

Estimating the Elasticity of Intertemporal Substitution

with Household-Specific Portfolios

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Abstract

This paper estimates the elasticity of intertemporal substitution (EIS), allowing for household-specific portfolio. Previous studies that estimated the EIS used financial indexes as a proxy for the risky return on a representative household portfolio. According to the latest data from the 2004 Survey of Consumer Finances, however, the median US stockholders who own stocks directly hold only 3 stock securities. If a large fraction of stockholders do not own a financial index and hold only few individual stocks, then how does that affect inference about household risk aversion? We estimate the EIS using the log-linearized Euler equation derived by Hansen and Singleton (1983) and accounting for household-specific portfolio choice instead of a financial index. Our results show two main findings. First, financial indexes are not a proper substitute for household-specific portfolio. Second, we find support for the standard representative agent assumption that there is a high degree of homogeneity in the EIS across households with different wealth levels (the EIS approximately is 0.22). Our findings have implications for models that assess the comovement between consumption and return on stocks since the value of EIS reflects the comovement level. We argue that a consideration of financial indexes instead of household-specific portfolio explains the small comovement puzzle introduced by Mankiw and Zeldes (1991).

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1. Introduction

The elasticity of intertemporal substitution (EIS) is considered one of the main behavioral parameters in macroeconomics and financial economics. The magnitude of the EIS is central for policy analysis and for a host of economic issues including: (1) The value of the EIS determines the consumption saving decisions, since it measures the sensitivity of changes in the expected consumption growth rate in response to changes in the expected return on the portfolio (interest rate) for a typical stockholder (bondholder). (2) The effectiveness of fiscal and monetary policies depends on the level of the EIS. Specifically, the higher the value of the EIS, the less effective fiscal policy, and the higher the value of the EIS the more effective monetary policy in increasing output (see Hall [1988]). (3) The EIS plays a key role in fitting the data in a real business cycle. The value of the EIS is a central determinant of the level and volatility of interest rates over the business cycle.

Two generations of empirical studies estimated the EIS based on asset pricing models developed by Lucas (1978), Breeden (1979), and Brock (1982). The first generation employed the representative agent assumption and used per capita consumption growth and found that the EIS is small and perhaps close to zero (see Hall [1988] who summarizes the evidence up to the late 80s). The second generation accounts for heterogeneity in the consumption growth rates across households and showed: (i) the EIS is significantly greater than zero and (ii) wealthy stockholders have a higher EIS than their poorer counterparts (see Attanasio and Browning [1995] and Vissing-Jørgensen [2002]). Both generations used a financial index (the Standard and Poor [S&P], the New

York Stock Exchange [NYSE], or the 25 Fama and French portfolio) as a proxy for household-specific portfolio.

Do households hold the portfolio which comprises the financial index? A variety of data resources have shown that investors who own stocks directly hold only few stocks in their portfolios. Conine, Jensen, Tamarkin (1989), and Polkovnichenko (2005) summarize studies that account for portfolio diversity and argue that the majority of individual investors in the U.S. hold highly undiversified portfolios. Moreover, Barber and Odean (2000) and Goetzmann and Kumar (2001) utilize data at a brokerage firm with more than 60,000 stock accounts in the period between 1991 and 1996 and find that the mean number of stocks in a portfolio was four and the median was three.¹ Studies by Calvet et. al (2006) and Bonaparte (2006) show that as a result of the heterogeneity in households' portfolios, wealthy stockholders have higher Sharpe ratios. If a large fraction of stockholders do not own a financial index and hold only few individual stocks, then how does that affect our inference about how willing households are to substitute consumption over time for the incentives that asset returns present?

The purpose of this paper is to estimate the EIS using a household-specific portfolio instead of a financial index.² In the absence of appropriate U.S. data on consumption and asset holdings at the household level over time, estimating the EIS brings some econometric challenges. Although some U.S. data sets that provide micro panel data on nondurable consumption, these data sets provide little information on households' portfolios. Specifically, the Panel Study of Income Dynamics (PSID) provides panel data

¹ See Statman (2004) for literature review of the diversification puzzle, wherein households own only a few individual stocks.

² Gruber (2005) conducts a tax-based estimate of the EIS for bondholders and shows that even the T-bill cannot be a good proxy for bondholders because households face different tax rates.

on food consumption and the Consumer Expenditure Survey (CEX) provides quarterly data on consumption. The Survey of Consumer Finance (SCF) is the only available U.S. data that provides substantial details on households' portfolio allocation and diversification. Unfortunately, the SCF is not a panel and does not have information on consumption.

Our methodology for estimating the EIS follows three steps and uses a two-sample approach in order to characterize household-specific portfolio and consumption.³ In the first step, we use the comparable financial data that is provided in surveys of the SCF to characterize household-specific portfolio. In the second step, we match these portfolio characteristics into the CEX data, and then impute the rate of returns on stocks from two data sets to the CEX based on the observable portfolio characteristics.⁴ In the third step, we employ the generalized method of moments (GMM) and estimate the EIS using household-specific portfolio returns.

