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Incentives to Borrow and the Demand for Mortgage Debt:
An Analysis of Tax Reforms

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ABSTRACT

Before 1992 mortgage interest in Italy was fully tax deductible up to 3,500 Euro (7,000 for two cosigners). In 1992-94 the government implemented a series of tax reforms whose ultimate effect was to cancel the relation between the after-tax mortgage rate and the marginal tax rate. Using data from the 1987-2000 Survey of Household Income and Wealth we test if the cancellation of incentives has reduced the propensity to borrow of high-income taxpayers relative to the other population groups. Difference-in-differences estimates and regression analysis indicate that tax considerations have not affected the demand for mortgage debt, either at the extensive or intensive margin.

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Table of Contents

1. Introduction

The theory of portfolio taxation suggests that investors' portfolio choices are affected by the *after-tax* returns on each asset, and that the differing fiscal treatment of the various assets creates wedges in the structure of the returns. The empirical literature for the US, as summarized by Poterba (2001), appears to support the view that taxes affect asset selection and allocation. Evidence on households' response to changes in the tax treatments of debt is far more limited.

In this paper we bring new evidence to the effect of the tax treatment of household liabilities by studying the effect of changes in the tax treatment of mortgages on the propensity to borrow and on the amount borrowed. The change that we consider is the cancellation of tax incentives in the Italian mortgage market for borrowers with high marginal tax rates. We use repeated cross-sectional data drawn from the 1987-2000 Bank of Italy Survey of Household Income and Wealth (SHIW). The survey, which is representative of the Italian population, contains microeconomic data on mortgage debt, after-tax income and demographic variables.

The richness of our data and the features of the tax reform provide a truly unique setting for spotlighting the effect of tax incentives on borrowing in particular, and on household portfolio selection and allocation more generally. From 1982 to 1992 mortgage interests were fully tax-deductible up to approximately 3,500 Euro (7 million lire), so that the tax incentives was proportional to the borrower's marginal tax rate. In 1992 the link with the marginal tax rates was broken, and the incentive made proportional to interests paid (a flat rate of 27 percent, lowered to 22 percent in 1994 and 19 percent in 1998). As a consequence, after 1992 the incentive to borrow was substantially reduced for the rich, slightly increased for the poor, and unchanged for borrowers in the intermediate tax brackets.

These group-specific tax changes provide the ground for our empirical analysis and for the identification of the effect of the tax reform. Theory predicts that the decisions to borrow and of how much to borrow are affected, among other variables, by the after-tax interest rate on borrowing. However, since the after-tax borrowing rate depends on the taxpayer's marginal income tax rate, which is inherently correlated with the level of income, it is difficult to disentangle genuine variation in after-tax interest rates, for given income, from genuine variations in income, for given after-tax interest rates. In the absence of tax incentives this is actually

impossible if, at any point in time, all borrowers face the same interest rate. When the interest rate varies across borrowers, it is generally not observed. And even when it is observed, cross-sectional variability in the price of borrowing tends to be correlated with other household characteristics.

The 1992-94 Italian tax reforms create exogenous variability in after-tax interest rates on borrowing that can be exploited to identify the effects of changes in interest rates on household debt. In particular, if the tax reform had an impact on the decision to borrow and on the amount borrowed, it should emerge among households in the highest and lowest tax brackets after 1992.

The results have important implications that go far beyond the specificities of mortgage markets or household liabilities. Under the pressure of unsustainable financial prospects, several European countries have implemented pension reforms and introduced incentive schemes for private retirement saving. Studying if and how households react to tax incentives is of paramount importance for understanding the effectiveness of the incentive.

The paper has six more sections. Section 2 reviews previous studies on tax incentives to borrow, with particular reference to the US 1986 tax reform and the phasing out of the MIRAS program in the UK. Section 3 provides institutional background on the Italian mortgage market and explains how the 1992-94 reforms affected the tax treatment of mortgage interest. Section 4 presents the data used in the empirical analysis, and Sections 5 and 6 the econometric results. There turns out to be no detectable effect of the tax reforms on the demand for mortgage debt or the amount borrowed. Section 7 concludes suggesting various explanations for these findings, such as the role of information.

2. International evidence

In many countries the tax code gives preferential treatment to mortgages, as part of broader government intervention to subsidize housing. There are several reasons that justify housing incentives. One of the most compelling is that housing is an investment good; hence tax-deductible capital costs are in principle offset by imputed rental values. In practice the offset is

modest, as the market value on which imputed rents are computed is underestimated. So the main goal of these programs is to shift the portfolio allocation of wealth towards goods to which society assigns an important weight in creating positive externalities and raising living conditions, much like targeting retirement saving is a remedy to household myopia and potential free-riding problems.

Arguments to discriminate in favor of one type of housing tenure (homeownership against renting) are much weaker.[1] In this paper we take the system of incentives as given and do not address important questions such as whether the tax code should favor housing in the first place, whether incentives for homeownership should be higher than those for renting, and how homeownership could be promoted.

Poterba (2001) provides international evidence on the type of borrowing incentives for house purchase that exist in nine OECD countries. Three countries, the US, the Netherlands, and France, allow relatively unrestricted deductions for mortgage interest, and a fourth, Italy, allows mortgage interest deductions for first-time homeowners only.[2] In Japan taxpayers are not allowed to deduct mortgage interest payments, but enjoy a special tax credit for first-time home purchase, subject to a time limit.

Historically, the UK featured one of the most generous mortgage incentives programs (MIRAS, or *Mortgage Interest Relief at Source*). Over time, the treatment of mortgage interest was subject to considerable changes. Before 1983, the interest on the first £30,000 of a mortgage was deductible from taxable income. In April 1983, the MIRAS scheme was introduced and initially provided two sources of variability in the after-tax mortgage interest rate. Under MIRAS, a borrower paid the lender the interest less the tax relief, initially equal to the marginal tax rate. Moreover, until 1988 the £30,000 limit applied on single mortgagers rather than the property, so married people could each receive relief on loans up to £30,000, including more than one on the same property.

The MIRAS scheme was criticized as a strongly distortionary measure introducing a bias in favor of owner-occupation and in favor of higher income households who are more likely to

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[1] Major features of housing taxation include the tax treatment of mortgage interest rates and capital gains from sales, inclusion of imputed rents in taxable income, and local taxation.
[2] In the US households cannot deduct interest on more than $1,000,000 of mortgage debt, but in practice this constraint rarely binds.

finance large houses. Moreover, the relief was believed to result in higher house prices, which prevented new homebuyers from gaining fully from it. This led to several reductions in the relief rate that culminated with the phasing out of MIRAS in April 2000.[3] As we shall see, some of the developments in MIRAS parallel the series of reforms in the tax treatment of mortgage interests in Italy. The tax change that we analyze might therefore prove useful to understand the portfolio effects of MIRAS as well.

