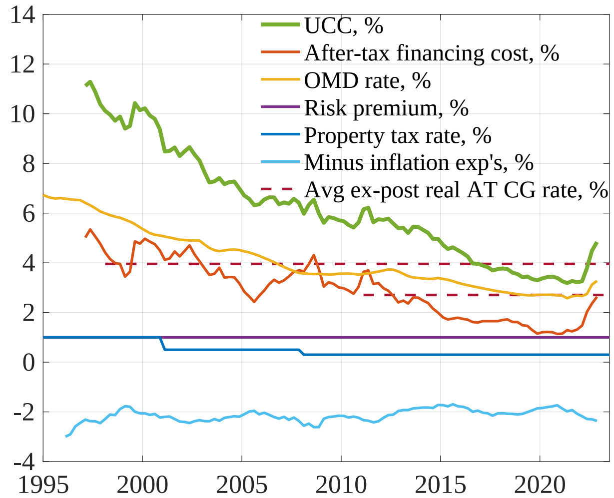
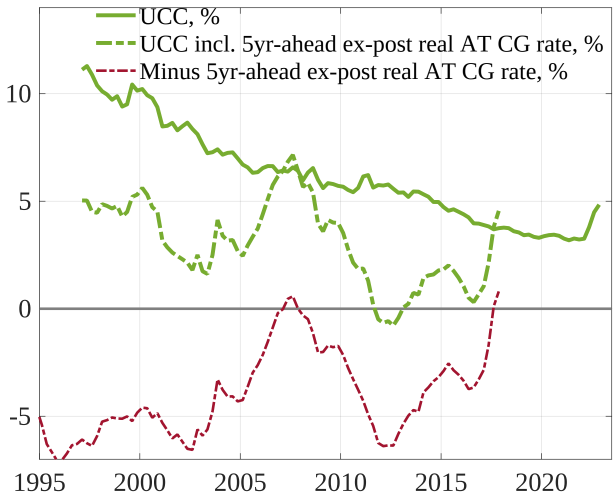


Figure E.4: The UCC excluding and including the ex-post 5-year-ahead real after-tax capital-gains rate.



Source and note: Sources and notes to figures 3.4 and E.2 and own calculations.

Figure E.3 adds the averages of the ex-post real after-tax capital-gains rate to figure 3.4. We see that expectations of real after-tax capital-gains equal to the average of the ex-post real after-tax

[74] Let $x_t = (1 - \tau_t^{cg})(P_t/P_{t-1} - 1)$ denote the 1-quarter (ex-post) nominal capital-gains rate in quarter t. The 4-quarter nominal after-tax capital-gains rate in quarter t is calculated as $\Pi_{s=-3}^{0}(1 + x_{t+s}) - 1$. Let $y_t = x_t - \pi_t$ denote the 1-quarter real capital-gains rate in quarter t, where π_t denotes the one-quarter CPI inflation rate. The 4-quarter real capital-gains rate in quarter t is calculated as $\Pi_{s=-3}^{0}(1 + y_{t+s}) - 1$.

capital gains during 1997q1–2022q1 would result in negative UCCs from 2016, implying that the perceived cost of living in owner-occupied housing would be negative. That is, owner-occupiers would except to not only to "live for free" but make a net profit, be "paid to live." For expectations of capital gains equal to the average during 2010q1–2022q1, the UCC would fall to zero around 2020, corresponding to expectations of living for free.[75]

The dash-dotted dark red line in figure E.4 shows the ex-post 5-year forward real after-tax capital gains at a 4-quarter rate. (Values after 2016q2 are missing because the latest data point of house prices is 2021q2.)[76] A house buyer with perfect foresight and a 5-year horizon—or using a 5-year horizon as an estimate of a longer horizon—could include this capital gains rate in the UCC, resulting in a modified UCC given by the dash-dotted green line. We see that this inclusive UCC is close to zero in 2012 and 2016.

The fact that user costs and UCTI ratios *excluding* capital gains in figures 3.5 and 4.1 are low and for the UCTI ratios even falling indicates that Swedish house buyers generally do not speculate in receiving large capital gains. High and rising UCTI ratios excluding capital gains might have indicated that such speculation occurs.

Can housing capital gains be positive indefinitely, in a steady state with a constant real interest rate? The price of a dwelling is the sum of the value of the structure and the value of the land the dwelling sits on, including the value of the location of the dwelling. The value of the structure should be determined by the cost and productivity of and competition in the construction of structures. Depending on these factors, the real value of structures may very well be approximately constant on the long run, making nominal capital-gains rates positive and approximately equal to the CPI inflation rate. But the real value of land and location need not be constant in the long run. According to the classic Muth-Mills model (DiPasquale and Wheaton, 1996; Brueckner, 1987), the value of land in attractive locations may increase in steady state with real incomes or GDP, resulting in nominal capital-gains rates approximately equal to the growth rate of nominal incomes or GDP, that is, to the sum of the real growth rate and the rate of inflation. In such a steady state, the share of land and location in the value of housing will grow and the share of structures will fall, but nominal and real capital gains on housing will remain positive.

F Housing expenditures as a percentage of disposable income by tenure

Statistics Sweden (2014, 2022d) reports housing expenditures as a percentage of disposable income for rented, tenant-owned, and owner-occupied dwellings, averages in an older series for 2004–2013 and medians in a new series for 2015, 2017, and 2020. They are shown in figure F.1. For owner-occupied dwellings, these housing expenditures include after-tax interest, amortization, and operation, maintenance, and repair expenditures. They correspond to housing payments (cash outflows) rather than user cost.

We see that households in rented dwellings have the highest expenditure shares. The expenditure shares for tenant-owned dwellings and, in particular, owner-occupied dwellings, are substantially lower than then those for rented dwellings. This is to a substantial extent because owners have higher disposable incomes than renters (figure F.2). The expenditure shares of owners are low, do not show any upward trend, and do not indicate any overvaluation in the sense of housing payments

[75] That owner-occupation in Sweden ex post has resulted in a net profit during some periods has been discussed in Sandelin and Södersten (1978), Hansson (2019) and Englund (2020).

[76] It is calculated as $[\Pi_{s=1}^{20}(1 + y_{t+s})]^{(1/5)} - 1$.

Figure F.1: Housing expenditure as a percentage of disposable income by tenure.

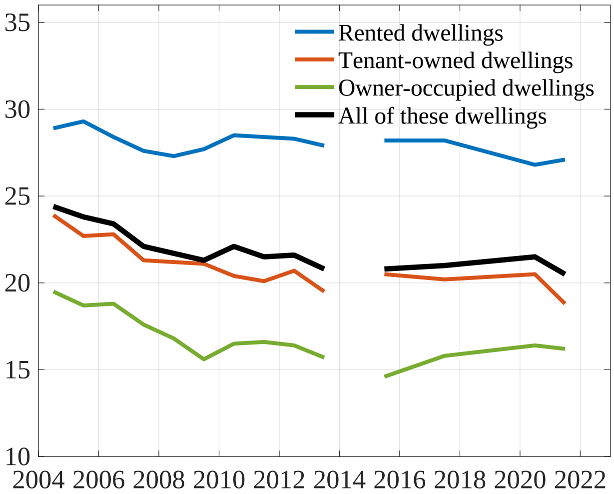
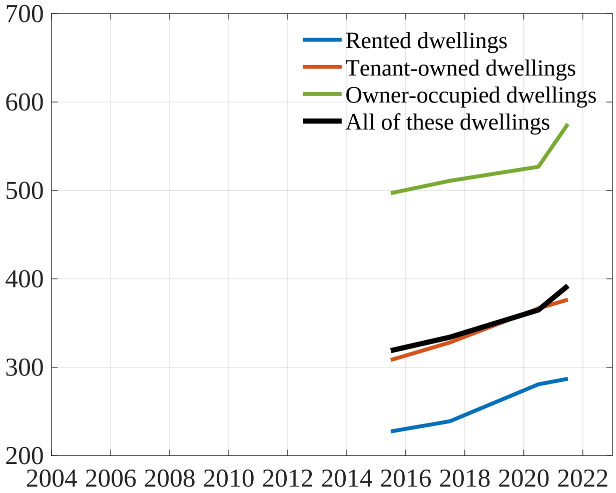


Figure F.2: Disposable income by tenure. SEK thousands.



Source and note: Statistics Sweden (2014), averages for housing expenditure 2004–2013; Statistics Sweden (2022d), medians for housing expenditure and disposable income for 2015, 2017, 2020, and 2021.

becoming large relative to disposable income.[77]

[77] See also section 5.3, figure 5.13, and OECD's work on housing affordability discussed there.

G Additional figures and table

Figure G.1: Nominal house prices, disposable income, disposable income per capita, and rents, and population.

