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From data to levy design
The five stages of implementing housing taxes

Abstract:
Taxes on housing consumption have attractive features. They can enhance overall efficiency, function as automatic stabilizers, and work progressively. Implementation, however, requires a careful balance between economic ambition and political reality. This article suggests a 5-stage procedure: identification; estimation; data acquisition and combination; empirical investigation; and tax function construction. It illustrates how to implement by employing 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. It analyzes the distribution of imputed rent over the income range, and demonstrates that imputed rent is a necessary good. A simple tax scheme on real households in a dataset from 2006, shows how a housing tax can be structured with attractive features. 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. In its suggested form, it would generate approximately 12 billion NOK in revenue for Norway.

Keywords: automatic stabilization, deadweight loss, distribution, efficiency, housing taxation, imputed rent, progressive levy, rental equivalence

JEL classification: C14, C21, D12, D63, H23

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1. Introduction

In the aftermath of the worldwide financial crisis, many policymakers and economists are looking at how best to stabilize housing markets. One option is to introduce automatic stabilizers in the form of housing taxation where it does not exist and revise it where it does. Intriguingly, such a tax can have several dividends. First, it can help stabilize economic development since it can be fashioned to work counter-cyclically and dampen highly pro-cyclical housing consumption; see e.g. Leung (2004); Davis and Heathcote (2005); Jud and Winkler (2002); and Leamer (2007). In fact, the governor of Norway's central bank has recently argued the benefits of housing taxation on exactly these grounds.[1] This is firstly because, he explains, the favorable tax treatment could make housing assets more attractive than other assets, and because the central bank's only tool, the interest rate, cannot be used to target inflation, limit interest-rate differentials to other currencies, and function as a housing market stabilizer at one and the same time. Second, a revenue-neutral substitution of a housing tax for an income tax could reduce deadweight losses; see simulations on general-equilibrium models by Nakagami and Pereira (1996) and Bye and Åvitsland (2003). Third, since the demand for housing may have relatively stable and monotone Engel curves, a properly designed housing tax could be constructed to function progressively. The latter point is important since a proposal of a new and *regressive* tax would be dead on arrival in many economies and where they do exist the flat-rate property taxes and the small scale housing taxation most likely work regressively; see Hendershott and White's (2000) survey. The design of such taxes and whom they affect and how may explain their unpopularity. On the other hand, there is an urgent need to reform the tax given recent concerns about housing inequity (Thalmann (2007)) and since many authors have pointed towards 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)). This article seeks to define the core elements of an implementation procedure of housing taxation and how existing housing taxation could be practically revised to become cheaper, quicker, and progressive.

This article partitions the procedure in five key stages: identification; estimation; data acquisition and combination; empirical investigation; and tax function construction. None are trivial. Consider first the concept of housing. Designing a tax system implies a classification of the tax object. A house may generate rental income, it is a capital asset, and it facilitates the consumption of housing services.

[1] See story in *Aftenposten*, October 1 2009, economy section, pp. 1 and 4. For an English version of the governor's September 30 speech, use the internet permalink: http://www.norges-bank.no/templates/article____75542.aspx.

Thus, since a tax system can levy an income tax, a wealth tax, a property tax, or a consumption tax on the house-owner the tax designer must be careful to specify and analyze the tax base. Second, owner-occupiers receive no observable rental income, they own assets of unknown market value, and they extract consumption services of unobserved magnitude. Thus, a tax designer has to construct an estimation procedure. Third, for an empirically based data driven tax design a statistical agency must acquire and update data on a continuous basis. Fourth, the distribution of taxes is a political issue and a sensitive question of equity. Thus, a designer would be well advised to anticipate who will bear the burden of a housing tax. This involves mapping housing consumption along the spectrum of material standard of living. Fifth, since the opposition towards new taxes plausibly depends upon the progressivity of the system, the designer might benefit from contemplating certain basic attributes of tax functions. I suggest four.

This article presents theoretical and empirical results of implementing a housing tax in a certain way. I call it the “consumption method” because levies are computed directly on the basis of estimated housing consumption in contrast to indirect methods of taxing housing ownership which involve adding imputed housing income to labor income, adding estimated housing wealth to financial wealth, or levying a property tax. There are two principal advantages to this approach. It allows one to employ conventional methodology, i.e. the rental-equivalence principle; and the method is transparent. Moreover, since the estimation technique it employs relies on an algorithm derived from a combination of data bases rather than manual appraisals, it is cheaper, quicker, and less subjective. Having said, that the consumption method also involves the introduction of a new tax, unlike implementing a house tax through the utilization of income or wealth taxes.

My contribution is threefold. First, I attempt to demonstrate the sufficiency of the suggested procedure from data acquisition to policy introduction. Second, I construct an estimator of latent housing consumption based on the combination of observed rents and rental attributes with attributes of owner-occupied housing to impute counter-factual rents using a rental-equivalence principle that goes back at least to Aaron (1970). Third, I construct a progressive tax function and show that it would satisfy four progressivity principles on real and recent data from Norway in 2006.

The results could help policymakers since they spell out how a housing tax can be implemented in economies that do not have one. In fact, many countries appear to be contemplating such a tax, not least because the recent rise and fall in house prices may have amplified the business cycle and destabilized the banking sector and overall economy. In countries with a housing tax based on appraisals, for example the Netherlands (see de Vries et al. (2009), this article's set-up offers a potentially much less resource-demanding and time-consuming way of maintaining the system of house price estimates. 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, and hence lower deadweight losses. For an economy whose gross domestic product (GDP) is NOK 2,160 billion, it might, however, appear somewhat insubstantial since the housing tax revenue is just a little more than half a percent of GDP. But the revenue can easily be increased by changing the scale of the levy.

In summary, this article combines an understanding of the construction of house price indices, results from tax theory, and empirical techniques from the literature on Engel curves. I hesitate to offer even a basic review of these expansive fields of knowledge. Let me instead briefly sketch the contours of some useful studies at the point of convergence between taxes and distribution and housing and taxes. A useful starting point is Atkinson and Stiglitz (1976), according to whom "tax structures must be centrally concerned with distributional considerations" (page 55). They found no role for commodity taxes: "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 off distributive issues, even if it is as complicated as Okun (1975) describes when he likened redistribution to transferring water from the rich to the poor in a leaky bucket. Slemrod (1994) addressed the issues underlying that leak, suggesting there exists an optimal rate of leakage. The optimal rate is an empirical entity and closely related both to actual behavior and to the multiplicity of instruments for tax revenue generation. So, it may be argued that policymakers would be well advised to study theoretical studies in tandem with empirical investigations. Recently, Slemrod and Kopczuk (2002) examined 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 include 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 for individuals to avoid taxation of housing because of its durability and immobility (Leung (2004, p. 252). We might add observability. Hendershott and White (2000) survey the shifts in the status of housing taxation and subsidization from the 1970s and explain 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 taxpayers deduct mortgage interest payments. This followed the earlier study of Nakagami and Pereira (1996) who use a dynamic general equilibrium model to show how removing interest deductibility and imputed rent exemption would affect both the budget and efficiency. It would boost revenues and improve allocation efficiency, they found. Cremer and Gahvari (1998) examine the question of optimal taxation of housing, and note that the recent literature has raised the possibility of substantial efficiency loss by the preferential treatment of owner-occupied housing. They point out how, under certain conditions, housing for the poor can be subsidized and how optimal taxes must be non-linear, both results being consistent with my findings in this article. Leung (2004) surveys the new and emerging literature on the link between macro and housing and asks pertinently why, given the apparent consensus among economists, is it that preferential treatment of housing is undesirable, and why was it implemented in the first place. Unable to give exhaustive answers, he points to the assumed positive externalities and social benefits of homeownership, governmental myopia and time-inconsistency as likely possibilities. It is a timely question, and this article calls for a renewed effort to overhaul the housing tax system and suggests how this could be accomplished.

