# The Political Feasibility of Housing Taxation: A Potential Scheme Derived from Empirical Analyses of Distributional Effects

*Preliminary version. Please do not quote. Suggestions are welcome.*
*February 2009*

**Erling Røed Larsen**
**Senior Research Fellow, Statistics Norway**
**Visiting Scholar, Dept. of Finance, Copenhagen Business School**

**Abstract: Taxes on housing consumption have attractive features. They can enhance efficiency, function as automatic stabilizers, and work progressively. However, new housing taxes may not be political feasible unless they can be demonstrated to have acceptable distributional effects. I employ the rental-equivalence principle to estimate recent values of owner-occupied housing consumption in a cross-section of Norwegian households by imputing rent for owners based on observed rents in rental markets. I analyze the distribution of imputed rent over the income range, and demonstrate that imputed rent is a necessary good. Then, I construct a simple tax scheme on real households in a dataset from 2006, and show that a housing tax may be structured such that i) taxes increase in imputed rent, ii) taxes increase in gross income, and iii) tax shares increase in gross income. Such a tax scheme would, in contrast to the current interest payment subsidy, work counter-cyclically and could, if used as a substitute for income taxes, reduce deadweight losses from labor income taxes.**

**Key Words:** automatic stabilization, deadweight loss, distribution, efficiency, housing, imputed rent, progressive taxes, rental equivalence

**JEL Classification:** C14, C21, D12, D63, H23

**Corresponding Address:** Erling Røed Larsen, Research Dept., Statistics Norway, P. O. Box 8131 Dep., N-0033 Oslo, Norway. E-mail address: erling.roed.larsen@ssb.no

**Acknowledgements:** Financial support was given by the Norwegian Research Council, project no. xx.

## 1. Introduction

Economists have long been concerned with taxation. This interest started with the need to raise revenue, but shifted towards such issues as efficiency and automatic stabilization. Distributional concerns were also raised and scrutinized, and, today, many tax systems are constructed to work progressively. A housing tax stands at the intersection of these three major strains of the tax literature. Some observers even suggest that a housing tax may be an example of a triple-dividend scheme. How? First, a revenue-neutral substitution from an income tax to a housing tax could reduce deadweight losses; see simulations on general-equilibrium models by Nakagami and Pereira (1996) and Bye and Åvitsland (2003) Second, a housing tax could work counter-cyclically since housing consumption is highly pro-cyclical; see e.g. Leung (2004); Davis and Heathcote (2001); Jud and Winkler (2002); and Leamer (2007). Third, since the demand for housing may have relatively stable and monotone Engel curves, a properly designed housing tax could function progressively. The latter point is important since a proposal of a new and regressive tax would be dead on arrival. The need for such a tax appears to be acute since concerns about housing inequity have emerged (Thalmann (2007)) and since many authors have long been skeptical about the regressive nature of the interest subsidy (Poterba (1992)), the preferential treatment of owner-occupied housing (Cremer and Gahvari (1998)), and the favorable treatment of housing overall (see Hendershott and White (2000) for a survey). In fact, the recent financial turmoil appears to have originated in a housing boom, which begs the question of how to use the tax system to help stabilize the housing market.

However, even if there do exist theoretical results, model computations, and practical simulations, there still seems to be a gap in the literature. There is a need for an empirical examination of the demand for disaggregated housing components and a case study of how real households would be affected in real-life by a housing consumption tax. This article offers both. I analyze housing demand empirically in a cross-section of Norwegian households and demonstrate how the distribution of a housing consumption tax could and would be in a sample of households.

I find that even though core elements of the demand for housing are necessities, i.e. the proportion of gross income devoted to these elements decline with gross income, it is possible to implement a housing consumption tax scheme that makes it progressive. Moreover, I detect an empirical regularity between interest payments and gross income. The share of interest payments appears to fall with income, but not in every year, and a flat-rate subsidy may not be especially progressive. Since housing consumption and interest payments are pro-cyclical, the existing interest payment subsidy (i.e. the tax deductibility) actually amplifies the business cycle while a new tax on the former would work counter-cyclically. This could in fact allow policymakers to attain several targets with one tool.

The distributional consequences of a tax on or subsidy of housing depend on whether or not the demand for housing is a necessity or a luxury. It is, ultimately, an empirical question. But it is a challenging question because it requires detailed data and finely-tuned techniques, so the analyst must take care to avoid several caveats. First, in order to examine observed housing expenditures and interest payments the analyst must control for mortgage amortization and interest rate variation across time and space. Second, in order to analyze observed rent the analyst must keep in mind that tenants often comprise only a fraction of the households, and sometimes even a small fraction. Third, in order to employ a proxy for housing consumption, e.g. observed payments of insurance premiums, the analyst must separate the consumption of hedonic attributes from the consumption of spatial features. Insurance premiums may reflect the value of the house;

i.e. the re-construction cost; and even if that is an important component of housing consumption, it does not include the consumption of geographical location. Spatial coordinates are important parts of housing consumption, and leaving them out for tax purposes could grossly skew housing tax schemes. In short, estimating what a household consumes of housing services as owner-occupiers is surprisingly intricate and data demanding. This may explain the shortage of statistically rigorous studies into the empirical distribution of core elements of housing consumption.

One possible approach is to estimate what an owner-occupying household consumes of housing services by invoking the rental-equivalence principle, a tradition that goes back at least to an influential article by Aaron (1970). The principle proposes that an owner-occupier's housing consumption equals foregone rental income, and this article employs this framework. Estimating the housing consumption value for owner-occupiers requires several datasets. First, one needs a dataset of market rents along with attributes of the rental objects, in order to regress rent onto a space of attributes. Second, one needs a dataset of housing attributes for owner-occupiers in order to reverse the computation and estimate foregone rent by using the observed housing attributes. Combining these two datasets, we are positioned to use the estimated rental price for a given set of attributes to impute the rental value of a given set of owner-occupier housing attributes. The accuracy of the imputation hinges crucially on the number and quality of attributes acquired. Third, one needs access to exogenous gross income for owner-occupiers in order to estimate the relationship between housing consumption and income. Due to endogeneity and simultaneity problems one cannot use total expenditures. Fourth, comparing imputed rent with interest payments and check for progressivity and regressivity, requires consumer expenditure survey data. This article uses such sets of cross-sectional data for Norway in the period 2004-2006.

Thus, this article combines elements of insights into the construction of house price indices, results from tax theory, and empirical techniques from the literature on Engel curves. I cannot offer even a basic review of these large fields of knowledge. Let me instead briefly sketch the contours of some useful studies into the overlap between taxes and distribution and housing and taxes. The starting point is the result by Atkinson and Stiglitz (1976), who stated that "tax structures must be centrally concerned with distributional considerations" (page 55). They found no role for commodity taxes and claimed that "the optimal tax system can rely solely on income taxation". However, the result depends crucially on homogeneity of preferences. Besides, income is not limited to labor and capital income but should comprise the latent income stream from an asset such as a house. Christiansen (1984) found conditions when goods that are complementary to leisure should be taxed, and finds that commodity taxation, under heterogeneous tastes and non-linear taxation, is warranted if it is positively related to leisure. This result led to intense scrutiny of commodity taxation. But authors never took their eyes of distributive issues, even if it is as complicated as Okun (1975) said when he likened redistribution to transferring water from the rich to the poor in a leaky bucket. Slemrod (1994) addressed that leak, and suggested that there existed an optimal rate of leakage. The optimal rate is an empirical entity and closely related to actual behavior, in addition to the multiplicity of instruments for tax revenue generation. Thus, theoretical studies must be followed by empirical investigations. Recently, Slemrod and Kopczuk (2002) examine behavioral responses to tax regimes. This article joins the debate on distribution by showing how a housing tax can attain distributional aims while being simple and potentially including stabilization and efficiency goals.

Given that preference heterogeneity allows commodity taxation, and given that actual behavior should be taken into account when constructing tax system, housing is an obvious target. After all, it is difficult to avoid taxation of housing because of its durability and immobility (Leung (2004, p. 252). Hendershott and White (2000) survey the shifts in the status of housing taxation and subsidization from the 1970s and gives us some answers into the puzzles of how and why housing taxation is set up the way it is. In a valuable contribution, Gervais (2002) studies the impact of preferential tax treatment of housing, using a dynamic general equilibrium life-cycle economy and finds in his simulations that individuals would prefer, at all income levels, to live in economies that tax imputed rents or do not let mortgage interest payments be deductible. This followed the earlier study of Nakagami and Pereira (1996) of, using a dynamic general equilibrium model, how removing interest deductibility and imputed rent exemption would affect both the budget and efficiency. They found that it would boost revenues and would improve allocation efficiency. Cremer and Gahvari (1998) examine the question of optimal taxation of housing, and notes that the recent literature has raised the possibility of substantial efficiency loss by the preferential treatment of owner-occupied housing. They show how, under certain conditions, housing by the poor may be subsidized and how optimal taxes must be non-linear, both results are consistent with my findings in this article. Leung (2004) surveys the new and emerging literature on the link between macro and housing and asks a pressing question: When there appears to be consensus among economists that preferential treatment of housing is undesirable, why was it implemented in the first place? He cannot give exhaustive answers, but points towards the assumed positive externalities and social benefits from homeownership, governmental myopia and time-inconsistency are some possibilities. It is a timely question, and this article calls for a renewed effort of overhauling the housing tax system and puts forward a proposal.

My contribution is twofold. First, I demonstrate, both parametrically and non-parametrically, that housing consumption in Norway is a necessity when measured as imputed rents for owner-occupiers. Second, I show how it is possible to construct a housing tax system that works progressively.

These results may be useful to policymakers since they combine to show how a housing tax can be made politically feasible. Such a tax is contemplated in the many countries where it does not yet exist, and is seen as especially acute in a period where the recent rise and fall of house prices may have contributed to amplify the business cycle and destabilize the economy. Moreover, as a matter of revenue generation, my proposal would generate tax revenues of the order of NOK 12 billion, which would warrant sizable income tax reductions. In an economy with a gross domestic product (GDP) of NOK 2,160 billion, this may, however, appear somewhat insubstantial since the housing tax revenue is just a little more than half a percent of GDP. But the revenue may easily be increased by changing the scale of the levy.

