Preliminary and incomplete. Comments are welcome.

A Note on Housing Depreciation*

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1 Introduction

Calculations and estimates of the user cost of owner-occupied housing requires estimates of or assumptions about the rate of depreciation of owner-occupied housing (OOH). Harding et al. (2007, table 4) have used a repeat-sales model to estimate the annual depreciation rate net of maintenance of OOH in the US to about 2%. Several calculations of the user cost of housing seem to assume a similar (net) depreciation rate.[1]

However, as emphasized in the discussion of the user cost of housing by Diewert (2013, appendix), the price of a dwelling consists of both a structures component and a land component. Furthermore, the structure may depreciate through aging and wear and tear, whereas the land is considered not to depreciate. The rate of depreciation relative to the price of OOH will thus depend on the relative shares of structures and land in the price.

2 Depreciation of Swedish owner-occupied housing

What about the calculation of depreciation and depreciation rates for Swedish OOH? To calculate the depreciation during a given year, Statistics Sweden considers the depreciation to be the sum of two parts. For the first part, Statistics Sweden applies an annual depreciation rate of 1.21% of the value of the structures component of the housing value at the beginning

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[1] For example, Himmelberg et al. (2005), Poterba and Sinai (2008), and Barrios et al. (2019) assume that the sum of any maintenance rate and the depreciation rate is 2.5%.

of the year. This follows the method of the US Bureau of Economic Analysis (BEA) described in Katz and Herman (1997) and assumes a "declining balance rate" of 0.91 and a service life of 75 years ($0.91/75 = 1.21\%$). For the second part, it considers 20% of renovation costs as additional depreciation. This motivated by the fact that renovations often occur many years before the end of a structure's service life. Adding the second part to the first then results in an annual geometric depreciation rate of about 1.5% of the value of structures at the beginning of the year.

Figure 2.1: Linear and geometric depreciation.

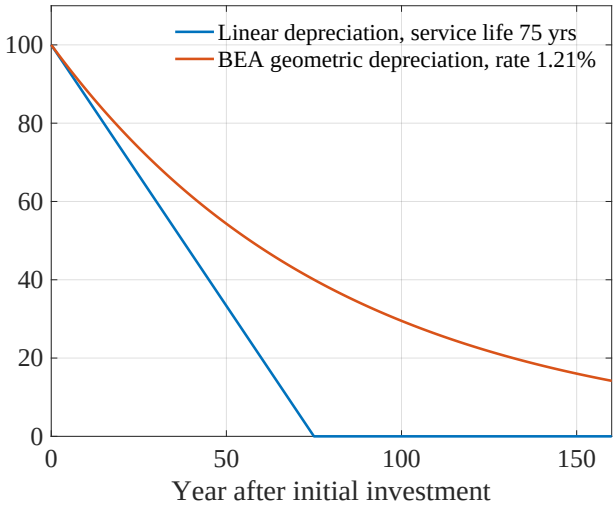
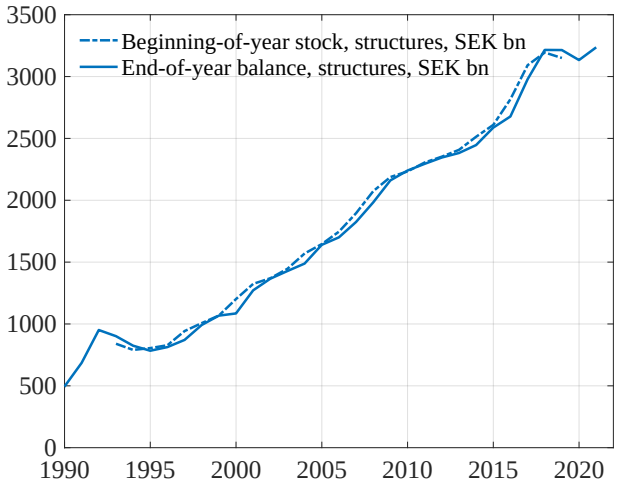


Figure 2.2: One-to-two-family houses and secondary homes, "small houses."



Source and note: Figure 2.1: See Katz and Herman (1997) for other cases. Figure 2.2: Statistics Sweden (2021a) for beginning-of-year physical stocks of industrial classification L68A, one-and-two family houses and secondary homes (plotted on January 1 of each year) and Statistics Sweden (2022) for households' end-of-year balance, asset type AN1112 and 1113 (plotted on December 31 each year.

Figure 2.1 contrasts geometric depreciation and linear depreciation, more precisely linear depreciation with a service life of 75 years and geometric depreciation of with an annual depreciation rate of 1.21%. With such a linear depreciation, an initial investment of 100 depreciates by $100/75 = 4/3$ each year. With the geometric depreciation, the depreciation each year is 1.21% of the remaining value of the investment at the beginning each year. This implies that 75 years after an initial investment of 100, the investments remaining value of is given by $100 \cdot (1 - 0.0121)^{75} = 40$, whereas the remaining value under linear depreciation is zero (see Katz and Herman, 1997, for further discussion).

