Distributional effects of VAT with housing*
(Preliminary and incomplete)

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Abstract

An increase in consumption taxes, of which VAT is the most important one in EU countries, reduces the purchasing power of existing wealth. Hence, it is effectively a capital levy. We study the distributional implications of VAT taking this capital levy mechanism into account. In contrast to the existing literature, we distinguish between financial wealth and housing wealth. We show that given how housing is typically treated in the tax system, the capital levy associated with an increase in VAT, does not apply to housing wealth. As a result, the distributional effects of tax reforms that consist of increasing VAT depend on the joint distribution of housing wealth, financial wealth, and labor income. Our numerical results suggest that taking the special role of housing wealth into account dramatically changes our view of the distributional effects of VAT.

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1 Introduction

Consumption taxes are often viewed as less distortionary than income taxes. That, together with fiscal pressures, may explain why many EU countries have recently increased the value

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added tax rate (VAT) or contemplate increasing it. On the other hand, many people are concerned that increases in consumption taxes makes the tax system less progressive. The starting point is typically the observation that consumption taxes are flat rate taxes on income.

Changes in VAT rates will also have distributionary effects via their effects on the purchasing power of existing wealth. A VAT increase decreases the amount of goods and services one euro can buy. A VAT increase can therefore be characterized as a capital levy. As recently stressed by Correia (2010), this capital levy needs to be taken into account if the distributional effects of tax reforms that involve changes in consumption taxes are to be accurately evaluated. Correia considers tax systems featuring constant tax rates on consumption, labor income and capital income and shows that a reform that increases the tax burden on consumption and lowers that on labor income can increase both efficiency and equity. The rationale for the efficiency result is based on the idea discussed above: Taxing consumption is an indirect effect way of taxing wealth. Therefore, a policy change that increases the tax on consumption and reduces the tax on labor income is equivalent to a "virtual" reform that reduces the labor income tax rate and taxes initial assets at a higher rate. Because part of the increased tax burden falls on past savings, the tax system becomes more efficient. Whether this type of reform also reduces inequality depends on the joint distribution of labor productivity and initial wealth.[1]

It is important to note, however, that housing wealth – which makes up a large share of households' total wealth – is different from financial wealth in this respect. The implicit capital levy provided by a VAT increase does not necessarily apply to housing wealth. This relates to the special role of housing as both and asset and a consumption good. Following an increase in VAT, homeowners can simply choose to live in the same house as before. Since existing houses are not directly taxed via VAT, homeowners do not pay more taxes on their housing. In fact, even the real market value of housing may be protected against a VAT increase. This is because most EU countries tax the construction of residential housing via VAT. In that case, a VAT increase should increase the (after-tax) price of new houses. Except for areas where house prices are determined by the scarcity of land, this should in turn increase the price of houses that were already built before the tax change as existing and new houses are close substitutes.

Given that the concentration of wealth is important for determining the distributional

[1] The predecessors of Correia's work include Ventura (1999) who conducts a steady state analysis employing life cycle economics and borrowing constraints and Altig et al. (2001) who consider several different tax reforms in a life cycle model taking into account transitional dynamics.

effects of consumption taxation, it is surprising that there are no previous studies aiming to incorporate housing wealth into the analysis.[2] In the light of the previous results, taking housing wealth explicitly into account seems nevertheless crucially important. It should also be noted that the distribution of financial wealth is very different from the distribution of household net worth or housing wealth. In fact, many households finance their housing with a relatively large mortgage. That is, they have negative financial wealth. For these housholds, rather than imposing a levy on their net wealth, an increase in VAT decreases the real value of their debt holdings.

The aim of this paper is to analyze the distributional effects of consumption taxation taking into account the special role of housing wealth. In order to address this issue, we build an infinite horizon (dynasty) model where households derive utility from non-housing and housing consumption, supply labor and can save by investing in owner-housing or financial asset. Since the focus is on the distributional effects of tax reforms, we will pay special attention to the transitional dynamics.[3]

We calibrate the model so that it replicates the empirical joint distribution of housing wealth and financial wealth across Finnish households. We use the model to experiment with different tax reforms that involve changing VAT. Our main focus is on reforms that consist of increasing VAT and lowering labor income taxes. We study the distributional effects of the tax reforms by computing the welfare gains or losses as well as changes in the tax burden for households with different initial levels of housing wealth, financial wealth and labor income.

The paper proceeds as follows: In the next section, we decribe the model, the household and government problems. In section 3, we use the household problem to show how housing

[2]Several studies have assessed the welfare consequences of a tax reform that imposes the same tax rate on housing and business capital. Berkovec and Fullerton (1992), Skinner (1996), and Gervais (2002), among others, have shown that such a reform would lead to substantial efficiency gains. The optimal tax system in a dynamic setting taking into account the transitional dynamics is studied in Eerola and Määttänen (2011). In these papers, the main question of interest is related to the welfare consequences of the tax favored status of owner housing relative to other forms of saving.

