The Returns on Human Capital:
Good News on Wall Street is Bad News on Main Street

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Abstract

We use a standard single-agent model to conduct a simple consumption growth accounting exercise. Consumption growth is driven by news about current and expected future returns on the market portfolio. The market portfolio includes financial and human wealth. We impute the residual of consumption growth innovations that cannot be attributed to either news about financial asset returns or future labor income growth to news about expected future returns on human wealth, and we back out the implied human wealth and market return process. This accounting procedure only depends on the agent's willingness to substitute consumption over time, not her consumption risk preferences. We find that innovations in current and future human wealth returns are *negatively* correlated with innovations in current and future financial asset returns, regardless of the elasticity of intertemporal substitution. The evidence from the cross-section of stock returns suggests that the market return we back out of aggregate consumption innovations is a better measure of market risk than the return on the stock market.

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1 Introduction

Following Roll (1977)'s critique, the literature has recognized the importance of including human wealth returns as part of the market return (e.g. Shiller (1993), Campbell (1996), and Jagannathan & Wang (1996)), but only the cash flows for human wealth are observed, not the actual returns. This paper uses observed aggregate consumption to learn about the human wealth returns. A standard single-agent model puts tight restrictions on the joint distribution of market returns and aggregate consumption. We exploit these restrictions to account for aggregate consumption growth, and we impute that part of consumption innovations not due to news about financial asset returns to human wealth returns.

To do so, we confront a single agent with the observed market returns on US household wealth and back out her implied consumption innovations. These consumption innovations are determined by news about current returns and by news about expected future returns on the market portfolio. The effect of news about future market returns on consumption depends only on how willing this agent is to substitute over time, not on her risk preferences (Campbell (1993)).

If her portfolio only includes financial wealth, the model-implied consumption innovations are radically different from those in the data. The agent's consumption innovations are at least eight times too volatile relative to US aggregate consumption innovations and the implied correlation of her consumption innovations with news about stock returns is three times higher than in the data, even for values of the intertemporal elasticity of substitution *EIS* close to zero. We call this the consumption correlation and volatility puzzle.

These two moments of aggregate consumption growth are also at the heart of Mehra & Prescott (1985)'s equity premium puzzle. However, the volatility and correlation puzzles only depend on the agent's willingness to transfer consumption between different periods in response to news about future returns; the equity premium puzzle only depends on the agent's aversion to consumption bets. In a model with only financial wealth, there is no value of the *EIS* that closes the gap between the model and the data, but large values definitely make matters worse.

In addition, the household budget constraint also implies that the present discounted value of aggregate consumption growth responds one-for-one to news about current and future market returns, regardless of the agent's preferences. In US data the present discounted value of consumption growth and future market returns are negatively correlated if the market portfolio only includes financial wealth. Clearly, financial wealth is not a good proxy for total wealth.

So, we introduce human wealth in our single agent's portfolio. In a first step, we show that a model in which the expected returns on human wealth and financial wealth are perfectly correlated, like Campbell (1996), cannot come close to matching the consumption moments in the data. Models in which the expected return on human wealth is constant, like Shiller (1993), or, in which the expected return on human wealth is perfectly correlated with expected labor income growth, like Jagannathan & Wang (1996), do better, but still over-predict the volatility of consumption innovations and their correlation with financial returns.

In a second step, we conduct a basic *consumption growth accounting* exercise. We impute that part of the consumption innovations that cannot be attributed to news about current or future financial returns to the returns on human wealth. This approach constructs a process for the expected return on human wealth that exactly matches the moments of aggregate consumption innovations in the data. We find that (1) good news about current returns in financial markets is bad news about current returns in labor markets, regardless of the intertemporal elasticity of substitution (EIS), and (2) the implied total market return is negatively correlated with the returns on financial wealth if the EIS is smaller than one.

This result reflects the negative correlation of the future discount rates and the future growth rates of cash flows for these two assets. First, the cash flows. Good news about future labor income growth is bad news for the future growth rate of pay-outs to securities holders. This is a feature of the raw data. Second, the discount rates. Positive innovations to future risk premia on financial wealth tend to coincide with negative innovations to expected future returns on human wealth. This is what comes out of our consumption growth accounting exercise. The negative correlation between the discount rates on these two assets is not surprising. Santos & Veronesi (2004) were the first to analyze composition effects on risk premia: e.g., in the two-tree Lucas endowment model with i.i.d dividend growth and log preferences, when the dividend share of the first tree increases, its expected return must go up to induce investors to hold it despite its larger share. Because the overall price-dividend ratio stays constant, the expected return on the second tree has to decrease (see Cochrane, Longstaff, & Santa-Clara (2004)).

In a third step, we allow for time-varying wealth shares. We estimate a linear factor model: The expected return on human wealth and the human wealth share are linear functions of the state, and the factor loadings are chosen to minimize the distance between the consumption innovation moments in the model and the data. Same results. In addition, we find that the news about the present discount value (henceforth PDV) of future consumption growth and news about the PDV of future market returns line up much better; the correlation increases to .7 at annual frequencies.

While Campbell's original work aimed to substitute consumption out of the asset pricing equations, we actually obtain better measures of market risk when the market return is forced to be consistent with the moments of aggregate consumption. We revisit the Roll critique, and ask whether our consumption-consistent capital asset pricing model improves the pricing of assets in the cross-section. Using our model-implied market returns and consumption, we find that our model produces the lowest pricing errors for size and value stock portfolios among the models that include human wealth in the market portfolio. Growth stocks provide better insurance against future human capital risk and therefore trade at a risk discount relative to value stocks.