The article is organized as follows. The next section introduces a parsimonious model of housing consumption and taxation and outlines the empirical techniques required to estimate the parameters. The third section describes my datasets. The fourth section presents empirical results. Then, I discuss the advantages and disadvantages of the approach. I investigate alternative approaches. Finally, I make concluding remarks and suggest policy implications. The appendix contains some finer details and robustness checks on regressions on earlier datasets and other variables.

**2. Theory**

If a tax t is put on manifest housing expenditures in household h, $y_h$, then the housing tax $ty_h$ involves paying in taxes a share $\theta_h = ty_h/x_h$ of manifest total expenditures, $x_h$. Let $\omega_h$ be the budget share of housing expenditures for household h. Equation (1) represents the relationship between the tax share and the budget share:

$$(1) \qquad \theta_h = \frac{ty_h}{x_h} = t\omega_h,$$

where the tax share, $\theta_h$, is a linear function of the budget share $\omega_h$. Since the budget share varies across households, then, in general, the tax share paid by household h is a function of both housing expenditures and total expenditures, $\theta_h = t\omega(y_h, x_h)$, where ω is a general function that maps housing expenditures and total expenditures into a budget share. If the relationship between housing expenditures $y_h$ and total expenditures $x_h$ is stable for all h, so that y simply is a function of x for all households, i.e. y(x), the function $\omega(y_h, x_h)$ may be simplified to a function only of total expenditures, ω(x). If so, and if this function is decreasing (increasing) in x, i.e. $\delta\omega/\delta x < 0$ ( $> 0$), the housing tax share of total expenditures is decreasing (increasing) with total expenditures since $\delta\theta/\delta x = t(\delta\omega/\delta x) < 0$ ($> 0$). It follows that such a tax is regressive (progressive). If indeed it is regressive, it may be turned into a progressive tax, if policymakers construct the tax scheme appropriately as a non-linear function of x such that the tax share of total expenditures increases with x, as given by equation (2):

$$82) \qquad \frac{\partial\theta(x)}{\partial x} = \frac{\partial t(x)}{\partial x}\omega(x) + t(x)\frac{\partial\omega(x)}{\partial x} > 0.$$

Equation (2) holds when the tax is progressive, i.e. it holds if the tax progression in the first component is sufficiently large to dominate the falling budget share in the second component. This simple exercise demonstrates that a policymaker's interest in empirical estimates of consumer behavior may be considerable, since t(x) is within their discretion to implement as policy while ω(x) is an empirical Engel function to be estimated from data on consumer behavior.

In order to examine the relationship between housing expenditures and total expenditures or income, and establish empirical regularities, several obstacles must be overcome. First, the definition of housing expenditures is non-trivial and controversial. Second, the measurement and employment of total expenditures is non-trivial. Third, the choice of functional form and how to control for important omitted variables is non-obvious.

I deal with the former by constructing both one broad and one narrow definition of manifest housing expenditures and by examining core disaggregated elements of housing expenditures separately. Manifest housing expenditures are observable entries in diaries obtained from Consumer Expenditure Surveys (CES). Latent housing consumption expenditure, however, is a variable that consists of the unobservable quantity of consumption and a theoretical price. This price depends on the unobservable value of the home. For example, some households have completed the amortization of the mortgage and have full equity. They do not pay interest, but they still enjoy a latent stream of housing services with a latent value. Other households have partially completed the amortization and have some equity. However, the latent stream of housing services has a latent value different from the interest payments. I estimate the value of this consumption, i.e. the owner-occupied housing consumption expenditure, by utilizing imputed rents from the application of the rental-equivalence principle.

I deal with the second and third challenge by substituting gross income for total expenditures and by employing both parametric and non-parametric techniques. The second challenge would have been manageable if we would have limited the analysis to employ linear instrumental variable models, i.e. two-stage-least-square types. The estimators in such models have well-known properties. But that would compromise the solutions to the third challenge, because the relationship between latent housing consumption and latent total consumption most likely is highly non-linear, so I choose instead to construct models that employ gross income, not total expenditure. The reason why is the endogeneity problem that emerges with the use of total expenditures. To see why, consider the following analysis. Let us inspect, empirically, the relationship between latent consumption expenditure in household h on category i, $\eta_{ih}$, and latent total consumption expenditure in household h, $\xi_h$, by examining their observable counterparts expenditures in category i, $y_{ih}$, and total expenditures, $x_h$. Equation (3) establishes the relationship between these two empirical counterparts.

$$(3) \qquad y_{ih} = f(x_h) + u_{ih}.$$

Manifest total expenditure, $x_h$ is the sum of latent total consumption expenditure and all measurement errors in individual categories, $\xi_h + \Sigma_i u_{ih}$. Thus, the regressor manifest total expenditure, $x_h$, contains (as part of the sum of measurement errors from each category) an element *identical* to the error term $u_{ih}$ in equation (3). In other words, the regressor $x_h$ is not exogenous. This could have been dealt with this by performing two-stage-least-square (2SLS) regressions by modelling total expenditure as endogenous and using income as exogenous instruments. However, the linear 2SLS-models cannot do justice to curvature, and much literature focuses attention on the non-linearity of Engel curves; see Banks et al. (1997) for non-linearity, Blundell et al. (2003) for non-parametric ones, and Lewbel (1998) for semi-parametric ones. On the other hand, attempting to model the relationship between housing expenditure and total consumption expenditure non-linearly with instruments, and yet retain certain estimator properties, is non-trivial. Thus, in order to examine curvature in a tractable and transparent fashion I avoid the usage of endogenous total expenditures and instead employ exogenous gross income. Equation (4) presents the parsimonious parametric model of the relationship between housing expenditures and gross income.

$$(4) \qquad \frac{y_{ih}}{GI_h} = a + b\log(GI_h) + c[(\log GI_h)^2] + dD_h + r_{ih},$$

where GI refers to gross income, D to a vector of demographic controls for household size and composition, and subscript h refers to a household h in the cross-sectional sample. The error term $r_{ih}$ is assumed to be classical and well-behaved stochastic variable with mean-zero and constant variance.

The omitted-variable problem is challenging. There will always be present a possibility that models miss some important factor, which would entail biases in the parameter estimates. In demand and Engel curve estimation certain shift parameters are, however, known ex ante to be of importance. One such factor is the vector of key demographic variables, e.g. size and composition of the household. Obviously, a large household needs a larger house than a small one. Thus, I use the number of children and the number of adults in the household as shift parameters of the curves.

Another core variable is relative price. It is convention in cross-sectional analyses to assume that consumers face the same relative prices at a given point in time. While this may be an innocuous assumption for many demand and Engel curves, it may not be for housing. Some would argue that relative prices cannot be identical to all households at one time for housing since one observes different prices across regions for a given set of hedonic attributes, e.g. size. This, however, is not necessarily a valid objection. Whether it is invalid or valid depends crucially on whether or not confounding is present or not. The partial price for a given hedonic attribute, such as size, is mis-measured if one has not controlled for a correlated determinant, such as quality of location. In fact, most of the different prices across regions for hedonic attributes may easily be explained when controlling for spatial qualities and amenities.

But even if relative prices for partial components of a house price between regions within a cross-section are similar, estimated demand and Engel curves for housing expenditures may not be immediately comparable between cross-sections since short-term market interest rates vary. This may not be too troublesome for our purpose if all estimated curves show similar signs of the relevant parameters. Nevertheless, one may want to control for price effects. There are several ways to approach this. One is to estimate the relationship between housing expenditures and gross income for each cross-section and argue that the changes in interest rates between cross-sections should be interpreted as price shocks that, if they span a sufficiently large spectrum, test the shifts of the relationships. Another is to attempt to decompose the shifts into price effects by merging all the cross-section datasets into one and including a relative price variable for each time period. The relative price variable may e.g. be the rental index (as in the rental-equivalence principle) or a combination of interest rate level and house price index. I use another approach. I avoid estimating the demand for housing consumption using interest payments when I employ the rental-equivalence principle and use imputed rents. These imputed rents are estimated in a two-stage methodology. First, the statistical agency collects observations on vectors containing market rent, hedonic attributes, spatial coordinates and other determinants. Then it regresses rent onto the relevant space by rent determinants and obtains the partial rental price for each housing components. Second, it collects vectors of such housing components from owner-occupier households and estimate what the households would have paid in rent had they rented their own home. It is still possible that rent is somewhat sensitive to interest rate changes. I attempt to control for this by segmenting the total sample of cross-sections into separate cross-sections, one for each year. Rent is nominally sticky due to inflation-adjustment paragraphs in contracts and not too sensitive to interest changes in the short-term.

Functional form is contentious in the literature of Engel and income curves. Thus, I supplement the parametric approach by employing a non-parametric technique to map the relationship between housing expenditures and income by estimating the Engel or income curves using a local regression technique. Since gross income is exogenous, it is well-suited as determinant in the non-parametric estimation process. I start my non-parametric estimation by noting that the relationship between the housing share of income before tax and income before tax, is generally given by a non-specified relationship g() in the equation (5):

$$(5) \qquad \omega_{hou,h} = g(GI_h, D_h) + \mu_h,$$

in which g(.) is an unspecified function, potentially non-monotonous, and the classically behaved error term $\mu$ is uncorrelated with gross income, GI. As before, D denotes demographic variables such as size and composition, and $\omega_{hou}$ now refers to housing's share of income before tax, GI. The local regression method fits a linear weighted regression line in a local neighborhood for each $GI_h$.[1] The linear regression weight assigned to an included observation $GI_i$ around $GI_h$, for which the local line is fit, is given by equation (6):

$$(6) \qquad W(GI_i, GI_h, b_i) = K_0(x) = K_0\left(\frac{GI_i - GI_h}{b_i}\right), i \in I, h \in H, x \in X,$$

where $GI_i$ is member of the bandwidth set around $GI_h$ such that the set that contains the observations used in the local regression, I, is a subset of H. The width variable $b_i$ specifies the range of bandwidth, and $K_0(x)$ is a smooth weighting function. The variable x is an intermediary variable and element in the real-number set X. This article uses the Tri-Cube function for $K_0(x)$, as given in equation (7):

[1] The neighborhood is chosen so that it contains a percentage of all available observations in the sample. These observations are weighted by a smooth, decreasing function of their distance for each center $I_{,h}$.

$$(7) \qquad K_0(x) = \begin{cases} (1-|x|^3)^3, & for\ |x| \leq 1, \\ 0, & otherwise. \end{cases}$$

## 3. Data

I use data on consumer expenditures, imputed rents, and income acquired by Statistics Norway for the period 2004-2006. In order to investigate sensitivity and robustness, I perform cross-checks on earlier data from 2000-2003 and report some, but not all, results in the Appendix.