The article is organized as follows. The next section discusses the different bases for housing taxation and the subsequent section introduces theory and empirical techniques of estimating latent housing consumption. The fourth section describes the acquisition and combination of required datasets. The fifth section presents empirical results on estimates of housing consumption and their distribution. In section 6, I design the proper housing tax system before discussing in the seventh section the advantages and disadvantages of the approach and investigating some of the alternatives. The final part is dedicated to concluding remarks and likely policy implications. The appendix contains some of the finer details and robustness checks on regressions on earlier datasets and other variables.

2. Stage One: Identification of the Housing Tax Base

This article suggests that the direct way to housing taxation may be the most politically feasible: levy house taxes directly on housing consumption. However, housing consumption can be measured in several ways. It may be seen as foregone rent – which is the basis for the rental-equivalence principle – or it can be derived as the component of housing expenditures that does not change household equity. Using the latter approach, payments on principal are not a component of housing consumption, they are classified as re-allocation of equity. However, manifest interest payments on mortgages are one, though not the only component of interest costs. Latent, implicit interests on own equity comprise the remainder. Thus, interest may be viewed as either the hypothetical interest payments paid on the mortgage that would have financed a purchase of a given home in the market at a given point in time, where the household has no equity. Alternatively, interest could be defined as the counter-factual shadow return on a full conversion from selling a home and placing the receipts in a fixed-income security. Both of these interest aggregates (outlays or income) can be estimated using a hedonic house price index that imputes a home's market value from the attributes of the home and using mean long-term market interest rates.

The direct taxation of housing consumption, whether based on the rental-equivalence principle of imputing rent or the interest-accrued approach, could be difficult to implement politically because of obstacles within the existing tax code. And policymakers might stall at the idea of introducing yet another *type* of tax object.

Policymakers, then, could require houses to be taxed in the same way as shares or savings deposits, that is, by levying a tax on what would be just another asset. It would be necessary, of course, in order to levy a wealth tax to assess the value of any and every house deemed to belong to the tax base, and the assessment would have to be undertaken frequently in order to avoid over- or undervaluation. The assessment scheme could become quite a drain on resources; see De Vries et al. (2009) for more on such schemes.

Another option is to classify housing consumption of owner-occupiers as implicit income, adding this income to a household's labor income in the same manner as financial income is. It could be argued that a first-best solution is simply to view a house as a capital asset and tax it as an asset exactly the same way other assets are taxed: housing income by capital income taxes and housing wealth by wealth taxes. The capital asset approach is consistent with this article's set-up since such a tax base could be identified in stage one and such a tax scheme could be constructed in stage five. However, the capital asset approach faces practical and political challenges. First, the housing dividend is not manifest as other dividends. It would have to be estimated, e.g. by way of employing this article's imputed rent estimator. Second, the political opposition to treating a necessary consumption good, housing, identically to capital assets such as stocks and bonds would be formidable. Since many countries have a flat-rate tax on capital income a distributional analysis would demonstrate that a similar flat-rate tax on a necessary consumption good would function regressively. So, although transparent and logical, the drawback is that "housing income" could be considered "a special" income source by politicians and have to be distinguished from labor and financial income. If not, households whose income was largely derived from "housing income" would face a dramatic increase in tax levies, creating its own political headaches. Instances in which housing taxes exceeded labor income and pensions would obviously attract a lot of publicity and political and public resistance. In Stage Five, I suggest a scheme based on postponed taxes to deal with this objection.

Policymakers could possibly prefer a housing taxation scheme that satisfies the following conditions: a) its purpose and function can be explained in a comprehensible way; b) it allows for a timely updating of level of levy; c) it can utilize databases and an algorithm platform instead of physical assessment by subjective appraisers; and d) it allows but does not rely on an ability to isolate/differentiate income sources such as labor income. All these conditions are satisfied if we use "imputed rent" as an estimator of housing consumption, as indeed the rental-equivalence principle states. It is easy to explain and the public understands it intuitively. Levies can be changed every year, computed on the basis of two datasets, namely rental data on the association between rents and hedonic attributes and spatial coordinates, and owner data on hedonic attributes and spatial coordinates. The method also allows for tax codes that differentiate it from labor income. This article demonstrates one efficient mode of implementation.

3. Stage Two: Estimation Theory and Empirical Technique

The second stage involves three sub-stages: an analysis of when a tax is regressive and progressive, the establishment of an estimation procedure for housing consumption, and the empirical technique to be used when investigating the distribution of housing and housing tax. I present below a detailed account of all three.

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 ω_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 θ_h is a linear function of the budget share ω_h when t is a constant. Since the budget share varies across households, then when t is a constant 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 here 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 $\omega(y_h, x_h)$ can be simplified to a function only of total expenditures, $\omega(x)$. 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 $\delta\theta/\delta x = t(\delta\omega/\delta x) < 0(> 0)$. Such a tax, it follows, is therefore regressive (progressive). If indeed it is regressive, it can be turned into a progressive tax by policymakers constructing an appropriate tax scheme $t(x)$ as a non-linear function of x such that the tax share of total expenditures increases with x, as given by equation (2):

$$\text{(2)} \qquad \frac{\partial \theta(x)}{\partial x} = \frac{\partial t(x)}{\partial x}\omega(x) + t(x)\frac{\partial \omega(x)}{\partial x} > 0.$$

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 in absolute terms the possibly falling budget share in the second component. As this simple and straightforward exercise demonstrates, empirical estimates of consumer behavior could be of considerable interest to policymakers, since $t(x)$ is within their discretion to implement as policy while $\omega(x)$ 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 what counts as housing consumption is non-trivial and controversial. Employing manifest housing expenditures as estimates of latent housing consumption requires several tenuous assumptions and contains multiple sources of errors. Second, the measurement of total expenditures is non-trivial. Third, the choice of functional form and how to control for important omitted variables are non-obvious.

I define housing consumption to be a quantity and housing consumption expenditure to be that quantity multiplied by its price. I deal with the first challenge by using the rental-equivalence principle to employ imputed rent as an estimator of latent housing consumption expenditure. Now, even if manifest housing expenditures are directly observable as entries in diaries kept in connection with Consumer Expenditure Surveys (CES), they are rendered inadequate by heterogeneity in the completion of the amortization of the principal. Latent housing consumption expenditure as a variable consists of the unobservable quantity of consumption and a theoretical price. This price depends on the unobservable value of the home. 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 non-zero equity. However, the latent stream of housing services has a latent value that differs from the interest payments. Thus, I estimate the value of this consumption, i.e. the owner-occupied housing consumption expenditure, by identifying the housing consumption value as foregone rent.