Another important tax change that affected household liabilities was the US Tax Reform Act of 1986. That reform phased out deductions for interest on consumer credit − on the ground that they provided an incentive to invest in consumer durables rather than assets, which produce taxable income − while maintaining the residential mortgage interest deduction − on the ground that homeownership is an important policy goal. In short, the tax reform increased the price of borrowing through mortgages relative to consumer debt. Since there was no restriction on the use of home equity debt, homeowners were given an incentive to shift from consumer debt into mortgage debt. The incentive was higher for high-income households, who are subject to high marginal tax rates and more likely to itemize deductions.

The 1986 reform stimulated some empirical studies on the effect of changing the after-tax borrowing rate on consumer credit (Engen and Gale, 1996; Skinner and Feenberg, 1990; Scholz, 1994). The common finding of these studies is that household debt composition is sensitive to the tax treatment of different types of debt. Maki (2001) provides the most recent and careful analysis of the effect of the change in tax treatment of consumer credit on the demand for mortgages. Using data from the Consumer Expenditure Survey he concludes that after the reform high-income homeowners reduced consumer interest paid and increased mortgage interest paid relative to other households. On the other hand, high-income earners who were not homeowners and had therefore no access to home equity borrowing, did not reduce their consumer interest paid relative to other renters.

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[3] Hendershott, Pryce and White (2002) use a sample of loans originated in the UK to predict the probability that a loan exceeds the £30,000 limit. These probabilities are used to construct debt tax penalty variables that are then related to the LTVs on loans to finance home purchase. The authors find that the removal of deductibility has reduced the initial LTVs by about 30 percent.

3. The reform of the tax treatment of mortgage interest

Despite the increasing competitive pressure of European banks on financial intermediaries operating in the domestic market and the growth of the past two decades (the household debt-income ratio increases from 9 percent in 1985 to 19 percent in 2000), by international standards mortgage debt in Italy is relatively low. Chiuri and Jappelli (2001) document that the down payment and the cost of foreclosure in Italy are higher than in countries at a similar level of financial development. A further reason for the relatively thin mortgage market is the presence of informal arrangements and various forms of intergenerational transfers (bequests, *inter vivos* transfers, help for down payment or outright purchase, free housing or co-residency), partly overcoming borrowing constraints and reducing the need for mortgage credit.

In this paper we do not attempt at explaining the broad trends in Italian mortgage markets. Rather, we study if, given the institutional setting and existing constraints, borrowers have perceived the changes in the specific features of the tax treatment of mortgage interest.

Table 1 summarizes the series of tax reforms that took place in the mortgage market in the past two decades. In 1982 the tax code introduced substantial incentives for mortgage loans. Mortgage interests up to 7 million lire per year (about 3,500 Euro) were made deductible from the borrower's general income tax base. Eligibility applied to first-time buyers and repeat buyers as well, and to mortgages incurred not only for home purchase, but also repairs, additions and new constructions (in these cases interests up to about 2,000 Euro were deductible). In that tax regime the price of mortgage debt was $r(1-\tau_i\phi_i)$, where r denotes the mortgage interest rate, τ_i taxpayer's i marginal tax rate, and ϕ_i household's i fraction of deductible interests: 100 percent if mortgage interest payments did not exceed n_iL Euro (where n_i denotes the number of taxpayers co-signing the contract and L=3,500 Euro), and the limit-interest payments ratio otherwise. Therefore, $\phi_i = \min\left\{1, \dfrac{n_iL}{P_i}\right\}$, where P_i denotes mortgage interest payments.

In 1992 the tax incentive became a flat 27 percent of the interest paid, and the price of mortgage debt changed to $r(1-0.27\phi_i')$. With respect to the pre-1992 regime, the incentive to borrow was thus raised for investors with the lowest marginal tax rate, lowered for those with the

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highest marginal tax rate, and unaffected for those in the intermediate tax brackets. The tax reform also envisioned different tax provisions for contracts signed before or after 1993. Before 1993 the 3,500-euro limit applied to each taxpayer co-signing the contract; after 1993 to the interest paid for the mortgage ($\phi_i' = \min\left\{1, \dfrac{L}{P_i}\right\}$). The tax incentive was then further reduced to 22 percent in 1994 and 19 percent in 1998, with the limit still fixed, at least in nominal terms.

Since the effect of the reforms depends on the borrower's position in the tax distribution, Table 2 reports the tax brackets in place between 1987 (the first year of our sample) and 2000. Three changes are worth noticing. In 1989 the highest two tax brackets were eliminated and marginal tax rates reduced for all brackets but the second. In 1990-92 tax brackets were indexed to inflation. Finally, in 1992 marginal tax rates were raised by one percentage point for all but the bottom two brackets.

The change in incentives to borrow induced by the 1992-94 tax reforms was substantial, especially for borrowers in the top tax brackets. To illustrate these effects, in the top panel of Figure 1 we plot the yearly difference between the interest paid on a mortgage with no tax incentive and a tax-favored mortgage instrument for a borrower paying interests of 3,500 Euro for 10 years (the typical duration of mortgage contracts in Italy over the sample period). We assume that the mortgage is a fixed-rate mortgage at the 12 percent interest rate, approximately the rate prevailing in 1992-94.

In the pre-1992 regime the price of borrowing declines linearly with the marginal tax rate. A borrower with a marginal tax rate of 33 percent faces an after-tax borrowing rate of 8 percent; in the top bracket, the after-tax rate is 6 percent, and 11 percent in the bottom one. After 1992 the tax incentive is a flat 945 Euro for all tax brackets (0.27×3,500), so the after-tax rate is 8.8 percent, regardless of the tax rate. The 1994 reform reduced the incentive to 770 Euro (0.22×3,500), further lowered to 665 Euro in 1998 (0.19×3,500). In the example, the after-tax rate increases to 9.4 and 9.7 percent, respectively.

In the lower panel of Figure 1 we consider the effect of the reform for those with mortgage interest above the L=3,500 limit, assuming that the borrower is paying interests of 7,000 Euro for 10 years. The graph shows that the change in the price of borrowing induced by the reform depends also on the number of taxpayers in each household. Between 1992 and 1993 in the top

tax bracket the price of borrowing increases by 4.38 percentage points for households with two taxpayers, and by 1.38 points for single taxpayers. In the lowest tax bracket, the price of borrowing declines by abut half a percentage point for multiple taxpayers and by slightly more than one point for single taxpayers.

The abrupt cancellation of the tax incentive for the rich and the greater incentive given to low-income households should have reduced the former's propensity to borrow relatively to the latter's and relatively to the control group of households in the intermediate tax brackets. Furthermore, the increase in the price of borrowing is higher for households with two or more income recipients − who lost the possibility of double tax deductions − than for single income households. Our empirical strategy is thus to divide the sample into groups affected and unaffected by the reforms, according to their marginal tax rate and number of taxpayers, and to test whether the reform had any effect on mortgage debt of the groups affected.