### 3a. Consumer Expenditure Survey (CES) and Income Data

Statistics Norway contact 1/26 of their household sample every two weeks and ask households to keep a complete diary of all expenditures for a 14-day period. In addition, they interview the household and obtain information on demographic variables, housing arrangements and attributes, and other variables of interest. The CES data set includes household size and composition, age of household members, region of residence, vocation of main income earner, number of hours worked for main income earner, and ownership of a number of household durables such as cars, boats, refrigerators, washing machines, stoves, television sets, video recorders, and microwave ovens. Sample sizes are typically around 1000-1200 households per year. The sampling scheme is a two-stage stratified random sample of the universe of Norwegian households. Response rates vary around 60 percent. The expenditures are classified into a large array of different items when official data managers code them from households' accounting books into pre-assigned groups. Expenditures are annualized (by multiplying with 26). Standard aggregation levels are 9, 37, 150 and 488 commodity groups. The demographic data include variables on number of children below 7, 16, and 20 years of age. I chose my variable "No. of Children in household" as number of children below 16 years of age. I truncate the data in order to minimize outlier influence.

Statistics Norway may, with certain permissions, link Consumer Expenditure Surveys data sets with data sets from income registers. These income registers are not surveys, but complete and exhaustive full-count registers from the Norwegian tax authorities ("Skattedirektoratet"; the Norwegian equivalent of the IRS) and social support authorities ("Rikstrygdeverket"). They cover all Norwegian residents. From such a merger of datasets, I was able to access several income variables, e.g. income before taxes and income after taxes. Thus, the income data in this article are high quality since they are not reported by individual memory or at individual discretion, but are collected from the income registers, which in turn are acquired by using direct reports from employers.

Table 1 tabulates some summary statistics for the data.

**Table 1. Data[1] characteristics. CES and income tax data. Norway. 2004-2006**

| Variable | N | 10th Percentile | Median | Mean | 90th Percentile |
|---|---|---|---|---|---|
| **2004** | | | | | |
| Share of | 882 | 0.0366 | 0.0679 | 0.0872 | 0.153 |

| | | | | | |
|---|---|---|---|---|---|
| Imputed Rent[2] | | | | | |
| Gross Income | 1,097 | 251,266 | 563,153 | 588,275 | 955,812 |
| No. of Adults | 1,097 | 1 | 2 | 2.10 | 3 |
| No. of Children | 1,097 | 0 | 1 | 1.05 | 3 |
| **2005** | | | | | |
| Share of Imputed Rent | 846 | 0.0526 | 0.0950 | 0.118 | 0.202 |
| Gross Income | 1,049 | 240,840 | 576,392 | 616,115 | 1,022,257 |
| No. of Adults | 1,049 | 1 | 2 | 2.11 | 3 |
| No. of Children | 1,049 | 0 | 0 | 0.93 | 2 |
| **2006** | | | | | |
| Share of Imputed Rent | 819 | 0.0612 | 0.108 | 0.126 | 0.207 |
| Gross Income | 955 | 263,849 | 618,959 | 645,565 | 1,066,453 |
| No. of Adults | 955 | 1 | 2 | 2.12 | 3 |
| No. of Children | 955 | 0 | 0 | 0.96 | 3 |

Notes: [1]Truncation at NOK 100,000 and 2,000,000. [2]Share of imputed rent is the ratio of imputed rent on gross income.

**3b. Imputed Rent and Owner-Occupier's Housing Attributes**

For each of the participating households in the CES survey, an imputed rent was assigned on the basis of observable attributes of the household's home. This was done by a special task force within Statistics Norway as a pilot project. Since it is a novel statistical project, there exist only three years of data. Moreover, there was a methodological break between the 2004-2005 methodology and the 2006-methodology. The latter improved the former, and is more sophisticated and the imputing-algorithm is superior in accuracy. This article uses only the 2006 cross-section in constructing the housing tax example.

For the years 2004 and 2005, the sample was stratified into strata of geographical location, size of home, and home type. In total, 24 strata were utilized, and all households in a given stratum were assigned an imputed rent obtained from average rent using a rental survey. In 2006, the imputation method included an algorithm that constructed imputed rent as an explicit function of size and spatial residence, which was designed to account for the non-linearity in imputed rent for different sizes. The parameters used were obtained from estimates based on collected monthly rents in the Norwegian Rental Survey of 2006; see Røed Larsen and Sommervoll (2009) for the use of the first vintage from the Norwegian Rental Survey, from 2005, another novel statistical project.

The population of rental objects in Norway is not known. Thus, a simple random sample cannot be drawn. A count of owner-occupied and rental objects was performed in 2001, in which all housing objects were analysts attempt to map all rental objects. The number of rental objects was estimated at 458,000, which is 23 percent of all housing objects. Rental frequencies, as measured as the ratio of rental objects on all housing objects, vary with region, so a weighted, stratified scheme underlies the sampling techniques. The resulting sampling scheme consisted of several stages, where the first stage involved constructing an address list with ex ante properties and the second and third stage involved drawing and contacting households. The Norwegian Rental Survey of 2006 acquired a collection of 28,000 addresses in Norway, which were assigned an interview object (IO), i.e. a personal name (tenant or owner). This collection was constructed on the basis of a main sample, based on a stratified sampling scheme, of 20,000 object addresses and a supplementary list of addresses of 8,000 persons in the age 20-29 years. The region including Norway's capital, Oslo, was over-sampled in the main sample with about 2,000 addresses. The reasons for these two sampling maneuvers were the desire to examine the rental market in Oslo in detail and to overcome non-responding tendencies for young people.

Statistics Norway contacted the IO, using mail and telephone. Non-responding IOs included 146 (deaths), no telephone number identified (7,464) and other non-respondents (4,572). The data acquisition field period covered February 27th – June 13th 2006. Average mean interview length for tenants was 8 minutes and a highly-detailed list of attributes was collected. From the address collection, 15,818 interviews (both postal and by telephone) were performed, out of which 5,169 IOs were identified as tenants.

There are differences in size and spatial attributes between rental objects and owner-occupied objects, but the differences are not completely documented. The Rental Survey is, to the best of my knowledge, unique in its coverage. It documents physical attributes of the rental object, types of renting agreement, characteristics of tenant, landlord, and their interaction, length of rental period, and types of contract.

The 2006-algorithm for computing monthly imputed rent (MHR) for owner-occupiers was constructed by statisticians at Statistics Norway. It is based on the observed association between rent and attributes of the rental object in the Rental Survey. The algorithm is presented in Table 2.

**Table 2. The 2006-algorithm for computing monthly imputed rent**

| | |
|---|---|
| **Zone 1. Oslo:** | |
| Size below 100 $m^2$: | MIR = 3329.11 + 59.57 * size |
| Size at and above 100 $m^2$: | MIR = 5566.48 + 42.13 * size |
| **Zone 2. Akershus, Bergen, Trondheim, Stavanger, and Tromsø** | |
| All sizes: | MIR = 3790.84 + 28.64 * size |
| **Zone 3. Cities and urban areas with population of more than 20 000 inhabitants (except households included in zone 1 and 2)** | |

| | |
|---|---|
| All sizes: | MIR = 3070.98 + 24.66 * size |

**Zone 4. Small towns and urban areas with population in interval 2 000 – 19 999 inhabitants**

| | |
|---|---|
| All sizes: | MIR = 2907.79 + 17.60 * size |

**Zone 5. Urban areas with population in interval 200 – 1999 inhabitants**

| | |
|---|---|
| All sizes: | MIR = 2504.72 + 13.48 * size |

## 4. Empirical Results

### 4a. The Distribution of Imputed Rent

In Table 3 I present the result of a parametric regression of the share of imputed rent on gross income onto a space spanned by a second order polynomial of the logarithm of gross income with the two demographic shift variables number of adults in the household and number of children in the household. Since the 2006-algorithm for imputed rent is more accurate than the predecessors, I exclusively analyze that year and include the results from 2004 and 2005 for comparison and sensitivity checks. We observe that the regression's adjusted R-squared is 0.587, a high score in a cross-section of size 819. Potentially, this could signal outlier influence, but my truncation scheme with cut-off points at NOK 100,000 and NOK 2,000,000 prevent the tail influencers. Moreover, Table 1 tabulates that the $10^{th}$ and $90^{th}$ percentile of the share of imputed rent in 2006 were 0.0612 and 0.207, and this indicates that the distribution of shares was quite compressed.

I interpret the high R-squared as indicative of preference homogeneity and good model fit. The estimated coefficient of log(gross income) is clearly negative, -2.29, and highly statistically significant. It demonstrates that housing consumption, measured by imputed rent, is a necessity. However, the estimated Engel curve shows curvature since the estimated coefficient of squared log(gross income) is positive, 0.0821, and highly statistically significant. The number of adults affects the share of imputed rent more than the number of children, since the former's estimated coefficient is 0.00463 and the latter's 0.00356. Although these estimates have the expected sign, absolute and relative magnitude, they are not both statistically significant. In the appendix, I list the results from a regression with an alternative specification, which supports the findings in Table 3. In summary, the parametric results demonstrate the homogeneity of households' choice of housing and the potential imputed rent holds as an instrument of tax computation.