Much of standard asset pricing theory seems to work better in practice if we entertain large values for the EIS. Bansal & Yaron (2004) show that a model with Epstein-Zin preferences and a persistent expected growth rate part in dividends and consumption can match the equity premium and the risk-free rate with a coefficient of risk aversion of nine. The Bansal-Yaron mechanism crucially relies on an EIS much larger than one. Vissing-Jorgensen & Attanasio (2003) use Campbell (1996)'s framework to estimate the EIS and the coefficient of risk aversion using household-level data. Vissing-Jorgensen & Attanasio (2003) conclude that the EIS of stockholders is likely to be above one, but they do not match the model-implied consumption volatility and correlation moments to data. Our paper adds these two consumption moments to the picture, and we are less sanguine about large values of the EIS, for two reasons. First, if the EIS is larger than one, the market return has to display multivariate mean aversion in order to match the aggregate consumption volatility, and we point out this has counterfactual asset pricing implications. Second, financial returns display strong mean reversion and, according to the model, an individual investor holding only financial wealth (e.g. a retiree) should have implausibly volatile consumption, if she is very willing to substitute consumption over time.

Our work suggests that standard macro models cannot match consumption moments at any *EIS* if its equilibrium returns are as volatile as in the data, because the workhorse model of modern business cycle theory model generates returns on human capital that are too highly correlated with returns on physical capital (Baxter & Jermann (1997)). Models with time-varying factor elasticities, such as the one of Young (2004), may allow for a better description of the data.

Other Explanations We attribute the component of aggregate consumption growth that is not accounted for by financial asset returns to human wealth returns. Other labels come to mind for this residual. In the paper, we consider four in detail. First, if the agent's preferences display habit formation, the volatility puzzle can be resolved, but the correlation puzzle cannot unless through heteroscedasticity in the market return. In a second step, we test for this possibility by checking if our consumption growth residual predicts the future volatility of stock returns, and it does not. Third, we argue that heterogeneity makes matters worse, if anything, because stock and bond holders seem to have a higher *EIS*. Finally, the omission of housing wealth may lead to the erroneous interpretation of the residual as a human wealth return. When we include housing wealth into the portfolio of the agent, the residual has the same properties as in the model without housing wealth.

Related Literature We infer from aggregate consumption that bad news for stock returns is good news for the rest of the economy. Interestingly, Boyd, Hu, & Jagannathan (2005) show that on average good news about unemployment implies lower stock returns, except in recessions. Similar results are obtained by Andersen, Bollerslev, Diebold, & Vega (2005) for a wide range of macro-economic announcements.

Bansal & Yaron (2004) back out a consumption and dividend process that can match expected returns on financial wealth. Instead, we back out a (human wealth) return process that implies the right aggregate consumption behavior. Our work is also related to Santos & Veronesi (2004). They set up two-sector-model, a labor-income and a capital-income generating sector; assets are priced off a conditional CAPM in which the labor income share is the conditioning variable. While the labor income share works well as a conditioning variable in explaining the cross-section of returns, they find that innovations to future labor income growth do not help much in pricing. We find that future human capital risk is priced, and that growth firms provide a better hedge against this risk.

Lettau & Ludvigson (2001a) and Lettau & Ludvigson (2001b) find that the single agent's budget constraint provides useful aggregate risk information: Lettau & Ludvigson (2001a) use a linearized version of the household budget constraint to show that the consumption-wealth ratio predicts stock returns. Lettau & Ludvigson (2001b) derive a scaled version of the Consumption CAPM from this budget constraint. In fact, we use the budget constraint *and* the Euler equation to derive a consumption-consistent version of the CAPM. Our market return process, derived from actual US aggregate consumption innovations, actually does better in explaining the cross-section of asset returns than the standard CAPM return on the stock market. Lewellen & Nagel (2004) argue the CAPM betas do not vary enough in order for a conditional version of the CAPM to explain the variation in returns. Our results shed some light on these findings; stock market risk is a poor measure of market risk.

Finally, our market return is consistent with household portfolio evidence. US household portfolios are biased towards US securities, and our model implies that domestic financial securities provide US investors with a hedge against human capital risk. Baxter & Jermann (1997) reach the opposite conclusion. In their results, introducing labor income risk unambiguously worsens the international diversification puzzle, but they do not use the information embedded in aggregate consumption . In recent work, Julliard (2003) and Palacios-Huerta (2001) qualify the Baxter-Jermann result. While there is a huge literature on the risk-return trade-off in financial markets, the role of risk is usually ignored when economists model human capital investment decisions. Palacios-Huerta (2001) is the first to focus on this trade-off in labor markets; he uses individual labor-income based measures of human capital returns[1]. We use the information in aggregate consumption innovations instead to learn about the aggregate human wealth returns.

We start by briefly reviewing the Campbell framework in section 2. In section 3, we describe the data we use and how to operationalize the model. In section 4 we describe the basic consumption correlation and volatility puzzle, and in 5 we explicitly introduce

[1] Two related papers are Palacios-Huerta (2003a) and Palacios-Huerta (2003b)).

human wealth returns. Next, section 6 tests our measure of market risk, and, finally, in section 7, we go over some non-human-wealth explanations of our findings.

2 Environment

We adopt the environment of Campbell (1993) and consider a single agent decision problem.

2.1 Preferences

The agent ranks consumption streams $\{C_t\}$ using the following utility index U_t, which is defined recursively:

$$U_t = \left((1-\beta) C_t^{(1-\gamma)/\theta} + \beta \left(E_t U_{t+1}^{1-\gamma} \right)^{1/\theta} \right)^{\theta/(1-\gamma)},$$

where γ is the coefficient of relative risk aversion and σ is the intertemporal elasticity of substitution (IES). Finally, θ is defined as $\theta = \frac{1-\gamma}{1-(1/\sigma)}$. In the case of separable utility, the EIS equals the inverse of the coefficient of risk aversion and θ is one. Distinguishing between the coefficient of risk aversion and the inverse of the EIS will prove important later on. Our results on the correlation structure between financial asset returns and human wealth returns only depend on the EIS, not on the coefficient of risk aversion. Epstein & Zin (1989) preferences impute a concern for long run risk to the agent. This plays potentially an important role in understanding risk premia (Bansal & Yaron (2004)).