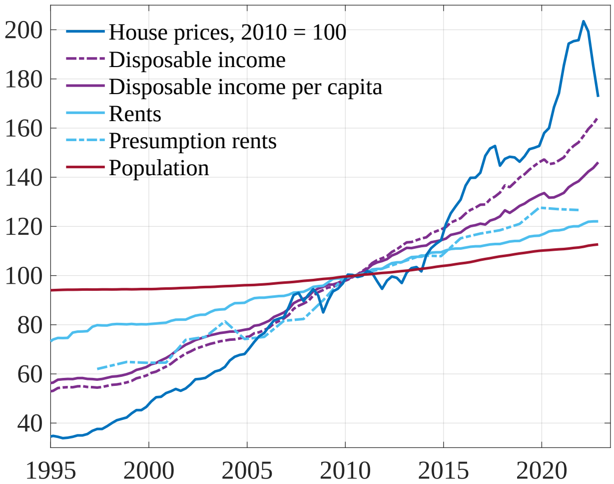
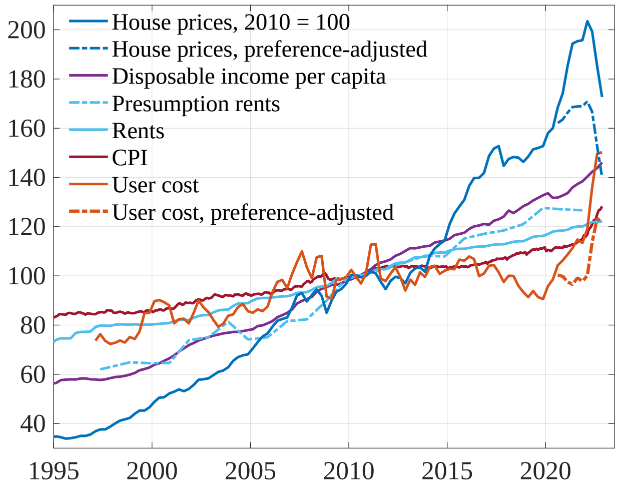


Figure G.2: Nominal house prices, disposable income per capita, rent, user cost, and the consumer price index.



Source and note: Figure G.1: Statistics Sweden (2022b,c,e,h) and own calculations. The linked house-price index is from figure G.3. Disposable income is net and a 4-quarter trailing moving sum; 2022q4 is a prediction using the forecast of NIER (2022a). Rents are a 3-quarter centered moving average. Presumption rents, rents in newly constructed buildings, from Statistics Sweden (2022i,j). Missing values for these rents in 2010 and 2012 have been replaced by interpolated values. The "preference-adjustment" is explained the text. Current prices, index 2010 = 100.

Figure G.3: Statistics Sweden house prices, HOX house prices; and the linked house-price index.

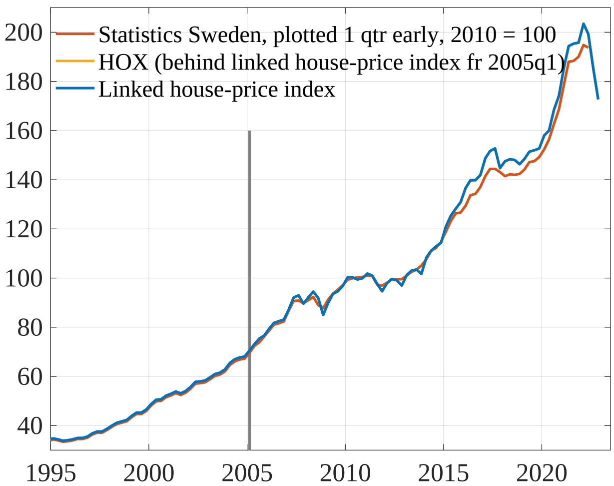
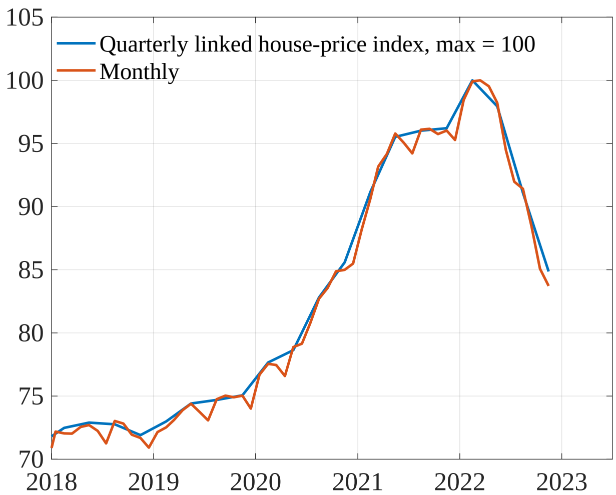


Figure G.4: The quarterly linked and monthly HOX house-price index, max = 100.



Source and note: Statistics Sweden (2022h), and Valueguard (2022). Index = 100 for 2010. The HOX price index is not available before 2005q1 (marked by the vertical gray line). The linked house-price index equals the Statistics Sweden house-price index (led by 1 quarter) up to 2005q1 and the HOX (quarterly) house-price index from 2005q1 (marked by the vertical gray line). The yellow line of the HOX price index is therefore hidden by the blue line of the linked price index. The Statics Sweden index is led by 1 quarter (plotted 1 quarter earlier) because it is dated by the date of the deed, which is normally 2–3 months later than the date of the contract.

Figure G.5: Disposable income, gross and net, and percentage difference.

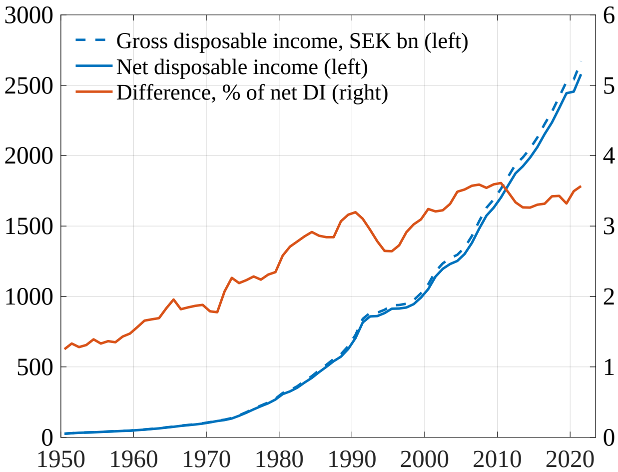
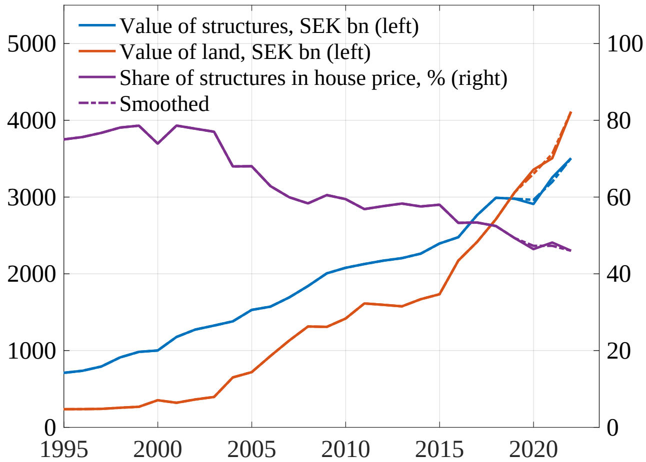


Figure G.6: Value of structures and land and the share of structures in house prices: Original and smoothed.



Source and note: See appendix A. Figure G.6: The smoothed variant removes a difficult-to-explain down-and-up blip for December 2019 and 2020 but keeps the total value constant.

Figure G.7: Operation, maintenance, and repair costs.

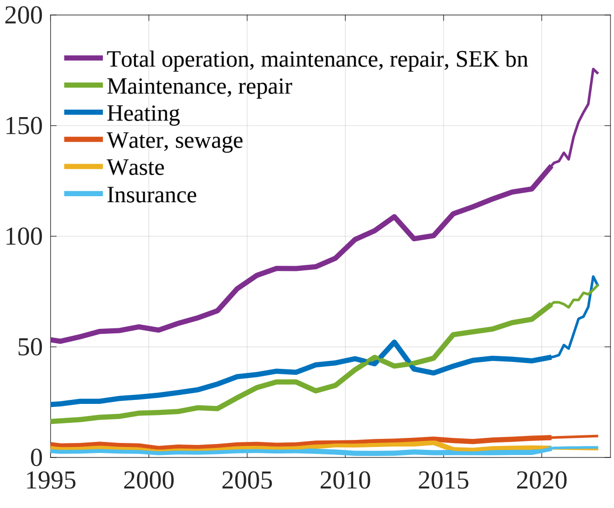
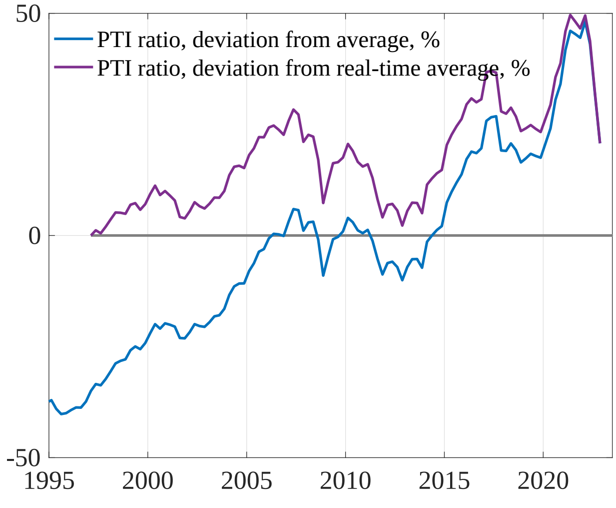


Figure G.8: Price-to-income ratio. Deviation from 1997q1–2022q4 average and real-time 1997q1– average.



