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Housing, Household Portfolio, and Intertemporal Elasticity of Substitution

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May 2007

Abstract

This paper investigates the impact of the inclusion of housing in a household portfolio on household's intertemporal decision making. Residential housing is one of the principal assets households hold, and thus changes in housing return can affect household consumption over time. We assess whether the inclusion of housing in the household portfolio affects one of the important parameters of the intertemporal choice, the intertemporal elasticity of substitution (IES). The IES measures how a change in asset return affects household's consumption growth. Since the use of aggregate time series data presents potential aggregation problems, we estimate a consumer model using household-level data, in particular the Consumer Expenditure Survey (CEX), and thus account for household heterogeneity and demographics. Moreover, utilizing a household-level data set, we estimate IES parameters for different groups of assetholders: stockholders, bondholders, and homeowners. Our results indicate that a higher housing return positively affects consumption growth, and housing is an important asset to account for in the household portfolio. The estimation with the portfolio return that includes housing results in the IES of about 0.3, which is lower than that obtained using the Treasury bill rate. The estimation is also more robust to alternative sets of instruments and for different groups of assetholders.

JEL classification: D91, E21, C13.
Keywords: intertemporal elasticity of substitution, consumption, housing, portfolio.

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I. Introduction

One of the central parameters governing household's consumption choice over time is the intertemporal elasticity of substitution (IES). This parameter measures how a change in expected return on an asset affects a household's expected consumption growth. The sensitivity of consumption to interest rates and asset returns is crucial in determining, for example, the reaction of saving to changes in after-tax interest rates or the effectiveness of fiscal policy. The value of the parameter is also important in model simulation exercises. Thus, the IES is not only an important behavioral parameter but also an essential element for evaluating various economic issues and policies.

Since most households hold portfolios of assets rather than a Treasury bill and/or a stock index, they make their spending decisions based on expected total returns of an array of assets. The total returns account for income, capital gains, taxes, and inflation. In addition to financial assets such as stocks and bonds, a real asset, residential housing, is one of the major components of a household portfolio. According to the 2004 Survey of Consumer Finances, about 21% of families held stock directly and about 49% held stock both directly and indirectly through pooled investment trusts, retirement accounts, and other managed assets with a total median value of $24,400. In contrast, about 69% of families owned a home (primary residence) with a median home equity of $86,000. The importance of housing assets is emphasized in recent papers by Case, Quigley, and Shiller (2001) and Benjamin, Chinloy, and Jud (2004a, 2004b), who find that marginal propensity to consume out of housing wealth is higher than that from financial assets. Moreover, many economists have argued that consumer spending due to an increase in recent housing wealth fueled the US economic growth in the last several years and may account for the growth slowdown today. Thus with housing being an important part of the household portfolio, households would care about the return on their home. Since changes in housing return can affect consumption of households over time and thus economy at large, it becomes important to assess how the inclusion of housing in the household portfolio impacts household consumption growth. We also explore whether the IES parameters differ across various groups of assetholders such as stockholders, bondholders, and homeowners. Lastly, since we use after-tax returns, we examine whether taxes matter for the IES estimation.

Our estimations show that the impact of the portfolio return with housing is smaller than that of the T-bill rate. A one percentage point increase in portfolio return raises a consumption growth rate by about 0.3%. The estimated parameter is more robust across samples of various assetholders and alternative instrument sets unlike that using the T-bill rate, which varies much across samples and becomes insignificant with other instrument sets. Further, the taxes do not seem to matter if using the portfolio return but are important to include if using the T-bill rate producing higher and more precise IES coefficients.

The literature review on this subject is presented in Section II. We present an economic model and discuss methodology in Section III. The data and descriptive statistics are presented in Section IV and Section V contains estimations and findings. We conclude the paper in Section VI.

II. Literature Review

The literature on estimation of the IES uses a wide variety of models and data sets.[1] Using the US aggregate consumption data, Hall (1988) found that expected interest rates had no

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[1] Many papers estimate the IES parameter using both aggregate and household-level data sets while testing for the Consumption Capital Asset Pricing Model (CCAPM). We, however, are not embarking on testing the CCAPM; rather, we are interested in the household's intertemporal consumption choice given returns on various assets households hold. Thus we test a consumption Euler equation rather than the CCAPM.

effect on consumption growth. Hansen and Singleton (1982) estimated a nonlinear version of the Euler equation and found the IES parameter of above one using stock return measures. However, in their 1983 study, using a linear version of the Euler equation the authors found insignificant IES estimates for stock returns and model rejection using the T-bill rate. Campbell and Mankiw (1989) found positive but small in magnitude intertemporal elasticity of substitution. Campbell and Mankiw's model incorporated borrowing constraints or rule-of-thumb consumers who consumed their current income. Mankiw (1985) and Ogaki and Reinhart (1998) argued for the importance of intratemporal substitution between durables and nondurables, which raised an estimate of the IES from almost zero to 0.32-0.45 range. Further, van Dalen (1995) explicitly included public consumption in the consumer's problem and arrived at the IES estimate of 0.24. Slesnick (1998) argued that personal consumption expenditures (PCE) from the US National Income and Product Accounts, in general, were not relevant to the theory of intertemporal consumption. Adjusting PCE data for service flows from durables and expenditures by nonprofit institutions and on health care, Slesnick (1998) showed that the estimated IES coefficient was not significantly different from 0, consistent with the Hall's (1988) estimate. Even though Ogaki (1992) indicated that an estimation using aggregate data provided some demand properties consistent with the household-level data, Attanasio and Weber (1993) showed evidence of aggregation bias in testing the Euler equation with aggregate data.

Using a framework of Campbell and Mankiw (1989), Beaudry and van Wincoop (1996) also showed that aggregate data was uninformative in the point estimate of the IES and used a panel of state-level data to conclude that the IES estimate was probably close to one. Atkeson and Ogaki (1996) and Ogaki and Atkeson (1997) used an Indian panel of food consumption and estimated wealth-varying IES models, in which the IES increased with the level of wealth. Naik and Moore (1996) estimated the IES to be 0.23 in the context of a habit formation model using food consumption data from the Panel of Study of Income Dynamics. However, Attanasio and Weber (1995) showed that the food consumption data was not a right measure of consumption to use. The state-level data used by Beaudry and van Wincoop (1996) was a regional panel of per capita consumption that included 19 states, which also ignored heterogeneity of households.

Other papers used household-level data constructed into synthetic panels and a richer measure of consumption. Working with the UK Family Expenditure Survey, Attanasio and Browning (1995) showed that the IES varied with wealth, consumption level, and family composition. For the US households, using the Consumer Expenditure Survey (CEX), Attanasio and Weber (1995) estimated the IES to be 0.56 in a model with multiple goods. Others also used above surveys in their analyses. Berloffa (1997) emphasized the effect of demographics on the IES. Blundell et. al. (1994) pointed out that the IES varied with consumption.