2.2 Trading Assets

All wealth, including human wealth, is tradable. We adopt Campbell's notation: W_t denotes the representative agent's total wealth at the start of period t, and R^m_{t+1} is the gross return on wealth invested from t to $t+1$. This representative agent's budget constraint is:

$$W_{t+1} = R^m_{t+1} \left(W_t - C_t \right). \tag{1}$$

Our single agent takes the returns on the market $\{R^m_t\}$ as given, and decides how much to consume. Instead of imposing market clearing and forcing the agent to consume aggregate dividends and labor income, we simply let her choose the optimal aggregate consumption process, taking the market return process $\{R^m_t\}$ as given.

2.3 The Joint Distribution of Consumption and Asset Returns

Campbell (1993) linearizes the budget constraint and uses the Euler equation to obtain an expression for consumption innovations as a function of innovations to current and future expected returns.

First, Campbell linearizes the budget constraint around the mean log consumption/wealth ratio $c - w$. Lowercase letters denote logs. If the consumption-wealth ratio is stationary, in the sense that $\lim_{j\to\infty} \rho^j (c_{t+j} - w_{t+j}) = 0$, this approximation implies that:

$$c_{t+1} - E_t c_{t+1} = (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j r^m_{t+1+j} - (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j \Delta c_{t+1+j}, \qquad (2)$$

where $r^m = \log(1 + R^m)$ and ρ is defined as $1 - exp(c - w)$.[2] Innovations to consumption today reflect innovations to current and future expected returns, and innovations to future expected consumption growth. Consumption and returns are assumed to be conditionally homoscedastic and jointly log normal.

Second, Campbell substitutes the consumption Euler equation:

$$E_t \Delta c_{t+1} = \mu_m + \sigma E_t r^m_{t+1}, \qquad (3)$$

where μ_m is a constant that includes the variance and covariance terms for consumption and market return innovations, back into the consumption innovation equation in (2), to obtain an expression with only returns on the right hand side:

$$c_{t+1} - E_t c_{t+1} = r^m_{t+1} - E_t r^m_{t+1} + (1 - \sigma)(E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j r^m_{t+1+j}, \qquad (4)$$

Campbell shows this agent incurs relatively small welfare losses from using this linear consumption rule. We will use this linear version of the model as our actual model.

Innovations to the representative agent's consumption are determined by (1) the unexpected part of this period's market return and (2) the innovation to expected future market returns. There is a one-for-one relation between current return and consumption innovations, regardless of the *EIS*. Instead, the relation with between consumption innovations and innovations to expected future returns depends on the *EIS*. If the agent has log utility over deterministic consumption streams and σ is one, the consumption innovations exactly equal the unanticipated return in this period. If σ is larger than one, the representative agent lowers her consumption to take advantage of higher expected future returns, while, if σ is smaller than one, she chooses to increase her consumption because the income effect dominates the substitution effect.

Equation (4) puts tight restrictions on the joint distribution of aggregate consumption innovations and total wealth return innovations. Our aim is to study the properties of aggregate consumption implied by this restriction. More specifically, we are interested in two moments of the consumption innovations: (1) the variance of consumption innovations and (2) the correlation of consumption innovations with financial return innovations. Matching these moments of the data is a major hurdle for the model with only financial wealth, be-

[2] Campbell (1993) shows that this approximation is accurate for values of the EIS between 0 and 4.

cause in the data financial returns and consumption innovations have a low correlation and because consumption innovations are much less volatile than financial return innovations.

2.4 Long-Run Restriction

The household budget constraint (2) also imposes a restriction on the long-run effect of news about market returns and consumption growth:

$$(E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j r^m_{t+1+j} = (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j \Delta c_{t+1+j}, \tag{5}$$

The force of this restriction is that it does not depend on preferences, only on the budget constraint. As we proceed, we will check whether the news about future consumption innovations in the data and the news about future market return innovations in the model are consistent.

3 Data and Model Implementation

This section discusses the measurement of financial asset returns, the computation of all the innovations that feed into consumption innovations, and finally, the relevant moments of the data.

3.1 Measuring Financial Asset Returns

We use two measures of financial asset returns. The first measure is the return on the value-weighted CRSP stock market portfolio: $R^a_{t+1} = \frac{P_{t+1}+D_{t+1}}{P_t}$, where D_t is the quarterly dividend in period t and P_t is the ex-dividend price. To remove the seasonal component in dividends, we define the log dividend price ratio as

$$dp^a_t = \log\left(\frac{.25D_t + .25D_{t-1} + .25D_{t-2} + .25D_{t-3}}{P_t}\right).$$

The full line in figure 1 shows the dividend-price ratio, $\exp(dp^a_t)$. We follow the literature on repurchases (Fama & French (2001) and Grullon & Michaely (2002)), and adjust the dividend yield for repurchases of equity, to ensure its stationarity. The repurchase data are from Boudoukh, Michaely, Richardson, & Roberts (2004). This is the dotted line in figure 1. The dividend-price ratio adjusted for repurchases is similar to the unadjusted series until 1980, and consistently higher afterwards.