This article uses imputed rent as an estimator of latent housing consumption expenditure. The estimation involves a two-step procedure. First, the statistical agency collects observations from rental markets on vectors containing market rent, hedonic attributes, spatial coordinates and other determinants. It regresses observed rent, R, onto the relevant space spanned by rent determinants and obtains the partial rental price for each hedonic and spatial housing components, as given in equation (3):

(3) $$R_{te} = k + hH_{te} + sS_{te} + oO_{te} + u_{Rte}, te \in TE,$$

where R is observed rent for tenant *te* in the tenant sample *TE*, and H, S, and O are hedonic attributes, spatial coordinates, and other determinants of the object the tenant rents. Second, the statistical agency conducts consumer expenditure surveys to collect vectors of such housing components from owner-occupier households, and estimates what the households would have paid in rent had they rented their own home. To this end, imputed rent functions as an estimator of latent housing consumption expenditure for owner-occupiers, as given in equation (4):

(4) $$\hat{y}_{ih} = \hat{R}_h = \hat{k} + \hat{h}H_h + \hat{s}S_h + \hat{o}O_h,$$

where i is the housing category among consumption categories; the estimated parameters k, h, s, and o are used in combination with the hedonic attributes, spatial coordinates, and other determinants of the housing object owned by the owner-occupier h to compute the estimate on latent housing consumption expenditure for the owner-occupier h.

Having established an estimator of housing consumption expenditure, I turn to the technique with which to examine the distribution. Then, I deal first with the second and third challenges mentioned above by substituting gross income for total expenditures and employing both parametric and non-parametric techniques. To see why, consider the following rationale. In general, we would like to inspect the empirical relationship between latent consumption expenditure in household *h* on category *i*, η_{ih}, and latent total consumption expenditure in household *h*, ξ_h, by examining their observable counterparts, i.e. expenditures in category *i*, y_{ih}, and total expenditures, x_h. Equation (5) establishes the relationship between these two empirical counterparts.

(5) $$y_{ih} = f\left(x_h\right) + u_{ih}.$$

Manifest total expenditure x_h is the sum of latent total consumption expenditure and all measurement errors in individual categories, $\xi_h + \sum_i u_{ih}$. 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 (5). In other words, the regressor x_h is not exogenous. This could have been dealt with by running two-stage-least-square (2SLS) regressions and modeling total expenditure as endogenous, and using income as an exogenous instrument. 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 consumption 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 endogenous variable total expenditures and use instead the exogenous variable gross income. Equation (6) presents the parsimonious parametric model of the relationship between the proportion of estimated housing consumption expenditure (imputed rent) out of gross income and gross income itself.

(6) $$\frac{\hat{y}_{ih}}{GI_h} = a + b\log\left(GI_h\right) + c\left(\log\left(GI_h\right)\right)^2 + dD_h + e_{ih},$$

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

The omitted-variable problem constitutes a challenge. There will almost always be a risk that models will miss some important factor, without the analyst knowing which variables are left out or how they influence the regressions. This entails possible biases in the parameter estimates. In demand and Engel curve estimation certain shift parameters are, however, known ex ante or in the literature to be of importance. One such factor is the vector of key demographic variables, e.g. size and composition of the household, and life-cycle stage indicators, e.g. age of main income earner. Obviously, a large household needs a larger house than a small one, everything else being the same. Thus, I use the number of children and the number of adults in the household as shift parameters of the curves. Moreover, a young household is likely to have different housing needs than an older one, everything else being the same, so I include age as a preference shifter.

Another core variable is relative price. It is conventional 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 so for housing. Some would argue that relative housing prices cannot be identical to all households at the same time since prices do vary across regions for a given set of hedonic attributes, e.g. size. This, however, is not necessarily a valid objection. Its relevance depends crucially on whether confounding is present or not. The partial price for a given hedonic attribute, such as size, is mis-measured if one fails to control for a correlated determinant, such as quality of location. In fact, it is easy to explain most of the different prices across regions for hedonic attributes when controlling for spatial qualities and amenities.

Functional form is contentious in the literature on Engel and income curves. I therefore supplement the parametric approach with a non-parametric technique to map the relationship between the share of imputed rent and income. A local regression technique then estimates the Engel (or income) curves. Since gross income is exogenous, it is a useful determinant in the non-parametric estimation process. I start my non-parametric estimation procedure by noting how the relationship between the housing share of income before tax and income before tax is given by equation (7):

$$(7) \qquad \omega_{hou,h} = \frac{\hat{y}_{ih}}{GI_h} = g\left(GI_h, D_h\right) + \mu_h,$$

in which $g(.)$ is an unspecified function, potentially non-monotonous, and the classically behaved error term μ is uncorrelated with gross income, GI. As before, D denotes demographic variables such as size and composition, and ω_{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.[2] The linear

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

regression weight assigned to an included observation GI_i around GI_h, for which the local line is fit, is given by equation (8):

$$(8) \qquad W\left(GI_i, GI_h, b_i\right) = K_0(x) = K_0\left(\frac{GI_i - GI_h}{b_i}\right), \qquad i \in I, h \in H, x \in X,$$

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 $K_0(x)$:

$$(9) \qquad K_0(x) = \begin{Bmatrix} \left(1 - |x|^3\right)^3, \text{ for } |x| \leq 1, \\ 0, \text{otherwise} \end{Bmatrix}.$$

4. Stage Three: Data Acquisition and Combination

In order to estimate latent housing consumption expenditure by employing the rental-equivalence principle, one needs rental data to obtain partial rental prices for housing attributes and consumer data to obtain housing attributes for owners. To this end, I combine data on consumer expenditures, imputed rents implied from a rental survey, and income acquired by Statistics Norway for the period 2004–06. In order to investigate sensitivity and robustness, I perform cross-checks on earlier data from 2000–03 and report some, but not all, results in the Appendix.

4a. 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 diary of all expenditures over a fortnight. These households are subsequently interviewed for 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, cooking stoves, television sets, video recorders, and microwave ovens. Sample sizes are typically around 1,000–1,200 households per year. The sampling scheme is a two-stage stratified random sample of the universe of Norwegian households. Response rates typically lie around 60 percent. The expenditures are classified into a large array of different items. Official data managers code from the entries in the households' accounting books and slot them into pre-assigned groups. Expenditures are annualized (by multiplying by 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. My variable "No. of Children in household" denotes number of children below 16 years of age. I truncate the data in order to minimize outlier influence.

Statistics Norway may, given the authorization, link Consumer Expenditure Survey datasets with datasets from income registers. These income registers are not surveys, but complete and exhaustive full-count registers compiled by the Norwegian Tax Administration (*Skattedirektoratet*, the Norwegian equivalent of the IRS) and National Insurance Administration (*Rikstrygdeverket*). and contain records of all Norwegian residents. I was able to access several income variables in these merged datasets, e.g. income before taxes and income after taxes. So insofar as the reported data do not rely on individual memory or individual discretion, but are transmitted to the income registers directly by the employers, they maintain a very high standard.