[3]In the literature on dynamic taxation consumption taxation is often ignored altogether. The most important exceptions include Jones et al. (1997) and Coleman (2000) who study the efficiency effects of different tax reforms and derive optimal policies when government can use consumption, labor income and capital income taxes. Coleman shows that implementing a tax reform featuring time-varying taxes on consumption, capital income and labor income leads to substantial efficiency gains. Most of these efficiency gains can be achieved by implementing a simple tax reform featuring constant tax rates on consumption, labor and capital income. The mechanism behind the results is related to capital levy: taxing consumption acts as a levy on existing wealth much in the same manner as very high initial tax rates on capital income in an optimal dynamic tax reform.

wealth is different from financial wealth. Section 4 discusses calibration and section 5 results. Section 6 concludes.

2 Model

We consider a deterministic model with infinitely lived households that derive utility from non-housing consumption, housing services, and leisure.[4] Households supply labor, consume non-durable goods and services, consume housing servives through owner-housing and can save through financial asset and housing wealth. Households differ in three dimensions: labor productivity, financial and housing wealth.

The production side consists of a representative firm that employs business capital and labor to produce output goods. The economy is small and open in the sense that interest rate is fixed. The international interest rate pins down the after-tax return to business capital in the economy. The wage rate is determined by the marginal productivity of labor.

The government faces an intertemporal budget constraint with the level of public spending being fixed. The tax system consists of flat-rate taxes on non-housing consumption (VAT on non-housing consumption), housing construction (VAT on housing), labor income, and return to financial wealth. VAT on housing also applies to the maintenance investments in housing. The return to owner housing (imputed rental income) is not taxed.

2.1 Firms

Every period t, a representative firm employs business capital, k_t, and labor, n_t, to produce output goods, y_t. The production function is

$$y_t = f(k_t, n_t). \tag{1}$$

Production function exhibits constant returns to scale. The firm's first-order conditions for profit maximization imply that the before-tax returns to business capital and labor are determined by marginal productivities, that is,[5]

$$r_t = f_{k_t} - \delta_k \tag{2}$$

$$w_t = f_{n_t} \tag{3}$$

[4] The model is similar to that in Eerola and Määttänen (2006), which in turn builds on Krusell and Rios-Rull (1999) and Caselli and Ventura (2000).

[5] We denote $\frac{\partial}{\partial k_t} f(k_t, n_t) = f_{k_t}$ and similarly for other derivatives throughout the paper.

Because the after-tax interest rate is determined by fixed international interest rate, $\overline{r}$, the domestic interest rate is given by

$$(1-\tau_t^a)\, r_t = \overline{r}.$$

2.2 Household's problem

The household is endowed with one unit of time every period. The periodic utility function is $u(c,h,n)$, where c is non-housing consumption, h stock of housing capital, and n labor. The utility function is strictly increasing in non-housing consumption and housing capital and strictly decreasing in labor, strictly concave, and satisfies the Inada conditions. The household has two savings vehicles: housing capital and financial wealth.

There are I types of households with different labor productivites. The mass of households of type i is $\eta_i > 0$. Total mass of households is one. We normalize the productivities so that $\sum_{i=1}^{I} \eta_i \varepsilon_i = 1$.

The maximization problem of a household of type i in period 1 is

$$\max_{\{c_{i,t},n_{i,t},a_{i,t+1},h_{i,t+1}\}_{t=1}^{\infty}} \sum_{t=1}^{\infty} \beta^{t-1} u\left(c_{i,t}, h_{i,t+1}, n_{i,t}\right) \tag{4}$$

subject to a sequence of periodic budget constraints and a no-Ponzi-game condition:

$$\begin{aligned}
(1+\tau_t^c)\, c_{i,t} + \left[p_t + \left(1+\tau_t^h\right)\kappa\right] h_{i,t+1} + a_{i,t+1} &= (1-\tau_t^n)\, \varepsilon_i w_t n_{i,t} + R_t a_{i,t} + p_t h_{i,t} \quad (5)\\
\lim_{t->\infty} a_{i,t+1} \prod_{s=2}^{t} R_s^{-1} &\geq 0 \quad (6)
\end{aligned}$$

where

$$R_t = 1 + (1-\tau_t^a)\, r_t.$$

In the budget constraint, p_t is the price of one housing unit in period t and κ is maintenance cost related to housing. The left hand side of the constraint includes expenditures on non-housing consumption, investment or savings in housing, and financial wealth. The terms in the right hand side are after-tax labor income, return to financial wealth and the value of house. We will discuss below how the price of housing is determined.