We consider Vissing-Jørgensen's (2002) results as a benchmark to our estimation of the EIS. While Vissing-Jørgensen (2002) allows heterogeneity in households' consumption growth rate, she uses a representative market portfolio (specifically the NYSE index). Our results indicate that there is a bias in estimating the EIS when we assume that all stockholders hold a financial index. In particular, there is a downward-bias in the EIS for poor stockholders and an upward-bias for the wealthy stockholders. These measurement biases are statistically significant, which means that financial indexes are not a good proxy for household-specific portfolio.

³ Moskowitz, Vissing-Jørgensen, and Malloy (2006) and Gruber (2005) also employ this two-sample approach to characterize households' portfolios of stocks and bonds in the CEX.

⁴ Specifically, for direct holdings of stocks we use Household Account Data (HAD) and for indirect holdings we use the CRSP index.

Another important result is that there is a high degree of homogeneity in the EIS for stockholders with different wealth levels. Contrary to previous studies, this paper shows that wealthy stockholders are not less averse to risk than their poorer counterparts. Our findings strengthen the representative agent assumption that households have a high degree of homogeneity in their risk preference.

The economic intuition behind our results is as follows. Models that allow heterogeneity in the EIS to explain the high concentration of risky assets for wealthy stockholders have not accounted for the effect of size on diversification of stock securities. Although wealthy stockholders hold a relatively large portion of stocks directly (which increase the unsystematic risk), they rebalance and own larger numbers of stock securities in their portfolios (that decreases the unsystematic risk in their portfolios). We show that there is a substitution relationship between the share of indirect stockholdings of assets and the number of stock securities in a portfolio (see Figures 3 and 5). The larger the portion of indirect stockholdings assets in a portfolio is, the smaller the number of stock securities. Due to the substitution relationship, the overall portfolio unsystematic risk for wealthy stockholders does not far exceed the unsystematic risk for poor stockholders, since they own larger selections of stock securities, so their EIS does not have to be larger than their poorer stockholders' counterparts.

Our results have implications for the comovement between consumption growth rate and the return on stocks. Mankiw and Zeldes (1991) introduce the comovement puzzle by finding that the covariance between consumption growth rates and return on stocks is small and stands at 0.0022. This puzzle has implication for the value of EIS since the value of EIS reflects the comovement level between consumption and return on stocks.

We argue that the consideration of financial indexes instead of household-specific portfolio helps to explain the small covariance puzzle.

The rest of the paper is organized as follows. Section 2 presents the econometrics theory problem and the indicated bias attributed to the assumption that all stockholders hold a financial index. Section 3 characterizes U.S. households' portfolios, and Section 4 estimates the EIS accounting for household-specific portfolio. We draw the conclusion that financial indexes are not a proper substitute for households in estimating the EIS in Section 5.

2. Households' Portfolio choice

This section develops the econometrics methodology that we employ to estimate the log-linearized Euler equation. First, we solve the household's optimization problem and present the log-linearized Euler equation with household-specific portfolio, and then we examine the bias associated with the assumption that all stockholders hold a financial index.

2.1 Household's optimization problem

The following dynamic programming presents household's optimization problem:

$$V(a_t^h, y_t^h) = \underset{a_{t+1}^h}{\text{Max}} \quad U(c_t^h) + \beta \text{EV}(a_{t+1}^h, y_{t+1}^h)$$

$$s.t.$$

$$c_t^h + q_t a_{t+1}^h \leq (q_t + d_t) a_t^h + y_t^h$$

Here $V(\cdot)$ is value function; a_t^h is a vector of asset holdings at period t for household h ;

y_t^h and c_t^h are the levels of real labor income and consumption for household h at period

t , respectively; $U(\cdot)$ is the utility from consumption and specified as $U(c_t^h) = \frac{c_t^{h1-\alpha}}{1-\alpha}$, where α is the parameter of risk aversion; β is the discount factor, and E is the conditional expectations operator. We assume that there are N assets in the market, and we refer to an asset by the index i , $i = 1, \dots, N$. In real consumption values, we denote q_t and d_t as vectors of prices and distributed dividends associated with the same assets in real consumption values, respectively.

From the above dynamic programming problem, the first-order necessary conditions for the maximization that involve the equilibrium prices of the N securities (see Lucas [1978]; Brock [1982]), are:

$$(1) \quad E_t \left[R_{i,t} \frac{U'(c_{t+1}^h)}{U'(c_t^h)} \right] = 1/\beta; \quad i = 1, \dots, N,$$

Here $R_{i,t}$ denote the net return on the i th security from period t to $t+1$.