The validity of the proposed test rests on some assumptions: (1) the tax reform is exogenous with respect to the decision to borrow, (2) it is exogenous with respect to changes in sample composition, (3) there are no group-specific trends in the propensity to borrow, and (4) there are no simultaneous credit supply shifts correlated with the reform (for instance, a credit crunch affecting taxpayers differently).

As far as assumption (1) is concerned, we believe that the possible endogeneity of the reforms can be safely ruled out. The reforms were not implemented in order to offset the different paths of borrowing by taxpayer groups (if this had been the case, there would be a problem of policy endogeneity). Rather, the 1992 reform was part of a major deficit-reduction package, prompted by a severe political crisis coupled with the dramatic devaluation of the lira; and it was followed shortly by the deepest recession of the post-war era.[4]

Assumption (2) posits that shifts in sample composition are exogenous with respect to the decision to borrow (and to the amount borrowed). In essence, we require that movements across the tax distribution (into higher or lower brackets) are independent of borrowing decisions, i.e.

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[4] The 1992 reform of the tax treatment of mortgage interest payments mirrors, in structure and timing, the reform of the tax incentives to life insurance. In previous work we analyzed the effect of this reform on the decision to purchase life insurance and found that it had no impact on the decision to purchase life insurance or on the contribution rate (Jappelli and Pistaferri, 2002). We considered as likely explanations minimum investment requirements, borrowing constraints, lack of commitment to long-term saving and of financial information about tax incentives.

that borrowers did not move within the income distribution as a result of the tax reform itself. Before 1993 for people at the margin a tax deduction of 3,500 Euro may actually change the relevant tax bracket. On this front, we present evidence that our results are robust to possible tax bracket shifts induced by the reform.

Assumption (3) avoids attributing to the tax reform the effect of underlying trends in the decision to borrow that differ across groups. Since our data spans both pre- and post-reform years, we can check the validity of this assumption by including group-specific time trends in estimation. Finally, assumption (4) rules out a simultaneous shift of the supply of loans. In the empirical test, however, we control for aggregate-wide changes in the supply of credit with the inclusion of time dummies.

4. The data

The 1987-2000 SHIW provides a unique opportunity to test the effect of the tax reform on the demand for mortgage loans. Conducted by the Bank of Italy in 1987, 1989, 1991, 1993, 1995, 1998 and 2000, it spans pre- and post-reform years. In each year it contains information on outstanding mortgage debt, income, and demographic variables. Each survey collects data on a representative sample of about 8,000 households. We drop the self-employed, whose debt is more likely to be business-related and exclude the 1993 transitional year. Our final sample includes almost 40,000 observations. Ideally, we would like to observe mortgage loans and pre-tax interest paid for home acquisition of first-time buyers. In practice we observe outstanding debt for home acquisition or repairs of all borrowers and do not observe interest paid.

To classify households according to mortgage incentives, we need to impute the marginal income tax rate. In estimating this tax rate one should consider that it might be affected by the structure of household portfolios, a problem pointed out by Poterba and Samwick (1999). Although in Italy income from most financial assets (such as bank deposits, mutual funds and government bonds) is subject to a flat rate withholding tax, dividends and income from capital (e.g., rents) enter the general income tax base and therefore affect marginal tax rates. And as we

have pointed out, part or all of the mortgage interest can be deducted. This generates potential correlation with the overall marginal tax rate and portfolio choice. We therefore estimate marginal tax rate only on the basis of labor income, excluding income from capital.

Since the incentive to borrow applies to individual borrowers, we proxy the investor's marginal tax rate with that of the household head's labor income, using the tax brackets and marginal rates reported in Table 2. The SHIW collects data on after-tax wages, salaries, self-employment income, income from capital and income from financial assets so imputation of tax brackets is straightforward.

In Figure 2 we plot the aggregate ratio of outstanding mortgages and household disposable income, drawn from the SHIW and aggregate financial accounts, respectively. Both series show an increasing trend in the debt-income ratio (mortgage debt doubles between 1987 and 2000). However, there are some discrepancies between the two series: the microeconomic data do not signal the vigorous growth of the late 1990s evident from the aggregate statistics. This is likely due to comparability problems. The financial accounts of the household sector do not provide a breakdown of total debt into mortgage debt and consumer credit on a consistent basis over time. The series plotted in Figure 2 refers to total financial liabilities of households, unincorporated business with less than 5 employees and no-profit organizations over 12 months of maturity. In contrast, the SHIW data include only household mortgage debt (rather than all liabilities), regardless of maturity.

Figure 3 plots the proportion of borrowers in 1987-2000 by marginal income tax rates. The proportion shifts with the tax rate, indicating that the decision to borrow is correlated with income. For instance, in 2000 only 5 percent of those in the lowest tax brackets had a mortgage, compared with 19 percent in the highest brackets. There is no clear trend in the propensity to borrow in the lowest tax bracket, a slowly increasing trend of those in the τ=0.22 tax bracket, and a decreasing trend of those in the τ=0.27 bracket. For the highest brackets the fraction of households with a mortgage increases between 1987 and 1991, flattens out until 1995, and declines afterwards. The debt-income ratios plotted in Figure 4 displays similar trends.[5]

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[5] Analyzing the amount borrowed as well as the decision to borrow is important if households respond to the increase in the price of borrowing induced by the reform buying smaller housing units, rather than reducing the frequency of mortgage loans.

As is explained in Section 3, the 1992-94 reforms should have reduced the tax incentive to borrow for the rich and increased it for the poor. The descriptive evidence presented in Figures 3 and 4 indicates that mortgage debt is lower for the poor and higher for the rich, and that the rich experienced a decline in the propensity to borrow and in the amount borrowed after 1995. But this cannot be taken as evidence either for or against the hypothesis that taxation affects borrowing, because different characteristics across groups and group-specific trends could mask the effect of the reform.

In the remaining of the paper we use a difference-in-difference estimator and regression analysis to test the hypothesis that the propensity to borrow of the poor has increased faster than that of the rich after the reform and that, for any given marginal tax rate, multiple income households have reduced the propensity to borrow more than single income households.

5. Difference-in-differences results

To study the effect of the 1992-94 reforms we identify a group of households unaffected by the reforms and one or more groups potentially affected by the new tax regime. Using standard terminology, we call the former the "control" group, and the latter the "treatment" groups. We illustrate the difference-in-difference estimator in relation to the effect of the tax reform on the amount borrowed by the group of rich taxpayers.