Our second measure of financial asset returns takes a broader perspective by including corporate debt and private companies: we value a claim to US non-financial, non-farm corporations and compute the total pay-outs to the owners of this claim. The value of US (non-financial, non-farm) corporations is the market value of all financial liabilities plus the market value of equity less the market value of financial assets. The payout measure includes all corporate pay-outs to securities holders, both stock holders and bond holders. See appendix A.1 for details. The dashed line in figure 1 shows the ratio of pay-outs to securities holders to the market value of firms. Over the last two decades, the dividend yield for the firm-value measure has been much higher than the dividend yield on stocks. This is consistent with the findings of Hall (2001). The firm value dividend yield departs from the CRSP-based repurchase adjusted series after the stock market crash of 2001.

[Figure 1 about here.]

3.2 Computing Innovations

We follow Campbell (1996) and estimate a VAR with real financial asset returns (r^a_{t+1}), real per capita labor income growth (Δy_{t+1}), and three return predictors: the log dividend yield on financial assets (dp^a_{t+1}), the relative T-bill return (rtb_{t+1}), and the yield spread (ysp_{t+1}). To be consistent with our exercises in the next section, we add the labor income share s_{t+1} and real per capita consumption growth on non-durables and services to the system Δc_{t+1}. We stack the $N = 7$ state variables into a vector z. The VAR describes a linear law of motion for the state:

$$z_{t+1} = Az_t + \varepsilon_{t+1},$$

with innovation covariance matrix $E[\varepsilon\varepsilon'] = \Sigma$. The dimensions of Σ and A are $N \times N$, the dimensions of ε and z are $N \times T$. Finally, we also define e_k as the k^{th} column of an identity matrix of the same dimension as A. Table 10 in appendix A.7 reports the VAR-estimates. The top panel uses firm value returns as the measure of financial asset returns, the bottom panel uses the value-weighted stock market return instead.

Once the VAR has been estimated, we can extract the news components that drive the consumption growth innovations: we define innovations in current financial asset returns $\{(a)_t\}$, innovations in current labor income growth $\{(f^y)_t\}$, news about current and future labor income growth $\{(d^y)_t\}$, and news about future financial asset returns $\{(h^a)_t\}$ and human capital returns $\{(h^y)_t\}$:

$$\begin{aligned}
(a)_{t+1} &= r^a_{t+1} - E_t[r^a_{t+1}] = e_1'\varepsilon_{t+1} \\
(f^y)_{t+1} &= \Delta y_{t+1} - E_t[\Delta y_{t+1}] = e_2'\varepsilon_{t+1} \\
(d^y)_{t+1} &= (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j \Delta y_{t+1+j} = e_2'(I - \rho A)^{-1}\varepsilon_{t+1} \\
(h^a)_{t+1} &= (E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j r^a_{t+1+j} = e_1'\rho A(I - \rho A)^{-1}\varepsilon_{t+1} \\
(h^y)_{t+1} &= (E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j r^y_{t+1+j}.
\end{aligned}$$

News about current and future dividend growth is backed out from news about asset returns:

$$(d^d)_{t+1} = (h^a)_{t+1} + (a)_{t+1}.$$

Finally, innovations to consumption are found as:

$$(c)_{t+1} = c_{t+1} - E_t[c_{t+1}] = \Delta c_{t+1} - E_t[\Delta c_{t+1}] = e_7' \varepsilon_{t+1}. \qquad (6)$$

The moments of these innovations will be denoted using $V_{i,j}$ and $Corr_{i,j}$ notation for variances and correlations respectively.

3.3 Stylized Facts

Table 1 summarizes the moments from the data at quarterly frequencies for the full post-war sample (1947.II-2004.III). The left panel uses the firm value returns as the measure of financial asset returns; the right panel uses stock market returns. Our benchmark case, a VAR with 1 lag, is reported in column 1. As a robustness check, we also report results obtained using a 2-lag VAR in column 2 and an annual VAR(1) in column 3.[3] All variances are multiplied by 10,000. Four key stylized facts deserve mention. We focus on column 1 in the discussion.

- Firm value return innovations are about 13 times as volatile as consumption innovations.[4] The standard deviation of news about financial returns is 14% for firm value returns and 16% per annum for stock returns; the same number for consumption is 1.15% per annum (V_a versus V_c). News about future financial returns is also volatile. In annualized terms, the standard deviation is 11% for firm value and 20% for stock returns (V_{h^a}).

- Consumption innovations and return innovations are only weakly correlated: $Corr_{c,a} = 0.17$ for firm value returns and 0.185 for stock returns.

- Current return innovations are negatively correlated with news about future expected returns: there is (multivariate) mean reversion in returns on firm value ($Corr_{a,h^a} = -.48$). Stock returns display even more mean reversion $Corr_{a,h^a}$ is -.92.

- For firm value returns, news about future dividend growth and news about future labor income growth are negatively correlated ($Corr_{d^y,d^d} < 0$) as is news about current labor income growth and current dividend growth ($Corr_{f^y,f^d} < 0$).

The first three facts are well-documented, at least for stock returns; the last one is not. The firm value data indicate that good cash flow news for securities holders (stock and

[3]The signs and relative magnitudes correspond to the ones reported in Campbell (1996) for monthly and annual data.

[4]Our measure of consumption is real per capita non-durables and services consumption. All results go through using total personal consumption. For total consumption V_c is .7 and $Corr_{c,a}$ is 0.1.

bond holders) may not necessarily be good cash flow news for workers. For stock returns these correlations are positive, but surprisingly small.