Let $\varpi_{i,t}^h$ denote the share (weight) of asset i from the overall portfolio for household h , and $\sum_{i=1}^N \varpi_{i,t}^h = 1$. By multiplying equation (1) for asset i with the comparable weight

$\varpi_{i,t}^h$:

$$E_t \left[\varpi_{i,t}^h R_{i,t} \frac{U'(c_{t+1}^h)}{U'(c_t^h)} \right] = (1/\beta) \varpi_{i,t}^h$$

Summing up over asset i :

$$\sum_{i=1}^N E_t \left[\varpi_{i,t}^h R_{i,t} \frac{U'(c_{t+1}^h)}{U'(c_t^h)} \right] = (1/\beta) \sum_{i=1}^N \varpi_{i,t}^h$$

$$\Leftrightarrow \quad E_t \left[\sum_{i=1}^N \varpi_{i,t}^h R_{i,t} \frac{U'(c_{t+1}^h)}{U'(c_t^h)} \right] = 1 / \beta$$

We define household's portfolio return as $R_t^h = \sum_{i=1}^N \varpi_{i,t}^h R_{i,t}$, then we can write the above equation as:

$$(2) \quad E_t \left[R_t^h \frac{U'(c_{t+1}^h)}{U'(c_t^h)} \right] = 1 / \beta$$

It is important to mention that in Hansen and Singleton (1983) as well as in Vissing-Jørgensen (2002) the employed weight vector for all households is equal to NYSE index weight.

2.2 Bias in estimating the EIS

In this subsection, we examine the bias that comes from the assumption that all stockholders hold the market portfolio. Let R_t^{Index} denote the net return of the financial index from period t to $t+1$. There is a bias term denoted by ε_t^h , where $\varepsilon_t^h R_t^{Index} = R_t^h$. For CRRA utility preference with risk aversion α (the inverse of the EIS with CRRA preference), the Euler equation using the financial index return on assets is:

$$(3) \quad E_t \left[\beta \left(\frac{c_{t+1}^h}{c_t^h} \right)^{-\alpha} R_t^{Index} \right] = 1$$

On the other hand the Euler equation with the true net return, R_t^h , is:

$$(4) \quad E_t \left[\beta \left(\frac{c_{t+1}^h}{c_t^h} \right)^{-\alpha} R_t^h \right] = 1 \quad \Leftrightarrow \quad E_t \left[\beta \left(\frac{c_{t+1}^h}{c_t^h} \right)^{-\alpha} \varepsilon_t^h R_t^{Index} \right] = 1$$

Here E_t is the conditional expectations operator at time t . If we assume that ε_t^h is independent of the index return and consumption then we can rewrite equation (4) as follows:

$$1 = E_t \left[\beta \left(\frac{c_{t+1}^h}{c_t^h} \right)^{-\alpha} (E_h \varepsilon_t^h) R_t^{Index} \right]$$

If, for instance, $\ln \varepsilon_t^h \sim N(\mu_\varepsilon, \sigma_\varepsilon^2)$, then the moment condition using the index return will be satisfied at a value for the discount factor that will be scaled by the amount $E_h \varepsilon_t^h = \exp\left(\mu_\varepsilon^h + \frac{1}{2} \sigma_\varepsilon^{h^2}\right)$. On the other hand the moment condition will be satisfied at the true value for the risk aversion parameter.

If, on the other hand, ε_t^h is correlated with the return on the financial index or the consumption growth rate, then the moment condition using the financial index will be satisfied at values that differ for both the discount rate and the risk aversion parameter. The degree of inconsistency depends on the magnitude of the value of $\ln \varepsilon_t^h$ (and/or the quantity $\mu_\varepsilon + \sigma_\varepsilon^2/2$), and the level of correlation between ε_t^h and the return on the financial index or the consumption growth rate.

3. Household-specific portfolio

In this section, we investigate the properties of households' portfolios and show that there is a substitution relationship between the share of indirect stockholdings and the number of stock securities, but first, we present the data sets that we use.

3.1 Data

This paper analyzes cross-sectional data from the Survey of Consumer Finance (SCF) for 1989, 1992, 1995, 1998, 2001, and 2004. The SCF provides detailed information on U.S. assets and liabilities, labor force participation, and social demographic characteristics. The survey also collects information on total family earnings and wealth. The actual number of respondents in each survey is approximately 4,300, where for each observation there are another 5 imputed observations. The total number of observations in the full dataset is 21,500. Because the SCF tilts towards the wealthier segment of the economy, the SCF sample weights are employed in the estimation. The weights in the SCF are designed to down-weight the over-sample so that the cases taken together are representative of the population of households. Furthermore, the additional cases in the upper tail tend to make for more efficient estimates of highly skewed variables, as are many wealth variables.

Since this study is mainly concerned with stockholders, our descriptive statistics distinguish between stockholders and non-stockholders. Households may hold stock in publicly traded companies in two different ways: (1) directly through ownership of shares, (2) indirectly through investing in mutual funds, retirement accounts, or other managed assets. The direct holders of publicly-traded stock include those that own stocks in a company where respondents work or have worked and stocks in a company headquartered outside of the United States.

There are two main statistics that characterize households' portfolios: the share of direct stock holdings in the entire portfolio and the number of stock securities. The larger the share of direct holdings of stocks, the larger the risk in the portfolio, and the smaller

the number of stock securities, the larger the portfolio risks. The next subsection reports these statistics for households with different wealth levels.⁵

3.2 The number and share of direct holdings of stocks securities

The SCF asks households who own publicly traded stocks “In how many different companies do you own stock?” Figure 1 demonstrates the distribution of average number of stocks by wealth level. Figure 1 shows that wealthy stockholders own stocks in many companies. To demonstrate the imperative role that the number of stocks plays on portfolio risks, we use the study by Campbell, Lettau, Malkiel, and Xu (2001) that measures the benefit of diversification and “excess” standard deviation from the market portfolio.⁶ In particular, they measure the excess standard deviations of portfolios containing different numbers of stocks by randomly selecting stocks, grouping them into portfolios, and calculating a simple average of portfolio standard deviations across portfolios.