The recent papers by Vissing-Jorgensen and Attanasio (2003), Attanasio, Banks, and Tanner (2002), and Vissing-Jorgensen (2002) considered household-level data sets and emphasized limited stock/bond market participation by households in estimating the IES. For instance, Vissing-Jorgensen (2002) utilized the Consumer Expenditure Survey and estimated the IES to be about 0.3-0.4 for stockholders and 0.8-1 for bondholders. Attanasio, Banks, and Tanner (2002) used the Family Expenditure Survey of the UK households and a sample of “likely” shareholders (based on estimated ownership probabilities) and estimated the relative risk aversion coefficient. Their results indicated that the IES coefficient for the “likely” shareholders was about 0.3-0.67 using the stock return measure. Lastly, the paper by Vissing-Jorgensen and Attanasio (2003) that estimated both the IES and relative risk aversion parameters using the Epstein-Zin preferences showed that the IES parameter for stockholders was likely to be above one.

The choice of a model and data set becomes an important issue. Viard (1998) noted that the IES estimation was sensitive to instrumental variables and a sample period. However, Hahm (1998) indicated that his estimated elasticity of 0.3 was robust to borrowing constraints, sample periods, and time aggregation bias. Attanasio, Banks, and Tanner (2002), Vissing-Jorgensen (2003), and Guvenen (2001) underscored the importance of limited asset market participation in the IES estimation. Further, Mulligan (2002), Viard (1998), and Beaudry and van Wincoop (1996) argued for using a correct measure of the interest rate or rate of return. This is the subject we explore.

This paper incorporates one of the major assets households may hold, residential housing. Since households hold portfolios of assets with housing as one of the major assets, omitting residential housing may impact the IES estimate. Thus in line with the importance of using a correct measure of return and limited asset market participation, we explore whether accounting for housing in the household portfolio is important for the household's intertemporal consumption choice. Since the use of aggregate time series data presents aggregation problems, we estimate consumer behavior using household-level data, in particular CEX, and thus account for household heterogeneity and demographics. In addition, as presented in Section III, we assume a simple constant elasticity of substitution (CES) model of consumer behavior thus abstracting from other IES models, to focus on the relationship between asset returns and consumption growth.

We also investigate whether the use of after-tax returns using differential marginal tax rates that households face matters in the IES estimation. The above studies that used after-tax returns mostly employed a constant marginal tax rate. Hall (1988) used after-tax returns with time-varying average marginal tax rates taken from Barro and Sahasakul (1983), and Beaudry and van Wincoop (1996) used time-varying tax rates in their work. However, these studies used aggregate and state-level data, respectively.

In summary, various models using both aggregate and household-level data sets produce different point estimates of the IES although values vary from less than 0.1 to above one. Most estimates cluster in 0.2-0.6 range.

III. Economic Model and Methodology

A. Economic Model

Consider an economy with households who receive uncertain stream of income over time and make consumption and portfolio decisions. A household h chooses a stochastic consumption plan to maximize the expected value of the lifetime utility function:

$$E_0\left[\sum_{t=0}^{\infty}\beta^t U_t^h\right],\ 0<\beta<1, \tag{1}$$

where β is a subjective discount factor; the expectations operator is conditioned on information available at time t; and U_t^h is of the following form:

$$U_t^h = U(c_t^h)\phi(z_t^h, \nu_t^h; \theta), \tag{2}$$

where c_t^h is household consumption; $\phi(z_t^h, \nu_t^h; \theta)$ is a function of various demographic variables and seasonality accounted by seasonal dummies, z_t^h; and ν_t^h represents preference/taste shocks. Further, we define $\phi(z_t^h, \nu_t^h; \theta) = \mathrm{e}^{\theta' z_t^h + \nu_t^h}$. This function is equivalent to a time-varying discount rate (Attanasio and Weber 1995). Let the utility function be of the isoelastic form:

$$U(c_t^h) = \frac{(c_t^h)^{1-\gamma}}{1-\gamma},\ \gamma > 0, \tag{3}$$

where γ is a coefficient of relative risk aversion. Households substitute present for future consumption by trading a portfolio of assets. Let a_{it}^h be holdings of asset i in terms of units of the consumption good, and let r_{it+1}^h be return on asset i between t and $t+1$. Then, a feasible consumption and investment plan, $\{c_t^h, a_{it}^h; i = 1,\ldots, N\}$, must satisfy a sequence of budget constraints:

$$c_t^h + \sum_{i=1}^{N} a_{it+1}^h \le \sum_{i=1}^{N} (1 + r_{it}^h) a_{it}^h + y_t^h, \tag{4}$$

where y_t^h represents real labor income at time t. Then the first-order condition for each asset i, namely, the consumption Euler equation, is:

$$E_t \left[\beta \left(\frac{c_t^h}{c_{t+1}^h} \right)^{\gamma} (1 + r_{it+1}^h)\, \mathrm{e}^{\theta'(z_{t+1}^h - z_t^h) + (v_{t+1}^h - v_t^h)} \right] = 1, \;\; i = 1,\ldots, N \tag{5}$$

Equation (5) holds only for households who have an interior position in asset i. Adding an expectation error and log-linearizing or assuming log-normality of consumption growth and asset returns, we obtain:

$$\Delta \ln c_{t+1}^h = \alpha + \frac{1}{\gamma} \ln(1 + r_{it+1}^h) + \frac{\theta' \Delta z_{t+1}^h}{\gamma} + \frac{1}{\gamma} \varepsilon_{it+1}^h + \frac{1}{\gamma} (v_{t+1}^h - v_t^h), \;\; i = 1,\ldots, N \tag{6}$$

Rewriting (6), we get:

$$\Delta \ln c_{t+1}^h = \alpha + \sigma \ln(1 + r_{it+1}^h) + \theta_0' \Delta z_{t+1}^h + \mu_{it+1}^h, \;\; i = 1,\ldots, N \tag{7}$$

where σ is the IES. Note that the return is household-specific in the presence of differential marginal tax rates and in the case of homeowners, due to differential housing returns as well. We assume that a household portfolio consists of stocks (S&P 500), bonds (Treasury bills), and residential housing. If households do not hold stocks and housing, then return they face is the

Treasury bill rate.[2] Further, since housing is an illiquid investment, it may seem households cannot adjust the amount of housing in their portfolios. However, since households do not need to buy different houses or pay for a house fully, they can adjust the amount of housing they hold by taking out mortgages, home equity loans, etc. On another note, since housing not only is an investment but also has a consumption value, we include housing consumption in the total consumption measure.