Note that financial wealth can be negative. In that case, the household holds a mortgage. As discussed by Gervais (2002) and others, unless mortgage interest payments are fully tax deductible, the user cost of housing depends on whether it is financed with equity or debt.

With full dedutibility, households are indifferent between using debt or own savings. The above budget constraint implies that this is indeed the case.[6]

Full mortgage interest deductibility implies that all households face the same after-tax interest rate. Focusing on full deductiblity of mortgage interests and assuming that the utility function is homothetic guarantees that the economy features a representative household. This is important for the analysis because it allows us to consider the representative household when discussing the efficiency properties of tax reforms.

By recursively using the budget constraints in (5) to eliminate $a_{i,t}$ terms and by taking into account the transversality condition, the periodic budget constraints can be merged into a single present-value budget constraint

$$\sum_{t=1}^{\infty} q_t \left[\left(1+\tau_t^c\right) c_{i,t} + \left(p_t + \left(1+\tau^h\right)\kappa - \frac{p_{t+1}}{R_{t+1}} \right) h_{i,t+1} \right] = \sum_{t=1}^{\infty} q_t (1-\tau_t^n)\varepsilon_i w_t n_{i,t} + R_1 a_{i,1} + p_1 h_{i,1} \tag{7}$$

where $q_t = \prod_{i=1}^{t-1} R_{i+1}^{-1}$.[7]

The first-order conditions characterizing individually optimal behavior may be written as

$$n_{i,t} \quad : \quad \beta^{t-1} u_{n_{i,t}} + \lambda q_t \left(1-\tau_t^n\right)\varepsilon_i w_t = 0 \tag{8}$$

$$c_{i,t} \quad : \quad \beta^{t-1} u_{c_{i,t}} - \lambda q_t \left(1+\tau_t^c\right) = 0 \tag{9}$$

$$h_{i,t+1} \quad : \quad \beta^{t-1} u_{h_{i,t+1}} - \lambda q_t \left(p_t + \left(1+\tau_t^h\right)\kappa - \frac{p_{t+1}}{R_{t+1}} \right) = 0 \tag{10}$$

where λ is the Lagrance multipier on (7).

Given that the share of type i households η_i, aggregate non-housing consumption, housing consumption, and financial wealth can be written as

$$\begin{aligned} c_t &= \sum_{i=1}^{I} \eta_i c_{i,t}, \\ h_t &= \sum_{i=1}^{I} \eta_i h_{i,t}, \\ a_t &= \sum_{i=1}^{I} \eta_i a_{i,t}. \end{aligned}$$

[6] See e.g. Eerola and Määttänen (2011) for a more detailed discussion on how the mortgage interest deduction affects the user cost of housing.

[7] For details on the formulation of the present-value budget constraint, see e.g. Ljungqvist and Sargent (2004).

2.3 Stock of housing

Changes in housing demand will affect house prices depending on the supply conditions of residential housing. Whether changes in taxation (or other factors affecting housing demand) capitalize into house prices or not will be important for the discussion of the short run distributional effects of tax reforms.

In this respect one can think of two exremes: If the supply of new housing units is completely elastic, the price of housing tends to reflect the construction cost. In this situation, changes in taxation will affect the price level of houses only through its effect on the cost of residential construction. If, on the other hand, housing supply is perfectly inelastic, all changes in the demand for housing caused by taxation (or by other changes, say, value of local amenities) tend to capitalize into house prices.

The set-up we have described above is compatible with these two very different approaches to the functioning of the housing market. Consider first the situation where any increase in housing demand can be matched with new housing construction. This means that in all periods the price of housing equals the tax inclusive cost of construction. We assume that one unit of non-housing consumption can be freely diverted into one unit of housing capital. Therefore, the price of one unit of housing satisfies

$$p_t = 1 + \tau^h.$$

If, in turn, housing supply is very inelastic, increases in housing demand cannot fuel new construction. If the housing stock is fixed at $\overline{h}$ in all periods, the price of housing units must be such that

$$\overline{h} = h_t = \sum_{i=1}^{I} \eta_i h_{i,t}.$$

2.4 Government

The government finances an amount of G_t of public consumption in period t. Public consumption is financed by setting taxes on labor income, τ^n, non-housing consumption, τ^c, new housing investments or residential construction and the maintenance cost of housing, τ^h, and the return to financial wealth, τ^a. The periodic tax revenue can be written as

$$Tax_t = \tau_t^c c_t + \tau_t^a r_t a_t + \tau_t^n \sum_{i=1}^{I} \eta_i \varepsilon_i w_t n_{i,t} + \tau_t^h \left(h_t - h_{t-1}\right) + \tau_t^h \kappa h_t.$$

2.5 Equilibrium

For a given sequence of tax rates, a competitive equilibrium consists of individual policies and prices such that the individual policies solve the household's problem in (4) and (7), wage rate is given by (2) and the government budget constraint is satisfied with equality.