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 Imputed Rent[2]	882	0.0366	0.0679	0.0872	0.153
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.

4b. Imputed Rent and Owner-Occupier's Housing Attributes

For every CES survey household, an imputed rent is assigned on the basis of observable attributes of the household's home. This is done by a special task force at Statistics Norway and is a pilot project, utilizing data from the rental survey described below (which the author participated in constructing). Given its novelty as a statistical project, there has only been time to build up three-year set of data. Moreover, there was a methodological break between the 2004-2005 methodology and the 2006-methodology. The latter improved the former; the latest method 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 divided into strata of geographical location, size of home, and home type, giving 24 strata in all. Every household in a given stratum is assigned an imputed rent derived from the average rent retrieved by a rental survey. In 2006, the imputation method included an algorithm that computes imputed rent as an explicit function of size and spatial residence. It was specifically designed to account for the non-linearity in imputed rent for different sizes. The parameters derive 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 of data from the Norwegian Rental Survey, 2005.

As the population of rental objects in Norway is not known it is impossible to draw a simple random sample. There was a count of owner-occupied and rental objects in 2001, which attempted to map all housing objects and identify 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 consists of several stages the first of which involves constructing an address list with ex ante properties, while the second and third involves drawing and contacting households. The Norwegian Rental Survey of 2006 assembled 28,000 addresses in Norway, each of which was assigned an interview object (IO), i.e. a personal name (tenant or owner). This set 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 age 20–29. The region including Norway's capital, Oslo, was over-sampled in the main sample with about 2,000 addresses. These two sampling maneuvers were carried out to detail the rental market in Oslo and overcome non-responding tendencies of young people.

Statistics Norway contacted the IO by mail and/or telephone. Non-responding IOs included 146 persons who had died, 7,464 who lacked an identifiable telephone number, and 4,572 in the miscellaneous category. The data acquisition field period covered February 27 – June 13 2006. Average mean interview length for tenants was 8 minutes and a highly-detailed list of attributes was collected. From the set of addresses, 15,818 interviews (postal and telephonic) were performed; of these 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 range and detail. 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

5. Stage Four: Empirical Investigation of the Distribution of Imputed Rent

Table 3 charts the results of a parametric regression of the share of imputed rent of 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. I include a second regression model for the most recent year with “Age of the main income earner” as a third candidate for preference shifter. All results are robust to this inclusion. Since the 2006 algorithm for imputed rent is more accurate than the predecessors, this is the only year I analyze. I do append however results from 2004 and 2005 in Table 3 for comparison purposes and sensitivity checks. We observe that the regression’s adjusted R-squared is 0.587, a high score in a cross-section with a size of 819. It could indicate an outlier influence, but my truncation scheme with cut-off points at NOK 100,000 and NOK 2,000,000 prevent the tail influencers. Table 1 tabulates the 10^{th} and 90^{th} percentile of the share of imputed rent in 2006 as 0.0612 and 0.207, which indicates a significant compression in the distribution of shares. More likely, the high R-squared reflects partially the fact that imputed rent is a constructed variable, as described above.

Nevertheless, I interpret the high R-squared as at least indicative of preference homogeneity and good model fit. The estimated coefficient of log(gross income) is clearly negative, -2.28, and highly statistically significant with an absolute t-value of 16.3. It demonstrates that housing consumption, measured by imputed rent, is a necessity. The estimated Engel curve for imputed rent 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 magnitudes, they are not both statistically significant. The age of the main income earner does not affect results much, as can be seen in Table 3's right-most column. The estimated coefficient is small and its t-value 0.45, making it far from statistically significant. In the appendix, I list the results of a regression with an alternative specification, a non-log polynomial, in Table A1 which supports the findings shown in Table 3. In summary, the parametric results demonstrate the homogeneity of households' choice of housing, which indicates the potential imputed rent holds as an object for taxation. However, the downward sloping Engel curve also implies that a flat-rate housing tax would work regressively.

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

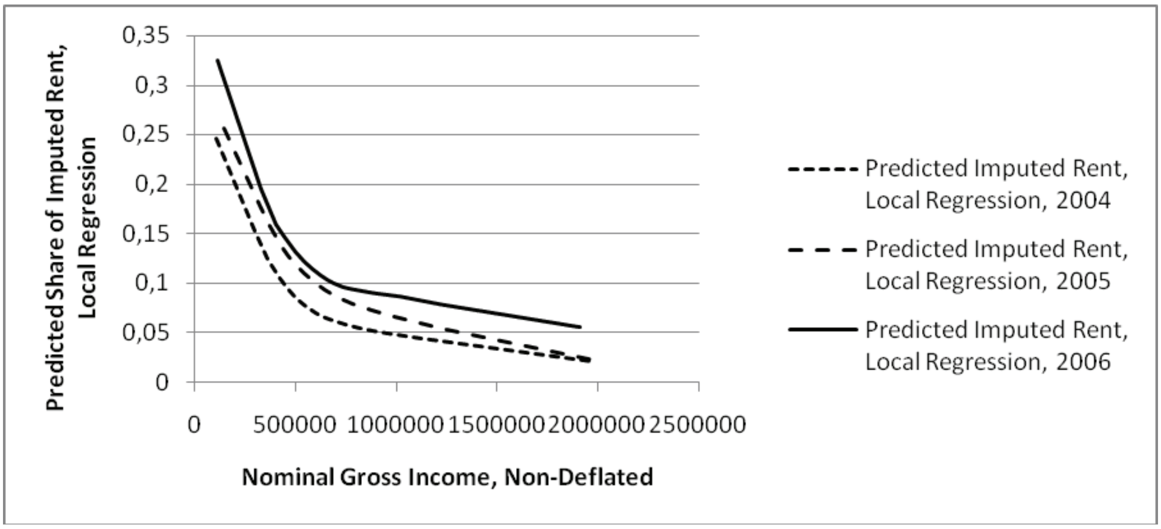
	Year			
	2004	**2005**	**2006**	**2006**
Imputed Rent/Gross Income = a + b*Log(Gross Income) + c*Log(Gross Income) Squared + d*No. Children + e*No. Adults + f*Age of Main Income Earner + u				
N[3]	882	846	819	819
Intercept	10.95 (21.5)	14.9 (23.7)	16.0 (17.3)	16.0 (17.2)
Log(Gross Income)	-1.56 (-20.1)	-2.11 (-22.2)	-2.29 (-16.3)	-2.28 (-16.3)
Log(Gross Income) Squared	0.0559 (18.9)	0.0755 (20.8)	0.0821 (15.5)	0.0820 (-15.4)
No. of Children	-0.00122 (-1.3)	-0.000727 (-0.6)	0.00356 (2.1)	0.00402 (2.02)
No. of Adults	-0.00382 (-2.3)	-0.00151 (-0.7)	0.00463 (1.6)	0.00448 (1.56)
Age of Main Income Earner	Excluded	Excluded	Excluded	0.000080 (0.45)
Adj R^2	0.738	0.761	0.587	0.586

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.