All of these stylized facts are robust to inclusion of additional forecasting variables in the VAR. They are also robust to different measures of labor income. Our benchmark measure for labor income is real, per capita compensation of all employees from the Bureau of Economic Analysis (Table 2.1 line 2). This measure excludes proprietor's income, but includes wages and salaries to government employees. Table 11 in appendix A.7 uses two alternative measures. In the left column, we use a measure that adds proprietor's income to the BEA labor income measure; in the right column a measure of pay-outs to employees of non-financial corporate businesses. The latter measure is the counterpart to our measure of pay-outs to securities holders of non-financial corporate business. Most moments are virtually unchanged relative to table 1.

[Table 1 about here.]

4 Model 1: Financial Wealth Only

We start by abstracting from non-financial wealth, and we compare the model-implied consumption innovation behavior to aggregate US data. We call the model with only financial wealth *Model 1.* This is a natural starting point, because (1) standard business cycle models imply that the returns on human and other assets are highly or even perfectly correlated (e.g. Baxter & Jermann (1997))[5], and (2) in finance, it is standard practice to consider the stock market return r_t^a a good measure for the market return r_t^m (Black (1987)).

We analyze the moments of the model-implied consumption innovations in (4) with $r^m = r^a$, simply by feeding the actual innovations to financial asset returns and news about future returns into the linearized policy function of our single agent. The procedure delivers a time series for the model-implied consumption innovations. We focus on two moments in particular: the variance of consumption innovations given by:

$$V_c = V_a + (1-\sigma)^2 V_{h^a} + 2(1-\sigma)V_{a,h^a}, \tag{7}$$

and their correlation with innovations to current financial asset returns:

$$V_{c,a} = V_a + (1-\sigma)V_{a,h^a}. \tag{8}$$

[5]The capital and labor dividend streams are perfectly correlated in a Cobb-Douglas production economy in which the entire, random, capital stock process is fixed exogenously (i.e. no investment choice and no depreciation). Even with investment and depreciation, standard business cycle models imply a very high correlation between human wealth and physical capital returns.

4.1 Fails to Match The Variance and Correlation Moments

In the data, the standard deviation of consumption innovations is only 0.58% per quarter, compared to 6.95% per quarter for firm return innovations, and the correlation with return innovations is .17 (see Table 1). Model 1 fails miserably to match either moment *for all values of EIS.* Figure 2 plots the standard deviation of the model-implied consumption innovations in the top panel and their correlation with current firm value return innovations in the bottom panel. In both panels, the *EIS* ranges between 0 and 1.5.

In the log case ($\sigma = 1$), consumption responds one-for-one to current return innovations. The standard deviation of consumption innovations equals the standard deviation of news about current financial returns, which is 6.95% per quarter (see equation 7). The correlation of consumption innovations with financial asset return innovations is 1 (see equation 8).

As the *EIS* decreases below 1, consumption absorbs part of the volatility of shocks to future asset returns V_{h^a}, but the effect on the variance of consumption innovations can be mitigated by the mean-reversion in returns ($V_{h^a,a} < 0$). If $\sigma < 1$, a negative covariance of current and future return innovations also lowers the covariance of consumption with current return innovations: the agent adjusts her consumption by less in response to a positive surprise if the same news lowers her expectation about future asset returns. Indeed, figure 2 illustrates that the mean reversion in returns helps to lower the implied volatility and correlation of consumption innovations somewhat, but not nearly enough. In the bottom panel we see that the correlation goes down as the *EIS* declines below 1, but it never reaches the observed correlation of 0.17. Even if σ is zero - this value of the *EIS* maximizes the effect of the mean reversion on the volatility of consumption innovations and on their correlation with return innovations- Model 1 does not even come to close to matching the moments of the data. The standard deviation of consumption innovations is off by a factor of 10 and the correlation by a factor of almost 4.

Mean reversion in returns actually increases the volatility of consumption if the *EIS* exceeds one; in response to good news, the agent increases his consumption, but this effect is reinforced because the agent anticipates lower returns in the future and decides to save less as a result! As the *EIS* increases beyond the log case, the variance of consumption indeed increases in the top panel. The correlation between consumption and stock market return innovations never falls below 0.9.[6]

[Figure 2 about here.]

If we use stock returns instead of firm value returns, model 1 can match the correlation

[6]There is little evidence for an *EIS* in excess of one. Browning, Hansen, & Heckman (2000) conduct an extensive survey of the consumption literature that estimates the *EIS* off household data; they conclude the consensus estimate is less than one, around .5 for food consumption. The estimates from macro data are much lower. Hall (1988) concludes the *EIS* is close to zero. Vissing-Jorgensen (2002) finds *EIS* estimates of around .3-.4 for stockholders and .8-.9 for bondholders; these are larger than the *IES* estimates for non-asset holders. One exception is **?**, where the *EIS* is estimated to be above one, based on an estimation of an equation similar to (4), they find $\sigma = 1.17$ with standard error 0.47.

moment for $\sigma = 0.2$, because of the large mean-reversion in stock returns (-0.92, see table 1). However, the volatility of consumption innovations is off by the same order of magnitude. Also, the mean reversion of stock returns is lower in the VAR(2) model and at annual frequencies. Figure 8 in the appendix shows Model 1's consumption moments for annual data using stock returns. The implied correlation between consumption and financial asset return innovations never goes below 0.4, twice the value in the data.

We refer to these first two facts, respectively, as the consumption volatility and the consumption correlation puzzle. These are both tied to the lack of a large financial *wealth effect* on aggregate consumption.

This exercise has implications for household consumption data as well: These innovations are also the consumption innovations of an investor with only financial wealth, e.g. a retiree, and high values of the EIS look extremely implausible, if we consider the implied consumption volatility and correlations for this investor.