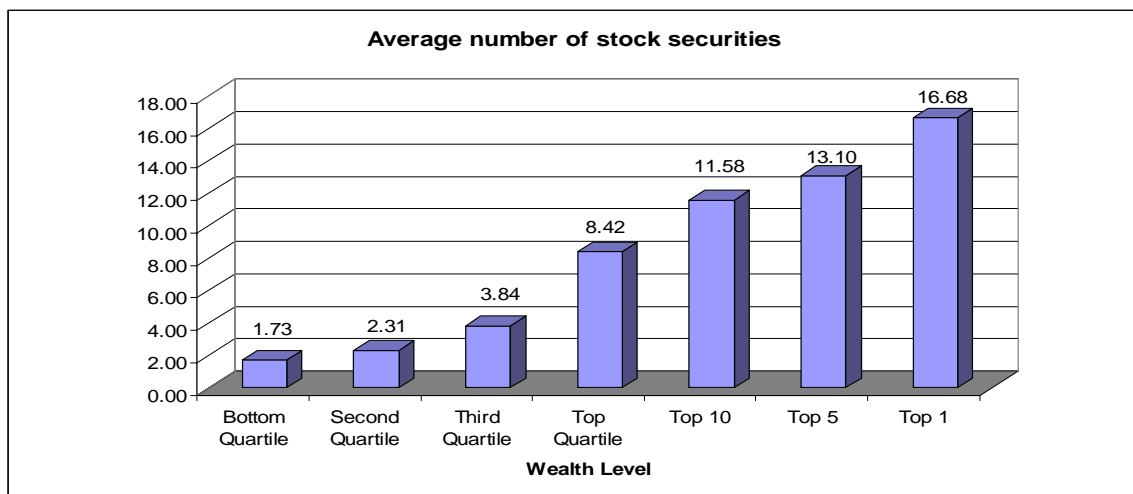


Figure 1: The average number of stocks by wealth level- SCF years 1989-2004

⁵ See Polkovnichenko (2005) for further details about the properties of U.S. households’ portfolios.

⁶ The excess standard deviation of a portfolio is the difference between the portfolio’s standard deviation and the standard deviation of an equally weighted index.

Figure 2 depicts the annual excess standard deviation for a given number of stocks for sample period 1986–1997.

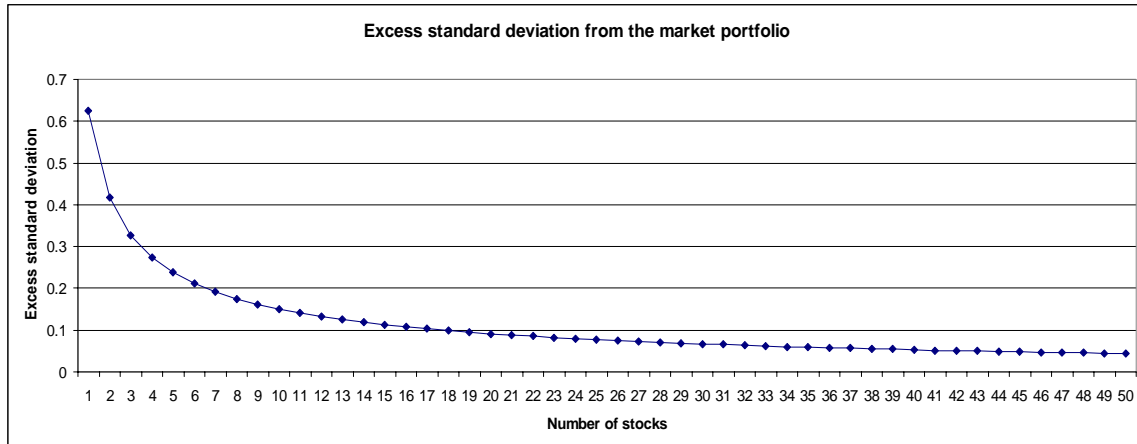


Figure 2: Excess standard deviation against the number of stocks

According to the SCF data for years 1998-2004, about one third of households who hold publicly traded stocks have only one stock, which means their excess risk is 63 percent. The median stockholder holds only 2 stocks, which indicates that the excess risk is 42 percent. Campbell et. al. show that a portfolio containing at least 20 stocks attains a large portion of the diversification benefits. According to the SCF for the same years, only 4.2 percent of households who owned publicly traded stocks had 20 stocks or more.

