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THE EFFECT OF MORTGAGE INTEREST RELIEF ON HOUSING PRICES

or Bubble-inducing Subsidising

Sofia Fölster (22111) and Carl Larsson (22219)

Abstract: This thesis aims to analyse whether, and by how much, mortgage interest relief is capitalized in higher housing prices. Using fixed-effects regression with cost of housing on house prices during a 20-year period in Sweden, we estimate the housing price sensitivity to cost increases. We find a statically significant negative coefficient estimate of -3.502, indicating that removal the Swedish mortgage interest relief might induce a housing price fall of 3.55% in average.

Keywords: Housing Economics, Mortgage Interest Deduction, Government Subsidies

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Discussants: Christoffer Friedl
Johanna Lundgren Gestlöf
Examiner: Johanna Wallenius

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INTRODUCTION

The Swedish mortgage interest relief has been a much debated subject the last couple of years both nationally and on EU level. Advocates argue that it is crucial for low-income households to be able to become homeowners. On the other hand institutions like the European Commission, IMF and ECOFIN are critical, emphasizing a possible the inflationary effect on housing prices and banks mortgage interest rates. The critique has already caused EU countries like Finland, Netherland and Belgium to reduce their mortgage interest relief. (Vacher, Honjo, Jaumotte etc., 2011).

A similar reform in Sweden is proposed occasionally by expert and journalists, citing its harmful effects on increasing house prices and exposing consumers to insurmountable debt levels (Hamilton, 2011; Issal, 2011; Åkesson 2014). While experts and their critics argue over the level of risk contra the societal gain of encouraging home ownership, few studies target this issue specifically. In our thesis we analyse how the Swedish mortgage interest relief actually affects housing prices, and estimate the price level of housing without the subsidy.

The issue is not only interesting due to the media coverage, but also due to the massive scope of the subsidy. Sources claim a grand sum of 25-30 billion SEK yearly in Sweden alone (Hamilton, 2011; Åkesson 2014). Comparing to a yearly total government turnover of circa 800 billion this subsidy is huge and plays an important role for future reform. For policy makers it could be considered a reserve to be spent more wisely.

As if yearly costs to the state isn't enough, the market for financing housing in Sweden amount to 3 000 billion SEK in total debt. Therefore any changes can result in major implications for the welfare of its citizens. Looking at the sub-prime crisis on the US market, which burst 2008, it caused major ripples we still struggle with today, worldwide.

In this thesis, we aim to estimate the effect on housing prices if the Swedish mortgage interest relief were to be removed. Following a thorough investigation of previous research and theory, we establish a model linking housing prices to cost of housing. Estimating the effect cost has on price, we may then estimate the price change given a change in cost of housing equal to that of the mortgage interest relief, holding all else equal.

MORTGAGE INTEREST RELIEF IN SWEDEN

Mortgage Interest Relief, Mortgage Interest Deduction or *Skattereduktion för kapitalförlust*, has long since been an integral part of the Swedish tax system. It takes the form of a tax return on capital losses, which, for most consumers, mean a subsidy of interest costs. It was introduced in order to create symmetry such that taxes on capital gains are matched by tax reductions on capital costs and losses. This is commonly referred to as a symmetrical tax system, and is commonplace worldwide.

Swedish tax distinguishes income in several brackets: taxes on income and profits (*inkomst av tjänst*), taxes on goods and services (*inkomst av näringsverksamhet*), and taxes on property (*inkomst av kapital*). Each of these brackets face different tax levels, and are not fully transferable from one to another, nor within each other. One may not fully deduct gains on sale of shares or stocks against losses on interest and vice versa. One may neither fully deduct losses on capital as a whole against taxes payable on income and profits. Instead, potential gains or losses within said bracket are prone to a quota, where only a certain percentage may be deducted.

The exact amount available for relief has however been changed on numerous occasions over the past decades. Until 1982, during what in Sweden has been dubbed *the Wonderful Night*, capital losses – such as interest on house mortgages – was fully deductible towards income and profits. [1] That is, if one had sufficiently high taxes payable one year, the entire cost of interest on mortgage would be zero – or in other terms, the state fully subsidized interest payments on house mortgages.

Following a settlement between several leading political parties, a new, simplified tax system was sought after. It should be mentioned that marginal tax could surpass 100%, meaning each SEK earned at the margin, could entail more than one SEK in taxes, but due to an intricate web of tax deductions, effective tax rate was in reality far less.

In 1983 the amount of relief available from capital losses was reduced to a maximum 50%. This was subsequently further lowered, to the amounts still in use today, where in 30% of capital losses up to 100 000SEK may be deducted, and 21% of the amount surpassing 100 000SEK. These deductions apply to the net amount of capital losses, and do not distinguish mortgage interest costs from losses on shares or stock. However, within the capital

[1] *Den underbara natten*, as famously quoted by Rolf Wirtén, then minister of finance.

brackets, these are further divided into sub-brackets. The level of deduction available is 70% of total loss. That is, if a person has a capital gain of 100 000SEK from selling of a house, and a mortgage interest cost of 50 000SEK, then taxable capital gain equals 100 000SEK - 70% of 50 000 = 65 000, which at a 30% capital gains tax results in 19 500 taxes payable. In this example, due to the deductibility of the mortgage interest cost, capital gains tax payable is thusly reduced from 30 000 by more than a third.

The implication of this is that mortgage interest relief is even higher for individuals who have income in these other brackets, compared to the majority of taxpayers whose income to an overwhelming amount stems from income and profits. Additionally, due to Swedish tax laws imposing restrictions on carry-back and -forward of capital profits and losses, realized capital gain may be in abnormal excess. Suppose a property has increased in value with 100 000SEK per year over a 10 year period, with a yearly interest cost of 50 000SEK. Being unable to accrue costs, when the property is sold year 10, taxable capital gain would be 965 000SEK[2]. However, allowing for a carry-back of capital gains, yearly capital gains tax payable would be equal to the first example, totalling 650 000SEK over 10 years, substantially lower than 965 000SEK.

This issue further adds restrictions to what in theory is simplified to a perfect capital markets or the absence of tax altogether, but in real life adds severe financial and economical implications for consumers.

Internationally, solving for these issues and concurrently maintaining a symmetrical tax system with the removal of deductions on mortgage interest cost, the solution has been exempting the corresponding capital gains from taxes. That is a capital gain on real estate may under certain circumstances, such as gains on primary residence or otherwise distinguished from real estate owned as investments, be fully tax-exempt. This offsets the increased interest costs, by reduced taxes, while preventing a tax penalty for debt holders (Hendershott and Pryce, 2006). However additional exemptions may create loopholes and other abusive behaviour among consumers or investors, aiming to reduce their taxes payable by any means necessary.