3 Illustration of the mechanism

In this section, we discuss the main mechanism that we are interested in. In what follows, we will consider tax systems featuring constant tax rates over time. We start from the present value budget constraint of the representative household:

$$(1+\tau^c)\sum_{t=1}^{\infty} q_t c_t + \sum_{t=1}^{\infty} q_t \left(p_t + \left(1+\tau^h\right)\kappa - \frac{p_{t+1}}{R_{t+1}} \right) h_{t+1} - (1-\tau^n)\sum_{t=1}^{\infty} q_t \varepsilon w_t n_t - R_1 a_1 - p_1 h_1 = 0 \tag{11}$$

where the first two terms denote the present value of all consumption, the third term is the present value of all labor income, and the last two terms are the value of initial resources.

Compare then two different tax policies which generate the same tax revenue but differ in relative tax burden on consumption. We denote the tax policies by $f^A = \left(\tau^{cA}, \tau^{nA}, \tau^a\right)$ and $f^B = \left(\tau^{cB}, \tau^{nB}, \tau^a\right)$ and assume that $\tau^{cA} < \tau^{cB}$. In order to focus on the role of consumption and labor income taxes we keep the capital income tax rate fixed so that $\tau^{aA} = \tau^{aB} > 0$. Since the tax policies generate the same amount of tax revenue, it must be the case that $\tau^{nA} > \tau^{nB}$.

As shown by Correia (2010) and others, part of the consumption tax increase falls on past savings. Therefore, tax policy f^B is less distortionary than policy f^A. It therefore follows that[8]

Result 1 *Consider two tax policies* $f^A = \left(\tau^{cA}, \tau^{nA}, \tau^{aA}\right)$ *and* $f^B = \left(\tau^{cB}, \tau^{nB}, \tau^{aB}\right)$ *such that* $\tau^{cA} < \tau^{cB}$, $\tau^{nA} > \tau^{nB}$ *and* $\tau^{aA} = \tau^{aB}$ *generating the same tax revenue. Policy* f^B *is more efficient. The representative household must be better off under policy* f^B *than under policy* f^A.

Assume then that policy f^A is the status quo and the government contemplates executing a reform where tax policy f^B is implemented. From Result 1 we know that this reform benefits the representative household. In what follows, we analyze how other households are affected.

[8] For details on the derivation of this result in the absence of housing wealth, see Correia (2010).

For the analysis, we denote the present value of optimal labor supply and consumption for the representative household under tax policy $\varphi = A, B$ by

$$\begin{aligned} C^{\varphi} &= (1+\tau^{c\varphi})\sum_{t=1}^{\infty} q_t c_t^{\varphi} \\ H^{\varphi} &= \sum_{t=1}^{\infty} q_t \left(p_t^{\varphi} + \left(1+\tau^{h}\right)\kappa - \frac{p_{t+1}^{\varphi}}{R_{t+1}} \right) h_{t+1}^{\varphi} \\ N^{\varphi} &= (1-\tau^{n\varphi})\sum_{t=1}^{\infty} q_t \varepsilon w_t n_t^{\varphi} \end{aligned}$$

where p^{φ} is the price of housing under tax policy $\varphi = A, B$. By using these expressions, we can write the budget constraint of the representative household in (11) as

$$C^{\varphi} + H^{\varphi} - N^{\varphi} - R_1 a_1 - p_1^{\varphi} h_1 = 0 \text{ for } \varphi = A, B. \tag{12}$$

This equation simply restates that the budget constraint of the presentative household holds with equality in the case where the consumption and labor supply choices are optimal.

Consider then another household, say household s, which is identical to the representative household in all respects apart from the composition of initial wealth before the tax reform. In particular, assume that

$$R_1 a_1 + p_1^A h_1 = R_1 a_{s,1} + p_1^A h_{s,1} \tag{13}$$

where on the left hand side we have the value of the initial resources of the representative household and on the right hand side the value of the initial resources of household s (both under tax policy A).[9] Using (13) we can rewrite

$$a_{s,1} = \left(a_1 - \frac{p_1^A \left(h_{s,1} - h_1\right)}{R_1} \right).$$

Because the households have the same initial wealth under tax policy f^A and are otherwise identical, they will choose the same paths for non-housing and housing consumption and labor supply. In addition, we know that the representative household will choose consumption and labor supply so that the present value of its consumption and labor income equal C^B, H^B and N^B. Are these choices also possible for household s after the reform? Assume that household s makes the same choices as the representative household after the reform and denote the net expenditure, that is, present value of all consumption net of all resources, of the household by E_s^B. Then we have that

[9] This assumption is made for illustrative purposes only. It is artificial in the sense that if the households had chosen different levels of housing they would not be identical.