4.2 Violates Long-Run Restriction

The budget constraint imposes that the revision of expected future consumption growth has to be identical to the revision of expected current and future market returns: $(m)_t + (h^m)_t = (d^c)_t$ (see equation 5). The long-run response of consumption growth can be computed from the VAR, where consumption is the $7th$ element:

$$(d^c)_{t+1} = (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j \Delta c_{t+1+j} = e_7'(I - \rho A)^{-1} \varepsilon_{t+1}.$$

Because the market returns only includes financial assets, $(m) + (h^m)$ equals news about current and future dividend growth, or (d^d). These two objects should be perfectly correlated. However, for *Model 1* at quarterly frequencies, the correlation is negative: -28 for stock returns and -.18 for firm value returns. At annual frequencies, the correlation between these two objects is basically zero: .03 for stock returns and .05 for firm value returns. This would amount to a severe violation of the household budget constraint if the household only had financial wealth. We conclude that the returns on financial wealth do an even worse job of measuring market risk in the long run! The logical next step is to include human wealth into the analysis.

5 Adding Human Wealth

The market portfolio now includes a claim to the entire aggregate labor income stream. The total market return can be decomposed into the return on financial assets R^a and returns on human capital R^y. For log returns, we have:

$$r_{t+1}^m = (1 - \nu_t) r_{t+1}^a + \nu_t r_{t+1}^y, \tag{9}$$

where ν_t is the ratio of human wealth to total wealth.

The innovation to the return on human capital equals the innovation to the expected present discounted value of labor income less the innovation to the present discounted value of future returns. The Campbell (1991) decomposition gives:

$$r_{t+1}^y - E_t[r_{t+1}^y] = (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j \Delta y_{t+1+j} - (E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j r_{t+1+j}^y. \qquad (10)$$

A windfall in human wealth returns is driven by higher expected labor income ("dividend") growth or by lower expected risk premia on human wealth. In the notation of the previous section: $(y)_{t+1} = (d^y)_{t+1} - (h^y)_{t+1}$.

To the econometrician, the process $\{(h^y)\}$ is unobserved, and therefore so is $\{(y)\}$. In section 5.1, we introduce three benchmark models (Models 2, 3, and 4) that make assumptions on $\{(h^y)\}$ to render $\{(y)\}$ observable. Each of these models specifies a h^y process as a particular linear function of the state. We will show that all three imply consumption moments that are at odds with the data. They don't solve the two puzzles illustrated for Model 1 above. Our strategy is to stay within the class of linear models for $\{(h^y)\}$, but to find within this class the $\{(h^y)\}$ process that implies consumption moments consistent with the data.

Campbell (1996) assumes that the human wealth share is constant: $\nu_t = \bar{\nu}$. The constant human wealth share then equals the constant labor income share: $\bar{\nu} = \bar{s}$. Before presenting the results, we generalize the analysis to time-varying wealth shares (section 5.2). The results for constant wealth shares are presented as a special case in section 5.3. We then present the general results in section 5.4.

5.1 Models 2, 3, and 4: Benchmark Models of Expected Human Wealth Returns

Each of the three benchmark models differ only in the $N \times 1$ vector C which measures how the innovations to the expected human wealth returns relate to the state vector z:

$$E_t[r_{t+1}^y] = C' z_t.$$

In *Model 2*, the model of Campbell (1996), expected future human wealth returns are assumed to equal expected future asset returns: $E_t[r_{t+1}^y] = E_t[r_{t+1}^a]$, $\forall t$. Because asset returns are the first element of the VAR, we have $C' = e_1' A$. The second term in equation (10) is $-(h^a)_{t+1}$. In *Model 3*, the model of Shiller (1993), the discount rate on human capital is constant $E_t[r_{t+1}^y] = 0$, $\forall t$, and therefore $C' = 0$. The second term in equation (10) is zero. Finally, in *Model 4*, the model of Jagannathan & Wang (1996), the innovation to human wealth return equals the innovation to the labor income growth rate. The underlying assumptions are that (i) the discount rate on human capital is constant, implying that the second term in equation (10) is zero, and (ii) labor income growth is unpredictable, so that the first term in equation (10) is $\Delta y_{t+1} - E_t \Delta y_{t+1}$. The corresponding vector is $C' = e_2' A$.

Having specified three different models for the expected returns on human wealth, or equivalently a C vector, we immediately obtain a process for $\{(h^y)_t\}$, the innovations to expected future returns on human wealth:

$$(h^y)_t = C' \rho (I - \rho A)^{-1} \varepsilon_t, \tag{11}$$

and a process for $\{(y)_t\}$, the current innovation to the return on human wealth:

$$\begin{aligned} (y)_t &= (d^y)_t - (h^y)_t, \\ &= e_2'(I - \rho A)^{-1} \varepsilon_t - C' \rho (I - \rho A)^{-1} \varepsilon_t. \end{aligned} \tag{12}$$

For example, in the JW model, equation (12) implies that C' needs to equal $e_2' A$ for $(y)_{t+1}$ to equal $\Delta y_{t+1} - E_t \Delta y_{t+1} = e_2' \varepsilon_{t+1}$. We can now back out the moments of the implied aggregate consumption innovations. In the next section, we do this in the context of a model with time-varying wealth shares.

5.2 Incorporating Time-Varying Wealth Shares

Holding the share of human wealth in the market portfolio constant may introduce approximation errors. These errors are small in Campbell's model because the risk premia on the two assets are perfectly correlated. When they are allowed to differ, the errors could be large.

The human wealth share ν_t in equation (9) depends on all the state variables in z: $\nu_t(z_t)$. We first derive a linear expression for the human wealth share, and then show how to compute consumption innovations.