**Table 3. Imputed[1] rent's share of gross income on a second order polynomial of logarithm of gross income, number of children[2], and number of adults (t-values). Norway. 2004-2006**

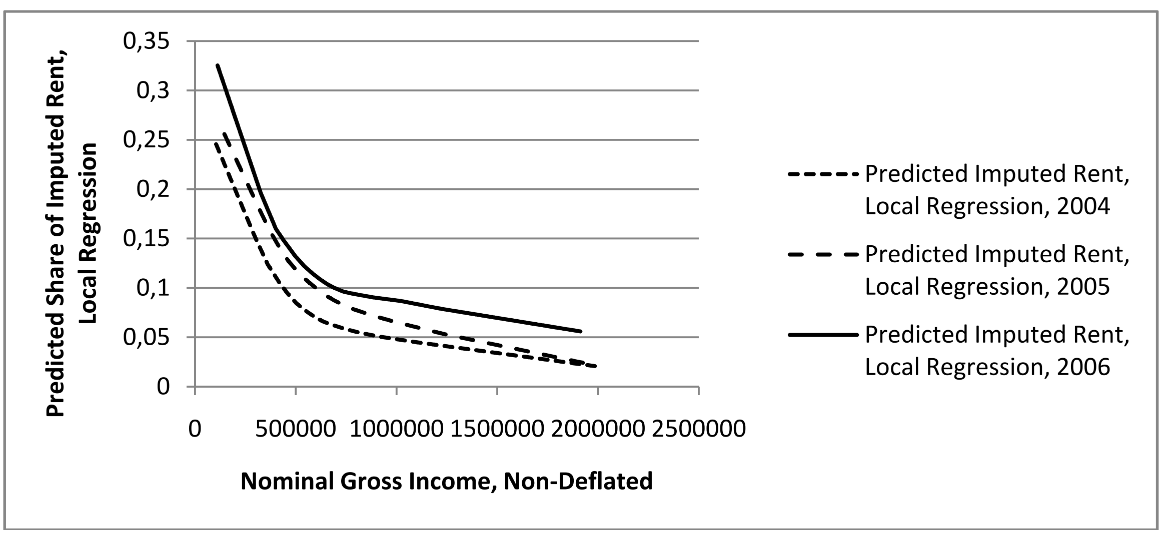
| | **Year** | | |
|---|---|---|---|
| | **2004** | **2005** | **2006** |
| Model 1: Imputed Rent/Gross Income = a + b*Log(Gross Income) + c*Log(Gross Income) Squared + d* No. Children + e* No. Adults + u | | | |
| **N[3]** | 882 | 846 | 819 |

| | | | |
|---|---|---|---|
| **Intercept** | 10.95 (21.5) | 14.9 (23.7) | 16.0 (17.3) |
| **Log(Gross Income)** | -1.56 (-20.1) | -2.11 (-22.2) | -2.29 (-16.3) |
| **Log(Gross Income) Squared** | 0.0559 (18.9) | 0.0755 (20.8) | 0.0821 (15.5) |
| **No. of Children** | -0.00122 (-1.3) | -0.000727 (-0.6) | 0.00356 (2.1) |
| **No. of Adults** | -0.00382 (-2.3) | -0.00151 (-0.7) | 0.00463 (1.6) |
| **Adj $R^2$** | 0.738 | 0.761 | 0.587 |

Note: [1]Imputed rent methodology change in 2006. See the Data section for details. Truncation at NOK 100,000 and 2,000,000 household gross income. Consumer Expenditure Surveys 2004-2006. [2]Children are defined as household members below 16 years of age. [3]N is the number of observations with positive imputed rent, i.e. homeowners.

However, although parametric results are highly useful since they allow reduction of data dimensionality into a few interpretable parameters, such results may sometimes be deceptively simple and mask empirical problems. Thus, I also perform a non-parametric regression of the proportion of imputed rent onto gross income. In this non-parametric regression type, I control for household type, composition, and size by segmentation. I divide the sample into different segments, and Figure 1 shows the results for the type with 2 adults, with or without children of any age. I do not report results from other types, since they followed the same pattern, but show in Figure 2 the results from the 1-adult type.

**Figure 1. Non-parametric local regression of imputed rent's share of gross income on gross income. Households of 2 adults (and zero, one, or several children). Non-deflated. Norway. 2004-2006**

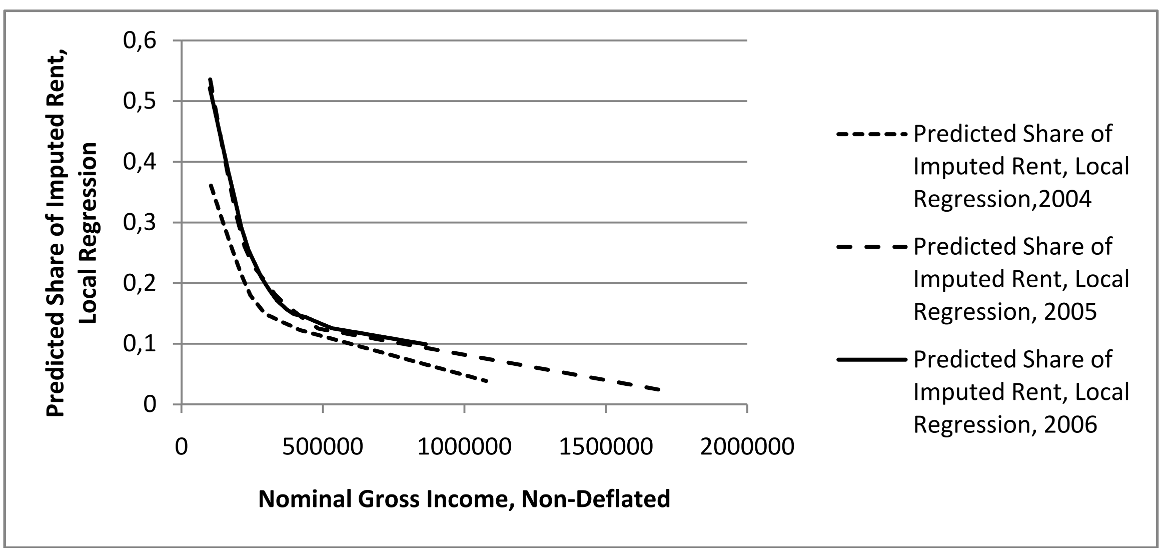



Notes: Nominal Gross Income does not include imputed rent. I truncated all datasets by requiring gross income to be more than 100 000 NOK per household and less than 2 000 000 NOK per household. The non-parametric regression line for households of 2 adults and an unspecified number of children in the year 2004 included 579 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 347. Residual sum of squares: 0.584. Equivalent number of parameters: 4.12. The non-parametric regression line for households of 2 adults and an unspecified number of children in the year 2005 included 530 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 318. Residual sum of squares: 0.449. Equivalent number of parameters: 4.04. The non-parametric regression line for households of 2 adults and an unspecified number of children in the year 2006 included 508 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 304. Residual sum of squares: 1.33. Equivalent number of parameters: 4.03.

We see from Figure 1, that although functional form always is contentious in Engel curve studies, the non-parametric regressions demonstrate that the parametric model consisting of second order log-polynomial would capture the essence of curvature. The impression of imputed rent being a necessary good is reinforced as the proportion of imputed rent clearly falls with gross income, although at a decreasing rate.

There are at least two noteworthy findings in Figure 1. First, notice the difference in the proportion of imputed rents for a given year. While households with low material standard of living may devote as much as 30 percent of gross income to housing, households with higher material standards of living may devote as little as 5 percent. Second, imputed rents show cyclicality. The 2004 and 2005 methodology was identical, yet the imputed rent shares of 2004 were considerably lower than those of 2005. My interpretation of this is that imputed rents partially reflect general economic conditions, including interest rates and house values. In other words, the shift up-wards of imputed rent-share indicates that a tax on imputed rent would be relatively higher (lower) in relatively favorable (unfavorable) economic conditions. They would work counter-cyclically. Figure 2 for smaller households of only one adult shows the same empirical regularity, although less pronounced for the shifts, but more dramatic for the difference in rent proportion between low and high material standards of living. The latter is consistent with the need for making housing taxes progressive in order to make them politically acceptable.

**Figure 2. Non-parametric local regression of imputed rent's share of gross income on gross income. Households of 1 adult. Non-deflated. Norway. 2004-2006**

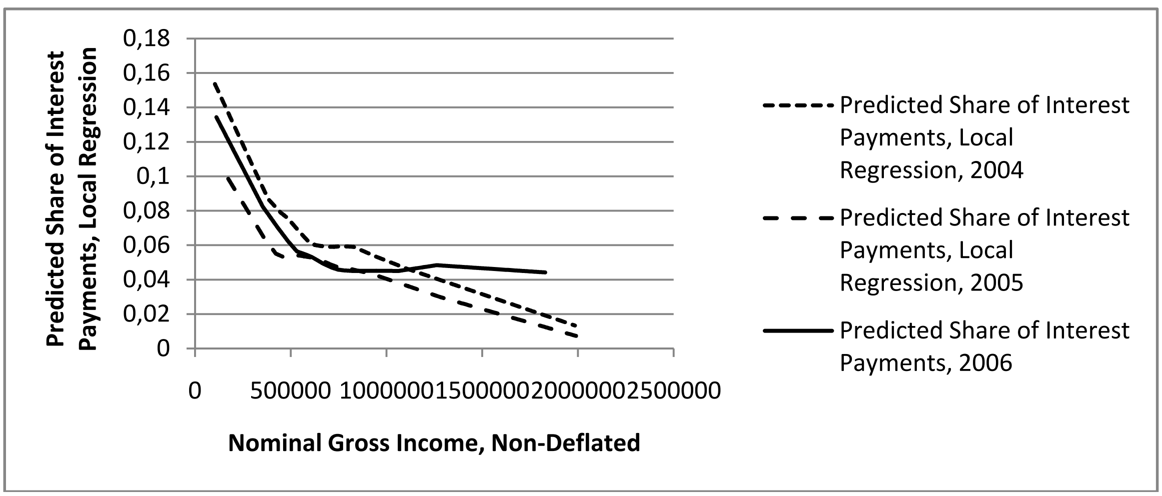



Notes: I truncated all datasets by requiring gross income to be more than 100,000 NOK per household and less than 2,000,000 NOK per household. The non-parametric regression line for singles in the year 2004 included 85 observations. It had 14 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 51. Residual sum of squares: 0.208. Equivalent number of parameters: 4.03. The non-parametric regression line for singles in the year 2005 included 101 observations. It had 14 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 60. Residual sum of squares: 0.77. Equivalent number of parameters: 3.87. The non-parametric regression line for singles in the year 2006 included 89 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 53. Residual sum of squares: 0.88. Equivalent number of parameters: 4.03.