$$E_s^B = C^B + H^B - N^B - R_1 a_{s,1} - p_1^B h_{s,1}.$$

By rewriting equation (12) in the case $\varphi = B$, we have

$$C^B + H^B - N^B = R_1 a_1 + p_1^B h_1.$$

By plugging this equation into the new expenditure of household s we have

$$\begin{aligned} E_s^B &= R_1 a_1 + p_1^B h_1 - R_1 a_{s,1} - p_1^B h_{s,1} \\ &= R_1 a_1 + p_1^B h_1 - R_1 \left(a_1 - \frac{p_1^A \left(h_{s,1} - h_1 \right)}{R_1} \right) - p_1^B h_{s,1} \\ &= \left(p_1^A - p_1^B \right) \left(h_{s,1} - h_1 \right) \end{aligned}$$

If $E_s^B < 0$, household s cannot afford the same allocation as the representative household after the reform: the present value of all consumption exceeds the value of resources. On the other hand, if $E_s^B > 0$, household s affords more consumption than the representative household after the reform.

Clearly, whether $E_s^B > 0$ or $E_s^B < 0$ depends on two things: 1) what happens to housing prices if one moves from tax policy A to tax policy B and 2) whether household s has more housing wealth than the representative household. Therefore, it follows that

Result 2 *A revenue neutral tax reform increases the tax burden on consumption and lowers the tax burden on labor income. Consider two households: the representative household and an otherwise identical household with different composition of initial wealth (household s). The two households choose the same allocation before the reform. After the reform, household s*

i) cannot afford the same allocation as the representative household if housing becomes more expensive and its net worth is mostly in the form of financial wealth.

ii) affords more consumption than the representative household if housing becomes more expensive and its net worth is mostly in the form of housing wealth.

What happens to housing prices, depends on two things: The tax treatment housing relative to other consumption and the supply conditions. We have outlined above two extremes in this sense; perfectly elastic supply and perfectly inelastic supply which implies that housing prices adjust to the level where demand equals the fixed stock of housing.

Assume now that housing supply is infinitely elastic. This means that the price of housing units always equals construction costs, that is $p = 1 + \tau^h$. Assume, in addition, that the same

VAT rate is applied to non-housing consumption and housing investments, that is $\tau^h = \tau^c$. In that case, because $p_1^A - p_1^B = \tau^{cA} - \tau^{cB} < 0$, it directly follows that if $h_{s,1} - h_1 > 0$, $E_s^B < 0$. This means that household s has a positive amount of resources left if it chooses the same allocation as the representative household. On the other hand, if $h_{s,1} - h_1 < 0$, it follows that $E_s^B > 0$. This means that the present value of all consumption exceeds the value of the resources of the household.

Result 1 shows that consumption tax is more efficient than labor income tax because it acts as a capital levy. Result 2 in turn shows the tax reform treats otherwise similar households differently depending on how big a fraction housing wealth constitutes of the their total wealth.

4 Calibration

The model period corresponds to one year. We set the international interest rate at $\overline{r} = 0.06$. For the model to have a steady state, the discount factor must be set at $\beta = 1/(1 + r_t)$. The production technology is Cobb-Douglas. We set the capital share at $\alpha = 0.30$ and the depreciation rate of business capital at $\delta_k = 0.10$.

We consider a standard logarithmic utility function

$$u(c, h, n) = \theta^c \log c + (1 - \theta^c)\theta^h \log h + (1 - \theta^c)(1 - \theta^h) \log (1 - n) . \tag{14}$$

where θ^c and θ^h are the utility shares of non-housing consumption and housing consumption, respectively. This specification means that the elasticity of subsitution between housing and non-housing consumption is equal to one. Empirical estimates of this elasticity vary a lot. Using a structural life cycle model, Li et al. (2009) find an elasticity of substitution equal to 0.33. On the other hand, much of the related literature uses Cobb-Douglas preferences implying an elasticity of substitution equal to 1. Davis and Ortalo-Magné (2011) provide empirical support for that assumption.

The initial tax system is as follows: $\tau^c = \tau^h = 23\%$, $\tau^a = 28\%$, $\tau^n = 22\%$. This is based on the following observations. First, the general VAT rate in Finland is 23%. Certain goods and services (e.g. food and restaurant meals) are taxed at a lower rate while some are exempted from VAT. On the other hand, some specific goods and services are subject to excise taxes in addition to VAT. As a result, the average consumption tax rate should be rather close to the general VAT rate. Second, the general VAT rate applies also to residential construction. Third, Finland has a dual tax system where labor and capital incomes are taxed separately at the individual level. Labor income is subject to progressive taxation

while capital income taxation is based on a flat rate. The average tax rate on earnings is about 22%. This measure does not include contributions to the mandatory earnings-related pensions.