Denote by $b_{i \in g_0, t}$ ($b_{i \in g_1, t}$) mortgage debt of borrower i in the control group g_0 (treatment group g_1) in period t. Between period t and t' a tax reform takes place that changes borrowers' tax incentive in the treatment group. For instance, the 1992-94 reforms affect the treatment group of rich tax-payers (with a marginal tax rate greater than 0.22) by eliminating the link between after-tax returns and marginal tax rates, but not the control group (those with a marginal tax rate equal to 0.22).

We assume that before the reform the demand for mortgage debt is:

$$b_{i \in g_j, t} = \beta_t + f_{g_j} + v_{i \in g_j, t}$$

for $j=\{0,1\}$. Both groups are subject to an aggregate shock β_t. Long-term differences between groups are captured by the fixed effects f_{g_0} and f_{g_1}. In the absence of such differences across groups, the average debt is equal for g_0 and g_1. After the tax reform the demand shifts for both groups:

$$b_{i \in g_j, t'} = \beta_{t'} + f_{g_j} + \delta \times \mathbf{1}\{j \neq 0\} + v_{i \in g_j, t'}$$

where $\mathbf{1}\{.\}$ is an indicator function that equals 1 if the statement in bracket is true and zero otherwise. According to this specification, the reform affects mortgage debt by an amount δ in the treatment group. Given this structure, one can identify the effect of the reform using the difference-in-difference estimator:

$$E(b_{i \in g_1, t'} - b_{i \in g_1, t}) - E(b_{i \in g_0, t'} - b_{i \in g_0, t}) = \delta$$

The identifying assumption, then, is that controlling for group and time effects, the error term v has mean zero. Note that panel data are not required to compute the conditional means that form the basis of the difference-in-difference estimator. What we need to observe is a representative sample of the two groups g_0 and g_1 in each of the two periods t and t'. For our purposes therefore one can rely on repeated cross-sectional data.

Since time effects are common to both groups, in the pre-reform period t the control and treatment groups differ only in long run fixed effects, $(f_{g_1} - f_{g_0})$. Thus, the model is consistent with the fact that high-income borrowers behave differently than those in low tax brackets, regardless of policy interventions. In the post-reform period t' the treatment group now differs not only because of fixed effects, but also because of the tax reform $(f_{g_1} - f_{g_0} + \delta)$.

A finding that $\delta < 0$ signals that the reform has reduced the propensity of rich tax-payers to borrow relatively to the control group. By appropriately redefining the variable b or the treatment

group g_1, one can readily extend this framework to examine the propensity to borrow rather than the amount borrowed and the separate behavior of the low-income group after the reform (where theory suggests $\delta > 0$).

In Tables 3 and 4 we report separate estimates for the effect of the 1992-94 reforms on the decision to borrow and the amount borrowed, respectively. The pre-reform period is 1987-91, the post-reform period is 1995-2000. The transitional year 1993 is omitted. The upper panels in both tables look at the impact of the reform on low-income tax-payers ($\tau<0.22$) relative to the control group ($\tau=0.22$). The other two panels refer to the intermediate ($\tau=0.27$) and high-income taxpayers ($\tau>0.27$), again relative to the control group.

Table 3 shows that the difference-in-difference estimates for the propensity to borrow are negative in all groups, regardless of marginal tax rate. In the medium and high income groups, for instance, the difference-in-difference estimates are -5.7 and -2.1 percentage points, respectively (and statistically different from zero at the 1 percent level), indicating that these group reduced participation more than those who were not affected by the reform. However, the result for the low-income group (-3.2 percent) is not consistent with the theory, which predicts that the group of low-income taxpayers should have increased participation relative to the control group.

Table 4 documents another clash with the theory. The amount borrowed declines for low-income taxpayers and increases among high-income taxpayers. Both results are the reverse of what theory predicts.[6]

We know from Section 3 that in 1993 the reform eliminated the possibility of interest deductions for mortgage co-signers. To see the effect of this further aspect of the tax reform, denote by $r(1-\tau_i\phi_i)$ the price of mortgage debt before the reform and $r(1-\tau_i'\phi_i')$ the price after the reform.[7] The price change is $-r(\tau_i'\phi_i'-\tau_i\phi_i)$, which can be decomposed as:

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[6] Results are similar when we examine the separate effect of the 1992 reform. In this experiment the pre-reform period is 1987-91 and the post-reform period is just 1993. The control group includes taxpayers with a marginal tax rate of 27 percent. There are two treatment groups, rich taxpayers, with a marginal tax rate above 27 percent, and poor taxpayers with a marginal tax rate below that threshold.

[7] Household's i fraction of deductible interests ϕ_i is defined in Section 3, and for simplicity we assume no change in the mortgage interest rate after the reform.

$$- r\left[\left(\tau_i{}' - \tau_i\right)\phi_i + \left(\phi_i{}' - \phi_i\right)\tau_i\right]$$

The first term in the square brackets is the effect of changing the rate at which mortgage interests are deducted, for *given* deductibility limit, while the second is the effect of changing the deductibility limit, for *given* deduction rate.

We know that after the reform $\tau_i{}' = 0.22$ for all *i*, so that $\left(\tau_i{}' - \tau_i\right)\phi_i = 0$ for individuals in the $\tau=0.22$ tax bracket, positive for individuals in lower tax brackets, and negative for the highest brackets. On the other hand, $\left(\phi_i{}' - \phi_i\right)\tau_i = 0$ for single-taxpayer households and $\left(\phi_i{}' - \phi_i\right)\tau_i \leq 0$ for households with multiple-taxpayers.

This additional feature of the tax reform has several implications. First, the control group in Tables 3 and 4 includes households that, at least in principle, are not neutral with respect to the reform. Moreover, for single taxpayer households in high tax brackets ($\tau > 0.22$), $\left(\tau_i{}' - \tau_i\right)\phi_i < 0$ and $\left(\phi_i{}' - \phi_i\right)\tau_i = 0$, while for multiple-taxpayer households $\left(\tau_i{}' - \tau_i\right)\phi_i < 0$ and $\left(\phi_i{}' - \phi_i\right)\tau_i \leq 0$, implying a stronger negative effect of the reform for the latter group. Finally, for single taxpayers in the lowest tax bracket ($\tau = 0.1$), $\left(\tau_i{}' - \tau_i\right)\phi_i > 0$ and $\left(\phi_i{}' - \phi_i\right)\tau_i = 0$, while for multiple taxpayers $\left(\tau_i{}' - \tau_i\right)\phi_i > 0$ and $\left(\phi_i{}' - \phi_i\right)\tau_i \leq 0$, implying that, in principle, the tax reform might have an ambiguous effect on the price of borrowing for the latter group.