### 4b. Observed interest payments

Interest payments in Norway are deductible at a 28-percent rate. Although such a scheme clearly amounts to a negative tax or a subsidy, it remains an empirical question whether this subsidy is progressive or regressive. Moreover, it is also an empirical question if the subsidy functions pro-cyclically or counter-cyclically. Since the subsidy must be financed, it implies, given the government's budgetary needs, that labor income taxes are higher than they otherwise would have been. Then, most likely, the interest rate subsidy is efficiency-reducing. I examine the income distribution of the proportion of interest payments for the three cross-sections of 2004, 2005, and 2006. Figure 3 shows the results of non-parametric regressions.

**Figure 3. Non-parametric local regression of paid interest's share of gross income on gross income. Households of 2 adults (and zero, one, or several children). Non-deflated. Norway. 2004-2006**




Notes: I truncated all datasets by requiring gross income to be more than 100,000 NOK per household and less than 2,000,000 NOK per household. I also required positive entries on the variable interest payment. The non-parametric regression line for families of 2 adults and children in the year 2004 included 472 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 283. Residual sum of squares: 1.11. Equivalent number of parameters: 4.20. The non-parametric regression line for singles in the year 2005 included 428 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 256. Residual sum of squares: 0.61. Equivalent number of parameters: 4.08. The non-parametric regression line for singles in the year 2006 included 375 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 225. Residual sum of squares: 0.59. Equivalent number of parameters: 4.15.

Notice two features. First, the share of interest payments falls with income, and this supports the notion of housing consumption as a necessary good. Second, the magnitude of the housing subsidy is highly sensitive to changes in monetary policy and the business cycle. In Norway, most households use variable-interest mortgages when they finance house purchases. This means that interest payments are extremely sensitive to the central bank's target rate, which in Norway is the folio interest rate, since the mortgage rate is closely related to the target rate.

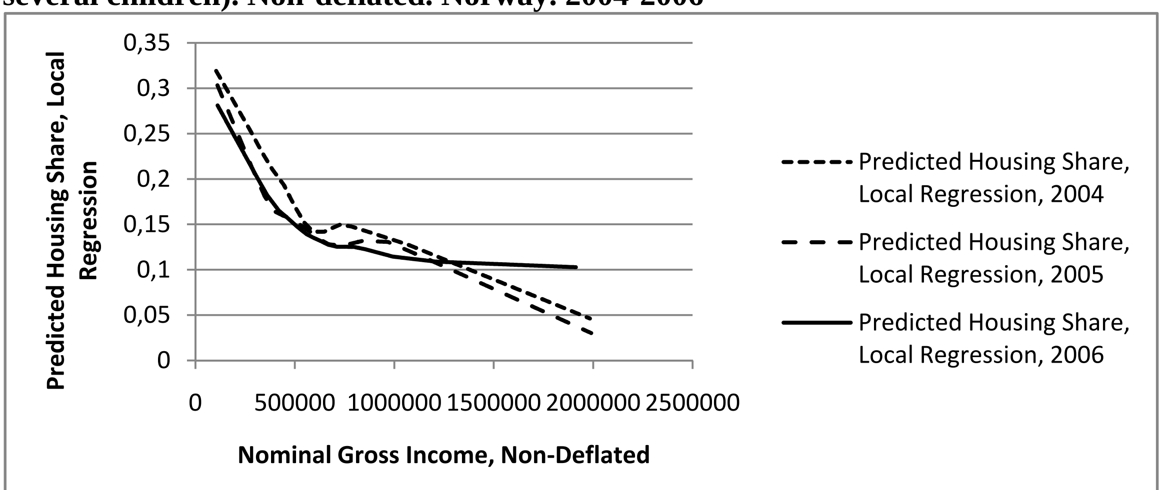
The central bank's policy rate was reduced on March 11 2004 from 2.0 percent to 1.75 percent. On June 30th 2005, it was raised back up to 2.0 percent. Then it was raised regularly on central bank meetings and on December 13th 2006 it was raised to 3.5 percent. The ramifications of the sensitivity of interest payments to the policy rate can be detected in Figure 3. We see that the 2005-curve lies below the 2004-curve, an effect attributed to how banks respond to the policy rate and when the households were interviewed. The 2006-curve shifts again, and even the curvature changed. I interpret these shifts as consistent with the hypothesis that the interest payment deductibility, i.e. the housing subsidy, is pro-cyclical. The larger the central bank's target rate, the larger the subsidy. Since the central bank's target rate is larger (smaller) the better (worse) the economic conditions are, the subsidy works pro-cyclically and exacerbates the business cycle.

**4c. Expenditures on rent, fuel, and power**

Both imputed rent and interest payments constitute one element out of several elements in a household's housing needs. Households also require fuel and power. Moreover, they must pay insurance premiums and accept maintenance outlays. In the CES-system housing expenditures in general comprise one out of nine major expenditure categories. In order to examine housing demand completely, I also inspect this general category.

In Figure 4 I show the results from a non-parametric local regression of the proportion of the main expenditure category "Housing Expenditures" onto gross income. The empirical pattern is clear. Housing expenditures decline with income, so the aggregate good "Housing" is a necessity.

**Figure 4. Non-parametric local regression of aggregated[1] housing expenditure's share of gross income on gross income. Households of 2 adults (and zero, one, or several children). Non-deflated. Norway. 2004-2006**




Notes: [1]Aggregated housing expenditures is one of nine main (exhaustive) expenditure categories. This category encompasses all types of observed expenditures related to housing, including rent, fuel, and power. I truncated all datasets by requiring gross income to be more than 100,000 NOK per household and less than 2,000,000 NOK per household. I also required positive entries on the variable interest payment. The non-parametric regression line for families of 2 adults and children in the year 2004 included 693 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 415. Residual sum of squares: 28.9. Equivalent number of parameters: 4.09. The non-parametric regression line for singles in the year 2005 included 632 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 379. Residual sum of squares: 11.7. Equivalent number of parameters: 4.06. The non-parametric regression line for singles in the year 2006 included 578 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 346. Residual sum of squares: 8.47. Equivalent number of parameters: 4.02.

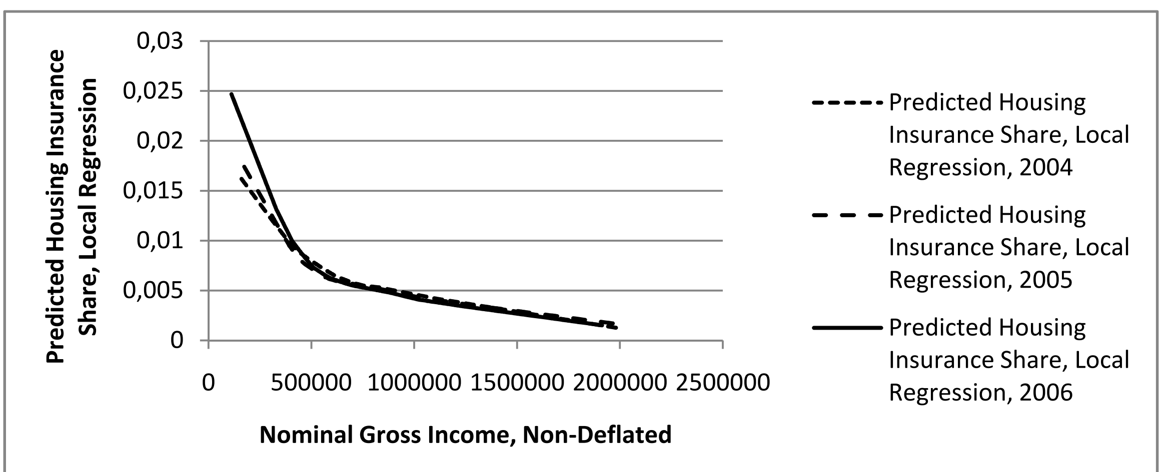
Potentially, policymakers could contemplate levying a housing tax on the observed expenditures on the main category housing expenditures. After all, the demand curve is fairly robust and the need for heat and electricity may share some of the immobility status with shelter consumption. Figure 4 reveals a fairly monotonous curve with few kinks. Still, a housing tax based on this general category would not be practical. There would exist incentives to misreport outlays, and controlling the misreports would be costly. Potentially, then, some policymakers would consider a tax related to the value of the home, as assessed for insurance purposes.

### 4d. Observed insurance payments

Insurance payments are related to the value of the house and housing consumption is related to the value of the home. Thus, one could fathom a proposal to construct a tax scheme based on insurance value. One advantage is that, in contrast to interest payments, insurance payments do not change with payments on principal and they are relatively insensitive to the business cycle (although the value of the house does vary pro-cyclically).

In Figure 5, I show the results from a non-parametric regression of the share of insurance premiums onto gross income. They are remarkably smooth across the income spectrum and very stable over time. The curves are almost identical for the three cross-sections.