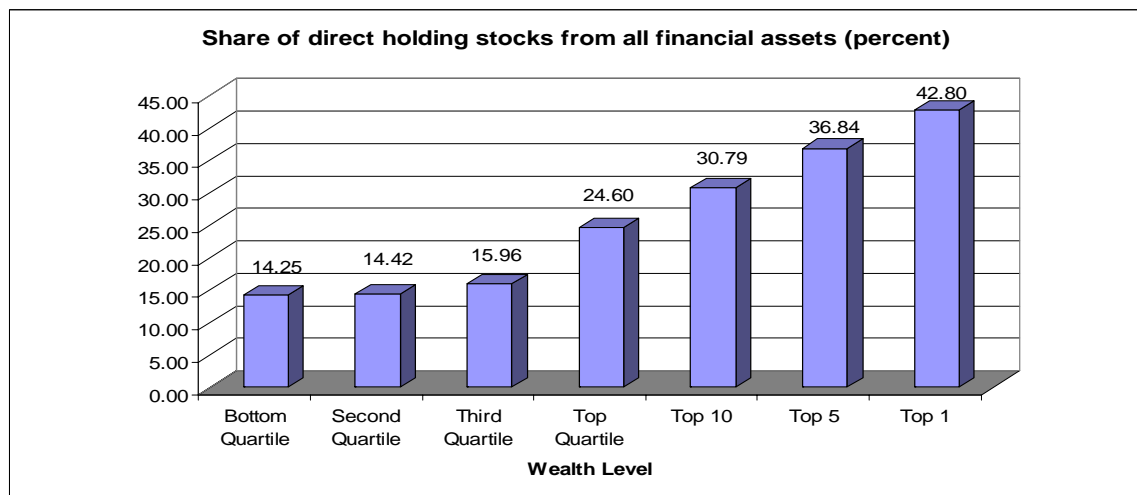


Figure 3: Share of direct holding of stocks from all financial assets- SCF years 1989-2004

Next, we report another important statistic, which is the share of direct holdings stocks in the total financial assets (for only stockholders). Figure 3 demonstrates that the share of direct holdings of stocks increases as wealth increases. That means wealthy households bear higher financial risk since they own more risky assets in their portfolios. Figures 1 and 3 demonstrate that there is a substitution relationship between the share of indirect stockholdings assets and the number of stock securities in a portfolio. The smaller the number of stock securities is, the larger the portion of indirect holding assets in a portfolio.

These findings question the validity of financial indexes as a proxy for household-specific portfolio, especially for the less wealthy households who do not have enough diversification in their portfolios.

3.4 Household Account Data (HAD)

This data set contains information from a large discount brokerage firm on the investments of 78,000 households from January 1991 through December 1996. The data set contains information on the common stock investments of households and does not include information on investments in mutual funds (both open-end and closed-end), American Depositary Receipts (ADRs), warrants, and options. About 66,465 households have positions in common stocks during at least one month (the remaining households hold either investments in other than individual common stocks or cash). In our sample, the median household holds 2.61 stocks worth \$16,210, and the mean household holds 4.3 stocks worth \$47,334. It is important to mention that this data used by Barber and

Odean (2000) and Goetzmann and Kumar (2001) and in December 1996, these households held more than \$4.5 billion in common stock.

Our main target is to measure the return performance of investments in common stocks by households. We analyze the net performance by accounting for commissions, the bid-ask spread, and the market impact of trades. Using the CRSP (Center for Research in Securities Prices) monthly returns file, we estimate the net monthly return on each common stock investment using the beginning-of-month position statements from our household data. We follow the Barber and Odean's (2000) methodology (see more details in their methodology in Section II, B; page 781) in estimating the monthly net returns. Since the consumption data from the CEX is semiannual, we estimate the semiannual net return for households based on households' characteristics and portfolio properties such as the number of stock securities in the portfolio. We use the average number of stock securities during the semiannual period if the number of securities varies during the 6 months.

4. Estimating the EIS

In this section, we estimate the EIS by accounting for household-specific portfolio using a two-sample approach. The two-sample approach is employed in order to characterize households' portfolios, specifically the share of direct holdings of stocks and the numbers of stock securities.

4.1 Econometrics procedure

Our methodology follows three steps. Step 1 uses comparable SCF data that is provided in the surveys in 1989, 1992, and 1995 to compute the asset properties of portfolio holdings for households. From the SCF data, we define a variable called the *Share* variable that measures the share of direct stockholding in the entire portfolio (share of stocks in the sum of stocks, mutual funds, retirement accounts and bonds) and another variable called *Number* that measures the number of stock securities. We run regressions and save the regression coefficients. Step 2 utilizes those same characteristics in the CEX along with the regression coefficients from the SCF to calculate the *Share* and *Number* variables for each household in the CEX (see Appendix A and B for more details about the above two steps). We divide assets in 2 categories: directly through ownership of stocks and indirectly through investing in mutual funds or other managed assets and retirement accounts. We assign a corresponding rate of return for each category and take a weighted average of log returns (using the *Share* variable). For the mutual funds and other indirect assets, we use the rate of return of the CRSP index.⁷ For the rate of return of the direct ownership of stocks, we use imputed data from the HAD to the CEX. Table 1 reports the rate of return for households with different wealth levels.