We determine the maintenance cost parameter, κ, by using the 2004 Wealth Survey conducted by Statistics Finland. Except for single family houses, the legal structure for home ownership in Finland is a limited liability housing company. Homeowners own housing company shares which give them the possession of a specific apartment.[10] The company is responsible for the management and upkeep of the building. To that end, it collects management fees which are proportional to the size of the apartment. The Wealth Survey includes information about this management fee. In addition, households were asked to estimate how much they spend on maintenance operations in their own apartment. Together these costs were annually on average 2.5% of the reported house value. As a result, we set $\kappa = 0.025$.

The most important part of the calibration procedure involves the distributions of housing and financial wealth as well as labor probuctivities. We take the joint distribution of financial and housing wealth from the data and choose (permanent) labor income so that the housing wealth distribution in the model matches that in the data. We base our calibration on the 2004 Wealth Survey conducted by Statistics Finland. The survey includes portfolio information from 3455 Finnish households. In the survey, the households were asked, among other things, to give an estimate of the current market value of their house.

We construct two variables for the analysis: 'housing wealth' and 'financial wealth'. We define housing wealth as the value of primary residence and the value of other residential real estate. Financial wealth is defined as the sum of all financial assets, the net equity in non-residential real estate, and the value of net equity in businesses less all debt (including mortgages). We consider only homeowners between 35 and 60 years of age (the age of the household head). We focus on middle-aged households because our model abstracts from life cycle features.[11]

In order to calibrate the distributions, we sort the households in our sample along two dimensions: financial wealth and housing wealth. We first determine for each household the financial wealth quintile and the housing wealth quintile it belongs to. This creates 25 groups of households with different levels of financial wealth and housing wealth. Accordingly, we

[10] The shares are treated as private property and can be used as collateral for mortgage loans.

[11] About 30% of all households in the survey are renters. However, most of the rental dwellings in Finland are part of social housing where rents are regulated and tenants are selected on the basis of social and financial needs. Only 10% of the households in the survey have rented from the private rental market.

also create 25 different household types in the model, i.e. $I = 25$.

For each of the 25 groups, we compute the average financial wealth and the average housing wealth in our sample. Table 1 shows the resulting financial and housing wealth distributions.

	Housing wealth quintile									
	Housing wealth, 1000 €					Financial wealth, 1000 €				
Financial wealth quintile	1	2	3	4	5	1	2	3	4	5
1	61	92	134	178	295	-80	-73	-85	-55	-127
2	59	92	129	180	280	-25	-27	-28	-29	-26
3	55	93	129	176	288	0	-1	-0	-1	1
4	54	93	133	178	350	18	20	18	23	22
5	51	92	130	179	386	113	115	145	127	298

Table 1: Relative distributions of financial wealth and housing wealth.

We then divide the average financial wealth in each group by the average financial wealth of all households in our sample and similarly for the housing wealth. As a first step in replicating the joint distribution of financial wealth and housing wealth, we assign financial wealth holdings $\{a_{i,1}\}_{i=1}^{I}$ for each household type, so that the relative financial wealth distribution across the 25 different types matches that in the data. After that, we choose the labor productivity parameters $\{\varepsilon_i\}_{i=1}^{I}$ so that, given the distribution of financial wealth, the initial steady state distribution of housing wealth also matches the empirical distribution. In practice, this is done by using the households' first-order conditions (8)-(10) and budget constraints.

Table 2 shows the resulting relative labor productivities. For instance, the labor productivity (or wage level) of households belonging to the bottom housing wealth quintile and bottom financial wealth quintile is 40% of the average labor productivity. Clearly, for a given level of financial wealth, higher housing wealth must be associated with higher labor productivity. Otherwise the household could not afford its housing. Similarly, for a given housing wealth, higher financial wealth must be associated with lower labor productivity since households with more financial wealth receive also capital income (or at least need to pay less interest on their debt). The reason why labor productivity nevertheless sometimes increases as we go down the columns is that housing wealth varies substantially even within a housing wealth quintile. In particular, households in the top housing and financial wealth

quintile have much more housing than households in the top housing wealth quintile and the bottom financial wealth quintile.

	Housing wealth quintile				
Financial wealth quintile	1	2	3	4	5
1	0.4	0.6	0.8	1.1	1.9
2	0.4	0.6	0.8	1.1	1.8
3	0.3	0.6	0.8	1.1	1.8
4	0.3	0.6	0.8	1.1	2.2
5	0.3	0.6	0.9	1.2	2.5

Table 2: Distribution of labor productivities.

In the calibrated model economy, labor income is more evenly distributed than capital income (which is proportional to financial wealth).[12] The reason why this implies that housing wealth is more evenly distributed than financial wealth is simple: Households' demand for housing is proportional to the sum of their after-tax capital and labor income, or total income. Since labor income is more evenly distributed than capital income, total income is more evenly distributed than financial wealth. Hence, the distribution of housing wealth, which is proportional to the distribution of total income, is more even than the distribution of financial wealth.