**Figure 5. Non-parametric local regression of proportion of housing[1] insurance expenditures on gross income. Households of 2 adults and an unspecified number of children. Non-deflated. Norway. 2004-2006**



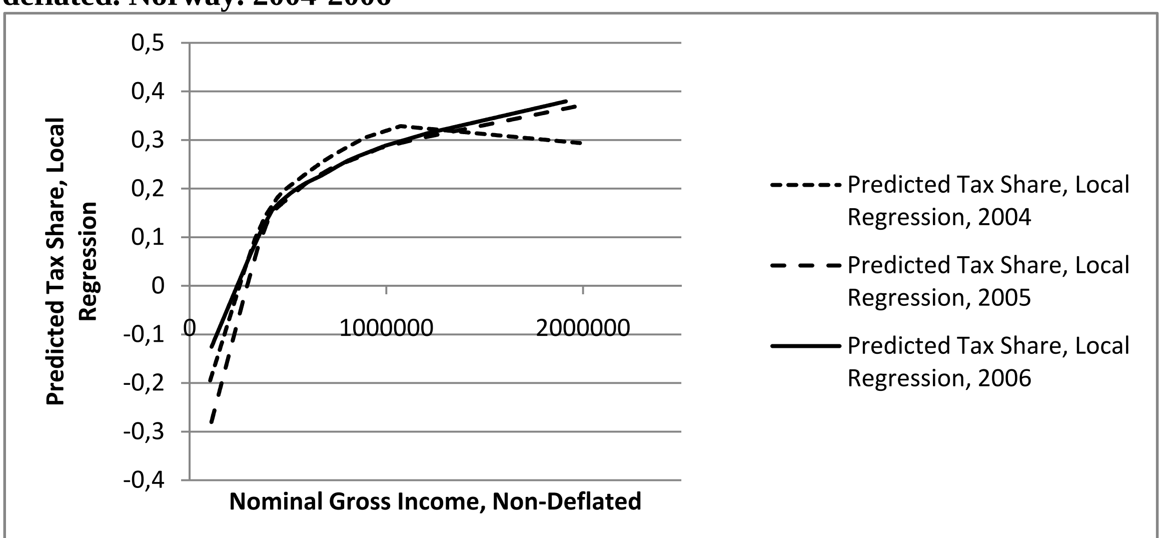

Notes: [1]I truncated on positive expenditures on housing insurance. I also truncated all datasets by requiring gross income to be more than 100,000 NOK per household and less than 2,000,000 NOK per household. I also required positive entries on the variable interest payment. The non-parametric regression line for families of 2 adults and children in the year 2004 included 503 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 301. Residual sum of squares: 0.0065. Equivalent number of parameters: 4.14. The non-parametric regression line for singles in the year 2005 included 418 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 250. Residual sum of squares: 0.0083. Equivalent number of parameters: 3.98. The non-parametric regression line for singles in the year 2006 included 385 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 231. Residual sum of squares: 0.0074. Equivalent number of parameters: 4.08.

However, the insurance value of a house is the rebuilding cost, and this may not accurately reflect the value of the home since it could be of an impractical type or be located at a low-value site. The latter is important since a key component of the value of a home is the value of its spatial coordinates. Housing consumption is not only a consumption of hedonic, physical housing attributes, but also a consumption of location and position. Households have a willingness to pay for proximity to urban centers and geographical amenities, and it is this willingness to pay that may represent the immobile and immutable core part of housing demand, which makes it attractive for tax purposes.

### 4e. The distribution of total taxes and housing taxes

This article claims that a proposal of a new tax scheme is not feasible if it is regressive. Many authors focus attention on the redistributive aspect of suggestions of tax reforms, and this makes it only natural to inspect the progressivity of the Norwegian tax system. In Figure 5 I depict how the tax (measured as the difference between gross and net income) proportion of gross income varies with gross income. We observe that the non-parametric regression uncovers strong progressivity. Households with low gross income either pay little in tax, or they receive subsidies and transfers. Households with high gross income pay almost 40 percent of it in taxes in 2006. The tax share increases almost monotonically with gross income. This supports the claim that in Norway a new tax would not be viable if it were to be borne mostly by households with little income.

**Figure 5. Non-parametric local regression of total tax[1] share of gross income on gross income. Households of 2 adults and an unspecified number of children. Non-deflated. Norway. 2004-2006**




Notes: [1]I defined tax as the difference between gross income and net income as reported by the tax register. I truncated all datasets by requiring gross income to be more than 100,000 NOK per household and less than 2,000,000 NOK per household. I also required positive entries on the variable interest payment. The non-parametric regression line for families of 2 adults and children in the year 2004 included 693 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 415. Residual sum of squares: 14.2. Equivalent number of parameters: 4.09. The non-parametric regression line for singles in the year 2005 included 632 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 379. Residual sum of squares: 10.0. Equivalent number of parameters: 4.06. The non-parametric regression line for singles in the year 2006 included 578 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 346. Residual sum of squares: 5.52. Equivalent number of parameters: 4.02.

### 4f. Necessary features of a politically feasible (housing) tax

I constructed an example of a housing tax based on imputed rent. In order to do so, I suggest that a housing tax must fulfill at least four criteria in order to be politically feasible.

1. A cut-off point for gross income must be introduced, below which no housing tax would be imposed. The idea is to avoid the possibility that some households have low income, but still live in valuable houses; i.e. because they have inherited the houses or are of old age. Such households could/would be forced to sell the house in order to finance a housing tax if a cut-off point were not implemented.
2. The tax rate must be increasing in imputed rent, i.e. the rental-equivalent housing consumption. The idea is that more valuable housing consumption should be associated with more taxes.
3. The proportion of a housing tax out of gross income must be increasing in gross income; i.e. the housing tax must be progressive.
4. The housing tax cannot be large compared to income and labor income taxes. The idea is that such a levy would be widely opposed and politically infeasible.

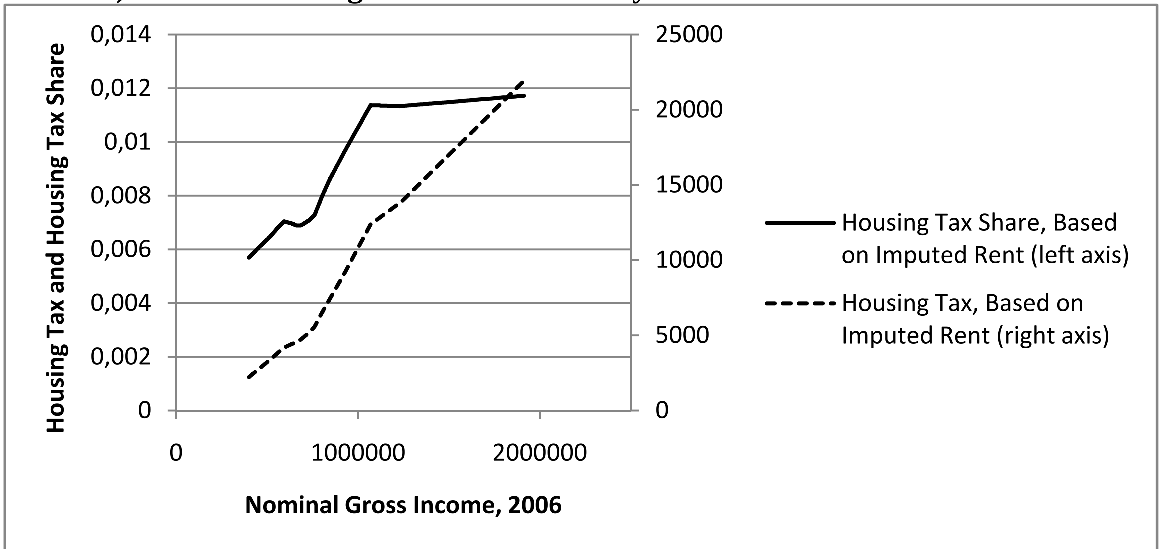
### 4g. A simple housing tax scheme

My simple scheme satisfies all four conditions. It consists of two elements. First, households with gross income below NOK 400,000 pay *no* housing tax regardless of the rental-equivalent consumption value estimated from imputed rent. Second, the housing tax levied upon the household based on imputed rent starts at 30 percent of all imputed rent above the value of NOK 60,000. Then, for values above NOK 70,000; 80,000; and 90,000 additional taxes are levied at rates 4 percent, 5 percent, and 6 percent so that the highest rate is 45 percent. This scheme's relation between housing tax rate and imputed rent is summarized in equation (8).

$$(8) \quad Housing\ tax\ rate = \begin{array}{cc} 0\% & \leq 60{,}000 \\ 30\% & > 60{,}000 \\ 4\%, 5\%, 6\% & > 70{,}000; > 80{,}000; > 90{,}000. \end{array}$$

Figure 6 demonstrates the features of such a housing tax scheme. First, no taxes are levied upon households with low income due to the cut-off point at NOK 400,000. Second, the housing tax rises with income. Third, the housing tax proportion also increases with income. This is clearly a progressive tax, but it is not prohibitively large as it flattens out at around 1.2 percent of gross income.

**Figure 6. Non-parametric local regression of housing tax and housing tax share[1] of gross income on gross income. Households of 2 adults (and zero, one, or several children). Truncation on gross income. Norway. 2006**




Note: [1]I truncated on gross income at the cut-off level of NOK 400 000, which reduced the observed number of households by 62 to 446 in this population segment. The earlier cut-off level at NOK 2 million still applied. The non-parametric regression line for computed housing tax for families of 2 adults and children in the year 2006 included 446 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 267. Residual sum of squares: 34610084910. Equivalent number of parameters: 3.98. The non-parametric regression line for housing tax share for families with 2 adults and children in the year 2006 included 446 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 267. Residual sum of squares: 0.0573. Equivalent number of parameters: 3.98.

In this hypothetical exercise, the 446 households would have paid NOK 2,845,792 in housing taxes, which amounts to NOK 6,381 per paying household. However, 62 households were exempted from tax, so the average tax per households in this segment is NOK 5,602. In Norway, there are about 2.1 million households, regardless of type and segment.[2] Thus, a crude ball-park estimate for the revenue generated by this scheme can be obtained by multiplying the amount of housing tax per household in the sample by the number of households in the population. This estimate is NOK 11.8 billion, which may appear relatively modest compared to a gross domestic product (GDP) of NOK 2,160 billion (NOK 1,581 billion when excluding the value of off-shore oil extraction). The housing tax revenue would be just a little more than half a percent of GDP. However, the scale of revenue may easily be increased.