Parametric results are highly useful since they allow data dimensionality to be reduced into a few interpretable parameters. The results, however, may suppress interesting empirical patterns, so to offset this likelihood I ran a non-parametric regression of the proportion of imputed rent onto gross income, see Table 3. Again, in this non-parametric regression type, I control for household type, composition, and size by segmentation. I divide the sample into different segments; 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, though I do show the results from the 1-adult type in Figure 2.

Analysts could worry that the stage at which a household found itself in its life-cycle could be a confounder and that the declining Engel curve could be explained by the high housing consumption of young households relative to gross income and vice versa for the old households. This being the case, by carefully controlling for age, one would expect an Engel curve that declined less with gross income. In fact, age appears *not* to be a dominant preference shifter. The right-most column in Table 3 demonstrates the non-statistical significance of the estimate of the age coefficient and Figures A1a and A1b in the Appendix show that when segmenting households into one population sub-segment consisting of households of 2 adults and 0 children where main income earner is above 50 and another where the households consist of 2 adults and 2 children, and the main income earner is between 35 and 50, roughly uncovers the same Engel curve pattern.

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



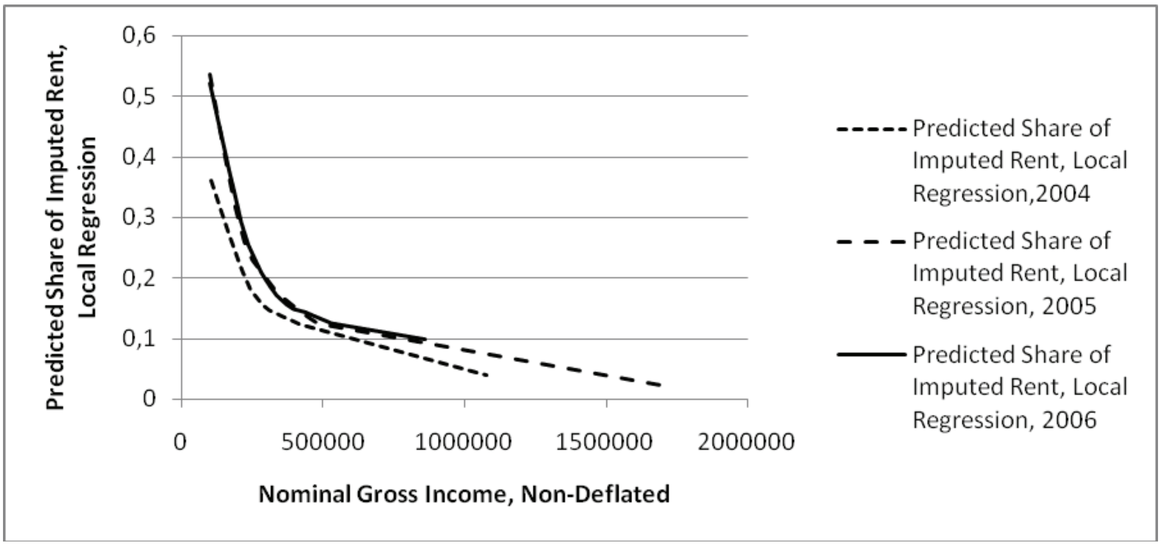
Notes: Nominal Gross Income does not include imputed rent. I truncate all datasets by requiring gross income to be more than 100,000 NOK per household and less than 2,000,000 NOK per household. The non-parametric regression line for households of 2 adults and an unspecified number of children in the 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.

Moreover, as we see from Figure 1, although functional form is always contentious in Engel curve studies, the non-parametric regressions demonstrate the ability of a parametric model consisting of second order log-polynomial to 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 to be drawn from Figure 1. First, notice the difference in the proportion of imputed rents for a given year. While households with low material standards 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 methodologies were identical, yet the imputed rent shares for 2004 were considerably lower than those for 2005. Imputed rents can therefore be taken to reflect, it seems reasonable to assume, wider general economic conditions, including house values. In other words, the upward shift of the imputed rent-share indicates that a tax on imputed rent would be relatively higher (lower) in relatively favorable (unfavorable) economic conditions. Such a tax would work *counter-cyclically*, if the rent imputation is done frequently. This is an important feature given recent declarations made by policymakers that they need a housing tax to stabilize the macroeconomic development.

Figure 2 for smaller households of only one adult shows the same empirical regularity, albeit 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 feasible.

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

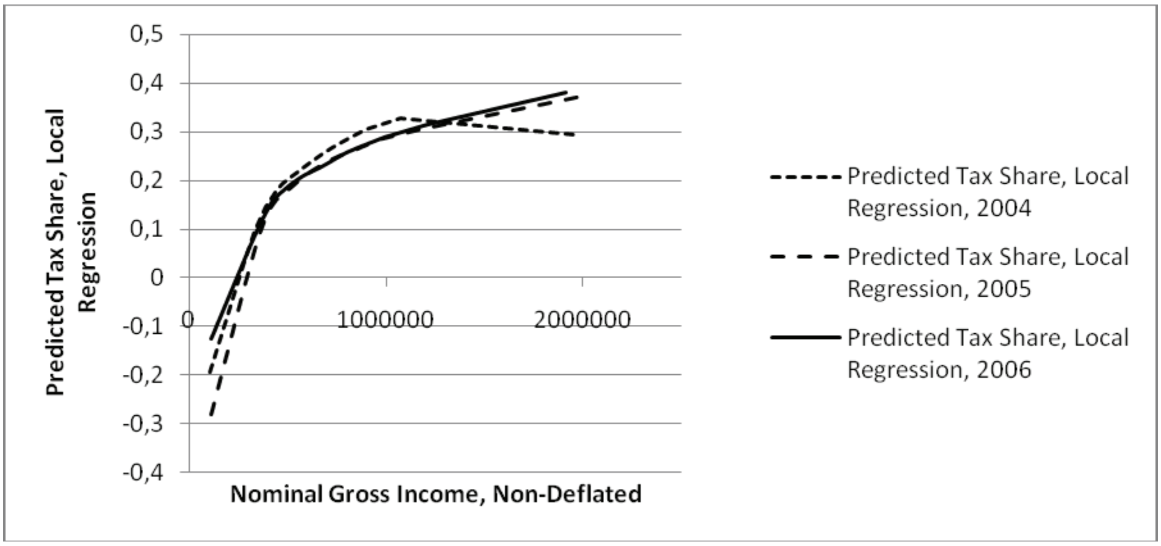


Notes: I truncate all datasets by requiring gross income to be more than 100,000 NOK per household and less than 2,000,000 NOK per household. The non-parametric regression line for singles in the year 2004 included 85 observations. It had 14 fitting points and the smoothing parameter was 0.60. Points 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.

6. Stage Five: Construction of the Housing Taxation Scheme

In the opinion of this article, a new tax scheme would not be feasible politically if it is regressive. Since many authors focus attention on the redistributive aspect of tax reform plans, it makes sense to inspect the actual progressivity of the Norwegian tax system. Figure 3 depicts how the tax (measured as the difference between gross and net income, which includes transfers) proportion of gross income varies with gross income. As we can see, the non-parametric regression reveals strong progressivity. Low gross income households either pay little in tax, or they receive subsidies and transfers. High gross income households pay almost 40 percent in taxes in 2006. The tax share increases almost monotonically with gross income. A new tax would therefore not be viable in Norway if the most of the burden was shifted onto low-income households because it would violate and change existing progressivity.