Source and note: Figure G.7: The thick lines are data. The thin lines are extrapolations for 2021 and 2022. Heating, insurance, and maintenance and repair are extrapolated with the electricity, insurance, and repair goods prices in figure G.19. The costs of water and sewage and of waste collection are linearly extrapolated. Figure G.8: Statistics Sweden (2022e,h), Valueguard (2022), and own calculations.

Figure G.9: Rent and presumption rent to income, index

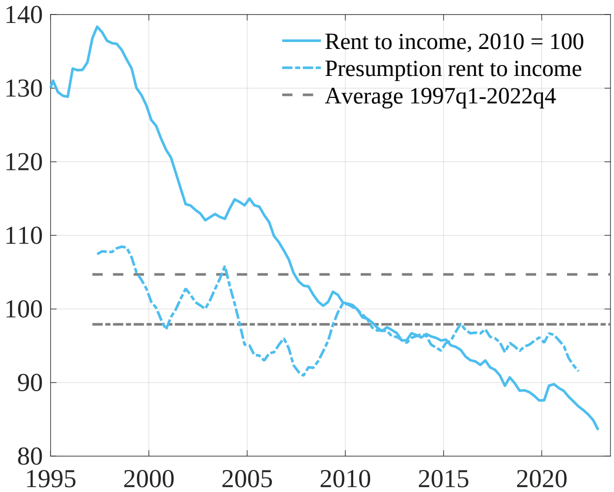
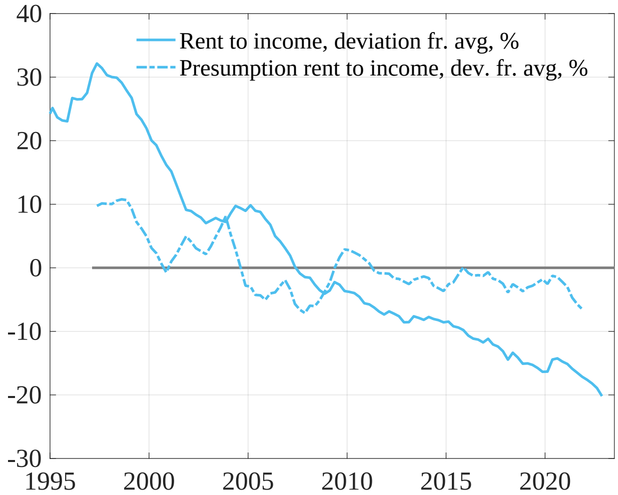


Figure G.10: Rent and presumption rent to income, deviation from average.



Source and note: Statistics Sweden (2022b,e,h).

Figure G.11: The UCC and its components. Average 5-year inflation expectations.

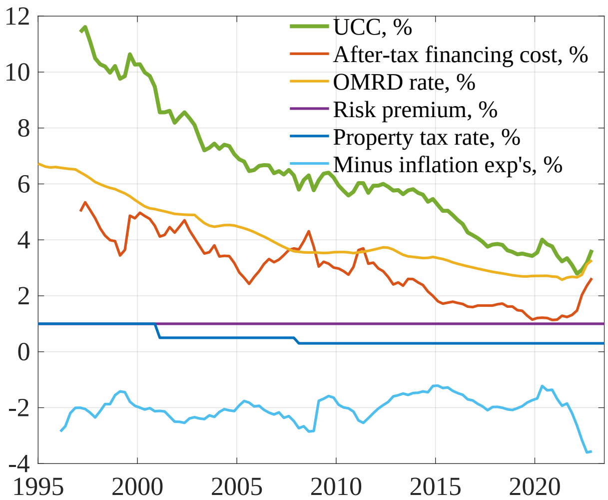
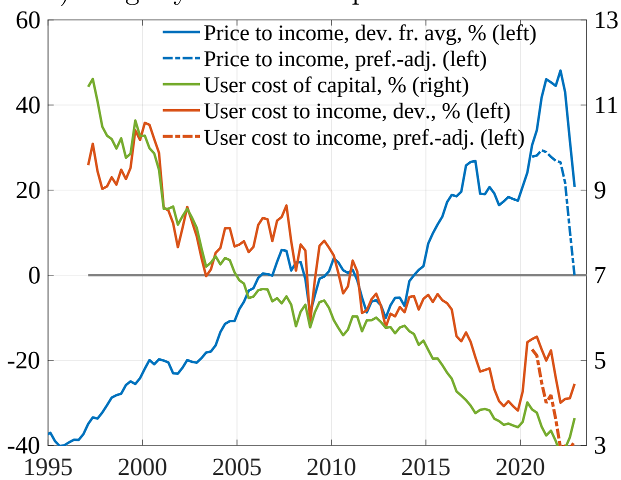


Figure G.12: Price-to-income and user-cost-to-income ratios (percentage deviation from historical averages) and the user cost of capital (percent). Avg 5-yr inflation expectations.



Source and note: See notes to figures 1.1 and 3.4. Average 5-year inflation expectations are used instead of expectations of annual inflation 5 years ahead. Own calculations.

Figure G.13: Housing prices. Index

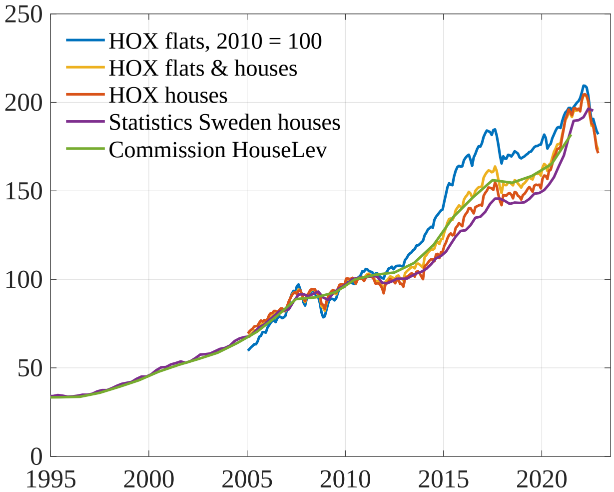
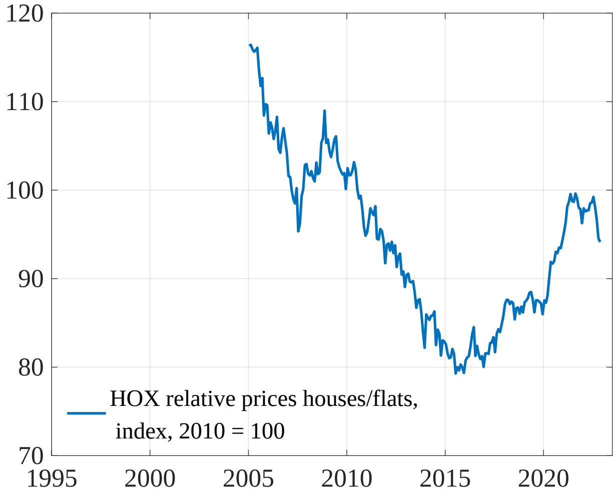


Figure G.14: The price of houses relative to apartments. Index.



Source and note: Bricongne et al. (2019), Statistics Sweden (2022h), and Valueguard (2022). Index = 100 for 2010.

Figure G.15: The SBAB 5-year mortgage rate, the cost of equity, and the resulting financing cost.