Statistics Sweden more precisely calculates the first part of each year's deprecation, the geometric one, as 1.21% of its series of the beginning-of-year stock of structures of one-and-two-family houses and secondary homes (Statistics Sweden, 2021a). This series is shown as the dashed-dotted blue line in figure 2.2. For convenience, I will use the term "small houses"

for "one-and-two-family houses and secondary home." [2]

Statistics Sweden also reports end-of-year balance sheets of households in a separate series, (Statistics Sweden, 2022). This series has the advantage that it reports both the value of the structures and the value of the land of small houses. The end-of-year values of the structures of small houses are shown as the solid blue line in figure 2.2. The two series in the figure are not identical, but they are sufficiently similar for the purpose here. The similarity implies that we can use the end-of-year balance series to construct depreciation rates relative to the total value of small houses, that is, the value of the combined structures and land components.

Figure 2.3: Small houses, structures and land values, depreciation, and depreciation rates.

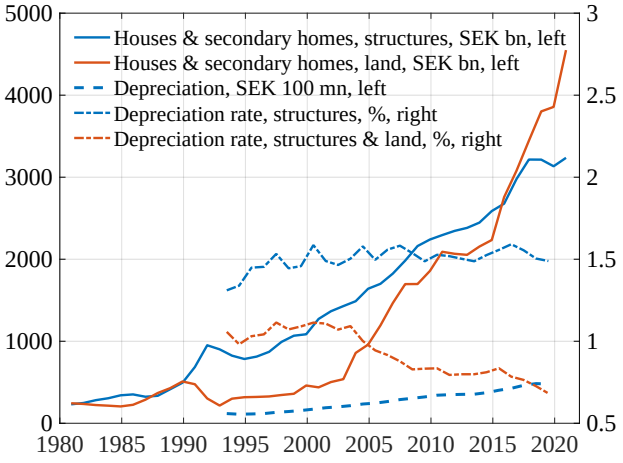
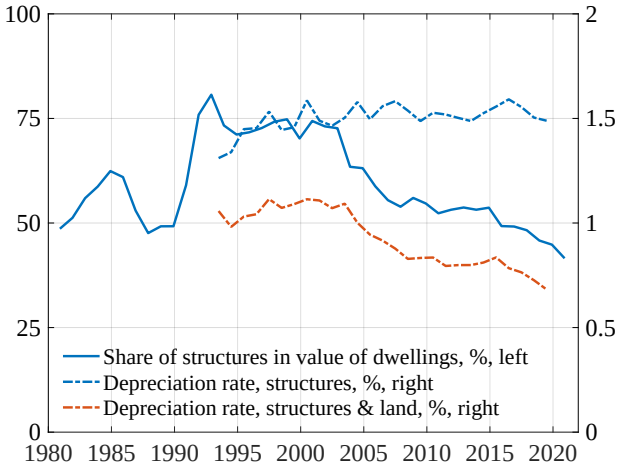


Figure 2.4: Depreciation rates and share of structures in the value of small houses



Source and note: "Small houses" refer to one-and-two-family houses and secondary homes. Statistics Sweden (2022) for end-of-year values of the structures (asset type AN1112 and 1113) and land (AN2111A2 and A3) of small houses. They are plotted at December 1 each year. Depreciation of structures during a year from Statistics Sweden (2021b) (industry classification L68A and transaction item P51c, consumption of fixed capital). Depreciation rates are percentages of values at the end of last year. Depreciation and depreciation rates are plotted mid year.

The total depreciation of small houses—the sum of the two parts— is reported in Statistics Sweden (2021b). It is shown as the dashed blue line in figure 2.3. The solid blue line shows the value of the structures of small houses at the end of the year, the end-of-year balances in figure 2.2 (Statistics Sweden, 2022). The dashed-dotted blue line shows the resulting depreciation rate as a percentage of the value of the structures at the end of last year/beginning of the year, about 1.5%, the rate mentioned above.

The solid red line shows the value of the land that the structures sit on. We see that from 2004 the value of the land has increased more rapidly than the value of the structures. From 2015, the value of the land exceed the value of the structures.

[2] This is a direct translation of the convenient Swedish term for this category.

The dashed-dotted red line shows the depreciation rate as a percentage of the total value of the dwellings—the sum of the values of the structures and land components—at the beginning of each year. The depreciation rate is relatively stable at around 1.1% through 2003 but then falls to about 0.7% in 2019.

Figure 2.4 shows the two depreciation rates as well as the share of structures in the value of small houses. The share of structures in the value of dwellings falls from about 75% during 1994–2003 to about 42% in 2020, causing a parallel fall in the depreciation rate.

3 Conclusions

For Sweden, the resulting depreciation rate of owner-occupied housing is substantially lower than the estimate of Harding et al. (2007, table 4). It also falls substantially over time—from about 1.1% in1990–2003 to about 0.7% in 2019—due to the rise in land values and the reduced share of structures in the value of owner-occupied housing.

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