B. Methodology

To mitigate a measurement error, we aggregate equation (7) across all households (or subgroups of households classified as stockholders, bondholders, and homeowners):

$$\frac{1}{H_t}\sum_{h=1}^{H_t}\Delta\ln c_{t+1}^{h} = \alpha + \sigma\frac{1}{H_t}\sum_{h=1}^{H_t}\ln(1+r_{it+1}^{h}) + \theta_0'\frac{1}{H_t}\sum_{h=1}^{H_t}\Delta z_{t+1}^{h} + \frac{1}{H_t}\sum_{h=1}^{H_t}\mu_{it+1}^{h},\ \ i=1,...,3 \qquad (8)$$

Equation (8) is our estimated equation. Thus, we have three equations with returns on stocks, T-bills, and housing. These equations can be estimated jointly with the cross-equation restrictions on the parameters. This is the first approach we take.

However, aggregation across all households presents us with another issue. Since only a fraction of the sample are stockholders or bondholders, and about 65% are homeowners, when aggregating across all households, we are also aggregating Euler equations that do not hold for households who do not own these assets. Consequently, we would like to aggregate equation (7) across only those households for whom Euler equations do hold. For instance, in the sample, we may have households who own all three assets, stocks, bonds, and housing, and we may have households who hold only housing. How can we aggregate these equations taking into account

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[2] Of course, some households may not hold T-bills or savings/money market accounts (which rates follow closely the T-bill rate). We can exclude these households from our sample by classifying them as non-assetholders and compare results with those using the whole sample. In our present estimations, we ignore this issue.

that not all three Euler equations hold for all households? If we aggregate across, for example, stockholders, then in our estimated Euler equation (8) for housing, we would include stockholders that do not hold housing while omitting households who hold housing. If we aggregate across stockholders, bondholders, and homeowners for each respective Euler equation (7), the result is that consumption growth would differ across equations thus amounting to estimating Euler equations for groups of various assetholders stacked together.

An alternative approach in the estimation strategy is to aggregate equation (7) for each household by adding up the equations for assets that households own (namely, Euler equations that hold with equality) and dividing by the total number of the equations and then to aggregate across all households:

$$\frac{1}{H_t}\sum_{h=1}^{H_t}\Delta\ln c_{t+1}^{h} = \alpha + \sigma\frac{1}{H_t}\sum_{h=1}^{H_t}\sum_{i=1}^{N^h}\frac{1}{N^h}\ln(1+r_{it+1}^{h}) + \theta_0'\frac{1}{H_t}\sum_{h=1}^{H_t}\Delta z_{t+1}^{h} + \frac{1}{H_t}\sum_{h=1}^{H_t}\sum_{i=1}^{N^h}\frac{1}{N^h}\mu_{it+1}^{h}, \qquad (9)$$

where N^h is the total number of assets in the household portfolio for household h and ranges from one to three (stocks, T-bills, and housing). Note that the second summation term for the return variable is an equally weighted household-specific portfolio return. Now, we have one estimated equation with the composite return and composite error term. Equation (9) provides consistent aggregation across households that hold stocks, T-bills, housing, or combination of these assets accounting for Euler equations that are not held with equality for some households.

In one of his estimations, Guvenen (2001) has a somewhat similar approach. The estimated equation is obtained by adding up the stock return Euler equation multiplied by a free parameter, or weight, $Q \in (0,1)$ and the T-bill rate equation multiplied by $1-Q$. The equation has both returns as regressors, and the IES can be recovered by adding up the estimated parameters, $\sigma \cdot Q$ and $\sigma \cdot (1-Q)$. A free parameter, Q, can also be interpreted as an optimal stock share of the household portfolio, which can be derived using the Epstein-Zin preferences and log-normality of the optimal portfolio (Guvenen 2001). We prefer to follow our simple aggregation procedure without introducing a free parameter or constant optimal portfolio shares over time. However, we perform this estimation as well and report the results for comparison purposes.

C. Econometric Issues

There are several econometric issues that have to be taken into account when deriving consistent estimates. Semiannual observations of the consumption growth data and monthly observations (time periods) used in estimation imply an MA(5) error process due to overlapping time periods and thus expectational errors (Vissing-Jorgensen 2002). If a measurement error coupled with preference shocks are not correlated across households, the error process is still MA(5). However, if they are correlated across households, then the error process is MA(11) since at each time period, t, the error term involves difference components of the measurement error and preference shocks (e.g., $v_{t+1}^{h} - v_{t}^{h}$). We construct instruments of lag two and three (based on the semiannual data) such that they do not overlap with observations used for estimation.[3] We also allow for heteroskedasticity of unknown form. With these issues in mind, we estimate our equations using the generalized method of moments (GMM) estimator.[4] Lastly,

[3] Since we use instruments of lag two and three, our instrument set should be uncorrelated with the error term even in the presence of MA(11). In addition, our variance-covariance matrix is based on MA(5) rather than MA(11). However, we performed a few estimations with the MA(11) process and the results were similar.

[4] Since the GMM estimator may have poor small sample properties, we also perform a few estimations using the empirical likelihood (EL) method for the sample of all households. The Bruce Hansen's GAUSS EL algorithm is used (it does not account for autocorrelation). The estimated IES using the net real T-bill rate is larger, but the IES coefficients using the portfolio and housing returns are similar to the GMM estimates.

when estimating equation (8) jointly, we allow for different constant terms and coefficients on seasonal dummies but restrict the IES to be equal across equations.[5]

IV. Data and Descriptive Statistics

A. Data Description

The data used are taken from the Consumer Expenditure Survey conducted by the Bureau of Labor Statistics (BLS). The data are quarterly, and the sample covers interviews from the first quarter of 1984 through the first quarter of 2002. The CEX contains a comprehensive measure of household characteristics and a detailed expenditure list. About 4500 households are interviewed every quarter, and 80 percent of them are re-interviewed the following quarter. The sample is representative of the US population. The CEX is not a full panel, but following Vissing-Jorgensen (2002), we compute consumption growth rates and other variables on a semiannual basis and thus have one observation per household in our panel. Since interviews are scattered throughout the quarter, we have monthly observations in our sample.

The sample used in the analysis includes only households who have completed all four interviews (2nd-5th with the 1st interview as a trial) since we need to match households across quarters. We have a few missing quarters in 1985, 1995, and 1999 due to a change in the sample design. We drop households whose consumption growth rate exceeds 5 and is below 0.2. Households with a house equity value (house market value minus mortgage) below zero and with a housing return on equity (discussed below) less than -1 and greater than 5 are dropped as well.