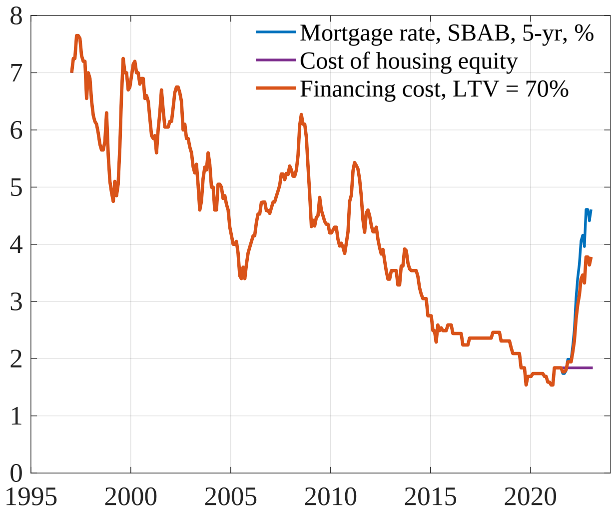
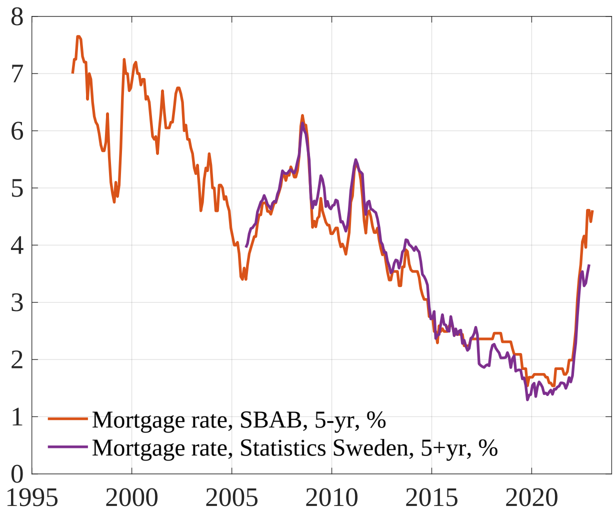


Figure G.16: The SBAB 5-year and the Statistics Sweden 5+-year mortgage rates.



Source and note: SBAB (2022) and Statistics Sweden (2022f). The mortgage rates refer to new and renegotiated loans.

Figure G.17: SBAB 5-year mortgage rate, Statistics Sweden 5+year and average mortgages rates, and Riksbank policy rate and November 2022 policy-rate path.

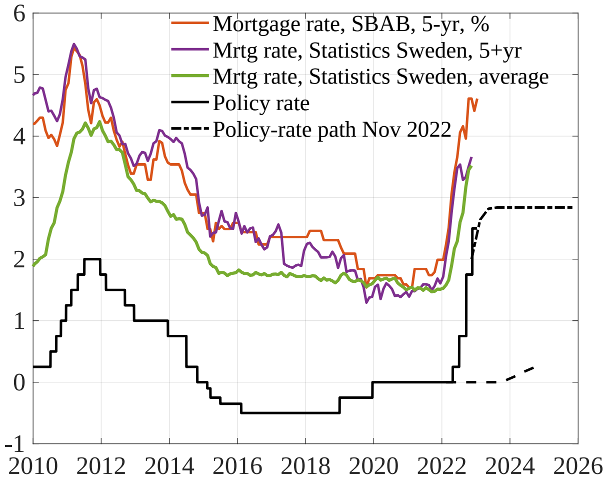
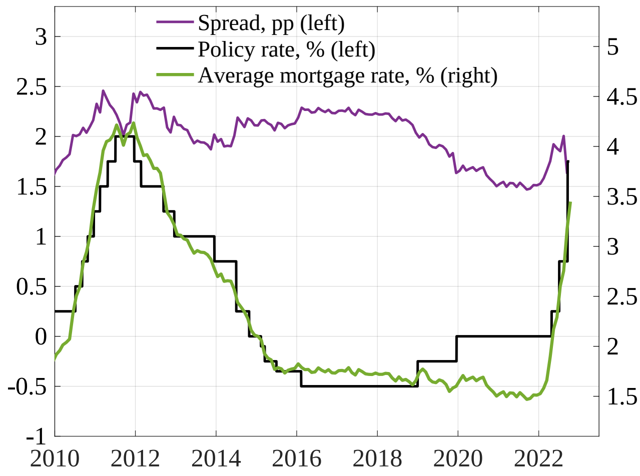


Figure G.18: The average mortgage rate for new and renegotiated loans, the policy rate, and their spread.



Source and note: Erikson and Vestin (2021), SBAB (2022), Statistics Sweden (2022f), Refinitiv Datastream, and Sveriges Riksbank (2022). The mortgage rates refer to new and renegotiated loans. The dashed black line is the Riksbank's policy-rate path of February 10, 2022.

Figure G.19: Electricity prices, insurance fees and repair-goods prices: Owner-occupied housing. Index.

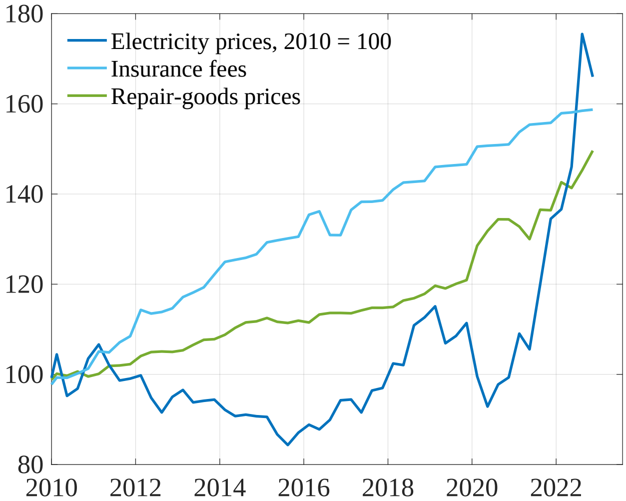
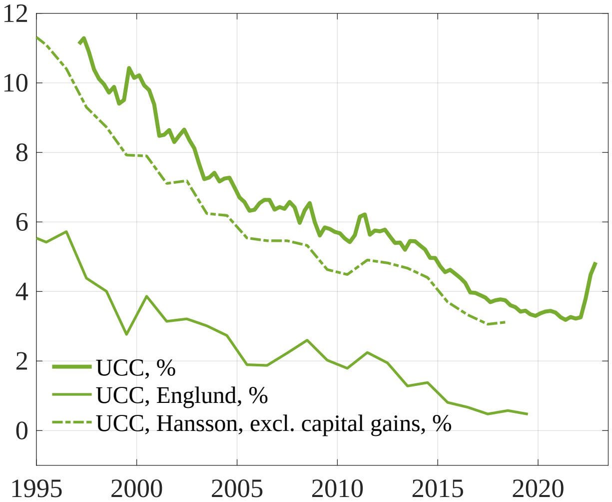


Figure G.20: The user cost of capital of Hansson (2019, figure 7, excl. capital gains) and Englund (2020, diagram 9) .



Source and note: Figure G.19: Statistics Sweden (2022b, 4703 Electricity, 4605 Repair goods, 4606 Insurance fees, owner-occupied housing). Figure G.20: Hansson (2019, figure 7, excl. capital gains) and Englund (2020, diagram 9). The thick green line is the UCC from figure 3.4. Hansson's UCC is shown excluding expected real after-tax capital gains. It is calculated for a 2% depreciation rate of the value of structures and a zero risk premium. Englund's UCC is calculated for a zero OMRD rate and risk premium. The calculation of the relevant taxes is more detailed than in this paper. One-year capital gains are equal to firms' one-year inflation expectations (NIER, 2022c) up to 1997 and 2% thereafter. A 5-year mortgage rate is used from 1997 and 5-year mortgage bonds plus 1 pp is used before.

Figure G.21: ECB estimates of residential property overvaluation: Sweden.

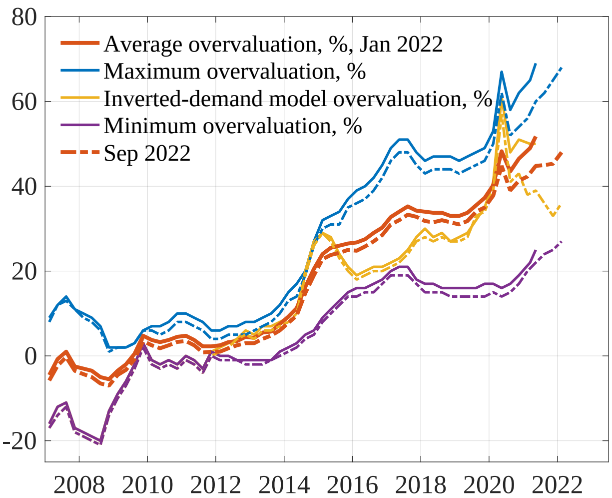
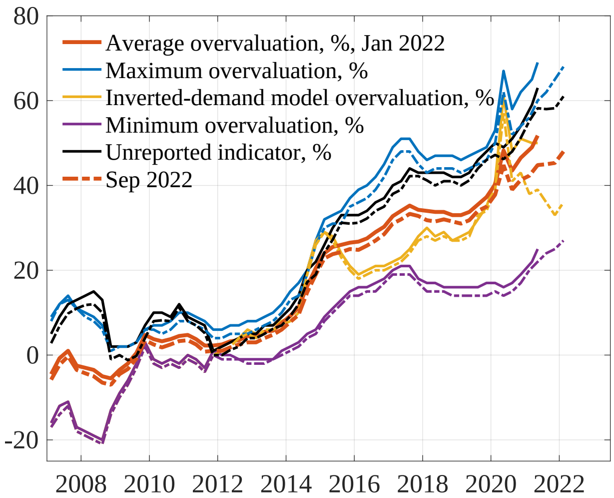


Figure G.22: ECB estimates of residential property overvaluation: Sweden, including the unreported overvaluation indicator.