Table 3 displays households' financial wealth relative to their labor income. As we will explain, it is this relation that largely determines the distributional effects of the tax reforms considered. Clearly, given the observed levels of financial wealth and estimated (permanent) labor incomes, households have very different amounts of financial savings relative to their labor income.

	Housing wealth quintile				
Financial wealth quintile	1	2	3	4	5
1	-3.5	-2.3	-1.9	-1.6	-1.3
2	-1.3	-0.9	-0.7	-0.5	-0.3
3	0.0	0.0	0.0	0.0	0.0
4	1.2	0.7	0.4	0.4	0.2
5	11.3	5.1	4.4	2.6	2.9

Table 3: Financial wealth-to-labor income ratios.

[12] This reflects the well-known fact that total wealth is much more unevenly distributed than labor income. See e.g. Díaz-Giménez et al. (1997).

There are three distributional dimensions - financial wealth, housing, and labor income - in the model. As discussed above, we can always perfectly match two of them. Instead of matching the joint distribution of financial wealth and housing, we could match the joint distribution of financial wealth and labor income. The problem with this approach is that annual labor income observed in a cross-section data may be a poor proxy for permanent labor income. In matching housing wealth and financial wealth distributions, our underlying assumption is that given a household's financial wealth position, its housing wealth reflects its expectations about its future average labor income.

5 Reform analysis

In this section, we consider a tax reform which increases the VAT on both non-housing consumption and housing construction by 2 percentage points (from 0.23 to 0.25) and lowers the labor income tax so that the present value of government revenue stays constant. As a result, the labor income tax falls to $\tau^n = 20.7\%$. We focus on a situation where housing market conditions are such that housing supply is elastic. Therefore, the price level of housing reflects the construction costs.

We calculate the welfare gain or loss for all 25 household groups. Welfare change is defined as the percentage change in periodic consumption making households indifferent between reform and status quo.

The average welfare effect is positive but very small (about 0.01% in terms of consumption). In other words, a household with average financial wealth, housing wealth and labor income finds this tax reform slightly better than the status quo. Based on the previous discussion on the efficiency effects of consumption taxation, we would expect the average welfare effect to be positive. The reason is that part of the increase in VAT falls on past savings. This part of the tax increase is non-distortionary. In contrast, the entire labor income tax cut reduces the distortions to labor supply caused by the tax. Hence, the reform creates an efficiency gain.

Interestingly, even this relatively small tax reform has non-trivial distributional effects. Table 4 shows the welfare effects for different household types. It reveals a systematic pattern. The reform benefits especially those with little (or negative) financial wealth and little housing wealth. For instance, households in the first financial wealth quintile and the first housing wealth quintile gain by 0.8% in terms of non-housing consumption. Households with a lot of financial wealth and little housing wealth in turn lose the most. Households in the fifth

financial wealth quintile and the first housing wealth quintile lose by 1.1%.

	Housing wealth quintile				
Financial wealth quintile	1	2	3	4	5
1	0.8	0.5	0.4	0.4	0.3
2	0.3	0.2	0.2	0.2	0.1
3	0.1	0.1	0.1	0.1	0.1
4	-0.1	-0.1	-0.0	-0.0	0.0
5	-1.1	-0.6	-0.5	-0.3	-0.3

Table 4. Welfare effects (%).

Table 5 shows the change in taxes paid by different household groups. For instance, households in the first financial wealth quintile and the first housing wealth quintile pay 1.5% less taxes after the reform than in the status quo. Those in the last financial wealth quintile and the first housing wealth quintile in turn pay 1.8% more taxes. Numbers in table 5 roughly mirror those in table 4. Those that benefit from the reform in welfare terms also see their tax bill reduced.

	Housing wealth quintile				
Financial wealth quintile	1	2	3	4	5
1	-1.5	-0.9	-0.7	-0.6	-0.5
2	-0.5	-0.4	-0.3	-0.2	-0.2
3	-0.1	-0.1	-0.1	-0.1	-0.1
4	0.3	0.1	0.1	0.0	-0.0
5	1.8	1.1	0.9	0.6	0.6

Table 5. Change in taxes paid (%).

The pattern of these results is driven by households' financial wealth-to-labor income ratio. The higher that ratio is, the bigger is the welfare loss. As discussed above, an increase in the VAT rate is, in part, a capital levy on existing financial wealth. As a result, a VAT increase and a reduction in the labor income tax shift resources away from households having lots of financial wealth relative to labor income. For them, the reduction in the labor income tax rate is not sufficient to compensate for the decrease in the purchasing power of their financial savings. On the other hand, those who have lots of debt gain from the reduction in the real value of this debt.

Table 5 shows that in the bottom two financial wealth quintiles households with less housing benefit the most from the reform. In contrast, in the top two financial wealth quintiles households with more housing lose less than those with less housing.