To address these issues we redefine our control group to include only single taxpayer households with $\tau=0.22$, create a new treatment group (multiple taxpayers with $\tau = 0.22$, where we would expect the effect of the tax reform to be negative), and separate the three treatment groups of Tables 3 and 4 (with $\tau=0.10$, $\tau=0.27$, and $\tau>0.27$) into single- and multiple-taxpayers households. To check whether the effect of the reform is stronger among multiple income households, we assume sampling independence and test the null hypothesis of no difference between groups against the alternative that the difference is consistent with the theory of portfolio taxation.

The results, reported in Table 5, are qualitatively similar to those obtained ignoring the change in the deductibility limit. There is an across-the-board decline in the proportion of mortgage borrowers that is at variance with the theory's predictions. Moreover, the amount

borrowed declines among the poor and increases among the rich, again in contrast with the theory.

For any given tax bracket, one should expect a stronger effect of the reform on households with multiple earners, providing a further dimension to test the effect of the reform. For instance, one would expect that multiple income households with $\tau > 0.27$ reduced the propensity to borrow *more* than single income households in the same tax bracket. In contrast, the difference results indicate that they reduce the propensity to borrow *less* than single income households. Results for other groups and for the amount borrowed are qualitatively similar, and do not signal group-specific different reactions to the reform in the direction expected by the theory. The tests presented in the last column confirm that there is no significant difference between single- and multiple taxpayers, conditioning on any given tax group.

There are several reasons why the difference-in-difference estimates may not pin down the effect of the tax reform. First, the effect could be diluted because other determinants of borrowing induce different behavior across groups: one possibility is that there are events, other than tax reforms, that provide alternative explanations for the results. Second, the difference-in-difference estimator does not handle the analysis of the decision to borrow properly, because the estimated probabilities of having a mortgage do not necessarily lie in the [0,1] range. Third, trends in outcomes specific to groups may produce changes as a function of time *per se*, not of the tax reform. By the same token, differential trends in treatment and control groups that change in different ways for treatment and control group (for instance, a time trend in the treatment group that is not present in the control group) may be responsible for the results. Finally, we have not contemplated the potential impact of borrowing constraints. Some households (especially those in the lowest tax brackets) may be denied loans and have no access to credit. In the next section we turn to probit and Heckman selectivity analysis for the decision to borrow and the amount borrowed, controlling for other household characteristics, group-specific trends in outcomes, and borrowing constraints.

6. Regression results

To translate the difference-in-difference approach into a regression equation, we consider two time periods, t and t', and groups of borrowers affected or unaffected by the reforms. The demand for mortgage debt in the pre-reform period is:

$$b_{i \in g_j, s} = X_{i \in g_j, s} \theta + u_{i \in g_j, s}$$

for $j=0$ (the control group), 1,…, k (the treatment groups). The term $u_{i \in g_j, s}$ captures variability in the demand for mortgage debt not explained by observable demographic and socioeconomic characteristics $X_{i \in g_j, s}$. We assume that in the pre-reform period:

$$u_{i \in g_j, t} = \beta_t + f_{g_j} + v_{i \in g_j, t}$$

while in the post-reform period:

$$u_{i \in g_j, t'} = \beta_{t'} + f_{g_j} + \delta_{g_j} \times \mathbf{1}\{j \neq 0\} + v_{i \in g_j, t'}$$

The reduced form demand for mortgage debt can be written as:

$$b_{i \in g_j, s} = (\beta_t + f_{g_0}) + X'_{i \in g_j, s} \theta + (\beta_{t'} - \beta_t) D_{t'} + \sum_{j=1}^{k} (f_{g_j} - f_{g_0}) D_{g_j} + \sum_{j=1}^{k} \delta_{g_j} D_{g_j} D_{t'} + v_{i \in g_j, s} \qquad (1)$$

The group dummies D_{g_j} and the time dummy $D_{t'}$ measure, respectively, permanent differences between groups and shifts due to common time effects. The interaction terms $D_{g_j} D_t$ identify the impact of the reform ($\delta_{g_j} < 0$ for rich taxpayers and $\delta_{g_j} > 0$ for poor taxpayers). In contrast to the difference-in-difference approach, this framework allows us to consider additional explanatory variables that affect mortgage debt and to control for group-specific time trends.

The specification (1) neglects the effect of the change in the deductibility limit that affects differently single- and multiple-taxpayer households. To account for this further aspect of the reform, rewrite the demand for mortgage debt in the pre-reform period as:

$$u_{i \in g_j, n, t} = \beta_t + f_{g_j} + \gamma_n + v_{i \in g_j, n, t}$$

where $n=s$, m (single- and multiple-taxpayer households). The parameters γ_s and γ_m measure long-run differences in the demand for mortgage debt of single- vs. multiple-taxpayers. The demand in the post-reform period is:

$$u_{i \in g_j, n, t'} = \beta_{t'} + f_{g_j} + \gamma_n + \delta_{g_j, n} + v_{i \in g_j, n, t'}$$

where the control group has been re-defined to include only single-taxpayer households, so that $\delta_{g_0 s} \equiv 0$. The reduced form demand for mortgage debt is therefore:

$$b_{i \in g_j, n, s} = (\beta_t + f_{g_0} + \gamma_s) + X'_{i \in g_j, n, s} \theta + (\beta_{t'} - \beta_t) D_{t'} + \sum_{j=1}^{k} (f_{g_j} - f_{g_0}) D_{g_j} + (\gamma_m - \gamma_s) D_m$$

$$+ \sum_{j=0}^{k} \sum_{n=s, m} \delta_{g_j, n} D_{g_j} D_n D_{t'} + v_{i \in g_j, n, s}$$

(2)

where the dummies D_m and $D_s = 1 - D_m$ are for single- and multiple-taxpayer households, respectively. The interaction terms $D_{g_j} D_n D_{t'}$ identify the effect of the reform ($\delta_{g_j, n} > 0$ for poor taxpayers, $\delta_{g_j, n} < 0$ for rich taxpayers, and $\delta_{g_j, m} < \delta_{g_j, s}$ for all tax groups).

To introduce the regression results, Table 6 reports sample averages for households with and without a home mortgage in the pooled 1987-2000 sample (omitting 1993). On average, people with a mortgage are younger, more educated, more likely to have children and being

married, and their family income is higher. Average mortgage debt, conditional on having a mortgage, is about 15,000 Euro.

Table 7 reports regression results for the probability of having debt. Column (1) reports the result of estimating the basic specification (1) with demographic controls (age dummies, education, region dummies and family size), year dummies, tax bracket dummies, income quintile dummies, group-specific time trends, and the interaction of group and post-reform dummy. As explained above, the latter should capture the effect of 1992-1994 tax reforms for the different treatment groups involved. Column (2) expands further the specification to test for different tax reform effects for households with one or multiple income recipients (as per equation 2).

In both regressions there is either no detectable effect of the tax reform on the propensity to borrow, or a pattern that is at variance with the theory of portfolio taxation. In Table 7 we report only the effect of the variables of interest. The other coefficients indicate that the propensity to borrow declines with age and in the South, increases with income, education and family size. Group-specific time trends are positive for people at the bottom of the income distribution, and negative at the top.