[2] 1 000 000 - 70% of 50 000 = 965 000SEK

PREVIOUS RESEARCH

GENERAL CHARACTERISTICS OF THE HOUSING MARKET

The market for housing in general, and home ownership in particular, differs considerably from other goods in terms of heterogeneity, durability, transaction costs, delays, immobility, and the dichotomy of housing being both a consumption and investment good (Smith, Rosen, and Fallis, 1988).

Heterogeneity, while also applicable to numerous other goods, is even more so for housing. Houses and homes vary in shapes, sizes, locations, and numerous other features. While the main aspect – serving as a place to rest, recuperate, and store one's belongings – may be the same across the entire market, these other features, or the perception of them, greatly alter the price. The same is true for housing being – in general – immobile. Its consumption is restricted to a geographically designated area and force consumers to consume additional units (homes in multiple cities, summer homes etcetera) or none at all (borrowing or renting someone else's supply).

Durability characterizes the housing market in the sense that a house, given no extraordinary circumstances, will last indefinitely or at least beyond the lifetime of its residents.

Transaction costs, and delays such as that is long production and lead times give further rise to frictions on both supply and demand for housing. Investments made one year could take several years to be realized. This adds to consumers and lenders risk behaviour, as they may be forced to sign long-term mortgage payment plants while not being certain of their future financial well-being.

Lastly housing, being both used for investments and consumption, will additionally affect not only consumers but also policy makers and governments in terms of nominal, but not necessarily real, profits and alternative costs.

In dealing with these issues, when it comes to applying the standardized neoclassical framework for supply and demand several simplifications are necessary. The housing production is commonly simplified into a general homogenous consumption unit towards which consumers are indifferent (Olsen, 1969). This unit, or rather the benefit of a theoretical housing service, is produced merely by owning or renting certain properties (houses, apartments etcetera). More units consumed equal higher utility and a larger home simply translates into more units of housing.

Past research also reveal characteristics of real estate buyers. A typical buyer will purchase larger or more expensive homes if his or her income increases (Ling and McGill, 1998). Additionally they tend to increase their borrowing, regardless of net wealth, when purchasing larger homes.

Mortgage Interest Relief

Mortgage interest relief and other subsidy programs addressing the issue of low homeownership have long been a source of debate. While the main discussion concerns externalities of increased homeownership, such as to encourage investments or induce a stakeholder role (Woodward and Weicher, 1989; Glaeser and Shapiro, 2003), a few have also touched the nominal effects on the market for housing (Jappelli and Pistaferri, 2006; Hanson, 2012a).

In Hanson (2012b), the author examines the effect on mortgage interest rates caused by the federal home mortgage interest deduction (MID), and to what extent the subsidy is captured by the lenders or the borrowers. Hanson utilises the extremes of the MID, where all interest on home mortgage sizes up to 1 000 000USD is fully deductible, and no interest on the exceeding part is deductible to test whether effective mortgage interest is altered by the prevalence of deduction. Using existing data over mortgages in the US, their sizes and offered interest rates, and comparing it to calculated cost of housing, Hanson estimates that interest rates drop by between 3.3 and 4.4% for every 1000USD borrowed above the 1 000 000USD limit. This implies that borrowers facing less deductibility on their mortgage also face lower interest rates to reduce their cost of housing to a market level, a typical example of price discrimination from banks and lenders.

Incidentally, while the study focuses on the effect on interest rates, it gives an implication for the consumers demand function and the banks supply function. That is, facing constraints, consumers susceptibility to price is reduced, which is matched by the banks offering lower interest rates, and conversely, if facing a relative abundance of funds, they are enticed to increase their housing demand. Holding interest rates fixed, the affected variable would be mortgage sizes rather than mortgage interest.

Additionally, Hanson also estimates that lenders capture between 9 and 17% of the subsidy, implying that a considerably large amount of tax revenue is ends up subsidising home mortgage banks.

While Hanson's research and methodology seems ideal for replication and testing the effects of interest relief in Sweden, we lack the vast amount of data required. More importantly, the US MID is shaped differently, in the sense that it initially offers full deductibility, and surpassing a fixed amount offers no deduction, as compared to the Swedish MID that initially offers 30% and subsequently 21%. The difference, or kink, in the regression line, is a full 100% for the US, while only 9% for Sweden. This may not be large enough to pick up the desired effect using Hanson´s method. As we would only capture less than a tenth of the difference, the risk of the estimated effect drowning in measurement error and other noise is much greater. We will therefore focus our efforts on alternatives means of estimating the effect of interest relief.

In another study (Hanson, 2012a), the author measures the effect on housing size of MID. He concludes that allowing for higher levels of deduction will increase the size of housing units purchased, or in other terms, increase the demand on each unit of house square meter.

What is interesting to notice is a crucial difference between the US and Swedish markets. Sweden has been plagued by a very low level of housing production the past years to the point where demand continuously exceed supply, further increasing demand by accrual. Facing an extreme situation where it may be assumed that no additional unit of housing is being produced, any subsidies to incentivise house purchasing or demand, would rather increase price level than increase the average size of bought housing.

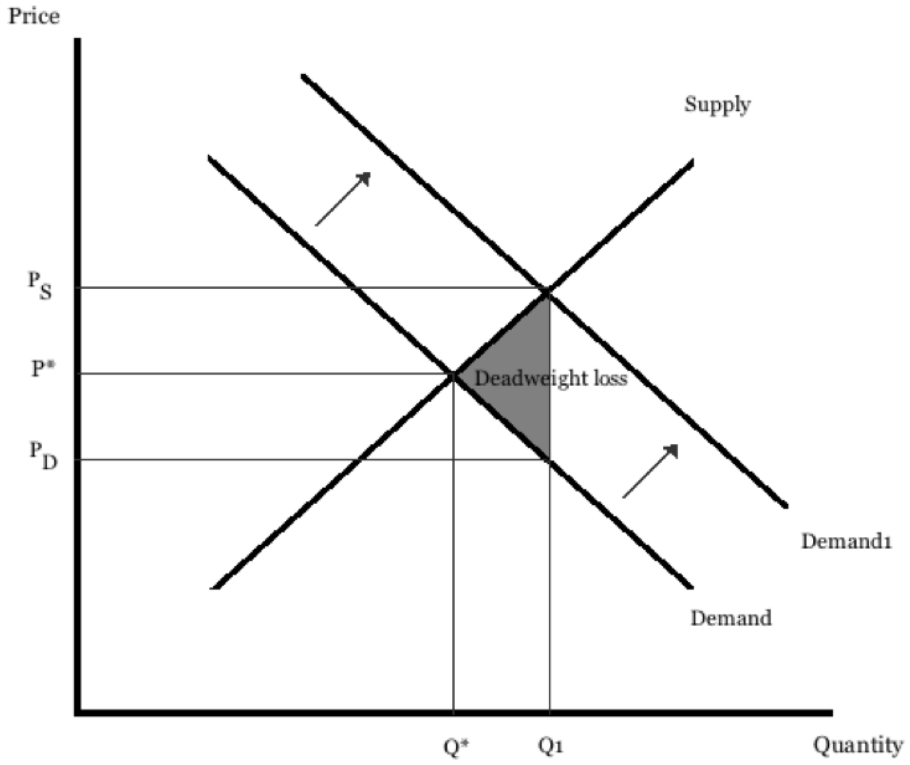
As an opposing view, some argue that the benefits of a subsidy outweigh the social costs of its financial implications (Glaeser and Shapiro, 2003), which justifies that housing prices rise. Others argue that abolishing the mortgage subsidy doesn't necessarily impact the supposed demand that induces a price drop (Jappelli and Pistaferri, 2006), but rather it depends on the economic situation and how a mortgage interest relief interacts with other aspects such as marginal tax rates.