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[5] Different constant terms and coefficients on seasonal dummies arise due to log-normality of consumption growth and asset returns (Vissing-Jorgensen 2002). We also could allow for different IES coefficients if, for instance, households respond differently to changes in the stock return, T-bill rate, or housing rate, a sort of “mental accounting.” We present estimations with the different IES coefficients across equations as well.

In total we have 38,518 observations, and after aggregating across households for each month for estimation purposes, we obtain 181 monthly observations ranging from October 1983 through March 2001.

We follow the same procedure as in Vissing-Jorgensen (2002) to separate stockholders and bondholders. Stockholders are defined as those who positively respond to the category "stocks, bonds, mutual funds and other such securities." Bondholders are those who respond positively to the previous category or to the "US savings bonds" category. We classify assetholders who hold assets at time t if households (i) have the same amount of an asset as a year ago and a positive amount at the time of the 5th interview, or (ii) have lower asset holdings than a year ago, or (iii) have higher holdings but by an amount lower than the reported market value at the time of the interview. We define homeowners as those who own houses in the 2nd and 5th interviews.

The measure of the consumption expenditure is total nondurable consumption plus some services and includes food, alcohol, tobacco, reading, apparel and services, personal care, household operations, public transportation, fuels and utilities, gasoline and motor oil, and rental and owner-occupied housing. The major exclusions are education, entertainment, health, and durables. The price indices for above expenditures are taken from the Consumer Price Index components published monthly by the BLS. The nominal variables are deflated by the corresponding price indices (regional ones, if available) to obtain real variables. A major demographic variable used is family size.[6]

[6] Following Attanasio and Weber (1995), we performed a few estimations using other demographic and labor supply variables such as number of children, wife's hours worked per week, and wife's full-time job status dummy. However, the use of these variables does not much affect the results.

We also compile the return data and compute marginal tax rates for individuals. The Treasury bill and stock (S&P 500) returns data are taken from Ibbotson's *Stocks, Bonds, Bills, and Inflation 2004 Yearbook*. These returns include income and capital gain components. The semiannual rate is a geometric average of the monthly rates. To construct individual specific tax rates, we use a standard deduction and a deduction based on family size to estimate taxable income from the total before-tax family income. Then, marginal income tax rates are obtained based on the income tax brackets. An effective capital gains tax rate is estimated using the following equation (Jorgenson and Yun 2001):

$$t_{cg}^{h} = 0.25(1-E)t_{i}^{h} \tag{10}$$

where t_{cg}^{h} is the capital gains tax rate for household *h*; E is the proportion of capital gains excluded, and t_{i}^{h} is the marginal income tax rate for household *h*. The coefficient of 0.25 is based on the assumptions that deferral of tax liabilities due to unrealization reduces the rate by 50% and that tax liabilities for capital gains included in bequest additionally reduce the rate by 50% (Jorgenson and Yun 2001).

The housing return is defined as the sum of rental income and capital gain returns. We have data for rental income and housing expenditures. We account for mortgage interest expense, property taxes, and depreciation. Depreciation is imputed based on a ratio of consumption of fixed capital for owner-occupied housing (taken from the National Income and Product Accounts produced by the Bureau of Economic Analysis) to the market value of owner-occupied housing (taken from the Fed's Flow of Funds Accounts). In computing rental income, we add a tax subsidy due to deductibility of mortgage interest and property taxes from federal income taxes defined as the product of the income tax rate and the sum of mortgage interest and property taxes. To compute a capital gain return, we use the market value of a house from the data set. However, since we have only one value, we impute change in the market value by applying the change in aggregate residential housing market values taken from the Flow of Funds Accounts. We compute housing return based on both house equity value and house market value (denominator in the return measure). However, we contend the equity value is a right measure to use since it represents return on household's investment in housing. Mortgage outstanding is computed by dividing mortgage interest expense by a mortgage rate (taken from the St. Louis Fed's FRED database). The rental income return is not taxed and we assume that the capital gain tax rate on housing is zero (Jorgenson and Yun 2001). The nominal returns on all assets are deflated by the Consumer Price Index (CPI).[7]

B. Descriptive Statistics

Table 1 presents descriptive statistics for the data aggregated across all households. A semiannual real consumption growth rate is 2%. In comparison, the consumption growth rate of stockholders is about 2.4%; that of homeowners is about 1.6%; and that of bondholders is about 2.2%. Interestingly, the consumption growth rate of non-assetholders is about 2.65%; however, looking at the log of the consumption growth rate data, we note that the number is positive for stockholders (0.003) and is negative for non-assetholders (-0.0008). As perhaps many non-assetholders are poor or liquidity constrained households, real consumption levels are low and a small increase in their consumption implies a higher consumption growth rate.

Stockholders account for about 26% of the sample, US savings bondholders—about 15%, and homeowners—about 65%. For the pooled disaggregated data, the semiannual real housing return is large, about 8.4%, with standard deviation of 13.3%, as compared to the net real stock return of 4.5% with standard deviation of 10.2%. However, unlike stocks, aggregation across

[7] Transaction costs are not included in the return computation as is usual in real estate literature. Future research can benefit from this addition.

households reduces the volatility of the housing return drastically. Table 1 shows that the real housing return is about 7.5% with standard deviation of 3.4% while the net real return on stocks is about 4.1% with standard deviation of 10.1%. Further, the net real T-bill rate is 0.9% and about 36% lower than the real T-bill rate, 1.4%. As is seen, taxes affect a mean return for T-bills substantially and we assess whether they matter in estimation.

We also compute correlation coefficients for the aggregated data among logs of the real consumption growth, of the net real stock return, of the net real T-bill rate, and of the real (net real) housing return. The correlation coefficient between the consumption growth rate and the net real stock return is negative at about -0.2. It is positive for the T-bill rate (0.13) and housing return (0.19). However, a negative coefficient for stocks is close to zero, -0.03, for the sample of stockholders.

Figure 1 plots logs of the net real stock, T-bill, and housing returns and log of the consumption growth rate.[8] As expected, the stock return is the most volatile while the T-bill rate is the least volatile. The housing return due to aggregation across households is less volatile and has a few negative returns throughout the time period considered. This is partially due to return computed on equity; the return is also in line with the aggregate housing return. The log of the real consumption growth rate is more volatile than the T-bill rate.

The descriptive statistics indicate that there is some relationship between the consumption growth rate and the rates of return. To formally investigate the effect of returns on the consumption growth rate and which return variable is important, we now turn to the estimation of Euler equations.

[8] Long connecting lines on the graph in 1985, 1995, and 1999 are due to missing data.