Source and note: ECB (2022). Data from January 2022 (as in figures 5.1 and 5.2) and September 2022. From the three reported indicators and the average of the four indicators, one can infer that the unreported indicator. It is added in figure G.22.

Figure G.23: The ESRB's Scoreboard (ESRB, 2022b, table 1, Scoreboard, part 1).

	Indicators						
	Collateral stretch				Lending stretch		
Country	Residential real estate price index, 36m real growth, average %	Residential price index relative to trend	House price to income ratio (deviation from average, %)	Econometric model (overvaluation, %)	Loans to households for house purchases, 36m real growth, average %	Loans to households for house purchases relative to trend	Household loan spread
AT	5.2	1.14	52.0	33.0	4.2	1.01	1.4
BE	4.7	1.02	24.0	14.0	7.9	1.16	1.7
BG	3.8	1.18	-5.0	-10.0	13.1	1.08	2.7
CY	1.5	0.97	0.0	5.0	-8.2	0.75	2.1
CZ	8.1	1.16	36.0	30.0	5.2	0.99	1.9
DE	7.1	1.20	23.0	19.0	4.6	1.08	1.7
DK	4.8	1.09	27.0	11.0	1.3	0.96	2.4
EE	5.2	1.16	13.0	17.0	5.3	1.12	1.7
ES	2.7	1.03	12.0	12.0	-1.9	0.80	1.4
FI	0.8	0.96	5.0	1.0	1.9	0.94	0.7
FR	3.8	1.00	17.0	-3.0	5.7	1.04	1.1
GR	6.3	1.10	-1.0	-2.0	-10.9	0.61	2.7
HR	8.1	1.21	1.0	-9.0	7.0	1.17	2.5
HU	7.5	1.17	12.0	-1.0	6.9	1.07	3.5
IE	2.3	1.10	-6.0	-20.0	-3.8	0.83	3.1
IS	5.4	1.20	3.7		8.2	1.04	2.3
IT	0.6	0.98	-3.0	-1.0	1.4	0.92	0.9
LI							
LT	7.0	1.26	4.0	14.0	6.7	1.04	2.1
LU	12.3	1.17	68.0	48.0	7.7	1.09	1.4
LV	5.8	1.27	4.0	-18.0	0.3	1.16	2.3
MT	4.1	1.05	26.0	-25.0	8.6	1.08	1.5
NL	6.8	1.15	19.0	14.0	0.5	0.95	1.5
NO	3.8	1.03	28.9		4.6	0.99	1.5
PL	5.8	1.12	5.0	-6.0	2.8	0.89	2.7
PT	8.7	1.27	22.0	6.0	0.7	0.86	0.8
RO	0.6	1.12	-23.0	-34.0	7.5	1.03	3.1
SE	4.0	1.04	66.0	51.0	4.1	1.00	1.3
SI	7.0	1.24	16.0	3.0	4.5	0.94	1.6
SK	10.2	1.23	17.0	13.0	7.6	1.05	0.9
EEA average	5.3	1.1	16.0	6.0	3.6	1.0	1.9
EEA median	5.2	1.1	13.0	5.0	4.6	1.0	1.7
Low	2.5	1.00	4.0	0.0	3.0	1.05	1.0
Medium	5.0	1.04	10.0	6.0	6.0	1.10	1.5
High	7.5	1.08	16.0	12.0	9.0	1.15	2.0

Source: ECB, the national authorities of Iceland and Norway, the Banque centrale du Luxembourg, the Central Bank of Malta.
Notes: The latest observation is the second quarter of 2021 for the indicators in the collateral stretch, August 2021 for those in the funding stretch and the first quarter of 2021 for those in the household stretch (with some exceptions). Official data from the National Statistics Office of Malta on disposable income are only available up to the second quarter of 2017 and the quarterly values for the first quarter of 2021 are based on Central Bank of Malta projections. Official data from STATEC on disposable income are only available on an annual basis up to 2020 and quarterly values for 2021 are Banque centrale du Luxembourg projections. The overvaluation figures are estimated by the European Central Bank.

Table G.1: Operation, maintenance, and repair costs for one- and two-dwelling houses, and values of structures of and land under one- and two-dwelling houses, 1993–2021. SEK mn.

Year	Heating	Water and sewage	Waste collection	Insurance	Maintenance and repair	Structures	Land
1993	22,252	6,295	4,457	3,392	14,740	747,690	219,078
1994	23,637	6,358	4,503	3,427	15,969	709,958	236,410
1995	24,224	5,227	3,703	2,818	16,544	736,901	237,295
1996	25,371	5,372	3,804	2,894	17,111	792,683	240,407
1997	25,390	5,975	4,232	3,220	18,151	911,094	255,393
1998	26,668	5,394	3,820	2,907	18,566	983,240	267,709
1999	27,307	5,212	3,689	2,806	20,028	1,001,072	352,981
2000	28,146	4,051	2,867	2,182	20,312	1,177,430	320,216
2001	29,324	4,685	3,317	2,524	20,778	1,273,651	363,164
2002	30,598	4,475	3,166	2,408	22,469	1,325,786	395,623
2003	33,182	4,926	3,488	2,652	22,071	1,380,811	650,400
2004	36,516	5,687	4,024	3,061	26,969	1,529,634	718,808
2005	37,470	5,907	4,178	3,179	31,572	1,572,545	929,247
2006	38,986	5,495	3,884	2,956	34,117	1,692,581	1,130,577
2007	38,498	5,683	4,016	3,058	34,135	1,840,730	1,313,651
2008	41,853	6,466	5,006	2,785	30,101	2,006,251	1,308,997
2009	42,735	6,577	5,733	2,435	32,571	2,078,388	1,417,055
2010	44,634	6,711	5,659	1,881	39,628	2,127,535	1,613,857
2011	42,341	7,153	5,902	1,834	45,268	2,171,235	1,596,288
2012	52,131	7,358	6,106	1,933	41,305	2,204,342	1,576,254
2013	39,972	7,766	6,103	2,463	42,560	2,263,034	1,669,260
2014	38,178	8,286	6,785	2,145	44,864	2,394,830	1,733,902
2015	41,270	7,632	3,528	2,215	55,497	2,476,612	2,171,702
2016	43,895	7,195	3,225	2,185	56,803	2,764,701	2,416,097
2017	44,819	7,867	3,951	2,156	58,054	2,990,605	2,710,881
2018	44,393	8,218	4,157	2,272	60,935	2,978,227	3,061,964
2019	43,668	8,679	4,281	2,283	62,457	2,909,513	3,356,705
2020	45,347	8,982	4,132	4,103	69,277	3,256,148	3,505,481
2021						3,505,904	4,112,616

Source and note: Statistics Sweden (2022a, AN1112 One- or two-dwelling buildings, AN2111A2 Land underlying one- or two-dwelling buildings) and Statistics Sweden (2022g).

References

Almenberg, Johan, Mattias Ankarhem, Karl Blom, and Thomas Jansson (2022), "House prices and interest rate expectations," Economic Commentary No. 10, September 20, 2022, Sveriges Riksbank, url to be added.

Barrios, Salvador, Cécile Denis, Viginta Ivaškaitė-Tamošiūnė, Andriana Reut, and Estefanía Vázquez Torres (2019), "Housing Taxation: A New Database for Europe," JRC Working Papers on Taxation and Structural Reforms No. 08/2019, European Commission, Joint Research Centre, Seville, https://joint-research-centre.ec.europa.eu/system/files/2019-10/jrc118277.pdf.

Bergman, U. Michael, and Peter Birch Sørensen (2013), "Estimating Fundamental House Prices: A General Method with an Application to Sweden," working paper, University of Copenhagen.

Bjellerup, Mårten, and Lina Majtorp (2019), "The Development of Swedish Housing Prices," Focus Report November 15, 2019, Riksgälden—The National Debt Office, https://www.riksgalden.se/contentassets/123d8a09ad2a46d6b2f5024d959477ad/2019-11-15-focus-report-the-development-of-housing-prices.pdf.

Boije, Robert (2019), "Swedish Household Debts at Risk: The Council Ignores Research," presentation at the European Commission's Swedish Representation, Stockholm, June 12, 2019, https://bloggen.sbab.se/swedish-household-debts-at-risk-the-council-ignores-research/.

Booli (2022), "Booli Pro House Price Index HPI," web page, SBAB Booli, https://pro.booli.se/indices.

Bricongne, Jean-Charles, Alessandro Turrini, and Peter Pontuch (2019), "Assessing House Prices: Insights from 'Houselev', a Dataset of Price Level Estimates," European Economy Discussion Paper 101, European Commission, https://ec.europa.eu/info/publications/assessing-house-prices-insights-houselev-dataset-price-level-estimates_en.