What is clear, however, is the importance of defining any necessary assumptions as markets for housing differ so greatly between cultures and countries. While private home ownership in some cultures has been idolized, such as in the idea of the American Dream, other cultures have long favoured collective ownership where private ownership even could be considered an abuse of entitlement.

THEORY

The application of the mortgage interest relief can be considered a government subsidy. According to the neoclassical thought, a subsidy like the MID would artificially shift the demand curve outwards. When demand goes up banks will raise their interest rates (P_S) to fit the new equilibrium, which leaves them better off. Even so, consumers face an interest cost which is lower (P_D) than the offered mortgage interest rate by the banks due to the subsidy. The fiscal cost of the subsidy is represented by (Ps - PD)*Q1. Most of the cost is a transfer from taxpayers to homeowners and banks. Part of the cost is also a deadweight loss, which is borne by the government and paid for by tax revenue. Assuming a perfect competitive market, government subsidies are split between suppliers and consumers depending on the slopes of the supply and demand curves. The less price sensitive banks for example, stand to gain more from the MID.

GRAPH I: SUPPLY AND DEMAND EFFECT OF GOVERNMENT SUBSIDY



Graph I: The effect for supply and demand following a government subsidy, creating a deadweight loss by shifting the demand curve.

According to basic microeconomic theory the removal of the subsidy should restore supply and demand to its previous equilibrium, inducing lower interests offered by the banks and higher interest costs to the consumer. Assuming a correlation between mortgage demand and housing demand this would cause a price fall in housing as well. As the cost to the government decreases, so does the need for tax revenues, yielding lower taxes or increased government expenditure elsewhere.

In reality the market faces several compounding effects and distortions following government regulations. It might be the case that this particular subsidy we intend to investigate in this thesis works to balance the other factors out. Factors such as transaction costs on real estate (capital gains taxes), capital adequacy requirements for banks and other constraints faced by consumers. If this is the case for the mortgage interest relief its removal could very well have the opposite effect, creating a sub optimally low demand and supply, inducing a situation where even less units of housing are being produced relative to population.

The argument for keeping the subsidy is that the benefits of the subsidy outweigh the cost borne by the government. Measuring the benefit, however, would prove intangible, and a major source of debate regarding taxes in general and mortgage interest relief in particular. However, since any societal gains of increased home ownership induced by mortgage interest relief are outside of this paper's scope, we will not delve further into this matter.

RESEARCH GAP

Due to the limitations of previous research and the distinguishing characteristics of the Swedish housing market relative foreign markets there remains a void to be filled; the specific study of mortgage interest relief and its effect on housing prices in Sweden. Therefore the research question we will pursue in this paper is the following:

Does mortgage interest relief lead to higher housing prices in Sweden?

HYPOTHESIS

A government subsidy aimed at reducing costs for consumers will effectively create an artificially higher demand and supply, resulting in higher housing prices. The removal of any such subsidy would thus restore the supply and demand to its long run equilibrium, resulting in lower housing prices.

Using numbers for the average house in Stockholm in the year of 2011, which sold for 4 639 000SEK, of which a mortgage is 2 495 584SEK at 3.54% interest, yearly maintenance of 43 286SEK and 6 825SEK of taxes, the yearly cost of housing would be roughly 138 455SEK per year without MID and 111 952SEK[3] with it. Assuming this amount and the mortgage interest rate is fixed, relative to income as the propensity to consume a unit of housing, the mortgage would have to be reduced to 1 746 908SEK[4] in order to maintain the same annual cost. According to the classic theory of supply and demand theory this scenario postulates that banks are price indifferent, which is both unlikely and would mean that lenders carry the whole gain of the subsidy for themselves. As Hanson has showed banks are likely to adjust their interest rates to consumers' willingness to pay (Hanson, 2012b). The opposite scenario, using our sample house, where banks capture the entire benefit from the MID would translate into the same demand for mortgages but at a lower interest rate for banks of 2.48%[5], if the deduction were to be removed. Since we don't know the price sensitivity of supply and demand we will assume perfectly competitive markets and that subsidy gains are evenly split between consumers and suppliers. In the same example these assumptions would yield a mortgage of 2 055 187SEK and an interest rate of 3.01%[6].

Further assuming that the propensity to borrow for housing remains fixed, i.e. the consumers debt equity ratio, the willingness to pay for a unit of housing would thus drop to 3 820 353SEK. In a perfectly competitive market consumers' reduced demand would translate into consumers buying smaller and fewer houses, which is in line with previous research (Hanson, 2012a). If we assume that supply of housing is fixed, the average house in

[3] 111 952 = Interest cost (2495584*0.0354) + Maintenance (43286) + Real estate tax (6825) - Interest relief (2495584*0.0354*0.3)
[4] 1 746 908 = Effective interest cost (2495584*0.0354*0.7) / Interest rate (3.54%)
[5] 2.48% = Interest rate (3.54%) *0.7
[6] 2055187 = Effective interest cost (2495584*0.0354*7) / Interest rate (3.54%*0.85)

Stockholm would theoretically face a reduction value of 17,6%[7], in other terms, MID increases house prices by 21.4%[8].

Other factors should be taken into consideration however, such as the government budget effect of lowered subsidy costs. Anticipating future tax cuts, or subsidies on other areas affecting the individual, his or her increased cost of housing may be offset by lower taxes in income or other measures. Also, it might not be correct to assume that the debt equity ratio remains constant since it is dependent on consumers' anticipation of the future housing market, an outlook that should be volatile.