Since the survey does not allow us to distinguish between first-time buyers (who are eligible for the tax incentive) from repeat buyers, we restrict the sample to those under 45 or under 40, again finding no impact for the reform.

We also estimate Heckman selectivity regression estimates for the amount borrowed. Since it is difficult to single out variables that affect the decision to borrow but not the amount borrowed, identification is achieved introducing a full set of regional dummies in the selectivity equation or via functional form, replacing income and age dummies in the selectivity equation with income and age levels. In no case do we find the interaction dummies to be statistically significant or even economically in agreement with the sign predictions of the theory.

These estimates can be criticized because we have not taken into account the potential impact of borrowing constraints. In the group of low income households, lack of tax effects might be due to the fact that these people have no access to credit, so that the availability of more generous tax incentives after 1992 does not affect their borrowing decisions because it does not ease the borrowing constraint. While the argument is valid in principle, in practice it cannot

explain the lack of effect among high-income individuals who should not be affected by borrowing constraints.

Nevertheless, we check the empirical relevance of this argument by estimating a probit regression only for a sample of unconstrained individuals. To classify households into constrained and unconstrained, we use information on the proportion of households turned down for credit or discouraged from borrowing, available in each year from 1987 to 2000.[8] We then estimate a bivariate probit model for the probability of not being liquidity constrained and for the probability of having mortgage debt. The results, omitted for brevity, are similar to those reported in Table 7, showing no impact of the reform.

7. Conclusions

Before 1992 mortgage interest was fully tax deductible up to 3,500 Euro (7,000 for two cosigners). In 1992-94 the Italian government implemented a series of tax reforms whose ultimate effect was to cancel the relation between the after-tax mortgage rate and the marginal tax rate. In the new regime the tax incentive applies to only one taxpayer and is proportional to the interests paid regardless of the marginal tax rate. This cancellation of incentives should have reduced the propensity to borrow of high-income taxpayers relative to other population groups and of multiple income households relative to single income.

In contrast, we find no evidence that tax considerations shape the demand for mortgage debt, either at the extensive or the intensive margin. The most likely explanation for the absence of response to these substantial changes in the incentives to borrow is lack of financial information in general, and awareness of the specific changes in tax incentives in the mortgage market in particular. In fact, in comparison with other industrialized countries, Italy lags behind

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[8] We estimate the probability that a household might be denied credit or discouraged from borrowing relying on information available in the SHIW. In each year we have information on households that, while needing credit to finance expenditures on non-durables and durable goods, did not apply for a loan in the reference survey year because expected to be refused, or applied for a loan, but were rejected. We define

17

in terms of financial information. The Annual Survey of the World Competitiveness Indicator indicates that Italy ranks 38th and 43th out of the 49 countries examined in terms of economic literacy and education in finance among the population. On a 1 to 10 scale, Italy receives a score of 3.98 in economic literacy and 3.73 in education, much lower values than, to name a few, the US, Sweden, Netherlands, Australia and Japan (all above 6).[9] This might explain also why our findings contrast with the US literature, where there is broad consensus that cancellation of tax incentives for consumer credit have induced portfolio shifts towards mortgages, and that people took advantage of the loophole created by the 1986 TRA.

This lack of responsiveness to tax incentives has important implications not only for the design and marketing of mortgage instruments, but in other areas as well. For instance, pension reforms rely crucially on tax incentives to stimulate retirement saving in individual accounts and pension funds contributions. To the extent that people are not aware or do not understand fully the implications of these incentives, one should expect limited growth of pension funds, at least initially. In this respect, reforms that raise financial institutions' transparency and the overall level of financial information can be expected to have great impact on household portfolios.

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these two groups of households as credit-constrained. Similar questions are posed in the US Survey of Consumer Finances.

[9] The 1995 and 1998 SHIW elicit data on the respondents' awareness about 17 financial assets. Guiso and Jappelli (2002) provide evidence that Italian households lack basic financial information. For instance, about two thirds of respondents are not aware of stocks, and about 50 percent of mutual funds. We don't have specific data, but find it highly plausible that information on mortgage characteristics is also poor, and that understanding of the tax treatment of mortgages and of the changes introduced by 1992-94 reforms is not common among potential borrowers.

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Table 1
The reform of mortgage interest deductions

	Price of mortgage debt	Limit	Joint contracts
1982-1992	$r(1-\tau*\phi)$	$L\leq3{,}500$	The 3,500 limit applies to each tax-payer co-signing the contract
1993-1994	$r(1-0.27*\phi)$	$L\leq3{,}500$	For contracts signed before 1993, the 3,500-euro limit applies to each taxpayer co-signing the contract. For contracts signed after 1993, the 3,500 limit applies to the interest paid on the mortgage
1995-1997	$r(1-0.22*\phi)$	$L\leq3{,}500$	
1998-2000	$r(1-0.19*\phi)$	$L\leq3{,}500$	

Table 2
Tax brackets and marginal tax rates, 1987-2000

The table reports the tax brackets and the marginal tax rates from 1987 to 2000. Tax bracket figures are in thousands of Euro.

1987-1988		1989-90		1991		1992-2000	
Tax bracket	Marginal tax rate	Tax bracket	Marginal tax rate	Tax bracket	Marginal tax rate	Tax bracket	Marginal tax rate
≤3.10	0.12	≤3.30	0.10	≤3.51	0.10	≤3.72	0.10
3.10-5.68	0.22	3.30-6.56	0.22	3.51-6.97	0.22	3.72-7.44	0.22
5.68-14.46	0.27	6.56-16.43	0.26	6.97-17.41	0.27	7.44-15.50	0.27
14.46-25.82	0.34	16.43-32.90	0.33	17.41-34.92	0.34	15.50-30.99	0.34
25.82-51.65	0.41	32.90-82.18	0.40	34.92-87.19	0.41	30.99-77.48	0.41
51.65-77.47	0.48	82.18-164.41	0.45	87.19-74.43	0.46	77.48-154.96	0.46
77.47-154.94	0.53	>164.41	0.50	>174.43	0.51	>154.96	0.51
154.94-309.87	0.58						
>309.87	0.62						

Table 3
Difference-in-difference results: proportion of borrowers

The three panels report difference-in-difference results for the proportion of borrowers. The difference-in-difference estimate is reported in the bottom right cell of each panel. The pre-reform period is 1987-1991, and the post-reform period is 1995-2000. Standard errors are reported in parenthesis.