In step 3, we employ the GMM to estimate the log-linearized Euler equation (or linear instrumental variables). Due to the endogeneity of asset returns (caused by the inclusion of the expectational error in the error term), instrumental variables estimation is

⁷ Wermers (2000) considers the CRSP index as the closest representative to households' mutual fund returns. In future work, we will impute the actual households' return on mutual fund returns to the CEX.

employed instead of ordinary least squares.⁸ We use the log dividend-price ratio as an instrument for the log stock return since it is considered to be among the best predictors of real stock returns. The dividend price is the ratio of dividends over the previous 12 months, and is based on data from Ibbotson Associates (1997).

Recall equation (2), Hansen and Singleton (1983) and Vissing-Jørgensen (2002) show that the standard log-linearized Euler equation can be employed as:

$$(5) \quad \Delta \ln C_{t+1}^h = \gamma \ln R_t^h + \delta D_h + \xi \Delta z_h + u_{t+1}$$

Here $\Delta \ln C_{t+1}^h = \ln(c_{t+1}^h / c_t^h)$ and. Also, D_h is a vector of binary variables that accounts for seasonal adjustments, and Δz_h is a vector that contains the change in family size. This is similar to the approach of Dynan (1993) and Vissing-Jørgensen (2002) using these CEX data. The error term u_{t+1} includes the expectational errors for log consumption growth and log stock returns and the measurement error in log consumption growth. Finally, γ is the EIS ($\gamma = 1/\alpha$), δ and ξ are estimators. Vissing-Jørgensen (2002) argues that in the CRRA case, the δ vector is a function of β and of the conditional variance and covariance of the gross stock return and the log consumption growth.

4.2 Comparison to previous literature

There are a few differences between the log linearized Euler equation that we estimate and those estimated by Hansen and Singleton (1983) and Vissing-Jørgensen (2002). Recall equation (5), which allows for household-specific consumption growth and household-specific portfolios:

⁸ We use small sets of instruments since the bias of the two-stage least squares estimator progressively worsen as the degree of overidentification increases. In addition to the instrument, we include 12 seasonal dummies and the log difference in family size.

$$(5) \quad \Delta \ln C_{t+1}^h = \gamma \ln R_t^h + \delta D_h + \xi \Delta z_h + u_{t+1}$$

Given this model, we can relate our work with Vissing-Jørgensen's (2002) study by introducing her Euler equation as follows:

$$\Delta \ln C_{t+1}^h = \gamma \ln R_t^{Index} + \delta D_h + \xi \Delta z_h + u_{t+1} + \gamma (\ln R_t^h - \ln R_t^{Index})$$

Let v_{t+1} denote the error term, $v_{t+1} = u_{t+1} + \gamma (\ln R_t^h - \ln R_t^{Index})$. For the moment condition $E(v_{t+1} | \psi_t) = 0$ to hold, one needs to have $E(u_{t+1} | \psi_t) = 0$ plus $E(\ln R_t^h - \ln R_t^{Index} | \psi_t) = 0$. If the latter fails, then the Vissing-Jørgensen's (2002) procedure will be inconsistent with biases depending on the relationship of $(\ln R_t^h - \ln R_t^{Index})$ to the information set ψ_t .

We can also relate our work with the model employed by Hansen and Singleton (1983). They use the per capita consumption growth rate and financial index (NYSE) as proxies for households' consumptions and returns. The Euler equation that they employ:

$$\Delta \ln C_{t+1} = \gamma \ln R_t^{Index} + u_{t+1} + \gamma (\ln R_t^h - \ln R_t^{Index}) + (\Delta \ln C_{t+1} - \Delta \ln C_{t+1}^h)$$

Here we denote the error term as $\xi_{t+1} = u_{t+1} + \gamma (\ln R_t^h - \ln R_t^{Index}) + (\Delta \ln C_{t+1} - \Delta \ln C_{t+1}^h)$.

Based in their specification, in order to derive consistent estimates of the EIS, they need both $E(u_{t+1} | \psi_t) = 0$ as well as $E(\gamma \ln R_t^h - \gamma \ln R_t^{Index} + \Delta \ln C_{t+1} - \Delta \ln C_{t+1}^h | \psi_t) = 0$ to hold.

Otherwise, the moment condition $E(\xi_{t+1} | \psi_t) = 0$ does not hold and Hansen and Singleton's (1983) procedure will be inconsistent with biases depending on the relationship of $(\gamma \ln R_t^h - \gamma \ln R_t^{Index} + \Delta \ln C_{t+1} - \Delta \ln C_{t+1}^h)$ to the information set ψ_t .

Finally, there is another econometrics issue in the current paper as well as in Vissing Jørgensen (2002). We both assume that in the CRRA case, the δ vector is not only a function of β , but also of the conditional variance and covariance of the gross stock

return and the log consumption growth. If the vector δ does not capture this household-specific conditional variance, then the moment condition $E(u_{t+1}|\psi_t) = 0$ would not hold. In this case, a possible remedy would be to use the differencing method, specifically looking at the difference between the Euler equation for asset i at two different time periods (say, time t and time $t + 1$).