Mortgage interest relief increases housing prices by 21.4%, and its removal would lower housing prices by 17.6%.

[7] 0.1764 = 1 - 3 820 353/4 639 000
[8] 0.2141 = 4 639 000/3 820 353

METHOD

In order to estimate the impact of the mortgage interest relief on housing prices we need to estimate the price elasticity of demand for housing. We will do so using yearly average values for our variables in all Swedish municipalities over a 20-year period. To get an accurate estimate of consumers' price sensitivity we will include not only interest costs but all major yearly costs linked to owning a house. Maintenance costs and real estate tax will also be included since they should affect the decision to buy a house. To find the equilibrium of the price level, supply will be taken into account and a variable for supply inserted in the regression. We will also control for influential factors affecting housing prices, such as income, inflation, debt level and general attributes of living in a particular municipality. When we have found the effect of cost of housing on housing prices we will be able to calculate a predicted value of the average house in each municipality at any given time within our dataset after removal of the mortgage interest relief, holding all else equal. This estimated value would then be compared to our previously discussed theoretically predicted value.

MODEL

In our version of the classic supply and demand model Quantity (Q) refers to the amount of houses for sale on the market. Price (P) is defined as the price level of housing. Both variables will be calculated using yearly municipality averages.

DEMAND FUNCTION

We have defined our simplified demand function as follows, where the subscript i denotes municipalities and t denotes time.

$$Q = D0 + D1\,P_{it} + D2\,Cost\ of\ Housing_{it} + D3\,Income_{it} + D4\,Debt_{it} + e_{it} \quad (1)$$

Under the assumption that house buyers are rational, all future costs from owning a house should affect the consumer's willingness to pay for a house today equally. Therefore our main variable cost of housing measures the joint effect of yearly costs associated with owning a house. Instead of just measuring each component separately, the aggregated measure for cost of housing will tell us how housing prices respond to changes in real yearly costs for consumers. This approach is useful because the mortgage interest relief does not directly affect the interest rate paid to the bank but the real yearly cost after a tax deduction. It should be observed as a fraction of real yearly costs associated with housing rather than on it's own. The function is

further modified by separating interest cost and interest relief even though they collectively constitute the interest payment for an average house owner each month.

$$Cost\ of\ Housing_{it} = Interest\ Cost_t - Interest\ Relief_t + Maintenance_i + Real\ Estate\ Tax_{it} \quad (2)$$

Maintenance fees are direct costs associated with owning a house for the purpose of maintaining the property's value indefinitely, such as repairs. Maintenance also includes costs for general upkeep, such as utilities: water, gas, and electricity etcetera. This is the equivalent to an association fee in a cooperative apartment. Real estate tax is designated as a yearly fee paid by real estate owners to the government.

We will treat cost of housing regardless of cash flow, which is why we disregard amortization from the cost of housing. Amortization can be seen as an investment rather than a cost since it effectively lowers interest costs over time. To simplify our function we will assume a symmetrical relationship between amortization today and the amount of saved interest cost in the future.

Furthermore we will control for a set of variables that might bias our results. Average income should capture the effect of higher willingness to pay for housing due to increase in wages. We will control for increases in housing prices due to generally higher price levels in Sweden by adjusting all data for inflation using *KPI* (consumer price index). Another factor that could bias our results is average debt. A driving factor in cost of housing is the interest cost, which depends on average debt and interest rates. It is intuitive that higher housing prices should correlate with higher debt levels. Even so, this is not the effect we want to capture. We would like to observe the effect of changes in interest cost on housing prices that are not due to higher debt levels. Therefore we will also control for average debt.

SUPPLY FUNCTION

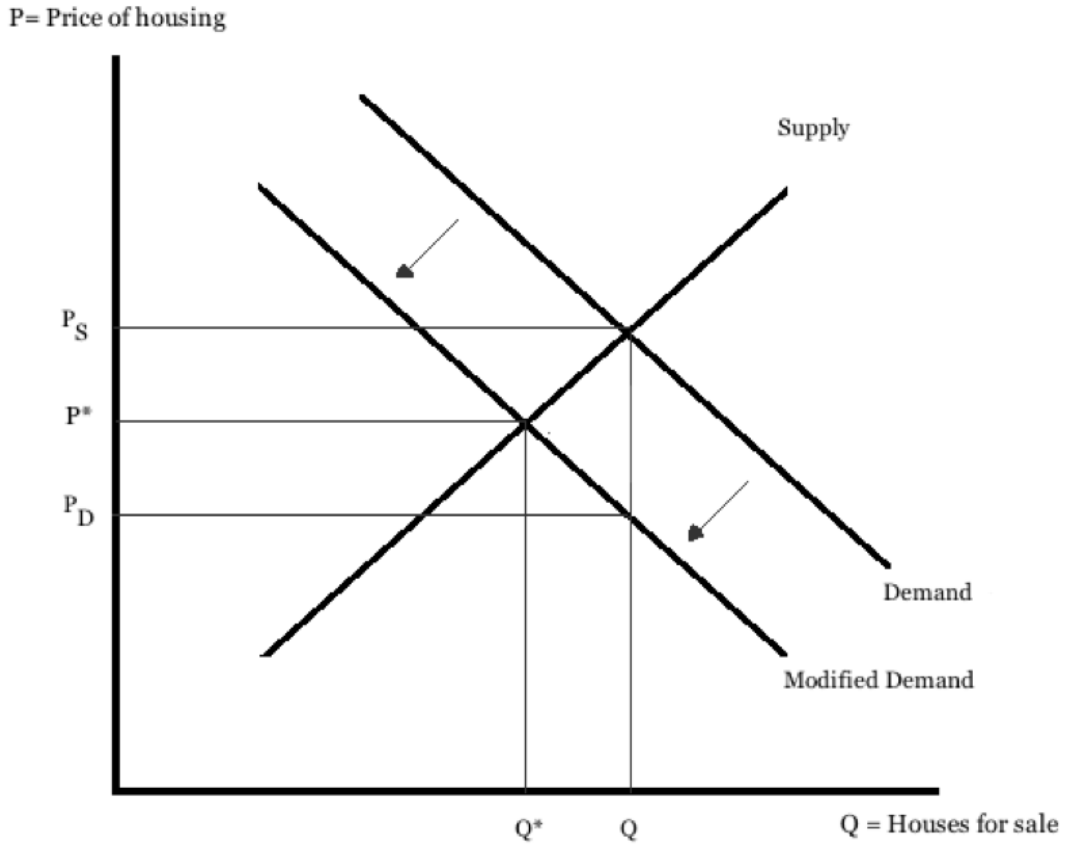
We have defined our simplified supply function as follows, where the subscript i denotes municipalities and t denotes time.

$$Q = \beta 0 + \beta 1\, P_{it} + \beta 2\, Housing\ Density_{it} + u_{it} \quad (3)$$

The ideal measure for supply would be yearly average number of houses for sale in each municipality. Since this data is not available we have chosen housing density as an alternative measure of housing supply. The

variable is defined as the housing stock in a municipality divided by the total municipality population at that point in time. This variable is naturally dependent on factors such as costs of building houses and costs of land. Even so, the supply of houses is heavily regulated which gives the consequence that the amount of houses on the market does not necessarily reflect these costs. Instead local politics can have a greater impact on the amount of houses being built each year. Therefore we have simplified the supply function to only control for the amount of houses per capita regardless of the underlying reasons for variations in supply.