Low-income tax-payers ($\tau=0.10$)			
	$\tau=0.10$	$\tau=0.22$	*Difference between groups*
After the reform	0.036	0.052	-0.016
	(0.006)	(0.004)	(0.007)
Before the reform	0.033	0.017	0.016
	(0.010)	(0.003)	(0.010)
Difference within groups	0.004	0.035	*Diff-in-diff*
	(0.011)	(0.006)	-0.032
			(0.013)

Medium-income tax-payers ($\tau = 0.27$)			
	$\tau > 0.27$	$\tau = 0.22$	*Difference between groups*
After the reform	0.039	0.052	-0.013
	(0.003)	(0.004)	(0.005)
Before the reform	0.061	0.017	0.044
	(0.002)	(0.004)	(0.004)
Difference within groups	-0.022	0.035	*Diff-in-diff*
	(0.004)	(0.006)	-0.057
			(0.007)

High-income tax-payers ($\tau > 0.27$)			
	$\tau > 0.27$	$\tau = 0.22$	*Difference between groups*
After the reform	0.156	0.052	0.104
	(0.003)	(0.004)	(0.005)
Before the reform	0.142	0.017	0.125
	(0.005)	(0.004)	(0.006)
Difference within groups	0.014	0.035	*Diff-in-diff*
	(0.006)	(0.006)	-0.021
			(0.008)

Table 4
Difference-in-difference results: debt amount

The three panels report difference-in-difference results for the amount of debt (in thousand Euro), conditioning on having a mortgage. The difference-in-difference estimate is reported in the bottom right cell of each panel. The pre-reform period is 1987-1991, and the post-reform period is 1995-2000. Standard errors are reported in parenthesis.

Low-income tax-payers (τ=0.10)			
	τ=0.10	τ=0.22	Difference between groups
After the reform	20.04	31.81	-11.78
	(3.88)	(2.72)	(4.74)
Before the reform	34.39	14.34	20.05
	(6.72)	(4.19)	(7.92)
Difference within groups	-14.35	17.48	*Diff-in-diff*
	(7.76)	(4.99)	-31.83
			(9.23)

Medium-income tax-payers (τ=0.27)			
	τ=0.27	τ=0.22	Difference between groups
After the reform	27.15	31.81	-4.66
	(1.72)	(2.72)	(3.21)
Before the reform	14.33	14.34	-0.00
	(0.91)	(4.19)	(4.29)
Difference within groups	12.82	17.48	*Diff-in-diff*
	(1.94)	(4.99)	-4.66
			(5.36)

High-income tax-payers (τ>0.27)			
	τ>0.270	τ=0.22	Difference between groups
After the reform	39.63	31.81	7.81
	(0.95)	(2.72)	(2.88)
Before the reform	18.45	14.34	4.11
	(1.46)	(4.19)	(4.44)
Difference within groups	21.18	17.48	*Diff-in-diff*
	(1.74)	(4.99)	3.70
			(5.29)

Table 5
Difference-in-difference estimates:
single and multiple taxpayers

The table reports difference-in-difference estimates for the propensity to borrow and the debt amount (in thousand Euro), conditioning on having a mortgage. The pre-reform period is 1987-1991 and the post-reform period is 1995-2000. The control group consists of single taxpayer households with τ=0.22. In the last column we test the null hypothesis that there is no difference between single and multiple taxpayer households within a given tax group, against the alternative that the effect is lower among multiple taxpayer households.

	Treatment group		Difference-in-difference estimate	Standard error	No difference within tax group (*test p-value*)
	Tax group	*Number of taxpayers*			
Proportion of borrowers	τ=0.10	Single	-0.013	0.012	
		Multiple	-0.031	0.020	0.27
	τ=0.22	Single	*Control group*		
		Multiple	0.024	0.011	-.-
	τ=0.27	Single	-0.045	0.008	
		Multiple	-0.047	0.008	0.44
	τ>0.27	Single	-0.027	0.010	
		Multiple	-0.002	0.010	0.90
Debt amount	τ=0.10	Single	-44.96	32.01	
		Multiple	-33.04	13.55	0.63
	τ=0.22	Single	*Control group*		
		Multiple	-1.51	12.27	-.-
	τ=0.27	Single	-10.46	11.90	
		Multiple	-3.49	11.22	0.67
	τ>0.27	Single	-0.76	11.29	
		Multiple	4.15	11.29	0.62

Table 6
Sample statistics

The table reports sample statistics from the 1987-2000 SHIW (omitting 1993). Statistics are computed using sample weights. Income and mortgage debt are expressed in 2000 Euro.

Variable	With mortgage	No mortgage	Total sample
Age	46.33	55.73	54.91
Years of schooling	10.31	7.72	7.95
Resident in the South	0.34	0.42	0.41
Family size	3.31	2.76	2.81
More than one taxpayer	0.68	0.53	0.55
Disposable income	22,062	15,535	16,105
Mortgage debt	15,327	0	1,339
Observations	3,778	36,094	39,872

Table 7
Regressions results: Probit estimates

Each regression also includes age dummies, years of schooling, resident in the South, family size, income quintile dummies, year dummies and group-specific time trends (for $\tau=0.10$, $\tau=0.22$, $\tau=0.27$, and $\tau>0.27$). The number of observations is 39,872. The sample period is 1987-2000, excluding 1993. The coefficients indicate marginal effects; *t*-statistics are reported in parenthesis.

	With demographics	*With demographics and dummies for multiple income recipients*
$\tau=0.10$	0.0364	0.0268
	(1.22)	(0.91)
$\tau=0.27$	0.0672	0.0871
	(4.37)	(5.42)
$\tau>0.27$	0.0844	0.1234
	(5.44)	(7.37)
$\tau=0.10$, after the reform	-0.0367	
	(-0.93)	
$\tau=0.27$, after the reform	0.0454	
	(1.36)	
$\tau>0.27$, after the reform	0.0392	
	(1.35)	
Multiple-taxpayer household		0.0375
		(0.0044)
$\tau=0.10$, after the reform, single income		-0.0551
		(-1.59)
$\tau=0.10$, after the reform, multiple income		-0.0443
		(1.22)
$\tau=0.22$, after the reform, multiple income		0.0028
		(0.18)
$\tau=0.27$, after the reform, single income		0.0504
		(1.32)
$\tau=0.27$, after the reform, multiple income		0.0697
		(1.74)
$\tau>0.27$, after the reform, single income		0.0762
		(2.02)
$\tau>0.27$, after the reform, multiple income		0.0561
		(1.61)
Number of observations	39,872	39,872