5.2.1 Computing the Human Wealth Share

When the expected return on human wealth is a linear function of the state (with loading vector C), the log dividend-price ratio on human wealth dp^y is also linear in the state. In particular, the demeaned log dividend-price ratio on human wealth is a linear function of the state z with a $N \times 1$ loading vector B:

$$\begin{aligned} dp_t^y - E[dp_t^y] &= E_t \sum_{j=1}^{\infty} \rho^j (r_{t+j}^y - \Delta y_{t+j}) \\ &= \rho (C' - e_2' A)(I - \rho A)^{-1} z_t \equiv B' z_t. \end{aligned} \tag{13}$$

The demeaned log dividend-price ratio on financial assets is also a linear function of the state, because it is simply the third element in the VAR: $dp_t^a - E[dp_t^a] = e_3' z_t$.

The price-dividend ratio for the market is the wealth-consumption ratio; it is a weighted average of the price-dividend ratio for human wealth and for financial wealth:

$$\frac{W}{C}C = \frac{P^y}{Y}Y + \frac{P^a}{D}D.$$

The human wealth to total wealth ratio is given by:

$$\nu_t = \frac{\frac{P^y}{Y}Y}{\frac{W}{C}C} = \frac{e^{-dp_t^y}s_t}{e^{-dp_t^y}s_t + e^{-dp_t^a}(1-s_t)} = \frac{1}{1+e^{x_t}}, \tag{14}$$

which is a logistic function of $x_t = dp_t^y - dp_t^a + \log\left(\frac{1-s_t}{s_t}\right)$, where $dp^y = -\log\left(\frac{P^y}{Y}\right)$. We recall that s denotes the labor income share $s_t = Y_t/C_t$ with mean mean $\bar{s}$. When $dp_t^a = dp_t^y$, the human wealth share equals the labor income share $\nu_t = s_t$. In general, ν_t moves around not only when the labor income share changes, but also when the difference between the log dividend price ratios on human and financial wealth changes. It is increasing in the former, and decreasing in the latter.

In section A.2.2 of the appendix, we derive a linear approximation to the logistic function in (14). The demeaned human wealth share $\tilde{\nu}_t \equiv \nu_t - \bar{\nu} = D'z_t$ is a linear function of the state, with loading vector D given by:

$$D \equiv e_6 - \bar{s}(1-\bar{s})B + \bar{s}(1-\bar{s})e_3. \tag{15}$$

5.2.2 Computing Consumption Innovations

When wealth shares are time-varying the agent considers the effect of (future) changes in the portfolio share of each asset when she adjusts consumption to news about returns. Combining equations (4), (9), and (10), the expression for consumption innovations becomes:

$$\begin{aligned}(c)_{t+1} = (1-\nu_t)(a)_{t+1} + \nu_t(d^y)_{t+1} - \nu_t(h^y)_{t+1} \\ +(1-\sigma)(E_{t+1}-E_t)\sum_{j=1}^{\infty}\rho^j(1-\nu_{t+j})r^a_{t+1+j} \\ +(1-\sigma)(E_{t+1}-E_t)\sum_{j=1}^{\infty}\rho^j\nu_{t+j}r^y_{t+1+j}\end{aligned} \tag{16}$$

Define the news about weighted future financial asset returns and human wealth returns as:

$$\begin{aligned} W^1_{t+1} &= (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j \tilde{\nu}_{t+j} r^a_{t+1+j} \\ W^2_{t+1} &= (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j \tilde{\nu}_{t+j} r^y_{t+1+j}. \end{aligned}$$

Using these definitions, the expression for consumption innovations reduces to:

$$\begin{aligned} (c)_{t+1} = (1 - \bar{\nu} - \tilde{\nu}_t)(a)_{t+1} + (\tilde{\nu}_t + \bar{\nu})(d^y)_{t+1} - (\tilde{\nu}_t + \sigma\bar{\nu})(h^y)_{t+1} \\ +(1-\sigma)(1-\bar{\nu})(h^a)_{t+1} - (1-\sigma)(W^1_{t+1} - W^2_{t+1}). \end{aligned} \tag{17}$$

When the human wealth share is constant ($\nu_t = \bar{\nu}$ or $\tilde{\nu} = 0$), we obtain the simpler expression

$$(c)_{t+1} = (1-\bar{\nu})(a)_{t+1} + \bar{\nu}(d^y)_{t+1} - \sigma\bar{\nu}(h^y)_{t+1} + (1-\sigma)(1-\bar{\nu})(h^a)_{t+1}. \tag{18}$$

Consumption responds one-for-one to news about current asset returns, weighted with the capital income share, and to news about discounted current and future labor income growth, weighted with the labor income share, regardless of the *EIS*. As in *Model 1*, the response to news about future asset returns is governed by $1 - \sigma$. The response to news about future human wealth returns is governed by $-\sigma$. This reflects the direct effect of future human wealth risk premia on consumption and the indirect effect on the current human wealth returns (see equation 10). In the log case ($\sigma = 1$), variation in future returns or in future human wealth shares has no bearing on consumption innovations today. In any other case, our single agent responds to news about future returns weighted by the portfolio shares.