GRAPH II: ASSUMED EFFECTS ON SUPPLY AND DEMAND FOLLOWING MID REMOVAL



Graph II: Effects on supply and demand following the removal of the mortgage interest relief by shifting the demand curve back to equilibrium.

Modified demand function

After we have estimated the supply and demand functions our model allows us to see the effects of a modified demand function where we deduct the effect of the interest relief. In our hypothetical scenario the assumption of a lower cost of housing will shift the demand curve for housing inwards, which results in lower housing prices.

Solving for the intercept

Since our main interest is housing prices the intercept will be solved by equating (1) and (3). This gives us an aggregated function for the price elasticity of housing prices.

$$\begin{aligned} &\beta 0 + \beta 1\, P_{it} + \beta 2\, Housing\ Density_{it} + u_{it} \\ &= D0 + D1\, P_{it} + D2\, Cost\ of\ Housing_{it} + D3\, Income_{it} + D4\, Debt_{it} + e_{it} \end{aligned} \tag{4}$$

rearranging of (4) yields

$$\begin{aligned} P_{it} = \frac{(D0 - \beta 0)}{(\beta 1 - D1)} + \frac{D2}{(\beta 1 - D1)} Cost\ of\ Housing_{it} + \frac{D3}{(\beta 1 - D1)} Income_{it} + \frac{D4}{(\beta 1 - D1)} Debt_{it} \\ - \frac{\beta 2}{(\beta 1 - D1)} Housing\ Density_{it} + \frac{e_{it} - u_{it}}{(\beta 1 - D1)} \end{aligned} \tag{5}$$

which is simplified into

$$P_{it} = X0 + X1\, Cost\ of\ Housing_{it} + X2\, Income_{it} + X3\, Debt_{it} - X4\, Housing\ Density_{it} + z_{it} \tag{6}$$

where

$$X0 = \frac{(D0 - \beta 0)}{(\beta 1 - D1)}$$
$$X1 = \frac{D2}{(\beta 1 - D1)}$$
$$X2 = \frac{D3}{(\beta 1 - D1)}$$
$$X3 = \frac{D4}{(\beta 1 - D1)}$$
$$X4 = \frac{\beta 2}{(\beta 1 - D1)}$$
$$z_{it} = \frac{e_{it} - u_{it}}{(\beta 1 - D1)}$$

Regression

There are several ways to estimate the function (6) for price elasticity of housing prices. We will analyse time series data over 20 years for all Swedish municipalities to get a large variation and be able to observe the effect of changes in cost of housing on housing prices over time.

The commonly used pooled OLS will most likely be inconsistent since a prerequisite is that the time-independent error term (z_i) is uncorrelated with the independent variables. Some municipalities will naturally be more attractive than others, which should increase sales prices and at the same time attract high-income groups who can afford higher interest rates. Possible reasons can be lower crime rate, geographical location or other unknown factors. To disregard these factors would be to bias the results by overstating the effect of the independent variables. Therefore it makes sense to control for the fixed effects between municipalities. The main consequence of controlling for fixed effects is that we are left with less variation in the data, which reduces efficiency and the degrees of freedom. This should not be a problem for us since we are using a large data set with observations of 290 municipalities over a 20-year time period.

There is also the possibility to use a random effects estimator, which is often used as a middle way between OLS and controlling for fixed effects. Even so, the RE-estimator also assumes that the time-independent error term (z_i) does not correlate with any of the independent variables, which would be wrong in our case.

When controlling for fixed effects the most common methods to use are the fixed effects estimator or first differences, which are both unbiased under the same assumptions. Our choice will depend on whether the idiosyncratic error term (z_{it}) or changes in the error term (Δz_{it}) are serially uncorrelated which we will be able to test. Using Wooldridge test for autocorrelation in panel data we found no serial correlation between the idiosyncratic error terms (z_{it}). This means that the fixed effects estimator is more efficient and therefore preferable. The fixed effects estimator compares observations with the within average in each municipality over time. This is how the fixed effects between municipalities are controlled for.

$$P - \bar{P} = X0 + \left(X1\ Cost\ of\ Housing_{it} - \overline{X1\ Cost\ of\ Housing_{it}}\right) + \left(X2\ Income_{it} - \overline{X2\ Income_{it}}\right) + \left(X3\ Debt_{it} - \overline{X3\ Debt_{it}}\right) - \left(X4\ Housing\ Density_{it} - \overline{X4\ Housing\ Density_{it}}\right) + \left(z_{it} - \overline{z_{it}}\right) \quad (7)$$

To use the fixed effects estimator we need to assume strict exogeneity with the idiosyncratic error term. This implies that z_{it} cannot correlate with any of the independent variables for any time period of time.

$$Cov\,(Cost\ of\ Housing_{it},\ Income_{it},\ Housing\ Density_{it},\ Debt_{it},\ z_{it}) = 0 \tag{8}$$

One could argue that since we are using yearly averages in our data the effect of cost of housing could be understated if changes to the cost of housing took place in the end of the year when most house sales already will have happened. On the other hand changes in cost of housing can be assumed to be predictable to consumers in the beginning of each year. Even so, we will test to use a lagged variable for cost of housing to see if there is some truth to the argument.

To avoid a problem with underestimating the variance of the variables we will also assume heteroscedasticity in our errors.

DATA

The compiled database consists of 6350 observations. As previously stated we will use yearly averages for each of the 290 municipalities. The variables included have been gathered mainly from second-hand sources, such as Statistiska Centralbyrån and associations covering housing issues. While this data could be gathered through surveys, it is not feasible to receive enough observations required for achieving significance. Rather, using the existing, though less informative, data with certain assumptions, we are still able to draw viable conclusions and make way for future studies within this field.