## 5. Discussion

One possible alternative to my method of estimating housing consumption using imputed rent for owner-occupiers is to estimate housing consumption from interest-rate adjusted estimated market house values. Assume that a given home may be rented for NOK 100,000 per year and that it could be purchased for NOK 2,000,000 at a time where fixed-rate mortgages are available at 5% interest rates. The former implies an estimation of owner-occupier consumption at face value, i.e. NOK 100,000. The latter involves an

---

[2] International readers may find more relevant statistics in English online: http://www.ssb.no/english/subjects/02/01/20/familie_en/

interest payment of NOK 100,000 per year (excluding amortization), and may also be used for consumption estimation since interest payments do not change equity and hence cannot be classified as saving. Both methods have advantages and disadvantages. The latter may be preferable if the rental sector is small, specialized, or localized. Then, market rents will not always be available, or they may be inaccurate. Out-of-sample predictions may be highly imprecise. However, estimating housing consumption from market values also comes with some challenges. First, market house prices appear more volatile than market rental values, so from a policymaker's point-of-view the tax revenue would vary much over time. A tax that varied much over time could be difficult to manage for an owner, since they would have preference for stable and predictable taxes, which facilitates economic planning. In order words, mark-to-market principles for tax purposes could negatively affect the implementability and sustainability of the scheme. Also, in order to preserve support for the tax system, or at least not create social disturbance, the tax would have to be computed from very recent value estimates, and such speed requirements would constitute a major practical challenge. Over the long-term, housing consumption computed from rents or market prices would be quite comparable in magnitude, since the P/E-rate (the price divided by annual rents) in housing markets appears to be mean-reverting. Put differently, the former method's advantage is low tax volatility and the latter method's advantage is its strong potency as a counter-cyclical stabilizer. As an example of a slightly different approach, see Thalmann's (2007) suggestion that market rent may not constitute an entirely appropriate basis for computation since rent may include a mark-up that is meant to take into account landlords' tax payments. He suggests that policymakers inspect households' available income *after* housing costs by keeping track of e.g. production costs and capital gains.

However, alternative methods and computations may require big data sets. The computed taxes may be volatile, unpredictable, and non-transparent. If policymakers and Treasuries shall have a chance of implementing housing taxes, they must be aware of the substantial pedagogical challenge of explaining why an owner should be taxed at all. The rental-equivalence principle is convincing since it is simple and transparent.

I performed model robustness checks, using both different models and different years. Table A2 in the appendix presents summary statistics for housing for the period 2000-2003 and results from a 2SLS regression of observable housing expenditures (main category) onto endogenous total expenditure, number of adults, and number of children, using income variables as instruments. Table A3 reports from a regression onto a second-order polynomial in gross income for years 2000-2003 and Table A4 results from a pooled regression with an adjustment for inflation. Figure A1 and A2 depict results from non-parametric results of the broad housing expenditure variable (main category) and housing insurance onto gross income for the period 2000-2003.

## 6. Concluding Remarks and Policy Implications

Housing may be an attractive object for tax purposes. Housing demand is universal, it is quite immobile, and it is relatively immutable. In fact, it is possible to think of a new housing tax as one with triple-dividends. First, it may be efficiency enhancing if it replaces labor income taxes that have large deadweight losses. Second, it may function as an automatic stabilizer since it would work counter-cyclically. Third, it may be redistributive.

This article claims the latter is a necessary, but not sufficient, condition for implementing a new tax scheme. If a new tax works regressively it would not pass into legislation because the political process would stop it. Thus, a simple scheme involving a flat tax rate on a proxy of housing consumption may be attractive in its simplicity, but it would work regressively if housing is a necessary good. In other words, an empirical analysis of housing demand must precede policymaking. Second, if empirical scrutiny of housing demand uncovers that real-world consumer behavior is complex and unpredictable, even a non-linear tax scheme could turn out to be regressive.

This article shows, however, that by invoking the rental-equivalent principle, it is possible to estimate housing demand by studying owner-occupiers' foregone rent. Combining data on market rents and rental object attributes with data on owner-occupiers' housing attributes, makes it possible to reverse-compute what owners forego in rent when they live in the home themselves. Inspecting these estimates of housing consumption, I find that that housing is, indeed, a necessary good. The demand for housing is quite predictable and stable. In fact, a parametric regression of imputed rent's share of gross income onto a second order polynomial in the logarithm of gross income, using number of adults and number of children as preference shifters, shows that the explanatory power is high. I obtain an adjusted R-squared of 0.587. Non-parametric analysis supports the finding that the share of imputed rent is decreasing in gross income, with curvature.

This clear empirical regularity allows me to construct a non-linear housing tax scheme. By first proposing key conditions for a house tax, I am able to demonstrate that a housing tax put on imputed rent can be increasing in rents and increasing in gross income. Moreover, the housing tax share may also be constructed to increase in gross income. My example would generate an estimated NOK 11.8 billion in year 2006 or about half a percentage of GDP. Thus, a housing tax can be made politically feasible and remain economically reasonable.

## References

Aaron, H. (1970): Income Taxes and Housing, *American Economic Review*, **60**: 5, pp. 789-806.

Atkinson, A. B. and J. E. Stigliz (1976): The Design of Tax Structure: Direct versus Indirect Taxation, *Journal of Public Economics*, **6**, pp. 55-75.

Banks, J., R. W. Blundell, and A. Lewbel (1997): Quadratic Engel Curves and Consumer Demand, *Review of Economics and Statistics*, **79**, pp. 527-539.

Blundell, R. W., M. Browning, and I. A. Crawford (2003): Nonparametric Engel Curves and Revealed Preference, *Econometrica*, **71**, pp. 205-240.

Bye, B. and T. Åvitsland (2003): The Welfare Effects of Housing Taxation in a Distorted Economy: A General Equilibrium Analysis, *Economic Modelling*, **20**, pp. 895-921.

Christiansen, V. (1984): Which Commodity Taxes Should Supplement the Income Tax? *Journal of Public Economics*, **24**, pp. 195-220.

Cremer, H. and F. Gahvari (1998): On Optimal Taxation of Housing, *Journal of Urban Economics*, **43**, pp. 315-335.

Davis, M. A. and J. Heathcote (2005): Housing and the Business Cycle, *International Economic Review*, **46**: 3, pp. 751-784.

Gervais, M. (2002): Housing Taxation and Capital Accumulation, *Journal of Monetary Economics*, **49**, pp. 1461-1489.

Hendershott, P. H. and M. White (2000): Taxing and Subsidizing Housing Investments, NBER Working Paper No. 7928.

Jud, D. and D. Winkler (2002): The Dynamics of Metropolitan Housing Prices, *Journal of Real Estate Research*, 23: 1-2, pp. 29-45.

Leamer, E. (2007): Housing Is the Business Cycle, NBER Working Paper No. 13428.

Lewbel, A. (1998): Semiparametric Latent Variable Model Estimation with Endogenous or Mismeasured Regressors, *Econometrica*, **66**, pp. 105-121.

Leung, C. (2004): Macroeconomics and Housing: A Review of the Literature, *Journal of Housing Economics*, **13**, pp. 249-267.

Nakagami, Y. and A. M. Pereira (1996): Budgetary and Efficiency Effects of Housing Taxation in the United States, *Journal of Urban Economics*, **39**, pp. 68-86.

Okun, A. M. (1975): Equality and Efficiency, in the Big Tradeoff. Washington, D. C.: The Brookings Institution.

Poterba, J. (1992): Taxation and Housing: Old Questions, New Answers, *American Economic Review*, **82**: 2, pp. 237-242.

Røed Larsen, E. and D. E. Sommervoll (2009): The Impact on Rent from Tenant and Landlord Characteristics and Interaction, forthcoming, *Regional Science and Urban Economics*.

Slemrod, J. (1994): Fixing the Leak in Okun's Bucket. Optimal Progressivity when Avoidance Can Be Controlled, *Journal of Public Economics*, **55**: 1, pp. 41-51.

Slemrod, J. and W. Kopczuk (2002): The Optimal Elasticity of Taxable Income, *Journal of Public Economics*, **84**: 1, pp. 91-112.

Thalmann, P. (2007): Tenure-Neutral and Equitable Housing Taxation, *Urban Studies,* **44**, pp. 275-296.

## Appendix

### A1. Alternative Parametric Specification of Table 3

**Table A1. Imputed[1] rent's share of gross income on a second order polynomial of gross income, number of children[2], and number of adults (t-values). Norway. 2004-2006**

| | Year | | |
|---|---|---|---|
| | **2004** | **2005** | **2006** |
| Model 1: Imputed Rent/Gross Income = a + b*(Gross Income) + c*(Gross Income) Squared + d* No. Children + e* No. Adults + u | | | |
| **N[3]** | 882 | 846 | 819 |
| **Intercept** | 0.273 (46.7) | 0.363 (45.2) | 0.343 (34.8) |
| **Gross Income** | -4.093E-7 (-24.9) | -5.27E-7 (-23.4) | -4.88E-7 (-18.2) |
| **Gross Income Squared** | 1.804E-13 (18.5) | 2.20 E-13 (17.8) | 2.05E-13 (14.0) |
| **No. of Children** | -0.00197 (-1.7) | -0.00183 (-1.1) | 0.00105 (0.5) |
| **No. of Adults** | -0.00623 (-3.1) | -0.00744 (-2.6) | -0.000705 (-0.2) |
| **Adj $R^2$** | 0.605 | 0.597 | 0.444 |

Note: [1]Imputed rent methodology change in 2006. See the Data section for details. Truncation at NOK 100,000 and 2,000,000 household gross income. Consumer Expenditure Surveys 2004-2006. [2]Children are defined as household members below 16 years of age. [3]N is the number of observations with positive imputed rent, i.e. homeowners.