V. Estimation and Results

A. All Households

Before analyzing the effect of housing on the IES, first we estimate Euler equation (8) using the T-bill rate and stock return. Then, we assess the IES estimate using the housing return, and lastly, we estimate equation (9) with the equally weighted portfolio return. The instrument set includes second and third lags of the T-bill and stock return, second and third lags of the bond horizon premium, $\left(\frac{1+R_t^{LT\ GOVE'T\ BONDS}}{1+R_t^{ST\ GOVE'T\ BONDS}}\right)$, and bond default premium, $\left(\frac{1+R_t^{LT\ CORP.BONDS}}{1+R_t^{LT\ GOVE'T\ BONDS}}\right)$, and a seventh-month lagged dividend-price ratio in addition to demographic variables (change in log of family size), 11 seasonal dummies and a constant. R^2 (adjusted R^2) for the T-bill and stock returns equations at the first-stage is 0.35 (0.26) and 0.18 (0.07), respectively; it is higher for the housing return equation and is equal to 0.57 (0.51). We also use the second and third lags of the inflation rate as instruments in some joint estimations. The use of relevant and valid instruments is important to obtain more precise as well as consistent and unbiased estimates. The fit for the T-bill equation is better than that for stocks. Dropping some of the variables does not affect the fit for the stock return equation much but reduces the fit for the T-bill and housing equations (and also reduces the precision of the IES estimates in some estimations).

The IES estimate obtained using the real T-bill rate is 0.19 but statistically insignificant (see Table 2). However, with the net real rate, the estimate increases to 0.32 and is statistically significant at the 5% level. Intuitively, a one percentage point increase in the expected after-tax after-inflation T-bill rate increases the expected consumption growth rate by 0.32 percentage points. In addition, the model is not rejected as indicated by the test of overidentifying restrictions (J-test) with the p-values of 0.12 and 0.16, respectively. However, the estimation of the Euler equation with the stock return still results in a negative and statistically significant coefficient. The model is not rejected, either. A joint estimation of the Euler equations with the T-bill rate and stock return results in a negative coefficient albeit very small (-0.0041). Relaxing the restriction that the IES is equal across the equations, we get an estimate of 0.023 for the T-bill rate equation and -0.0056 for the stock return equation. The parameter on the T-bill is statistically insignificant, but the coefficient on the stock is significant at the 5% level. Note that the IES coefficient drops in magnitude substantially in the joint estimation and becomes negative for the stock return equation. Since only a fraction of households hold stocks, using a right measure of return is probably crucial.

The above estimations omit housing, one of the major household assets that may affect intertemporal consumption. Using solely the housing return, we find that the IES estimate becomes smaller, 0.2, compared to that using the T-bill rate. Since households hold other assets as well, incorporating other assets, we jointly estimate the Euler equations with the T-bill, stock, and housing returns. In contrast to the joint estimation using the T-bill rate and the stock return, the introduction of housing produces a small but positive and statistically significant estimate (0.0014). It suggests that housing is an important asset to account for in the household portfolio. We also report the IES estimates if the IES were to differ across equations (see Table 2). A similar pattern emerges where a coefficient on the stock return is negative but coefficients on the T-bill rate and housing return are small and positive. Perhaps aggregation across all households, especially for the stock return equation, may bias the IES estimate as the stock return Euler equation does not hold for all households in the sample.

Next, we report the results from the estimation of aggregated Euler equation (9) with the equally weighted portfolio return. Now, each household faces its own portfolio return comprised of stocks, bonds (T-bill rate), and housing. The resulting IES estimate is 0.26, which is statistically significant, with the p-value for the J-test of 0.22. The IES falls from 0.32 to 0.26

when accounting for other assets in the household portfolio rather than using only the T-bill rate. Lastly, before discussing the differences in the IES estimates, we estimate the Euler equation using the returns on T-bills, stocks, and housing as regressors (Guvenen 2001). The implied IES parameter is about 0.5 although the coefficient on T-bill and housing are statistically insignificant. Adding the inflation rate to the instrument set, the implied IES declines to about 0.36 with only the coefficient on T-bill being statistically insignificant.

In the joint estimations, the IES parameter becomes quite small in magnitude. Even without a restriction on the IES across the equations, parameter values although different for all three returns, are below 0.1. An economic implication is that the effect of the rates of return on the consumption growth rate is minimal. The low IES estimate could also be a result of the joint estimations, which are less flexible as the dependent variable is equal across the equations. A sample of stockholders, which alleviates a possible problem of aggregation across non-stockholders, also produces small IES parameters in the joint estimations (discussed below). In contrast, single equation estimations have more flexibility and indicate much larger values of the IES. Perhaps the estimation with aggregated equation (9) and portfolio return has some merit.

Yet with single equation estimations, the IES estimates differ when using different measures of return. Why such a difference? Let us closely examine the definition of the IES:

$$\sigma = \frac{dE_t[\ln(c_{t+1}/c_t)]}{dE_t[\ln(1+r_{t+1})]} = \frac{dE_t[\ln(1+\Delta c_{t+1}/c_t)]}{dE_t[\ln(1+r_{t+1})]} \approx \frac{dE_t[\Delta c_{t+1}/c_t]}{dE_t[r_{t+1}]} \tag{11}$$

Thus approximately, the IES can be expressed as a derivative of the expected *net* consumption growth rate to the expected *net* rate of return. A 1% increase in the gross return amounts to about 1% absolute increase (one percentage point) in the net return. Since a 1% absolute increase in the T-bill rate is, comparatively to its mean, much larger increase in the rate of return than a 1% absolute increase in the stock, housing, or portfolio return, the response of the consumption growth is unsurprisingly larger. Alternatively, a 1% increase in the *gross* T-bill rate from its mean return (from 1.009 to 1.01909) amounts to an increase from 0.9% to 1.909% in the *net* T-bill rate, a rise of about 112%. However, a 1% increase in the gross portfolio rate amounts to an increase of about 33% in the net portfolio rate. A 1% increase in the gross return for different measures of return makes a huge difference. Now, it is not surprising that the IES estimate for the T-bill rate equation is larger than that of the portfolio return equation or the housing return equation. Of course, consumption growth would respond more to a larger change in the net rate of return. Computing the elasticity of the *net* consumption growth rate to the *net* rate of return around the mean point, we obtain a lower elasticity measure for the T-bill rate, 0.14, a larger measure for the portfolio return, 0.4, and even higher elasticity for the housing return, 0.75.

Vissing-Jorgensen (2002) shows that the IES for stockholders is lower than that for bondholders, 0.3-0.4 vs. 0.8-1.0. Our analysis suggests that higher IES estimates for bondholders and lower IES estimates for stockholders could be due to the return measure used in estimations. A 1% absolute increase in the net stock return, as compared to a 1% absolute rise in the net T-bill rate, amounts to a smaller relative increase in the stock rate of return thus weakening the consumption growth response and resulting in a lower IES. Furthermore, the paper by Attanasio, Banks, and Tanner (2002) suggests that for a given sample, the IES measure is lower for the stock return equation than that for the T-bill rate equation confirming the above statement. However, their results also indicate that the IES measure for stockholders is larger than that for non-stockholders for a given measure of return whether using the stock return or the T-bill rate. This brings forth another issue as to why the IES parameter would differ across stockholders and non-stockholders, but this is beyond the scope of this paper.