Our dataset consist of the following variables: sale price, mortgage interest rate, real estate tax, debt, income, maintenance costs and housing density. From these, additional variables are calculated: interest relief and user cost of housing. All variables except for housing density, which is a ratio not measured in SEK, will be divided by KPI hence inflation adjusted. Each observation is sorted by municipality average over the years 1991 to 2011.

Sale Price

Average sale price of single-family, permanent, detached house, gathered from SCB. This forms the dependent variable, and is the measurement of housing prices. Due to the illiquidity of the housing stock and the relatively few lifetime transactions of housing for each consumer, the sale price may differ from actual value at any given time. That is, each transaction may be altered heavily by external, irrational factors. However, for the sake of simplicity and our scope of research, the average sale price in each municipality per year will serve as the assumed average value of each unit of housing. To further simplify apartments will not be included in the dataset. This is mainly due to maintenance costs not being comparable between the two markets.

Interest cost

The interest cost variable is defined as follows.

$$Interest\ Cost_{it} = Interest\ Rate_t * Debt_{it} \quad (9)$$

The interest rate is calculated using the average of the national yearly average 2-year mortgage interest rates offered by Nordea, SEB and Swedbank. Data has been collected from the banks directly. The reason for choosing the 2-year rate is two-fold. 1) it being the only standardized rate offered by each of the three largest banks continuously during the time period of interest and 2) it is also one of the most commonly used by borrowers, it is feasible to use it to calculate annual interest cost. For simplification, we assume a perfect capital market, where each year every consumer pays the average interest rate, rather than as in real life where most consumers fix their mortgage rate over a set amount of time and at different set interest levels, and may or may not receive interest rebates.

Interest relief

Interest relief is defined as a non-linear function as follows.

$$Interest\ Relief_{it} = min(Interest\ Cost_{it}, 100\,000) * 30\% + max(Interest\ Cost_{it} - 100\,000, 0) * 21\% \quad (10)$$

Interest relief equals the sum 30% of current interest cost and 21% of current interest payment exceeding 100 000.

Maintenance

As gathered from Villaägarnas riksförbund, Swedish Homeowners Association, yearly review. Costs include proper maintenance needed to maintain real property value over time, as well as insurance fees and upkeep like water, gas, power etc. Maintenance fee is assumed to be constant over time, adjusted for inflation, due to lack of data available for years before 2005.

Real Estate Tax	As gathered from SCB based on assessed value of housing property and calculated according to tax laws. This is included as it serves as a major part of a household's annual cost of living. It is directly correlated to the property's market value, albeit with some delay. The amount is based on a property's assessed value, *taxeringsvärde,* which is set at 75% of the property's estimated market value. Due to the housing property being a relatively rare-purchase, with large variations between current value and former sale value, the amount is reviewed every 2 years. Assessed value, is then used to calculate the real estate tax. Until 2008, this factor was 1% of assessed value, capping at 4% of annual income. After 2008 it was adjusted to 0.75%, capping at 6000SEK, with the maximum amount paid adjusted annually to reflect inflationary effects.
KPI	*Konsumentprisindex*, or consumer price index, is used as standardized measurement of inflation. This is included as to observe real changes in housing prices, as opposed to nominal and collected from SCB. KPI will not be included as a variable. Instead all variables measured in SEK will be divided by KPI before used in the model.
Debt	Average debt at municipality level is only available years 2004 through 2007, while nationwide exist for all our years of interest. In order to derive municipal data for other years, further assumptions have been needed. Hence, each municipality's share of the total nationwide debt is assumed to follow a constant trend over time. The trend in each municipality's share of the national debt stock is calculated using the municipality data from 2004-2007. The trend in percentages was then used to generate municipal data on average debt using national numbers. To pursue this method we have also assumed that the national mortgage stock is equal to total national household debt minus student loans. This assumption is based on the fact that an absolute majority of total household debt constitutes of mortgages. The data is gathered from SCB.

Housing Density — Defined as number of houses and apartments in each municipality divided by the total population. Data is collected from SCB on a municipality basis. This ratio serves as a proxy for supply and captures changes in population relative to house property production. Assuming cultural probability to share roof with other consumers – that is stable marriage, divorce, birth, death rates etcetera – remains equal, an increase in this ratio would translate into a larger supply of property, which would logically bode for lower sale prices.

Income — Municipality data on average yearly income per person as collected from SCB.

Cost of Housing — The sum of interest cost, real estate tax and maintenance minus interest relief, as previously defined.

TABLE I: DESCRIPTIVE STATISTICS

Variable	Min	Mean	Max	Standard deviation
Sale price	169 231	752 338	5 154 015	598 623
Cost of Housing	36 586	50 685	143 289	10 562
Average Income	104 300	155 801	351 504	27 623
Average Debt	71 425	385 807	3 399 969	258 694
Housing Density	.334	.4778	.771	.046

Table I: Descriptive Statistics. Contains key statistics for independent variables in our dataset.

RESULTS

TABLE II: FIXED EFFECTS REGRESSION RESULTS

Variables	Aggregated Cost	Disaggregated Cost
Cost of Housing	-3.502***	
	(.4016)	
Interest Cost		-54.29***
		(4.211)
Interest Relief		175.8***
		(14.26)
Maintenance		-1.909
		(2.836)
Real Estate Tax		24.86***
		(2.378)
Average Income	1.298***	-.2106
	(.2236)	(.2380)
Average Debt	1.746***	1.884***
	(.0254)	(.0261)
Housing Density	-2 112 027***	-1 740 544***
	(108 841)	(118 867)
Constant	1 063 360***	898 879***
	(119 426)	(100 389)
R^2	.8182 within	.8264 within
	.8873 between	.9075 between
	.8619 overall	.8822 overall
F-test p-value	.0000	.0000
No. of observations	6 350	6 350

Note: All values are parameter estimates, with standard deviations in parentheses. (*p-value ≲ .10, ** p-value ≲ .05, *** p-value ≲ .01)

Table II: Regression Results. Contains regression results estimating the correlation between House Sale Price and Cost of Housing including control variables using a fixed effects estimator.