Figure 3. 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 define tax as the difference between gross income and net income as reported by the tax register. I truncate 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 require 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.

This article suggests 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 imposition of heavy levies on low income households which own valuable properties (which can happen when the property is inherited, for instance, or when owners have retired, relying partly on home equity as a pension scheme). These households could be forced to sell the house or take out a second mortgage simply to finance the housing tax if a cut-off point were not implemented. On the other hand it could be argued, not only income but wealth too should be taxed properly, and accrued tax for older people allowed to accumulate as an asset-backed liability with the house as security, postponing taxes indefinitely and collected post mortem before inheritance.

2. The tax rate must be increasing in imputed rent, i.e. the rental-equivalent housing consumption.

The idea is that as the value of housing consumption increases, so should the tax rate. The legitimacy of this attribute lies with public acceptance of progressive rates.

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.

Again, the attribute is considered a necessary condition for imposing new levies without public opposition.

4. The housing tax cannot be large compared to income and labor income taxes.

The idea is that the converse is not viable for implementing new taxes. A large levy would not be politically feasible and the public might not be convinced that it would substitute labor income taxes. A large housing tax could be seen as just another vehicle for imposing ever-growing taxes.

Of these four conditions, the first and last may provoke the strongest objections and controversy. The ideas, however, are tentative and meant primarily to illuminate the five stages. In other words, they are working hypotheses of what characterizes feasible outcomes in the political process of implementing tax regimes.

A simple housing tax scheme

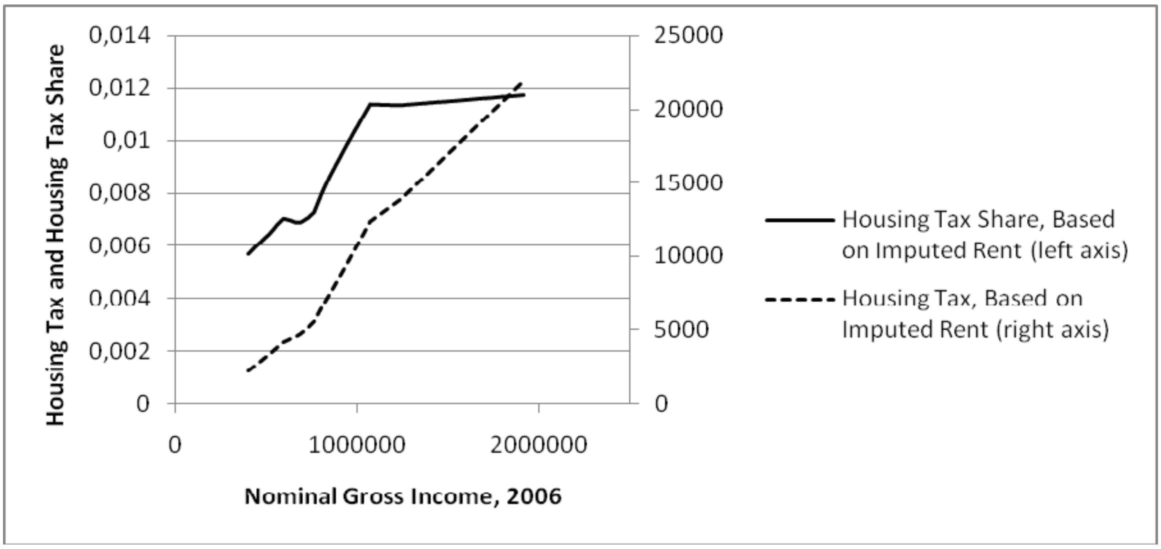
Let us inspect a scheme in which all four conditions are met. It consists of two elements. First, households with a gross income below NOK 400,000 pay *no* housing tax regardless of the rental-equivalent consumption value estimated from imputed rent. Second, the housing tax levied upon the household based on imputed rent starts at 30 percent of all imputed rent above the value of NOK 60,000. For values above NOK 70,000; 80,000; and 90,000 additional taxes would be levied at rates of

4 percent, 5 percent, and 6 percent so that the highest rate is 45 percent. This housing tax function is summarized in equation (8).

$$\text{(10)} \qquad \text{Tax-rate, housing} = \begin{cases} 0\%, \text{ when } \leq 60,000 \\ 30\%, \text{ when } > 60,000 \\ 4\%; 5\%; 6\%, \text{ when } > 70,000; > 80,000; > 90,000 \end{cases}$$

Figure 4 displays the features of such a housing tax scheme. First, no taxes are levied on low income households thanks to the cut-off point at NOK 400,000. Second, the housing tax rises with income. Third, the housing tax proportion increases with income. This is clearly a progressive tax, but it is not prohibitively large: indeed, it flattens out at around 1.2 percent of gross household income.

Figure 4. 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 truncate on gross income at the cut-off level of NOK 400,000, which reduces the observed number of households by 62 to 446 in this population segment. The earlier cut-off level at NOK 2 million is 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, 446 households would have paid NOK 2,845,792 in housing taxes, or NOK 6,381 per paying household. However, as 62 households are exempted from tax, 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.[3] 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.

7. Discussion

Implementing a partial tax scheme on one good necessarily involves considering the effects on the existing tax system. This is true even if a tax on housing consumption allows separation without much leakage given that everybody must consume housing and an escape into rental markets can be made unprofitable (and taxed, for that matter). Policymakers may still seek to prevent owner-occupiers from establishing a firm to which they sell their house and rent it back as tenants in order to avoid the housing tax *if* the existing tax code made the option economically tempting despite the tax landlords pay on profits. This could be done by taxing tenants as well as owner-occupiers, but would require simultaneous changes in interest deductibility. Additionally, they might find that capital gains from house transactions would have to be taxed as other capital gains in countries where they are not. Thus, changing one part of the tax system may require changing other parts. This article does not analyze the effect of a full reform of the whole system, and attempting such an analysis would require a detailed presentation of the whole Norwegian tax system, which again would exhaust the space available for a single article. The article's purpose is much narrower and specific; it aims to demonstrate what the stages of housing taxation are.

One possible alternative to using imputed rent for estimating latent housing consumption expenditures would be to use estimated market house values. If a home rents for NOK 100,000 per year and sells for 2,000,000 per year both the rent and the market price allow estimation of latent housing consumption expenditures. Both methods have advantages and disadvantages. The latter may be preferable if the rental sector is small, specialized, or localized. In those situations, market rents will not always be available, or accurate, and 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 revenues would vary. From a house owner's point of view, the tax liability

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

would vary. This would negatively affect the implementability and sustainability of the new scheme. Also, to preserve public support for the tax system, or at least avoid public displeasure and social unrest, the tax would have to be computed from very recent value estimates. Such speed requirements would be a major practical challenge. Over the longer 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 in the long run. However, the former method's low volatility is a definite advantage for practical purposes and the latter stronger potency as a counter-cyclical stabilizer also counts as a clear benefit.