B. Stockholders

This section presents estimations results (Table 3) for a sample of stockholders. Estimating the Euler equation with the real T-bill rate produces the IES estimate of 0.48 (statistically significant at the 10% level); the model is not rejected (the J-test's p-value is 0.16). In contrast, with the net real rate, the estimate increases to 0.93 and is also statistically significant (the p-value for the J-test is 0.34). This seems to indicate that taxes matter for the IES estimation if using the T-bill rate (which can also be noted in the whole sample estimation).

The estimation with the stock return still produces negative but statistically insignificant IES parameters though the J-test does not reject overidentifying restrictions. With alternative instruments, the parameter is still statistically insignificant. However, the joint estimation for the T-bills and stocks produces a small positive coefficient. The above results suggest that the negative IES coefficient on the stock return equation for the whole sample could be due to aggregation of the Euler equation for all households including non-stockholders. This is also confirmed by the negative IES estimate obtained for the sample of non-stockholders. For the sample of stockholders, although the resulting coefficient is negative, it is statistically insignificant. However, the inclusion of the T-bill in the estimation results in a positive albeit small IES parameter. In addition, negative parameters and imprecision of the IES estimates could be due to the weak instruments in predicting the stock return as indicated by a low R^2 in the first stage regression.

We also perform a joint estimation using all three returns but results are similar to the whole sample case with a low positive IES estimate. The estimation using aggregated equation (9) with the portfolio return results in the IES estimate of 0.37, which is higher than that estimated for the whole sample. In contrast, the estimation using the housing return results in the IES of about 0.26, which is similar to that for the sample of all households. Moreover, a coefficient of 0.18 is obtained for the sample of non-stockholders. About 85% of the sample of stockholders and about 62% of the sample of non-stockholders are homeowners. The above results seem to indicate that the housing return is relevant and important for both stockholders and non-stockholders samples.

C. Bondholders

The estimation of the Euler equation with the real T-bill rate for the sample of bondholders indicates that the IES coefficient is about 0.3 but statistically insignificant (Table 4). The estimation with net real rate results in the IES of 0.56 and a better precision. However, similar to the stockholders sample, the estimate becomes imprecise using alternative sets of instruments. The estimation with the stock return produces very small negative but insignificant parameters. This is in contrast to using the housing or the portfolio return with the resulting IES coefficient of 0.33 and 0.27, respectively.

Though there is quite an overlap with the stockholders sample, according to our classification, the IES estimates decline considerably when using the T-bill return, but with alternative instruments, both samples produce imprecise estimates. Furthermore, the IES falls from 0.37 to 0.27 in the portfolio return equation. It could be the case that the composition of housing is different across stockholders and bondholders or the IES for stockholders is higher (Vissing-Jorgensen and Attanasio 2003 and Guvenen 2001). For the sample of non-bondholders, the estimation results in a lower and insignificant parameter (0.29) using the T-bill rate and the statistically significant IES of 0.15 using the housing return as homeowners comprise about 62% of the sample.

D. Homeowners

Table 5 shows the estimation results for a sample of homeowners. The net real T-bill rate equation estimation produces a similar IES parameter (0.57) to that for the sample of stockholders. The estimation with the stock return results in negative coefficients. The IES estimates obtained using various housing returns vary but within the range of 0.22-0.4. For instance, the IES parameter with the housing return on equity is about 0.22 and with the housing return on market value of 0.4. Using the housing return on equity computed from the aggregate household equity and using the aggregate return on housing (Hasanov and Dacy 2006), we obtain close IES estimates, 0.32 and 0.27, respectively. Moreover, the IES estimate using the portfolio return is 0.27, which is similar to that for the whole sample. The joint estimation results are also similar to that for the whole sample. The introduction of housing produces a positive although small IES coefficient (0.0021) as opposed to the negative small parameter when using only the T-bill and stock returns.

The IES estimates from single equation estimations using all measures of return including the portfolio return, for the sample of non-homeowners, are small and statistically insignificant. The joint estimation with all three rates of return results in a negative coefficient. Similar results are obtained for the sample of non-assetholders. However, for both non-homeowners and non-assetholders samples, using alternative instrument sets, we obtain the statistically significant IES parameter of about 0.16 using the housing return. This could be due to the consumption measure including the rental housing, and as the housing return may influence rental values, housing consumption is affected as well.[9]

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[9] The exclusion of housing consumption from our consumption measure does not qualitatively affect our results. For the samples of all households and homeowners, the IES estimate using the housing and portfolio returns are similar. However, the estimate is larger and statistically significant using the net real T-bill rate. With the net real stock return, although the coefficient is a little larger (less negative), it is statistically insignificant. For the samples of stockholders and bondholders, the IES estimate using the portfolio return is somewhat larger. The IES parameter

E. Summary

Using single equation estimations, we obtain the IES estimates in the 0.2-0.93 range clustering in the 0.2-0.5 range. Using the T-bill rate for all households, the IES estimate is 0.32 but is larger for the subsamples of assetholders. However, with alternative instrument sets, the IES estimate is not statistically different from zero. Using the portfolio return which incorporates housing as well, the IES parameter is smaller in magnitude, 0.26. It rises to 0.37 for the sample of stockholders. The IES obtained using the stock return is negative, which could be due to the omission of relevant assets from the estimation. The estimates using the housing return on equity are in the 0.2-0.33 range for all samples. In addition to the single equation estimations, the joint estimations also suggest that the housing return is relevant to the intertemporal decision making although the resulting IES coefficients are quite small in magnitude. The IES values become insignificant for the sample of non-assetholders thus underscoring the importance of separation of assetholders and non-assetholders, or limited participation, in estimations. Similarly, omitting relevant returns may result in a negative IES estimate as the above analysis indicates.

VI. Conclusion

In this paper, we investigate whether the introduction of housing into the household portfolio is important to the household's intertemporal optimization. The Euler equation estimations show that the IES estimate becomes much smaller in magnitude in the joint estimations with the T-bill, stocks, and housing returns although larger in the single equation estimations. Using the portfolio return as opposed to the T-bill rate, the IES falls in magnitude from 0.32 to 0.26 for the sample of all households and declines even more for the other

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becomes statistically insignificant using all measures of returns for the samples of non-homeowners and non-assetholders.

subsamples (e.g. for the sample of stockholders, from 0.93 to 0.37). The obtained estimate using the portfolio return is still much larger than the estimates obtained in the joint estimations. In addition, the estimations for various assetholders indicate that the use of the T-bill rate results in a larger IES parameter than that for the portfolio return. However, with alternative sets of instruments, the parameter using the T-bill rate is imprecisely estimated as opposed to that using the portfolio return. Lastly, taxes seem to matter with the T-bill rate estimation since variations in taxes relative to variations in the T-bill rate are not as small as for other assets such as stocks. In addition, the tax rate used is the marginal income tax rate, which is high, as there are no capital gains on short-term T-bills.