Figure 1
The price of mortgages, 1982-2000

In the top panel we plot the after-tax interest rate on a mortgage for a borrower paying interests of 3,500 Euro for 10 years. In the lowe panel we plot the after-tax interest rate on a mortgage for a household paying interests of 7,000 Euro for 10 years, distinguishing between one- and two-taxpayers households. In both panels we assume that the mortgage is a fixed-rate mortgage at the 12 percent interest rate.
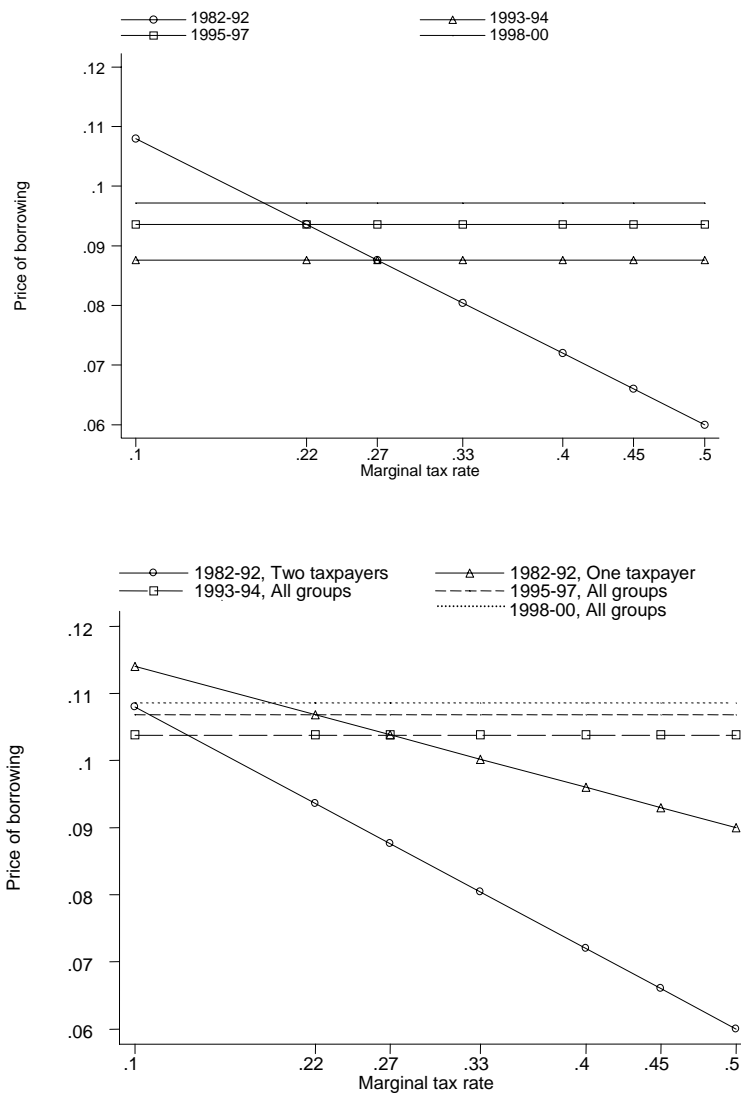
Figure 2
The debt-income ratio, 1987-2000

The figure plots the total debt-income ratio estimated from financial accounts data and the mortgage-income ratio estimated from the 1987-2000 SHIW.
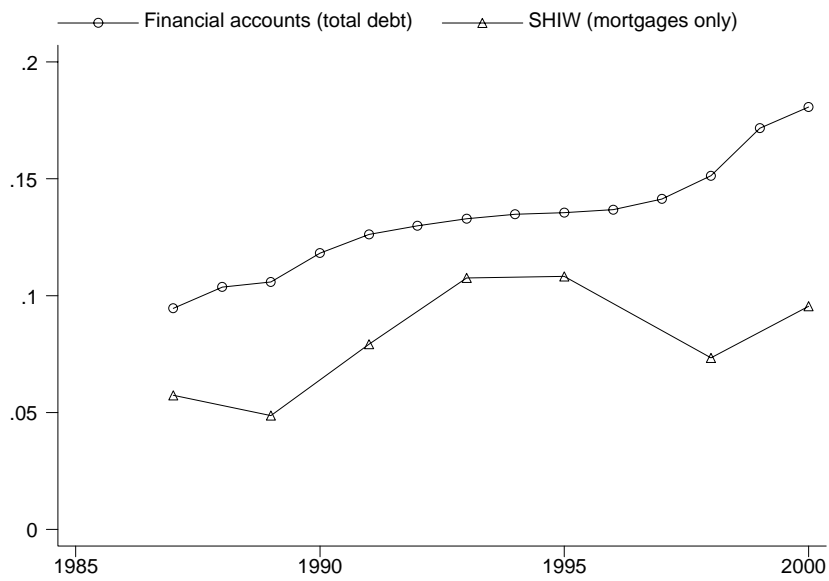
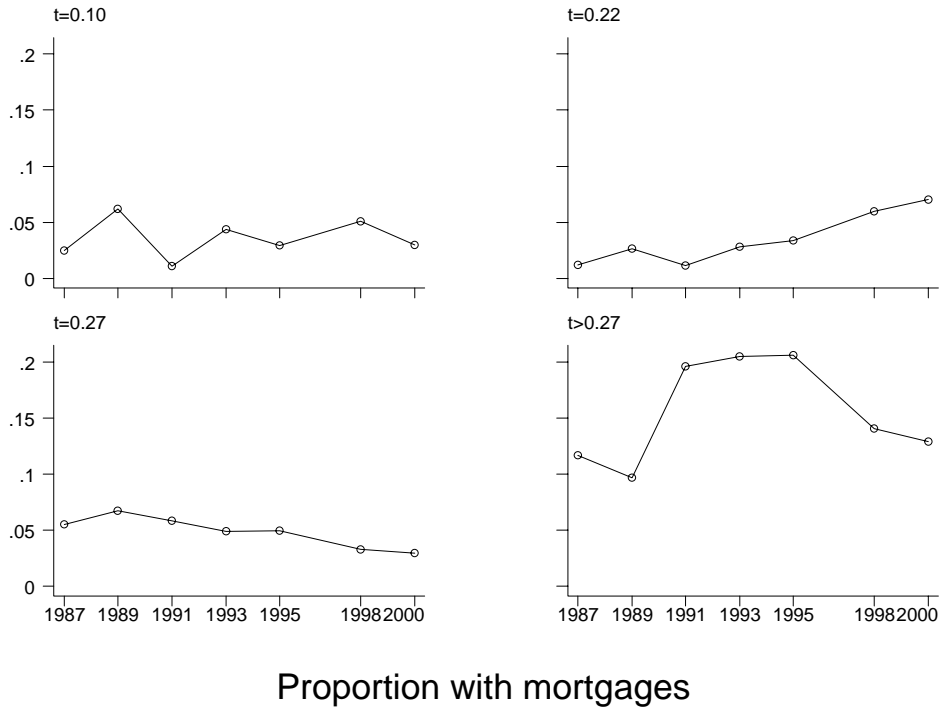**Figure 3**
The propensity to borrow, by marginal tax rates

Proportion with mortgages

Figure 4
The debt-income ratio, by marginal tax rates

Debt-income ratio