Thalman (2007) suggests that market rent may not constitute an entirely appropriate basis for computation since rent may include some mark-up to take into account landlords' tax payments. Policymakers should apply a housing income concept, the available income *after* housing costs by keeping track of e.g. production costs and capital gains, he suggests. His scheme is elaborate and involves close study of the consequences of renting or owning. There may not be much conflict between his resulting scheme and the one suggested here, however, as both end up using a type of imputed rent and the simplicity of this article's system of a direct rate on imputed rent is a clear advantage.

In fact, the alternatives to the method suggested in this article may require substantial datasets. The computed taxes from these alternatives could prove volatile, unpredictable, and non-transparent. For policymakers and Treasuries to have a chance of implementing housing taxes in countries where they do not exist, they must be aware of the difficulty of mounting a convincing argument explaining why an owner should be taxed at all. The rental-equivalence principle is convincing since it is simple and transparent. Most people realize that foregone rent is a real cost avoided which also reflects upon latent housing consumption expenditure.

In terms of empirical estimation, several points can be made. For example, even though the 2SLS method was considered inappropriate for estimating parameters of housing demand since curvature would be of the essence, it would still be interesting to cross-check results with the ones obtained. Although these regressions were run and I do not discuss the results here, they are in line with the ones presented. Moreover, even though imputed rents do not exist for years prior to 2004, it would still be interesting to follow housing expenditures over a longer period and test the sensitivity of the scheme to different macroeconomic environments. Table A2 in the appendix presents summary statistics for housing for the period 2000‒03 and a 2SLS regression of observable housing expenditures (main category) onto endogenous total expenditure, number of adults, and number of children, with income variables as instruments. Table A3 reports a regression onto a second-order polynomial in gross income for years 2000–03 and Table A4 results from a pooled regression with an adjustment for inflation.

As insurance payments are related to the value of the house and housing consumption is related to the value of the home, a proposal for a tax scheme based on insurance value would merit consideration. In contrast to interest payments, for example, 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). Figure A2 shows the results of a non-parametric regression of the share of insurance premiums onto gross income. The curves are remarkably smooth across the income spectrum and very stable over time and, indeed, almost identical for the three cross-sections. However, the insurance value of a house is the rebuilding cost, which may not accurately reflect the value of the home since it could be of an impractical type or 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 more than the consumption of hedonic, physical house attributes, it also includes consumption of location and position. Households have a willingness to pay for proximity to urban centers and geographical amenities, and it is this willingness that may represent the immobile and immutable core of housing demand that makes it attractive for tax purposes.

8. Concluding Remarks and Policy Implications

Housing is an attractive object for tax purposes since housing demand is universal, quite immobile and relatively immutable. Demand is not very elastic, so efficiency losses may be smaller than for labor income taxes. In fact, it is possible to conceive of a new housing tax as one with triple dividends. First, it could enhance efficiency if it replaces labor income taxes that have large deadweight losses. Second, it could function as an automatic stabilizer since it would tend to work counter-cyclically. Third, it could be made to be quite redistributive.

This article claims the latter as 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 of political opposition. Thus, a simple scheme involving a flat tax rate on a proxy of housing consumption may be attractive in its simplicity, but would work regressively if housing is a necessary good. In other words, an empirical analysis of housing demand must precede policymaking. In fact, this article suggests that the implementation of new housing taxation or the amelioration of existing housing taxation can be broken down into five core stages: identification; estimation and data acquisition; empirical investigation; and tax function construction.

Moreover, estimating the demand for housing is non-trivial. One cannot use observed interest payments, observed housing expenditures, or home insurance payments. Using market house values may prove difficult. This article shows, however, that invoking the rental-equivalent principle facilitates the estimation of latent housing consumption expenditures by studying owner-occupiers' foregone rent. Combining data on market rents and rental object attributes with data on owner-occupiers' housing attributes allows one to reverse-compute what owners forego in rent when they live in the home themselves. Inspecting these imputed rent estimates of latent housing consumption expenditures, 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, number of adults, and number of children reveals high explanatory power. I obtain an adjusted R-squared of 0.587. Even if this R-squared is artificially high in that imputed rent is a constructed variable, it is most likely still indicative of the explanatory power of the model. There is a clear and employable pattern between housing consumption and gross income. Non-parametric analysis supports the finding that the share of imputed rent is decreasing in gross income, with curvature.

Some practitioners may find the actual content of my tax proposal to be somewhat impractical. They could be right. This article's purpose is to demonstrate the plausibility of a procedure and explain stage-by-stage how to implement it, based on real households' real behavior, rather than putting forward a policy directive. It remains to be seen, some would add, how inelastic the demand for housing is compared to labor supply. The efficiency gains might prove smaller over time than the literature anticipates if households engage in tax avoidance behavior on the scale of labor supply. After all, this article's hypotheses are working hypotheses on consumer behavior.

However, the clear empirical regularity observed in this article's examination of how consumers behave allows us to construct a non-linear housing tax scheme that fulfills some conditions of what constitutes a politically feasible tax proposal. These conditions are working hypotheses and must be scrutinized, but employing them makes it possible 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 increasing in gross income. My example would have generated an estimated NOK 11.8 billion in 2006.

The tax scheme presented here allows cuts of labor income tax leading to lower deadweight losses. And since imputed rents are pro-cyclical, a tax on imputed rents would work counter-cyclically and act as an automatic stabilizer.

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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.

Table A2. Manifest housing expenditure on manifest 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 2000–03. 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. 4,152 observations in dataset for 2000–03. * 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	

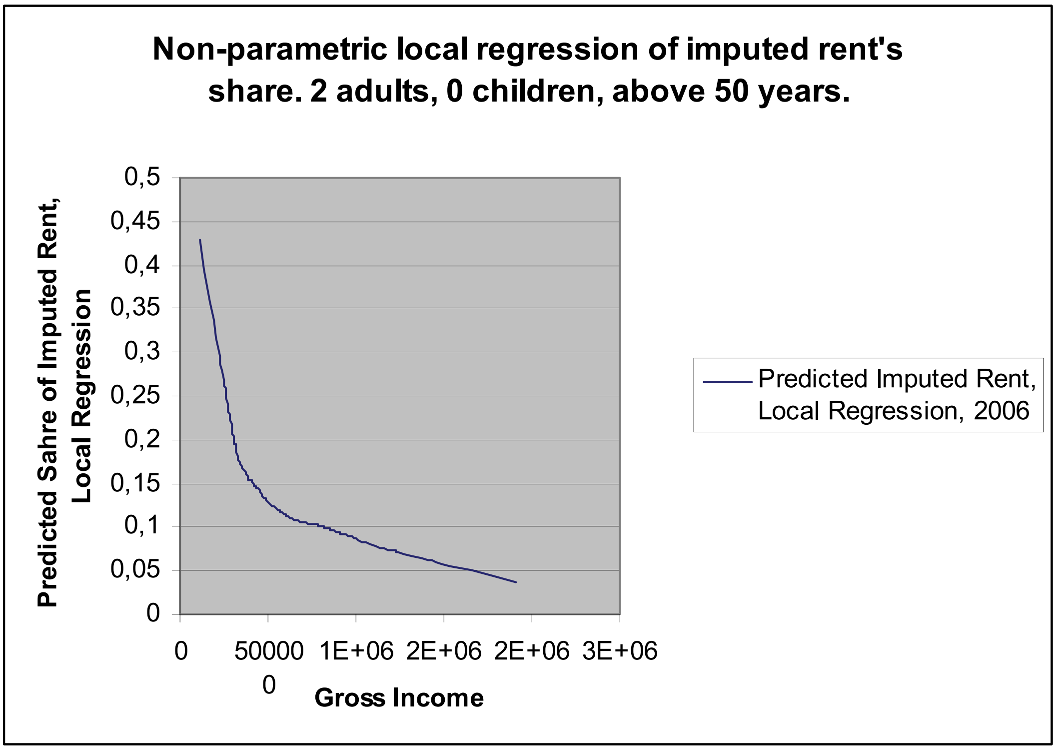
Note: Consumer Expenditure Surveys 2000–03. Truncation by gross income at gross income levels NOK 100,000 and 2,000,000. The former entail a loss of 86 observations; the latter 34 observations. 4,283 observations in dataset for 2000–03.