The results from our main regression where cost of housing is aggregated give the following function on housing prices where all coefficients are significant.

$$P = 1\,063\,360 - 3.502 * Cost\ of\ Housing + 1.298 * Income + 1.746 * Debt - (-2\,112\,027) * Housing\ Density + z_{it} \quad (12)$$

When running the FE-estimator and thereby controlling for fixed effects between municipalities we observe a negative coefficient between cost of housing and housing prices by -3.50. The interpretation of the

coefficient is that when the cost of housing increases by 1SEK housing prices decrease by 3.50SEK. In our main regression both average income and average debt correlate positively with housing prices. Average debt has a positive coefficient of 1.75, which implies that when housing prices go up consumers average mortgage rate go up as well. This result is quite intuitive since most house buyers need to take a mortgage corresponding to the price when buying a house. Average income has a low positive value in our main regression. In the regression where cost of housing is disaggregated, average income is no longer significant. The numbers indicate that there is a low variation in the variable. One possible explanation is co-linearity between average income and average debt. When using a simple correlation test, there is a correlation of 0.7729 between the two variables. This could explain why the effect of real average income on housing prices seems so low. It is reasonable to think that people with high incomes can afford to take on higher mortgages. Another possible explanation for the low variation in average income is that we have controlled for both inflation and municipality fixed effects, which combined, explain a major fraction of the variation in wages. Even though this co-linearity presents a problem when interpreting the coefficients for average income and average debt, since they are both only control variables the results for our main factor of interest in still holds.

Housing density correlates positively with housing prices when inserted in the function, which implies that when the number of houses per person go up, housing prices go up as well. This means that in municipalities where the number of possible suppliers of housing increases, the houses actually for sale on the market have higher prices. Housing density is supposed to captures the effect of supply in our function. The result is not in line with our hypothesis since we would expect supply of housing to match the density of housing. There are several possible reasons for this contradictory result. One is that we have not included a factor for size of houses in the simplified supply function. The fact that there are more houses per person in a municipality does not reflect whether these houses are more attractive. Another possible reason is that we have used total municipality population for calculating housing density. Since children don't generally buy houses, their inclusion will probably distort the results. There is a possibility that we have captured the fact that in municipalities where prices go down, more people live in single household homes. This could be the case in municipalities with more seniors and less families with children. Even though this variable did not capture the exact variation we were looking for it is still significant and should not bias our main factor of interest. Further, the coefficient for housing density looks large, but it is important to

remember that it is calculated as a ratio of housing stock to population ranging from 0.334 to 0.771.

In our main regression we have a high overall R^2 of 0.8619, which suggests strong explanatory power of the variables. In some cases controlling for fixed effects can drive up R^2. This is not likely in our regression since we have a high within R^2 of 0.8182 where the variation between municipalities is disregarded. Also when running a regular OLS regression without controlling for fixed effects R^2 is even higher.

Since cost of housing is defined as the sum of four variables we have run the same regression on the disaggregated cost of housing for comparison. Even though our main interest lies in observing the effect of the cost of housing it might be interesting to see which are the main driving factors in the variable. In the results from our secondary regression, presented above, interest cost correlates negatively with housing prices and the interest relief correlates positively. Since we have controlled for changes in debt level the interpretation should be that when the interest rate goes up housing prices drop. There is a corresponding positive effect from the interest relief on housing prices, which is in line with our hypothesis. Maintenance fees are not significant in the disaggregated version of cost of housing. This is expected due to our choice of using inflation adjusted municipality data assumed to be constant over time. It is included because it is a part of a house owners aggregated cost of housing and should affect the buying choice. Real estate tax is calculated by the tax agency on the basis of house value, which explains the positive correlation with housing prices. Clearly the interest cost and interest relief are the most important drivers in the aggregated variable for cost of housing.

As previously stated we have also tested to run the same regression but exchanged cost of housing for a one year lagged version of the same variable. The results, presented in the attached appendix, show an almost double sized negative coefficient for cost of housing of -6.40. All variables are still significant in this version and the overall R^2 is roughly the same. These results confirm our hunch that the effect of cost of housing on housing prices is lagged. Since we are using yearly averages, if cost of housing changes in the end of a year, most of the house sales will already have been made. When introducing a lagged variable for cost of housing this kind of distortion is impossible. Another possible explanation is that it takes time for consumers to adjust to changes in the prerequisites buying a house.

CONCLUSIONS

As an established result from the regression analysis, we find a negative correlation between sale price and cost of housing. Given that our assumptions of strict exogeneity and data selection hold the results show how changes in homeowners' yearly costs affect housing prices. Since we have controlled both for fixed effects between municipalities and debt levels, the results capture the effect of changes in costs not due to higher mortgage rates. Instead they capture the effect of real changes in mortgage interest costs, maintenance costs or the real estate tax level. This confirms our theoretical hypothesis that the classic supply and demand relationship is applicable on the housing market, which implies that consumers respond to changes in the real costs of housing. These changes in real costs can be due to various reasons and mostly they will reflect changes in mortgage interest rate. Another factor that would change the real costs of housing substantially is of course our factor of interest – the mortgage interest relief – that today lowers the cost of housing and therefore drives up housing prices. Even though the exact coefficient can be discussed, our results state the negative relationship between homeowners real cost of housing and housing prices which answers our research question. According to our analysis the mortgage interest relief *does* lead to higher housing prices in Sweden.

Using the results from our main regression with the aggregated cost of housing on the same figures as in our hypothesis, that is the average piece of real estate in Stockholm in the year of 2011, we can exemplify the effect of interest relief. The average real estate, which sold for 4 639 000SEK and garnered 26 503SEK in interest relief, using our estimator of -3.502 to factor the interest relief, we get an estimated effect on sale price at 92 813 SEK. This means that the existing interest relief effectively increases sale price by that amount, and the removal of interest relief would reduce sale price from 4 639 000 to 4 546 186SEK, a reduction of circa 2%.

Using the same procedure with all observations, we may summarise our findings into a table.

TABLE III: DESCRIPTIVE STATISTICS OF EFFECT ON SALE PRICE

	Min	Mean	Max	Standard deviation
Percentage price change due to a cost-increase equal to the interest relief	-.64%	-3.55%	-11.98%	1.64%

Table III: Descriptive Statistics of Effect. Contains the calculated effect on housing prices of a cost of housing increase equal to a removal of the mortgage interest relief.

This is in contrast to our theoretically derived hypothesis, which estimated the effect of interest relief at 17.6%. Our example indicates that the gain of the mortgage interest relief is not evenly split between suppliers and consumers of housing as assumed in our hypothesis. Rather, it suggests that suppliers' gain is far larger. There are several other possible explanations for the relatively small effect. First of all there is the possibility that we have captured only the short-term effect of the interest relief. There might be a long-term effect on housing prices not visible in our results. This argument is supported by the fact that the coefficient for cost of housing, when using a lagged variable was almost doubled. Secondly there is the prospect of over controlling which would undervalue the coefficient of interest. For example we have controlled for average debt, which should be closely correlated with cost of housing since the interest cost partly depends on the prior variable. This could result in an underestimation of the effect of cost of housing. Finally there is also the possibility that households being perfectly rational weigh in the risk of the mortgage interest relief being abolished, which would reduce their willingness to pay for housing today.