Brueckner, Jan K. (1987), "Chapter 20 The Structure of Urban Equilibria: A Unified Treatment of the Muth-Mills Model," in *Urban Economics*, vol. 2 of *Handbook of Regional and Urban Economics*, Elsevier, pages 821–845, https://doi.org/10.1016/S1574-0080(87)80006-8.

Claussen, Carl Andreas (2013), "Are Swedish Houses Overpriced?" *International Journal of Housing Markets and Analysis* 6(2), 180–196.

Council of the European Union (2001), "Council Directive 2001/55/EC on Temporary Protection," *Official Journal of the European Communities* L 212/12, 12–23, http://data.europa.eu/eli/dir/2001/55/oj.

Dermani, Emilio, Jesper Lindé, and Karl Walentin (2016), "Is There an Evident Bubble in Sweden," *Sveriges Riksbank Economic Review* 2016:2, 7–55, https://www.riksbank.se/globalassets/media/rapporter/pov/filer-fore-2017/artiklar/rap_pov_artikel_1_160922_eng.pdf.

Díaz, Antonia, and María José Luengo-Prado (2008), "On the User Cost and Homeownership," *Review of Economic Dynamics* 11(3), 584–613.

Diewert, W. Erwin (2013), "Elements for a Conceptual Framework," in *Handbook on Residential Property Prices Indices (RPPIs)*, chap. 3, Eurostat, pages 22–36, https://ec.europa.eu/eurostat/documents/3859598/5925925/KS-RA-12-022-EN.PDF.

DiPasquale, Denise, and William C. Wheaton (1996), "Chapter 3 The Urban Land Market: Rents and Prices," in *Urban Economics and Real Estate Markets*, chap. 3, Prentice-Hall, Englewood Cliffs, N.J., pages 35–59.

Dougherty, Ann, and Robert Van Order (1982), "Inflation, Housing Costs, and the Consumer Price Index," *The American Economic Review* 72(1), 154–164, http://www.jstor.org/stable/1808582.

Duca, John V., John Muellbauer, and Anthony Murphy (2016), "How Mortgage Finance Reform Could Affect Housing," *American Economic Review* 106(5), 620–24, https://www.aeaweb.org/articles?id=10.1257/aer.p20161083.

Duca, John V., John Muellbauer, and Anthony Murphy (2021a), "What Drives House Price Cycles? International Experience and Policy Issues," *Journal of Economic Literature* 59(3), 773–864, https://doi.org/10.1257/jel.20201325.

Duca, John V., John Muellbauer, and Anthony Murphy (2021b), "What Drives House Prices: Lessons from the Literature," VoxEU Column, September 13, 2021, https://voxeu.org/article/what-drives-house-prices-some-lessons-literature.

ECB (2011), "Tools for Detecting a Possible Misalignment of Residential Property Prices from Fundamentals," *Financial Stability Review, June 2011,* Box 3, 57–59, https://www.ecb.europa.eu/pub/financial-stability/fsr/focus/2011/pdf/ecb~5179a0aa86.fsrbox201106_03.pdf.

ECB (2015a), "A Model-Based Valuation Metric for Residential Property Markets," *Financial Stability Review, November 2015,* Box 3, 45–47, https://www.ecb.europa.eu/pub/pdf/fsr/financialstabilityreview201511.en.pdf.

ECB (2015b), "Statistical Valuation Metrics for Residential Property Markets," *Financial Stability Review, May 2015,* Box 3, 44–46, https://www.ecb.europa.eu/pub/pdf/fsr/financialstabilityreview201505.en.pdf.

ECB (2018), *Financial Stability Review, May 2018*, European Central Bank, https://www.ecb.europa.eu/pub/pdf/fsr/ecb.fsr201805.en.pdf.

ECB (2022), "RESV: Residential Property Valuation," RESV dataset in ECB Statistical Data Warehouse, European Central Bank, https://sdw.ecb.europa.eu/browse.do?node=9698056.

Engle, Robert F., and Clive W. J. Granger (1987), "Co-integration and Error Correction: Representation, Estimation, and Testing," *Econometrica* 55, 251–276.

Englund, Peter (2011), "Swedish House Prices in an International Perspective," in *The Riksbank's Inquiry into the Risks in the Swedish Housing Market*, Sveriges Riksbank, pages 23–66, http://archive.riksbank.se/Upload/Rapporter/2011/RUTH/RUTH_chapter1.pdf.

Englund, Peter (2020), "En ny bostadsbeskattning [A New Taxation of Housing]," research report, SNS, https://snsse.cdn.triggerfish.cloud/uploads/2020/10/en-ny-bostadsbeskattning.pdf.

Erikson, Henrik, and David Vestin (2021), "Pass-Through of Negative Policy Rates," Economic Commentary No. 9, May 28, 2021, Sveriges Riksbank, https://www.riksbank.se/globalassets/media/rapporter/ekonomiska-kommentarer/engelska/2021/pass-through-of-negative-policy-rates.pdf.

ESRB (2020), "Macro-Financial Scenario for the 2020 EU-wide Banking Sector Stress Test," Document submitted to the EBA in January 2020, European Systemic Risk Board, https://www.esrb.europa.eu/mppa/stress/shared/pdf/esrb.stress_test200131~09dbe748d4.en.pdf?d461d78898770edd35129a6eb6c09d5c.

ESRB (2021), "Macro-Financial Scenario for the 2021 EU-wide Banking Sector Stress Test," Document submitted to the EBA in January 2021, European Systemic Risk Board, https://www.esrb.europa.eu/mppa/stress/shared/pdf/esrb.stress_test210120~0879635930.en.pdf.

ESRB (2022a), "ESRB issues new warnings and recommendations on medium-term residential real estate vulnerabilities," press release, February 11, 2022, European Systemic Risk Board, https://www.esrb.europa.eu/news/pr/date/2022/html/esrb.pr220211~9393d5e991.en.html.

ESRB (2022b), "Vulnerabilities in the Residential Real Estate Sectors of the EEA Countries," report, February 2022, European Systemic Risk Board, https://www.esrb.europa.eu/pub/pdf/reports/esrb.report220211_vulnerabilities_eea_countries~27e571112b.en.pdf.

European Commission (2019), "Country Report Sweden 2019, Including an In-Depth Review on the Prevention and Correction of Macroeconomic Imbalances," Commission Staff Working Document SWD(2019) 1026 final, Brussels, February 27, 2019, European Commission, https://ec.europa.eu/info/sites/default/files/file_import/2019-european-semester-country-report-sweden_en.pdf.

European Commission (2020), "Refining the House Price Valuation Methodology: Using Housing Stocks and Nominal House Price," Note for the attention of the Economic Policy Committee LIME Working Group, European Commission, available upon request.

European Commission (2021), "In-Depth Review for Sweden," Commission Staff Working Document SWD(2021) 412 final, Brussels, June 2, 2021, European Commission, https://ec.europa.eu/info/sites/default/files/1_en_autre_document_travail_service_part1_v3_0.pdf.

European Commission (2022), "Macroeconomic Imbalance Procedure (MIP) – Overview," web page,, European Commission, https://ec.europa.eu/eurostat/web/macroeconomic-imbalances-procedure.

European Systemic Risk Board (2022), "Vulnerabilities in the Residential Real Estate Sectors of the EEA Countries," report, February 2022, European Systemic Risk Board, https://www.esrb.europa.eu/pub/pdf/reports/esrb.report220211_vulnerabilities_eea_countries~27e571112b.en.pdf.

FI (2021), "Large Swedish Banks Show Resilience in EU Stress Test," news item, August 2, 2021, Finansinspektionen—Sweden's financial supervisory authority, https://www.fi.se/en/published/news/2021/large-swedish-banks-show-resilience-in-eu-stress-test/.

FI (2022a), *The Swedish Mortgage Market 2022*, Finansinspektionen—Sweden's financial supervisory authority, https://www.fi.se/en/published/reports/swedish-mortgage-reports/the-swedish-mortgage-market-2022/.

FI (2022b), *The Swedish Mortgage Market 2022, Data Appendix*, Finansinspektionen—Sweden's financial supervisory authority, https://www.fi.se/en/published/reports/swedish-mortgage-reports/the-swedish-mortgage-market-2022/.

Flam, Harry (2016), "Har vi en bostadsbubbla? [Do We Have a Housing Bubble?]," *Ekonomisk Debatt* 44(4), 6–15, https://www.nationalekonomi.se/sites/default/files/NEFfiler/44-4-hf.pdf.

Flavin, Marjorie, and Takashi Yamashita (2002), "Owner-Occupied Housing and the Composition of the Household Portfolio," *American Economic Review* 92(1), 345–362, https://www.aeaweb.org/articles?id=10.1257/000282802760015775.

Fox, Ryan, and Peter Tulip (2014), "Is Housing Overvalued?" Research Discussion Paper RDP 2014-06, Reserve Bank of Australia, https://www.rba.gov.au/publications/rdp/2014/pdf/rdp2014-06.pdf.