In summary, housing is an important asset to include in the household portfolio as the majority of the households in our sample are homeowners. An increase in the housing return positively affects consumption growth although the effect is not as large as when using only the T-bill rate. Furthermore, as opposed to the T-bill rate, the portfolio return that includes housing produces statistically significant parameters with alternative sets of instruments. The estimated value of the IES using portfolio return, according to our CES model, is in the range of 0.3-0.4. Thus, one percentage point increase in asset return would increase consumption growth rate by 0.3-0.4 percentage points. With the expected slowdown in the housing market, the impact on the consumption growth, while still negative, may not be overly substantial.

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Figure 1. A plot of logs of net real returns and of real consumption growth rate

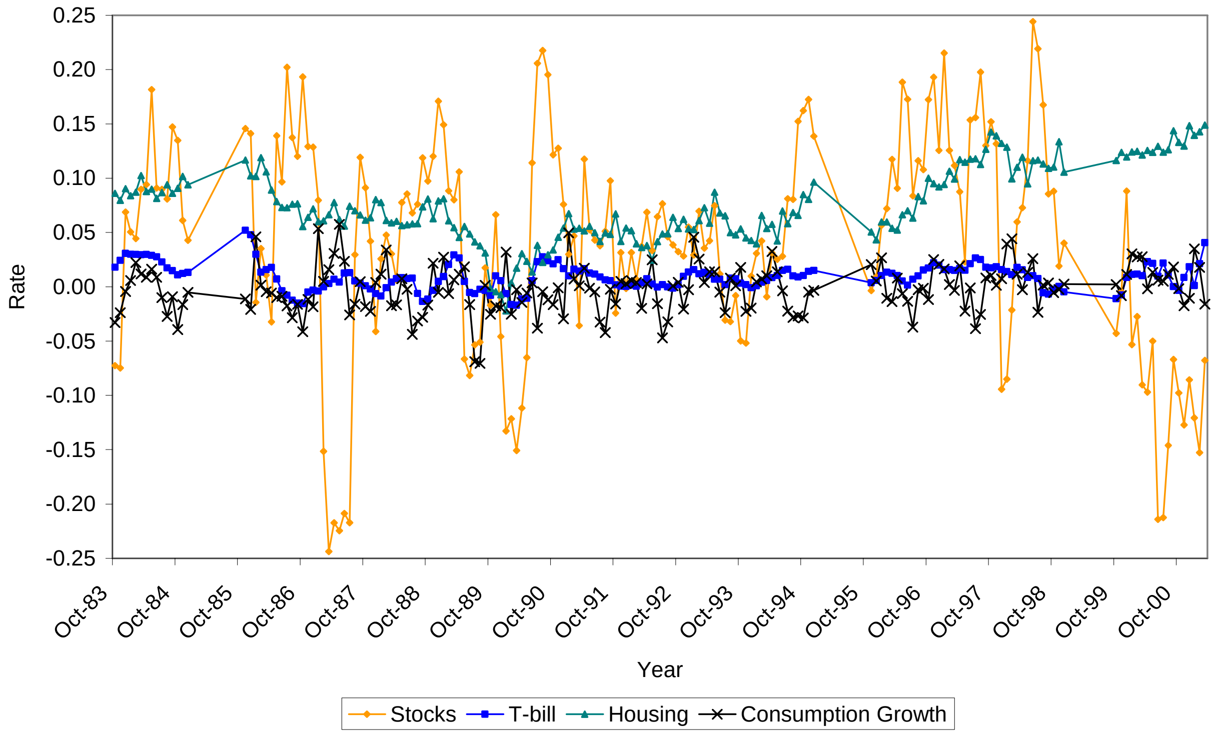

Table 1. Descriptive Statistics for Aggregated Data - All Households
(181 monthly observations, time period between t and t+1 is semiannual)

Variable	Mean	Standard Deviation	Minimum	Maximum
Semiannual real consumption growth rate	0.020	0.023	-0.050	0.085
Log family size at time t	0.794	0.044	0.659	0.885
Log family size at time t+1	0.799	0.045	0.656	0.906
Job status of spouse at t (=1 if has a job)	0.52	0.23	0.19	0.88
Job status of spouse at t+1 (=1 if has a job)	0.56	0.23	0.27	0.89
Wife working full-time at t (=1 if full-time)	0.20	0.03	0.10	0.29
Wife working full-time at t+1 (=1 if full-time)	0.22	0.03	0.09	0.31
Income tax rate at t	0.18	0.02	0.15	0.24
Income tax rate at t+1	0.18	0.02	0.15	0.23
Capital gain tax rate at t	0.04	0.01	0.02	0.05
Capital gain tax rate at t+1	0.04	0.01	0.02	0.05
Stockholders	0.26	0.44	0.00	1.00
US savings bondholders	0.15	0.36	0.00	1.00
Homeowners	0.65	0.48	0.00	1.00
Log real housing return	0.075	0.034	-0.022	0.149
Log real housing return (based on house market value)	0.035	0.018	-0.012	0.077
Log real housing return (based on aggregate house equity)	0.050	0.023	-0.006	0.099
Log real housing return (aggregate data)	0.031	0.027	-0.039	0.084
Log inflation rate	0.014	0.013	-0.028	0.049
Log nominal stock return	0.062	0.101	-0.215	0.264
Log real stock return	0.049	0.102	-0.235	0.256
Log net real stock return	0.041	0.101	-0.244	0.244
Log nominal T-bill rate	0.028	0.009	0.014	0.050
Log real T-bill rate	0.014	0.012	-0.011	0.059
Log net real T-bill rate	0.009	0.012	-0.017	0.052
Log net real composite return	0.031	0.043	-0.068	0.206