4.3 Results

Table 2 Panel A reports the estimation results of EIS when we account for household-specific portfolio. We consider Vissing-Jørgensen's (2002) study as a benchmark to our results, so we first reproduce her results by estimating the Euler equation using financial indexes and report them in the second column of Table 2. The third column of Table 2 reports the estimation results of the EIS accounting for household-specific portfolio. In the last column of Panel A, we report results about the Wald test that is performed to examine whether the differences on the estimated EIS are statistically significant.

Table 2 demonstrates two main results. First, the estimated EIS using household-specific portfolio derives different results than the financial index, especially for bottom and top layers. The index can be a good proxy only for the middle layer of stockholders, but not for the bottom and top layers. Second, the differences in the estimated EIS for layers of stockholders are not statistically significant when we consider household-specific portfolio, whereas it is more significant when we use financial indexes.

We perform a Wald test on the estimated EIS for the bottom layer to test whether it stands at zero. We find that when we use financial indexes, the test was not rejected, whereas when we use household-specific portfolio, the Wald test rejects the hypothesis that it is equal to zero. In Panel B of Table 2, we perform a Wald test to examine whether

the difference in the estimated EIS between the top and bottom layers is statistically significant and we find that the difference is not statistically significant. The Wald test does not reject the hypothesis that the EIS is the same for top and bottom layers of stockholders at the 84 percent level. Finally, Panel C of Table 2 tests whether the difference between the EIS for layers of stockholders is statistically significant when we use indexes. We find that the difference is statistically significant, and the Wald test rejects the hypothesis that the EIS is the same for top layers when we use financial indexes.

Using financial indexes instead of household-specific portfolio changes our understanding of the comovement between consumption growth rate and return on stocks. Mankiw and Zeldes (1991) find that the covariance between consumption growth rates and return on stocks stands at 0.0022. Since the value of EIS reflects the comovement level between consumption and return on stocks, low covariance implies that the value of EIS is small. In fact, Mankiw and Zeldes (1991) use financial index instead of household-specific portfolio. As we demonstrated in this paper, financial indexes are not a good proxy for household specific portfolio. We argue that using financial indexes instead of household-specific portfolio can be a factor that contributes to the small comovement.

5. Conclusion

The goal of this paper has been to estimate the EIS by accounting for household-specific portfolio. The data shows that households with different wealth levels have different portfolio diversification. This heterogeneity across households calls into question the validity of using financial indexes to represent household-specific portfolio.

This paper has two main findings. First, estimating the EIS using financial indexes generate an estimation bias. In particular, there is an upward bias for wealthy stockholders and a downward bias for less wealthy stockholders. Second, there is a high degree of homogeneity in the EIS for households with different wealth levels; this is in line with the standard representative agent assumption.

Our results have implications for the small comovement (covariance) puzzle that was introduced by Mankiw and Zeldes (1991) and the role that EIS plays to reflect this comovement. We argue that using financial indexes instead of household-specific portfolio can be a factor that causes the small comovement. For future work, it is important to study the case of Epstein-Zin preferences using household-specific portfolio instead of a financial index. Perhaps estimating the conditional log-linearized Euler equations with household-specific portfolio provides similar estimates of the EIS, but it is not informative about the risk aversion.

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Appendix A - CEX Data

This appendix briefly describes the disaggregated CEX household-level data on consumption for stockholders. The CEX data is repeated cross-sectional data so we can conduct cohort analysis, and it is available from the start of 1980. In each cross-sectional survey, about 4,500 households are interviewed per quarter (before 1999). Each household is interviewed five times, though the first time is only for practice, and the results are not included in the data files. Households are interviewed three months apart and report consumption for the previous three months. In each month, new households are interviewed in the sample, so that it is spread out over the quarter. In the fifth quarter, financial information is gathered. Although approximately 60 percent of households make it through all five quarters, the sample is considered to be representative of the U.S. population.

We follow Vissing-Jørgensen's (2002) study on defining the consumption definition and sample selection criteria, in particular:

1. We follow the definitions of nondurables and services in the National Income and Product Accounts (NIPA), and we code the nondurable consumption aggregated from the disaggregate CEX consumption categories.
2. The utility is separable in durables and nondurables services, so we leave out durables.
3. Categories that have substantial durable components are excluded, such as education costs, housing expenses (but not costs of household operations), and medical care costs.

4. The nominal consumption values are deflated by the BLS deflator for nondurables for urban households.
5. In order to account for consumption changes driven by changes in family size, we regress the change in log consumption on the change in log family size at the household level.
6. We account for monthly seasonal adjustment by using binary variables that take the value of one if the month the household was interviewed and zero otherwise.
7. Observations for which the consumption growth ratio is less than 0.2 or above 5 are dropped. These observations may reflect reporting or coding errors, so we consider them as extreme outliers.
8. We use Monthly NYSE value-weighted returns as a measure for the stock return.
9. The middle six months of relevant stock returns is used, hence, if the first interview reports data consumption on months m , $m + 1$, and $m + 2$, then the asset return that associates to this period is: $(1 + R_{m+2})(1 + R_{m+3}) \dots (1 + R_{m+7})$.