Frayne, Christine, Agnieszka Szczypińska, Bořek Vašíček, and Stefan Zeugner (2022), "Housing Market Developments in the Euro Area: Focus on Housing Affordability," Discussion Paper 171, September 2017, European Commission, https://economy-finance.ec.europa.eu/publications/housing-market-developments-euro-area-focus-housing-affordability_en.

Garner, Thesia I., and Randal Verbrugge (2009a), "The Puzzling Divergence of Rents and User Costs, 1980–2004: Summary and Extensions," in Diewert, W.E., B.M. Balk, D. Fixler, K.J. Fox, and A.O. Nakamura (eds.), *Price and Productivity Measurement, Volume 1: Housing*, chap. 8, Trafford Press, pages 125–146, http://www.indexmeasures.ca/V1_FCh8_2009_03_04_Garner_Verbrugge.pdf.

Garner, Thesia I., and Randal Verbrugge (2009b), "Reconciling User Costs and Rental Equivalence: Evidence from the US Consumer Expenditure Survey," *Journal of Housing Economics* 18(3), 172–192, special Issue on Owner Occupied Housing in National Accounts and Inflation Measures, https://doi.org/10.1016/j.jhe.2009.07.001.

Guðnason, Rósmundur, and Guðrún R. Jónsdóttir (2009), "Owner Occupied Housing in the Icelandic CPI," in Diewert, W.E., B.M. Balk, D. Fixler, K.J. Fox, and A.O. Nakamura (eds.), *Price and Productivity Measurement, Volume 1: Housing*, chap. 9, Trafford Press and http://www.indexmeasures.ca, pages 147–150, http://www.indexmeasures.ca/V1_FCh9_2009_03_04_Guonason_Jonsdottir.pdf.

Haffner, Marietta, and Kristof Heylen (2011), "User Costs and Housing Expenses. Towards a more Comprehensive Approach to Affordability," *Housing Studies* 26(04), 593–614, https://doi.org/10.1080/02673037.2011.559754.

Hansson, Bengt (2019), "Kostnaden för att bo [The Cost of Living in Owner-Occupied Housing]," Report 2019:14, Boverket—The Swedish National Board of Housing, https://www.boverket.se/sv/om-boverket/publicerat-av-boverket/publikationer/2019/kostnaden-for-att-bo/.

Harding, John P., Stuart S. Rosenthal, and C.F. Sirmans (2007), "Depreciation of Housing Capital, Maintenance, and House Price Inflation: Estimates from a Repeat Sales Model," *Journal of Urban Economics* 61(2), 193–217, https://doi.org/10.1016/j.jue.2006.07.007.

Himmelberg, Charles, Christopher Mayer, and Todd Sinai (2005), "Assessing High House Prices: Bubbles, Fundamentals and Misperceptions," *The Journal of Economic Perspectives* 19(4), 67–92, https://www.jstor.org/stable/4134955.

Hjalmarsson, Erik, and Pär Österholm (2017), "Households' Mortgage-Rate Expectations—More Realistic than At First Glance," *Sveriges Riksbank Economic Review* (2), 57–64, http://archive.riksbank.se/Documents/Rapporter/POV/2017/rap_pov_artikel_3_171116_eng.pdf.

IMF (2019), "Sweden: Staff Report for the 2019 Article IV Consultation," Staff Report, International Monetary Fund, https://www.imf.org/en/Publications/CR/Issues/2019/03/26/Sweden-2019-Article-IV-Consultation-Press-Release-Staff-Report-and-Statement-by-the-46709.

IMF (2021), “Sweden: Staff Report for the 2021 Article IV Consultation,” Staff Report, International Monetary Fund, https://www.imf.org/en/Publications/CR/Issues/2021/03/24/Sweden-2021-Article-IV-Consultation-Press-Release-and-Staff-Report-50303.

Kantar Sifo (2022), “Inflation Expectations,” Prospera inflation expectations, Kantar Sifo, https://www.kantarsifo.se/erbjudande/prospera/inflation-expectations.

Katz, Arnold J., and Shelby W. Herman (1997), “Improved Estimates of Fixed Reproducible Tangible Wealth, 1929–95,” *Survey of Current Business* (69-92), https://apps.bea.gov/scb/pdf/national/niparel/1997/0597niw.pdf.

Kelly, Jemima (2019), “Alphaville Spent 36 Hours on the Island of Sark. Here’s How It Went.” Alphaville article, January 30, 2019, Financial Times, https://ftalphaville.ft.com/2019/01/30/1548828002000/Alphaville-spent-36-hours-on-the-island-of-Sark--Here-s-how-it-went-/.

Lind, Hans (2021), “Comment on M. A. Bergman and S. Nyberg: Housing Prices, Construction Costs and Competition in the Construction Sector – A Swedish Perspective,” *Nordic Economic Policy Review 2021,* , 115–119https://pub.norden.org/nord2021-022/nord2021-022.pdf.

Liu, Haoyang, David Lucca, Dean Parker, and Gabriela Rays-Wahba (2021), “The Housing Boom and the Decline in Mortgage Rates,” Liberty Street Economics blog post, September 7, 2021, Federal Reserve Bank of New York, https://libertystreeteconomics.newyorkfed.org/2021/09/the-housing-boom-and-the-decline-in-mortgage-rates/.

Muellbauer, John (2012), “When Is a Housing Market Overheated Enough to Threaten Stability,” in Heath, Alexandra, Franck Packer, and Callan Windsor (eds.), *Property Markets and Financial Stability*, Reserve Bank of Australia, pages 73–105, https://www.rba.gov.au/publications/confs/2012/pdf/conf-vol-2012.pdf.

Muellbauer, John, and Anthony Murphy (1997), “Booms and Busts in the UK Housing Market,” *The Economic Journal* 107(445), 1701–1727, https://doi.org/10.1111/j.1468-0297.1997.tb00076.x.

Mulheirn, Ian (2019), “Tackling the UK Housing Crisis: Is Supply the Answer?” report, UK Collaborative Centre for Housing Evidence, https://housingevidence.ac.uk/publications/tackling-the-uk-housing-crisis-is-supply-the-answer/.

NIER (2022a), “Household Disposable Income. Year.” table in Forecast Database, National Institute of Economic Research, http://prognos.konj.se/PxWeb/pxweb/en/SenastePrognosen/SenastePrognosen__f12_hushallensdisponiblainkomster/F1201.px/.

NIER (2022b), “Households, Interest Rates, and Inflation,” table in Statistical Database, National Institute of Economic Research, http://statistik.konj.se/PXWeb/pxweb/en/KonjBar/KonjBar__hushall/HushallInfRant.px/?rxid=80d4d93b-beb1-403f-a3e6-cb56e629f881.

NIER (2022c), “Total Industry, Quarterly Series, Expected Inflation within the Next 12 Months,” table in Statistical Database, National Institute of Economic Research, https://statistik.konj.se/PxWeb/pxweb/sv/KonjBar/KonjBar__ftgkvartal/Bartotq.px/.

OECD (2017), *OECD Economic Outlook, June 2017*, OECD, https://www-oecd-ilibrary-org.ez.hhs.se/economics/oecd-economic-outlook-volume-2017-issue-1_eco_outlook-v2017-1-en.

OECD (2021a), “HC1.5. Overview of Affordable Housing Indicators,” memo, OECD, https://www.oecd.org/els/family/HC1-2-Housing-costs-over-income.pdf.

OECD (2021b), *OECD Economic Surveys: Sweden*, OECD, https://read.oecd-ilibrary.org/economics/oecd-economic-surveys-sweden-2021_f61d0a54-en#page1.

OECD (2022a), "HC1.2. Housing Costs Over Income," memo, OECD, https://www.oecd.org/els/family/HC1-2-Housing-costs-over-income.pdf.

OECD (2022b), "Housing Conditions," web page, OECD, https://www.oecd.org/housing/data/affordable-housing-database/housing-conditions.htm.

OECD (2022c), "OECD Affordable Housing Database," webpage, OECD, https://www.oecd.org/housing/data/affordable-housing-database/.

Office of Policy Development and Research (2000), "The User Cost of Homeownership," *U.S. Housing Market Conditions* (August 2000), U.S. Department of Housing and Urban Development, https://www.huduser.gov/periodicals/ushmc/summer2000/summary-2.html.

Österholm, Pär (2017), "Är hushållens ränteförväntningar rörande bolåneräntan realistiska? [Are Households' Expectations Concerning Mortgage Rates Realistic?]," *Ekonomisk Debatt* 45(5), 22–32, https://www.nationalekonomi.se/sites/default/files/NEFfiler/45-5-p%C3%B6.pdf.

Philiponnet, Nicolas, and Alessandro Turrini (2017), "Assessing House Price Developments in the EU," Discussion Paper 048, May 2017, European Commission, https://ec.europa.eu/info/sites/info/files/dp048_en.pdf.