SHORTCOMINGS

The main issue in our analysis is the fact that we did not have data from the years before and after the interest relief was changed in 1983 at our disposal. This means that we cannot definitively prove what the effect of a removal of the interest relief would actually have on housing price levels. To work our way around this issue we developed a model for estimating the effect based on a couple of assumptions. The strongest of which is controlling for many influential factors affecting housing prices to observe the effect of the interest relief. By doing so we have lost a lot of variation in housing prices and found the pure effect of the relief assuming all else is equal. In reality though, this is not likely to be the case. One example is that if the interest relief were to be removed by the government it is probable to

think that it would be packaged with other political reforms, possibly affecting consumers' ability to pay for housing. They could be changes in the capital gains tax, income taxes or mortgage regulations which all should affect demand for housing. Another example is the volatility of the housing market. Most current homeowners have bought their house under the prerequisite that the interest relief will stay and therefore taken on a larger mortgage than they would afford without the subsidy. Removing the interest relief could create an uncertainty in the housing market with irrational agents, which creates more volatility than we have anticipated in our analysis.

As in most regressions it is difficult to establish a causal relationship, in our case between the interest relief and housing prices. Applying the numbers into our model, we can only be certain of the stated correlation between the variables, not in which direction the causality goes. Even though we have controlled for important variables there is always the possibility that higher housing prices cause higher cost of housing and not the other way around. On the other hand the results from the regression using a lagged variable for cost of housing indicates that the causality probably runs in the direction we hypothesize. This is because it is hard to imagine housing prices affecting cost of housing one year earlier. Also, we have controlled for possible variables through which housing prices could affect cost of housing like average debt levels.

There is also the possibility that all control variables are not strictly exogenous. Since average debt is closely correlated with housing prices the error term could also be correlated with average debt. This might bias our regression since the prerequisite assumption for using the FE-estimator is no longer met.

Another possible problem is the assumption that consumers ignore cash flow effects of receiving interest relief as tax return up to a year after interest payments. While the net cost of housing is the same regardless of timing, an individual may have capital constraints or risk preferences preventing them borrowing the extra amount and repaying with the tax return. Furthermore, as interest relief is granted as tax returns, consumers without any taxes payable are not subject for any tax return, effectively omitting them from receiving interest relief and increasing their cost of housing. The effect of this issue is, however, not measurable due to the averaged data, but could be discerned in future studies using transactional data.

Also we need to be humble about the prospect of our data selection being flawed. The assumption that municipality average debt levels follow a trend plotted from only four years is quite strong which could bias our results. To be able to include the maintenance fee in our equation we had to assume it to be constant in real terms, which is not likely to be true. Another possible issue in our assumptions about the data might be our definition of housing density, which is supposed to capture supply of housing in municipalities. Here we used total housing stock and total population due to lack of more refined data. Additionally, possible homeowners are not separated from children in the population variable. Also there is a probable distinction between housing stock in a municipality and how many of those will actually ever be on the market for sale. Our variable, even if significant, might be flawed and bias our results.

FURTHER RESEARCH

There are several ways to extend our analysis in order to improve the findings and further contribute to the research on the mortgage interest relief.

To deepen our analysis on the Swedish market it would have been convenient to use our model with more precise data. Furthermore, the model could be extended using a more profound supply function. Instead of only using housing density as an explanatory variable for supply one could for example include building costs and suppliers anticipation of the future market. Also it would have been interesting to compare our results to results using data from the 80's when the rate of the mortgage interest relief was lastly changed in Sweden.

As mentioned in the introduction there are several countries in Europe that recently have lowered their mortgages interest relief rates or introduces stricter requirements of who is eligible for the subsidy. It would be interesting to compare our estimated results from the Swedish market with the actual outcomes in those countries. Also one could test the sustainability of our model by using it with time series data from, for example, Netherlands up to the point of their reduction of the mortgage interest rate and compare the estimated effect on housing prices with the actual outcome.

SUMMARY

Mortgage interest relief and other schemes for incentivising home ownership have long since been an integral part of western economies. Recent developments show, however, that policy makers are keen on revising these schemes reducing them to great extents or in some cases even removing them wholly, albeit under gradual reforms.

Previous research in the US have shown a positive correlation between house prices and interest relief, and more explicitly, that banks tend to adjust their offered interest rates as well to accommodate for all consumers. As the willingness for policy makers to bear the deadweight loss for these subsidies in the past have been offset by the social benefit of increased house ownership, it becomes of interest to investigate the effects of such a removal in Sweden, should they follow in the steps of Italy, UK, Finland and others.

To answer the question, '*Does mortgage interest relief lead to higher housing prices in Sweden?'* we first defined a regression model and key variables that we used to estimate the effect of the mortgage interest relief. As we lack data for changes in interest relief schemes, we instead aimed to estimate consumers' price sensitivity of housing to its associated costs. These primary cost drivers are identified as maintenance, interest cost and real estate taxes. In addition, we also control for attractiveness by using a fixed effects estimator in our regression and income, inflation, housing density and debt. Income is controlled for as previous research have shown a positive correlation between income and housing prices. Debt is controlled for as we aim to investigate changes in housing costs relative house prices, as separate from changes due to increased debt levels.

Data is collected primarily from statistical databases. Fixed effects regression analysis proves, with statistic significance, a negative correlation of -3.502 between cost of housing and house prices. For an average villa in Stockholm in the year of 2011 this indicates price fall of 2.00% assuming all else is equal in the event of a removal of the mortgage interest relief policy. Nationwide, independent of year, we estimate an average price fall of 3.55%.

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APPENDIX

TABLE IV: FIXED EFFECTS REGRESSION RESULTS USING LAGGED COSTS

Variables	Lagged Costs	Aggregated Cost
Cost of Housing	-6.401***	-3.502***
	(.3774)	(.4016)
Average Income	.6051***	1.298***
	(.2171)	(.2236)
Average Debt	1.794***	1.746***
	(.0243)	(.0254)
Housing Density	-1970 947***	-2 112 027***
	(117 517)	(108 841)
Constant	1 232 069***	1 063 360***
	(50 939)	(119 426)
R^2	.8242 within	.8182 within
	.8843 between	.8873 between
	.8554 between	.8619 overall
F-test p-value	0	.0000
No. of observations	6 350	6 350

Note: All values are parameter estimates, with standard deviations in parentheses. (*p-value ≲ .1, ** p-value ≲ .05, *** p-value ≲ .01)

Table IV: Regression Results. Contains regression results estimating the effect of a one year lagged Cost of Housing on Sale Price including control variables and estimates using Fixed Effects. The main regression as in Table II is included for comparison.