To see why this is, consider first households in the top two financial wealth quintiles. These households have all positive financial wealth. For a given financial wealth, households with less housing are inferred to have a lower labor income than households with more housing. Hence, households with little housing wealth have also more financial wealth relative to their labor income than those with lots of housing wealth. As a result, they benefit little from the reduction in the labor income tax relative to their loss related to the capital levy caused by the increased consumption tax rate.

Now consider households in the first two financial wealth quintiles. As revealed by Table 1, these households all have negative financial wealth. For a given financial wealth, households with less housing are again inferred to have lower labor income, and low consumption overall. As a result, households with little housing have lots of debt relative to labor income. Such highly indebted households must consume much less than what they earn as labor income and therefore are hit relatively little by the increase in VAT. Therefore they gain more than the high housing wealth households consuming relatively large amounts.

6 Conclusions

We have studied the distributional effects of tax reforms that consist of increasing VAT and lowering labor income taxation. Such tax reforms work as a capital levy in the sense that they reduce the purchasing power of households' existing savings. This mechanism may have substantial distributional effects. We have quantified these distributional effects using a dynastic model that is calibrated to Finnish household data. In contrast to the previous literature, we took housing wealth explicitly into account.

We found that the capital levy provided by an increase in VAT has indeed non-trivial distributional effects. These effects are driven by the way that households' financial wealth is distributed relative to their (permanent or life time) labor income. A tax reform that consists of increasing VAT and lowering labor income taxes tends to benefit households that are highly indebted. On one hand, they benefit from a lower labor income tax. On the other hand, since they don't have positive financial wealth, they do not contribute to the capital levy. At the same time, households with lots of financial wealth relative to their labor income are worse off. They are the ones that are hit by the capital levy.

The reason why housing wealth differs from financial wealth is related to the dual role of housing as both an asset and a consumption and to the way that housing is treated in the tax system. Since only construction is subject to VAT, housing wealth is effectively protected

against the capital levy. Things would be different if existing houses were taxed with VAT. This could be done, for instance, by applying VAT to the imputed rent. In that case, the capital levy would apply to housing wealth as well.

References

Altig, David, Alan J. Auerbach, Laurence J. Kotlikoff, Kent A. Smetters, and Jan Walliser (2001) "Simulating Fundamental Tax Refom in the United States" American Economic Review 91(3), 574-595.

Berkovec, J. and D. Fullerton (1992) "A General Equilibrium Model of Housing, Taxes, and Portfolio Choice" Journal of Political Economy 100(2), 390-429.

Caselli, F. and J. Ventura (2000) "A Representative Consumer Theory of Distribution" *American Economic Review* 90(4), 909-26.

Coleman II, W.J. (2000) "Welfare and optimum dynamic taxation of consumption and income" Journal of Public Economics 76, 1-39.

Correia, I. (2010) "Consumption taxes and redistribution" The American Economic Review 100(4), 1974-1694.

Davis, M. and F. Ortalo-Magné (2011) "Household expenditures, wages, rents" Review of Economic Dynamics 14, 248-261.

Díaz-Giménez, J., V. Quadrini, and J. Ríos-Rull (1997), Dimensions of Inequality: Facts on the U.S. Distributions of Earnings, Income, and Wealth, *Federal Reserve Bank of Minneapolis Quarterly Review,* Spring.

Eerola, E. and N. Määttänen (2011) "The optimal tax treatment of housing capital in the neoclassical growth model" forthcoming Journal of Public Economic Theory.

Eerola, E. and N. Määttänen (2006) "On the Political Economy of Housing's Tax Status" The B.E. Journal in Macroeconomics (Topics), Article 7.

Gervais, M. (2002) "Housing Taxation and Capital Accumulation" Journal of Monetary Economics 49(7), 1461-1489.

Krusell, P. and J.-V. Ríos-Rull (1999) "On the Size of U.S. Government: Political Economy in the Neoclassical Growth Model" *American Economic Review* **89**(5), 1156-81.

Kydland, F. (1995) "Business cycles and aggregate labor market fluctuations" in *Frontiers of Business Cycle Research*, by T. Cooley, Ed., Princeton University Press, 126-156.

Li, W., H. Liu and R. Yao (2009). "Housing over Time and over the Life Cycle: A Structural Estimation." Federal Reserve Bank of Philadelphia Working Paper No. 09-7.

Ljungqvist, L. and T.J. Sargent (2004) *Recursive Macroeconomic Theory*, The MIT Press.

Skinner, J. (1996) "The Dynamic Efficiency Cost of Not Taxing Housing" *Journal of Public Economics* **59**(3), 397-417.

Ventura, Gustavo (1999) "Flat tax reform: A quantitative exploration" *Journal of Economic Dynamics and Control* 23, 1425-1458.