Poterba, James M. (1984), "Tax Subsidies to Owner-Occupied Housing: An Asset Market Approach," *Quarterly Journal of Economics* 99, 229–252.

Poterba, James M., and Todd Sinai (2008), "Tax Expenditures for Owner-Occupied Housing: Deductions for Property Taxes and Mortgage Interest and the Exclusion of Imputed Rental Income," *The American Economic Review* 98(2), 84–89.

Prescott, Edward C. (1997), "On Defining Real Consumption," *Federal Reserve Bank of St. Louis Review* (May/June), 47–54, https://doi.org/10.20955/r.79.47-54.

Rajbhandari, Ashish (2016), "Cointegration or spurious regression?" blog post, September 6, 2016, Stata, https://blog.stata.com/2016/09/06/cointegration-or-spurious-regression/.

Rohatgi, Ankit (2021), "Webplotdigitizer: Version 4.5," https://automeris.io/WebPlotDigitizer.

Sandelin, Bo, and Bo Södersten (1978), *Betalt för att bo. Värdestegring och kapitalvinster på bostadsmarknaden [Paid to Live. Appreciation and Capital Gains in the Housing Market]*, Raben & Sjögren, Stockholm.

SBAB (2022), "Historiska boräntor [Historical Mortgage Rates]," website, SBAB Bank, https://www.sbab.se/1/privat/vara_rantor.html#/rantor.

Sinai, Todd, and Nicholas S. Souleles (2005), "Owner-Occupied Housing as a Hedge Against Rent Risk*," *The Quarterly Journal of Economics* 120(2), 763–789, https://academic.oup.com/qje/article/120/2/763/1933972.

Sørensen, Peter Birch (2013), "The Swedish Housing Market: Trends and Risks," Report to the Fiscal Policy Council 2013/5, Finanspolitiska rådet—The Fiscal Policy Council, http://www.finanspolitiskaradet.se/download/18.11165b2c13cf48416debd71/1420730439471/Underlagsrapport%202013-5%20S%C3%B6rensen.pdf.

Statistics Sweden (2014), "Average Housing Expenditures as a Percentage of Disposable Income Per Household by Region, Tenure, and Household Type. Year 2004–2013," table in Statistical Database, Statistics Sweden, https://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__HE__HE0103__HE0103E/Boendeutgift/.

Statistics Sweden (2019), "Population by Region, Marital Status, Age and Sex. Year 1968 - 2018," table in Statistical Database, Statistics Sweden, http://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__BE__BE0101__BE0101A/BefolkningNy/?rxid=e456341f-5163-47b7-aa52-bad20d4b6146.

Statistics Sweden (2022a), "Balance Sheets (ESA2010)," table in Statistical Database, Statistics Sweden, https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__NR__NR0103__NR0103K/SektorENS2010ArBR/.

Statistics Sweden (2022b), "Consumer Price Index (CPI) by Product Group, 1980=100. Month 1980M01–," table in Statistical Database, Statistics Sweden, https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__PR__PR0101__PR0101A/KPI19Bas1980/.

Statistics Sweden (2022c), "Consumer Price Index (CPI), Total 1980=100. Month 1980M01–," table in Statistical Database, Statistics Sweden, https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__PR__PR0101__PR0101A/KPItotM/.

Statistics Sweden (2022d), "Housing Expenditures as a Percentage of Disposable Income, Disposable Income and Residual Income per Household by Region, Tenure and Type of Household. Year 2015–2021," table in Statistical Database, Statistics Sweden, https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__HE__HE0202/HE0202T05/.

Statistics Sweden (2022e), "Institutional Non-Financial Sector Accounts (ESA2010), Current Prices, SEK mn. Quarter 1980K1–," table in Statistical Database, Statistics Sweden, https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__NR__NR0103__NR0103C/SektorENS2010Kv/.

Statistics Sweden (2022f), "Lending Rates to Households for Housing Loans, Breakdown by Fixation Periods. Month 2005M09–," table in Statistical Database, Statistics Sweden, https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__FM__FM5001__FM5001C/RantaT04N/.

Statistics Sweden (2022g), "Operation, Maintenance, and Repair Costs of One- and Two-Dwelling Houses, Year 1993–2020," data available upon request, Statistics Sweden.

Statistics Sweden (2022h), "Real Estate Price Index for One- and Two-Dwelling Buildings for Permanent Living by Region. Quarter 1986K1–," table in Statistical Database, Statistics Sweden, https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__BO__BO0501__BO0501A/FastpiPSRegKv/.

Statistics Sweden (2022i), "Rents in Newly Constructed Buildings (Rented Dwellings) by Region, Investor and Dwelling Type. Year 2014–2020," table in Statistical Database, Statistics Sweden, https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__BO__BO0404__BO0404A/HyresrattBygghLgh/.

Statistics Sweden (2022j), "Rents in Newly Constructed Buildings. Year 1997–2013," table in Statistical Database, Statistics Sweden, https://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__BO__BO0404__BO0404C/BoHyraNyprod1/.

Statistics Sweden (2022k), "Savings Barometer," web page, Statistics Sweden, https://www.scb.se/en/finding-statistics/statistics-by-subject-area/financial-markets/financial-accounts/savings-barometer/.

Svensson, Lars E.O. (2019), "Housing Prices, Household Debt, and Macroeconomic Risk: Problems of Macroeconomic Policy I," working paper, Stockholm School of Economics, https://larseosvensson.se/2018/12/16/housing-prices-household-debt-and-macroeconomic-risk-problems-of-macroprudential-policy-i/.

Svensson, Lars E.O. (2020), "Macroprudential Policy and Household Debt: What is Wrong with Swedish Macroprudential Policy?" *Nordic Economic Policy Review* 2020, 111–167, https://larseosvensson.se/2019/12/05/macroprudential-policy-and-household-debt-what-is-wrong-with-swedish-macroprudential-policy/.

Svensson, Lars E.O. (2021a), "Amorteringskraven snedvrider och utestänger, även i Stockholms län [The Amortization Requirements Distort and Exclude, Also in Stockholm County]," Ekonomistas blog post, September 28, 2021, https://ekonomistas.se/2021/09/28/amorteringskraven-snedvrider-och-utestanger-uppdatering-stockholms-lan/.

Svensson, Lars E.O. (2021b), "Amorteringskraven snedvrider och utestänger: Uppdatering [The Amortization Requirements Distort and Exclude: Update for Stockholm Municipality]," Ekonomistas blog post, April 13, 2021, https://ekonomistas.se/2021/04/13/amorteringskraven-snedvrider-och-utestanger-uppdatering/.

Svensson, Lars E.O. (2022a), "A Note on Housing Depreciation," note, Stockholm School of Economics, https://larseosvensson.se/files/papers/a-note-on-housing-depreciation.pdf.

Svensson, Lars E.O. (2022b), "A Simple Frictionless Model of User Cost and User-Cost-to-Income and User-Cost-to-Rent Ratios," note, Stockholm School of Economics, https://larseosvensson.se/files/papers/simple-frictionless-model-user-cost.pdf.

Sveriges Riksbank (2021), "Rapidly Rising Housing Prices despite the Corona Virus," *Monetary Policy Report April 2021* Box 2, 67–77, https://www.riksbank.se/globalassets/media/rapporter/ppr/fordjupningar/engelska/2021/rapidly-rising-housing-prices-despite-the-coronavirus-crisis-article-in-monetary-policy-report-april-2021.pdf.

Sveriges Riksbank (2022), "Monetary Policy Report April 2022: Numerical Data," excel workbook, Sveriges Riksbank, https://www.riksbank.se/en-gb/monetary-policy/monetary-policy-report/2022/monetary-policy-report-april-2022/.

Thiemann, Andreas, Klaus Grünberger, and Bianey Palma Fernández (2022a), "Housing Taxation Database 1995–2020, v. 3.1," dataset, European Commission, Joint Research Centre (JRC), https://data.jrc.ec.europa.eu/dataset/bc3be2bf-ecc3-429d-bf62-c56fde3cf071.

Thiemann, Andreas, Klaus Grünberger, and Bianey Palma Fernández (2022b), "Note on the Revision of the User Cost of Housing Indicator," note, European Commission, Joint Research Centre (JRC), https://joint-research-centre.ec.europa.eu/system/files/2022-05/Note_UCOH_May_2022.pdf.

Turk, Rima A. (2015), "Housing Price and Household Debt Interactions in Sweden," IMF Working Paper WP/15/276, International Monetary Fund, https://www.imf.org/en/Publications/WP/Issues/2016/12/31/Housing-Price-and-Household-Debt-Interactions-in-Sweden-43494.

Valueguard (2022), "Valueguard-KTH Housing Index (HOX)," website, Valueguard, https://www.valueguard.se/beskrivning.

Verbrugge, Randal (2008), "The Puzzling Divergence of Rents and User Costs, 1980–2004," *Review of Income and Wealth* 54(4), 671–699, https://doi.org/10.1111/j.1475-4991.2008.00295.x.