Appendix B – The two sample approach and the CEX Sample Choice

The CEX contains information about holdings of “stocks, bonds, mutual funds and other such securities.” We call this category “assets.” We generate the category of assets from the SCF which includes stocks, mutual funds, retirement accounts, and bonds.

In our regression estimates, data are averaged across SCF imputations, and SCF weights are employed to avoid the estimates being unduly influenced by the over-sampling of high wealth individuals in the SCF. The estimated results of the coefficients from the regression models in the SCF are used to predict the share of direct ownership of

stocks as well as the number of stock securities for households in the CEX who have information on the same observable characteristics. The estimated coefficients and t-statistics for the probit model of the share of direct stock ownership are:

$$Pr ob(Share) = \Phi(x'\delta)$$

$$x'\delta = \begin{matrix} -0.0839 \\ (-30.56) \end{matrix} age + \begin{matrix} 0.0009 \\ (37.03) \end{matrix} age^2 + \begin{matrix} -0.1990 \\ (-13.81) \end{matrix} married + \begin{matrix} -0.1372 \\ (-7.22) \end{matrix} highschool + \begin{matrix} 0.0946 \\ (5.36) \end{matrix} college \\ + \begin{matrix} 0.2053 \\ (8.04) \end{matrix} white + \begin{matrix} -0.1927 \\ (-11.60) \end{matrix} y1992 + \begin{matrix} -0.3406 \\ (-20.01) \end{matrix} y1995 + \begin{matrix} 0.0086 \\ (2.15) \end{matrix} \log(Assets) + \begin{matrix} 0.7511 \\ (10.59) \end{matrix}$$

where the pseudo R-squared from the first-stage probit model in the SCF is 0.308.

We also regress the number of stocks and choose the exponential specification so that when we impute the data at the CEX, all the results will be positive. The estimated coefficients and t-statistics for the number of stock securities for stockholders are:

$$Number = \exp(x'b)$$

$$x'b = \begin{matrix} 0.0099 \\ (14.77) \end{matrix} age + \begin{matrix} 0.0216 \\ (0.99) \end{matrix} married + \begin{matrix} 0.0532 \\ (1.61) \end{matrix} highschool + \begin{matrix} 0.1447 \\ (5.45) \end{matrix} college + \\ \begin{matrix} 0.1109 \\ (2.26) \end{matrix} white + \begin{matrix} -0.0473 \\ (-2.16) \end{matrix} y1992 + \begin{matrix} -0.0828 \\ (-3.83) \end{matrix} y1995 + \begin{matrix} 0.3980 \\ (72.91) \end{matrix} \log(Assets) + \begin{matrix} -3.646 \\ (-41.38) \end{matrix}$$

The $\exp(\cdot)$ specification assures that we have non-negative values for the number of stocks in the CEX.

Table 1: Index return (NYSE) versus households return

This table reports the average and standard deviation of the log Index returns, which used in Vissing-Jørgensen's study (column two), and the average and standard deviation of log household-specific portfolio returns (column three).

	Index	Household-specific portfolio
	$\ln(r_{t+1}^{Index})$	$\ln(r_{t+1}^h)$
All	0.048 (0.100)	0.0537 (0.172)
Top	0.048 (0.100)	0.129 (0.209)
Middle	0.048 (0.100)	0.039 (0.092)
Bottom	0.048 (0.100)	0.010 (0.073)

Table 2: GMM estimation of the EIS

This table reports GMM estimation of log-linearized Euler equations: Real value-weighted NYSE Return and household-specific portfolio, separate estimations (CEX, 1982–96, Semiannual Data). In Panel A, we reports the GMM estimation results of the EIS when we use financial index (column two), and when we account for household-specific portfolios (column three). We perform a Wald test in the third column to examine whether the difference in the estimation results between column two and three are statistically significant.

In Panel B, we report the Wald test results that examine the differences in the estimated EIS for different layers of stockholders when we use household-specific portfolio. Finally, Panel C reports the Wald test results that examine the differences in the estimated EIS for different layers of stockholders when we use financial indexes.

Group of stockholders (by wealth)	Financial Index	Household-specific portfolio	Wald test
	$\hat{\gamma}$	$\hat{\gamma}$	
Panel A			
GMM estimation of the EIS			
All stockholders	0.299 (0.126)	0.226 (0.083)	0.77 (0.381)
Bottom layer	0.046 (0.232)	0.219 (0.196)	0.78 (0.377)
Middle layer	0.175 (0.274)	0.212 (0.230)	0.03 (0.873)
Top layer	0.486 (0.284)	0.181 (0.195)	2.44 (0.118)
Panel B			
Wald test when we use household-specific portfolio			
Top layer vs. Bottom layer			0.04 (0.844)
Middle layer vs. Bottom layer			0.00 (0.975)
Top layer vs. Middle layer			0.03 (0.873)
Panel C			
Wald test when we use financial index			
Top layer vs. Bottom layer			2.39 (0.287)
Middle layer vs. Bottom layer			0.20 (0.653)
Top layer vs. Middle layer			0.119 (0.275)