Table 2. Estimation of the Euler Equation - All Households

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Real T-bill[1]	0.19 (0.15) [0.206]											
Net real T-bill		0.32 (0.16) [0.04]						0.018 (0.0056) [0.002]		0.023 (0.017) [0.178]		
Real stock			-0.14 (0.06) [0.017]									
Net real stock				-0.14 (0.06) [0.015]				-0.0054 (0.0015) [0.000]		-0.0056 (0.0023) [0.017]		
Net real housing					0.2 (0.04) [0.000]			0.014 (0.0019) [0.000]				
Net real portfolio						0.26 (0.07) [0.000]						
Net real T-bill, Stock & Housing[2]							0.0014 (0.0002) [0.000]					
Net real T-bill & Stock[2]									-0.0041 (0.0011) [0.000]			
Net real T-bill & Housing[2]											0.0164 (0.0028) [0.000]	
Net real Stock & Housing[2]												0.0019 (0.0005) [0.000]
J-test	12.9 [0.12]	11.8 [0.16]	8.7 [0.37]	8.8 [0.36]	5.9 [0.66]	10.8 [0.22]	19.4 [0.89]	19.6 [0.81]	17.8 [0.47]	16.3 [0.50]	16.08 [0.59]	17.2 [0.51]

Notes: A constant, 11 monthly dummies and Δln(family size) are included as explanatory variables and instruments. In addition, the instrument set includes second and third lag of the real T-bill rate and stock return, second and third lag of the bond horizon and bond default premiums, and dividend price ratio.

[1] The number in [ ] refers to the p-value.

[2] The constant term and dummies are not restricted to be equal.

Table 3. Estimation of the Euler Equation - Stockholders

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Real T-bill[1]	0.48											
	(0.27)											
	[0.079]											
Net real T-bill		0.93						0.013		0.024		
		(0.32)						(0.0043)		(0.0082)		
		[0.003]						[0.002]		[0.003]		
Real stock			-0.06									
			(0.08)									
			[0.422]									
Net real stock				-0.06				-0.0003		0.002		
				(0.08)				(0.001)		(0.0019)		
				[0.435]				[0.805]		[0.303]		
Net real housing					0.26			0.0075				
					(0.08)			(0.0016)				
					[0.001]			[0.000]				
Net real portfolio						0.37						
						(0.13)						
						[0.004]						
Net real T-bill, Stock & Housing[2]							0.0035					
							(0.0006)					
							[0.000]					
Net real T-bill & Stock[2]									0.0004			
									(0.0001)			
									[0.003]			
Net real T-bill & Housing[2]											0.0095	
											(0.0021)	
											[0.000]	
Net real Stock & Housing[2]												0.005
												(0.0029)
												[0.086]
J-test	11.9	9.1	11.1	11.2	8.9	11.3	17.9	15.2	14.7	13	14.5	13.9
	[0.16]	[0.34]	[0.2]	[0.19]	[0.36]	[0.19]	[0.93]	[0.95]	[0.68]	[0.74]	[0.69]	[0.73]

Notes: A constant, 11 monthly dummies and ∆ln(family size) are included as explanatory variables and instruments. In addition, the instrument set includes second and third lag of the real T-bill rate and stock return, second and third lag of the bond horizon and bond default premiums, and dividend price ratio.

[1] The number in [ ] refers to the p-value.

[2] The constant term and dummies are not restricted to be equal.

Table 4. Estimation of the Euler Equation - Bondholders

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Real T-bill[1]	0.3											
	(0.2)											
	[0.123]											
Net real T-bill		0.56						0.017		0.021		
		(0.22)						(0.0043)		(0.0067)		
		[0.012]						[0.000]		[0.001]		
Real stock			-0.05									
			(0.06)									
			[0.376]									
Net real stock				-0.05				-0.0003		-0.0001		
				(0.06)				(0.0009)		(0.0016)		
				[0.393]				[0.754]		[0.950]		
Net real housing					0.33			0.027				
					(0.07)			(0.0045)				
					[0.000]			[0.000]				
Net real portfolio						0.27						
						(0.11)						
						[0.013]						
Net real T-bill,							0.01					
Stock & Housing[2]							(0.0012)					
							[0.000]					
Net real T-bill									0.00007			
& Stock[2,3]									(0.0001)			
									[0.188]			
Net real T-bill											0.0333	
& Housing[2]											(0.0058)	
											[0.000]	
Net real Stock												0.0055
& Housing[2]												(0.0054)
												[0.304]
J-test	14.5	12.4	12.5	12.7	10.2	15.8	23.45	20.1	18.5	16.7	18.9	17.1
	[0.07]	[0.13]	[0.13]	[0.12]	[0.25]	[0.05]	[0.71]	[0.79]	[0.29]	[0.48]	[0.40]	[0.51]

Notes: A constant, 11 monthly dummies and Δln(family size) are included as explanatory variables and instruments. In addition, the instrument set includes second and third lag of the real T-bill rate and stock return, second and third lag of the bond horizon and bond default premiums, and dividend price ratio.

[1] The number in [ ] refers to the p-value.

[2] The constant term and dummies are not restricted to be equal.

[3] In the joint estimation, the instrument set includes 2nd and 3rd lags of real T-bill rate, inflation rate, and bond horizon premium, 3rd lag of bond default premium, and dividend-price ratio.

Table 5. Estimation of the Euler Equation - Homeowners

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Real T-bill[1]	0.4 (0.18) [0.026]														
Net real T-bill		0.57 (0.2) [0.004]									0.021 (0.0067) [0.002]		0.024 (0.023) [0.291]		
Real stock			-0.16 (0.08) [0.038]												
Net real stock				-0.15 (0.07) [0.037]							-0.0061 (0.0018) [0.001]		-0.0074 (0.0038) [0.049]		
Net real housing					0.22 (0.04) [0.000]						0.017 (0.0022) [0.000]				
Net real housing (based on house market value)						0.4 (0.08) [0.000]									
Net real housing (based on aggregate equity)							0.32 (0.06) [0.000]								
Net real housing (aggregate data)								0.27 (0.06) [0.000]							
Net real portfolio									0.27 (0.06) [0.000]						
Net real T-bill, Stock & Housing[2]										0.0021 (0.0002) [0.000]					
Net real T-bill & Stock[2]												-0.0037 (0.001) [0.000]			
Net real T-bill & Housing[2]														0.0188 (0.0032) [0.000]	
Net real Stock & Housing[2]															0.0031 (0.0009) [0.000]
J-test	11.8 [0.16]	10.2 [0.25]	10 [0.26]	10.2 [0.25]	6.5 [0.59]	7.9 [0.45]	7.5 [0.48]	9.1 [0.33]	6.6 [0.58]	21.3 [0.81]	20.7 [0.76]	16.8 [0.54]	16.6 [0.48]	17.6 [0.48]	17.2 [0.51]

Notes: A constant, 11 monthly dummies and Δln(family size) are included as explanatory variables and instruments. In addition, the instrument set includes second and third lag of the real T-bill rate and stock return, second and third lag of the bond horizon and bond default premiums, and dividend price ratio.

[1] The number in [ ] refers to the p-value.

[2] The constant term and dummies are not restricted to be equal.