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

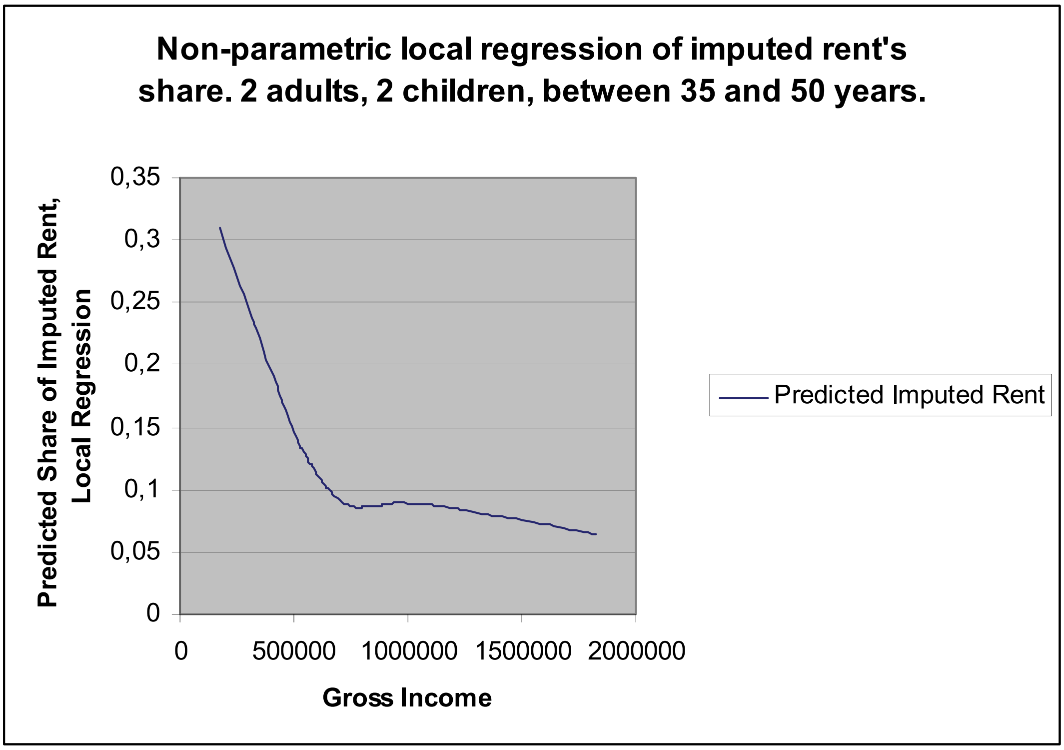
Note: Consumer Expenditure Surveys 2000–03. Truncation by gross income at gross income levels NOK 100,000 and 2,000,000. The former entail a loss of 86 observations; the latter 34 observations. 4,283 observations in dataset for 2000–03. Category 3 Index is *not* a house price index. It is the sub-index in the CPI associated with the category K3 Housing Expenditures, Electricity, Heating

Figure A1a. Non-parametric local regression of rent's share of gross income on gross income. Households of 2 adults and no children. Main income earner above 50 years of age. Norway. 2006



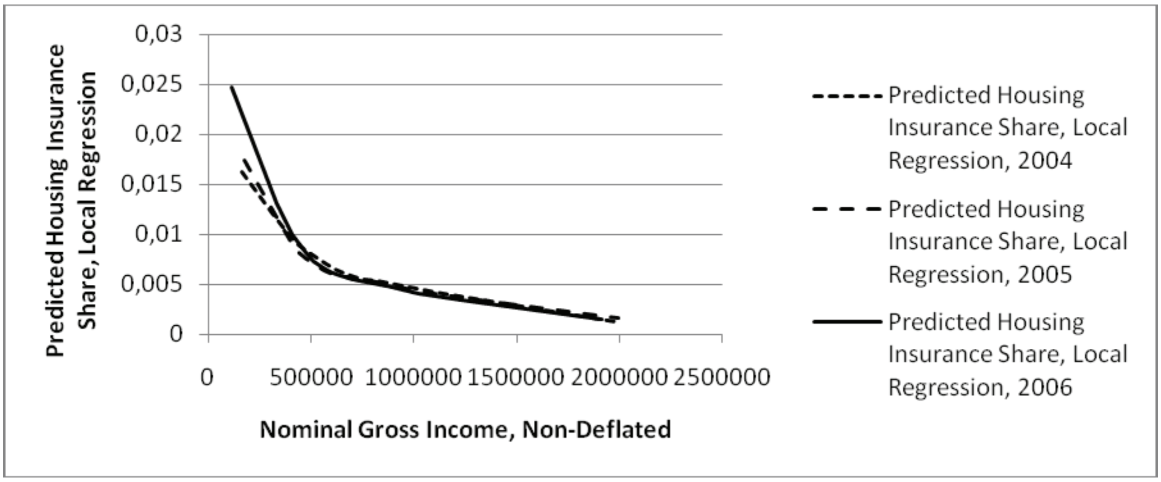
Notes: Nominal Gross Income does not include imputed rent. I truncate all datasets by requiring gross income to be more than 100,000 NOK per household and less than 2,000,000 NOK per household. The non-parametric regression line for households of 2 adults and no children in the year 2006 where main income earner was above 50 years of age included 179 observations. It had 17 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 107. Residual sum of squares: 0.787. Equivalent number of parameters: 4.03

Figure A1b. Non-parametric local regression of rent's share of gross income on gross income. Households of 2 adults and 2 children. Main income earner between 35 and 50 years of age. Norway. 2006



Notes: Nominal Gross Income does not include imputed rent. I truncate 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 2 children in the year 2006 where main income earner was between 35 and 50 years of age included 103 observations. It had 16 fitting points and the smoothing parameter was 0.60. Points in local neighborhood: 61. Residual sum of squares: 0.0973. Equivalent number of parameters: 4.15

Figure A2. 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 truncate on positive expenditures on housing insurance. I also truncate 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 require 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