### A2. Alternative parametric specifications in earlier years

**Table A2. Manifest housing expenditure on total expenditure, number of children, and number of adults (t-values). Broad housing measure*. Norway. 2000-2003**

| | Year | | | |
|---|---|---|---|---|
| | **2000** | **2001** | **2002** | **2003** |
| Model 1[**]: Housing expenditure = a + b*Total Expenditure + c* No. Children + d* No. Adults + u | | | | |
| **N** | 1052 | 989 | 1035 | 1076 |
| **Mean Housing** | 72 094 | 74 531 | 85 503 | 86 349 |
| **Mean Total Expenditure** | 346 351 | 355 630 | 368 580 | 381 917 |
| **Intercept** | 28704 (3.9) | 24771 (3.9) | 8848 (1.1) | 17580 (2.5) |
| **Total Expenditure** | 0.120 (4.1) | 0.190 (8.9) | 0.266 (8.2) | 0.237 (8.0) |
| **No. of Children** | 5684 (2.7) | 4115 (2.5) | 1764 (0.8) | 660 (0.3) |
| **No. of Adults** | -1939 (-0.7) | -10725 (-3.8) | -10918 (-2.9) | -10408 (-2.7) |

| | | | | |
|---|---|---|---|---|
| **Adj $R^2$** | 0.0661 | 0.116 | 0.116 | 0.119 |

Note: Consumer Expenditure Surveys 2000-2003. Truncation by total expenditure at levels NOK 100 000 and 2 000 000. The former led to deletion of 249 observations; the latter of 2 observations. 4152 observations in dataset for 2000-2003. *K3 is expenditure category 3 (out of 9). It includes housing maintenance, electricity, water etc. ** Two-stage-least-square set-up. Gross and net income are instruments for endogenous total expenditure.

**Table A3. Housing expenditures' share of gross income on a gross income polynomial, number of children, and number of adults (t-values). Broad housing measure*. Norway. 2000-2003**

| | Year | | | |
|---|---|---|---|---|
| | **2000** | **2001** | **2002** | **2003** |
| Model 2**: Housing expenditure/Gross Income = a + b*Gross Income + c*Gross Income Squared + d* No. Children + e* No. Adults + u | | | | |
| **N** | 1097 | 1022 | 1067 | 1097 |
| **Mean Housing** | 69 487 | 71 572 | 81 949 | 84 333 |
| **Mean Gross Income** | 508 639 | 510 739 | 547 967 | 582 897 |
| **Intercept** | 0.294 (16.4) | 0.310 (17.6) | 0.311 (15.7) | 0.308 (21.1) |
| **Gross Income** | -4.258E-7 (-7.5) | -4.683E-7 (-7.6) | -4.366E-7 (-6.8) | -4.508E-7 (-9.9) |
| **Gross Income Squared** | 1.717E-13 (5.1) | 2.323E-13 (5.3) | 1.907E-13 (4.6) | 2.059E-13 (7.3) |
| **No. of Children** | 0.0233 (5.6) | 0.0235 (6.1) | 0.0297 (7.1) | 0.0248 (8.2) |
| **No. of Adults** | 0.000527 (0.07) | -0.00464 (-0.7) | -0.000932 (-0.1) | 0.00287 (0.5) |
| **Adj $R^2$** | 0.107 | 0.129 | 0.118 | |

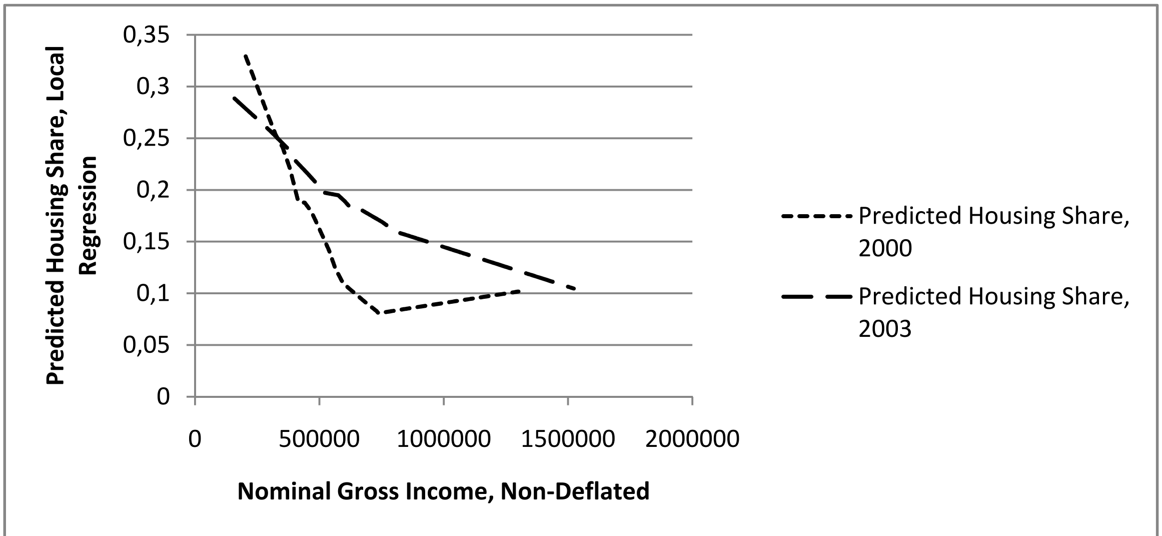
Note: Consumer Expenditure Surveys 2000-2003. Truncation by gross income at gross income levels NOK 100 000 and 2 000 000. The former entail a loss of 86 observations; the latter 34 observations. 4283 observations in dataset for 2000-2003.

**Table A4. Housing expenditures' share of gross income on a real gross income polynomial, number of children, number of adults, and a deflated category 3 index (t-values). Broad housing measure*. Norway. 2000-2003**

| | **2000-2003** |
|---|---|
| Model 2**: Housing expenditure/Gross Income = a + b*Real Gross Income + c*Real Gross Income Squared + d* No. Children + e* No. Adults + f*(Category 3 Index/CPI) + u | |
| **N** | 4,283 |
| **Intercept** | 0.206 (4.5) |
| **Real Gross Income** | -4.472E-7 (-15.3) |
| **Real Gross Income Squared** | 2.038E-13 (10.6) |
| **No. of Children** | 0.0252 (13.2) |
| **No. of Adults** | -0.00095 (-0.3) |
| **Category 3 Index/CPI** | 0.0912 (2.1) |
| **Adj $R^2$** | 0.127 |

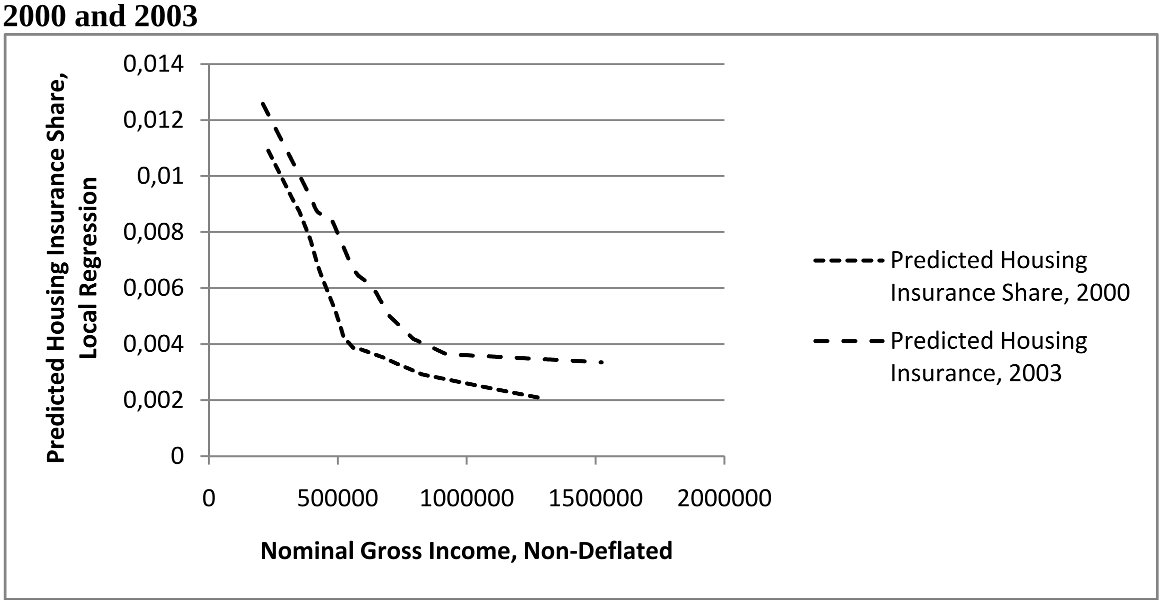
Note: Consumer Expenditure Surveys 2000-2003. Truncation by gross income at gross income levels NOK 100 000 and 2 000 000. The former entail a loss of 86 observations; the latter 34 observations. 4283 observations in dataset for 2000-2003. Category 3 Index is *not* a house price index. It is the sub-index in the CPI associated with the category K3 Housing Expenditures, Electricity, Heating

**Figure A1. Non-parametric local regression of housing[1] expenditure's share of gross income on gross income. Households of 2 adults and 1 child. Non-deflated. Norway. 2000 and 2003**




Notes: [1]The housing measure was the broadest, the full category of housing, heating, and electricity.The non-parametric regression line for households of 2 adults and 1 child in the year 2000 included 116 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 69. Residual sum of squares: 6.96. Equivalent number of parameters: 4.12. The non-parametric regression line for households of 2 adults and 1 child in the year 2003 included 118 observations. It had 15 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 70. Residual sum of squares: 3.56. Equivalent number of parameters: 4.13.

**Figure A2. Non-parametric local regression of housing insurance share of gross income on gross income. Households of 2 adults and 1 child. Non-deflated. Norway. 2000 and 2003**




Notes: Housing insurance does not include insurance premium for the interior content of the home, it covers the physical structure only. The non-parametric regression line for households of 2 adults and 1 child in the year 2000 included 72 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 43. Residual sum of squares: 0.0007. Equivalent number of parameters: 4.18. The non-parametric regression line for households of 2 adults and 1 child in the year 2003 included 77 observations. It had 14 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 46. Residual sum of squares: 0.00080. Equivalent number of parameters: 4.25.