We compute the function W^1_{t+1} and W^2_{t+1}, using value function iteration. Define the news about weighted future asset returns as $\widetilde{W}^1_{t+1} = E_{t+1} \sum_{j=1}^{\infty} \rho^j \tilde{\nu}_{t+j} r^a_{t+1+j}$ and $\widetilde{W}^2_{t+1} = E_{t+1} \sum_{j=1}^{\infty} \rho^j \tilde{\nu}_{t+j} r^y_{t+1+j}$. In section A.2.3 of the appendix we exploit the recursive structure of $\widetilde{W}^1$ and the linearity of the human wealth share to show that $\widetilde{W}^1$ can be stated as a quadratic function of the state:

$$\widetilde{W}^1_{t+1}(z_{t+1}) = z'_{t+1} P z_{t+1} + d,$$

where P solves the matrix Sylvester equation

$$P_{j+1} = R + \rho A' P_j A. \tag{19}$$

We solve this equation by iteration, starting from $P_0 = 0$, and $R = \rho D e'_1 A$. The constant d

in the value function equals $d = \frac{\rho}{1-\rho} tr(P\Sigma)$. This also implies that the news about future returns is a quadratic function of the VAR innovations and the matrix P:

$$W^1(z_{t+1}) = (E_{t+1} - E_t)\widetilde{W}^1_{t+1}(z_{t+1}) = \varepsilon'_{t+1} P \varepsilon_{t+1} - \sum_{i=1}^{N}\sum_{j=1}^{N} \Sigma_{ij} P_{ij}.$$

which turns out to be a simple quadratic function of the VAR shocks, their covariance matrix Σ, and the matrix P. In the same manner we calculate $\widetilde{W}^2$ and W^2, replacing R in equation (19) by $\rho DC'$.

5.3 Results With Constant Wealth Shares

To gain intuition, we first shut down the time-variation in the human wealth share and estimate equation (18) for the three benchmark models. As was the case for *Model 1*, *Models 2, 3, & 4* cannot match the low volatility of consumption innovations and their low correlation with financial asset return innovations. To understand the problem, we must study these models' implications for human wealth returns. One particularly useful way is to reverse the logic and to impute the part of actual innovations in consumption that is not due to news about financial returns or labor income growth, to news about future human wealth returns. We fix a value for the *EIS* parameter σ and back out the innovations to future human capital returns that are implied by the observed aggregate consumption innovations. The moments of consumption are matched by construction. We can now trace back the failure of the benchmark models to the difference in the moments of human wealth returns they imply and the moments that are consistent with consumption data. Our main finding is that the data require that good news for current financial wealth returns is bad news for current human wealth returns. The benchmark models imply a positive correlation instead.

Table 2 summarizes the moments of consumption and human capital return innovations for quarterly data, and for a calibration with constant human wealth share $\bar{\nu} = \bar{s} = .70$, and *EIS* of $\sigma = .28$. The left panel reports the results using firm value returns; the right panel is for stock returns. Columns 1-3 in each panel report the properties of human wealth returns and consumption for *Model 2* (Campbell (1996)), *Model 3* (Shiller (1993)), and *Model 4* (Jagannathan & Wang (1996)).

[Table 2 about here.]

Because it equates expected future human wealth and financial wealth returns, *Model 2* sets: $V_{h^y} = V_{h^a}$, $Corr_{a,h^y} = Corr_{a,h^a}$, $Corr_{d^y,h^y} = Corr_{d^y,h^a}$, $Corr_{h^a,h^y} = 1$. To understand the implications of these assumptions on the model-implied variance of consumption V_c and the covariance between consumption and financial asset return innovations $V_{c,a}$, table 3 lists the sign of the effect of each variable's variance and all covariances on V_c and $V_{c,a}$. For example, a positive $(4,4)$ entry in the top panel means that a higher V_{h^y} implies a higher V_c. Indeed, for *Model 2*, the news about future expected returns on human capital is very volatile; as volatile as the news about financial returns. This volatility is one contributing factor to the high variance of consumption. The negative $(1,4)$ entries in the top and bottom panels show that $Corr_{a,h^y}$ has a negative effect on V_c and $Corr_{c,a}$. But since *Model 2* sets it equal to $Corr_{a,h^a}$, the mean reversion in the financial return data acts to increase the variance of consumption innovations and the correlation of financial return innovations and consumption innovations. Intuitively, when good news in the stock market also leads to lower future risk premia on human wealth, positive consumption responses are magnified. Likewise, $Corr_{d^y,h^y}$ negatively affects V_c and $Corr_{c,a}$, but because h^a and d^y are negatively correlated in the data, the assumption $Corr_{d^y,h^y} = Corr_{d^y,h^a}$ again increases V_c and $Corr_{c,a}$. The only assumption that helps to reduce the variance of consumption and the correlation with financial asset returns is $Corr_{h^a,h^y} = 1$. The net result is that aggregate consumption innovations in *Model 2* are much too volatile (by a factor of 4.3 in panel A and 4.8 in panel B) and much too highly correlated with return innovations (by a factor of 5.6 in panel A and 5.2 in panel B).

[Table 3 about here.]

We expect *Model 3* to do better by assuming a constant discount rate for human capital, because this implies that $V_{h^y} = Corr_{a,h^y} = Corr_{d^y,h^y} = Corr_{a,h^y} = 0$, all of which help to lower the variance and correlation moment compared to *Model 2*. Indeed, the variance of consumption is 4.30 per quarter and the correlation moment is .865, lower than the 6.05 and .946 of *Model 2*. However, they are still far way from the observed magnitudes. When we use stock returns instead of the returns on firm value (panel B), the predicted correlation of innovations in consumption decreases to 0.518, because stock market returns display more mean reversion. The variance of consumption news is still off by an order of magnitude, and the correlation by a factor of 2.8.

Model 4 further improves the results. News in future human wealth returns equals news in future labor income growth. This means $V_{h^y} \approx V_{d^y}$.[7] In the data, news in future labor income growth is not very volatile, especially compared to news in future financial asset returns. Also $Corr_{h^y,a} \approx Corr_{d^y,a} > 0$, a good assumption, because we know from table 3 that $Corr_{h^y,a} > 0$ helps to lower the volatility and correlation of consumption innovations when the IES is smaller than one. Yet, quantitatively, these correlations are too small in absolute magnitude to improve on *Model 3*.

The variance of innovations to current human wealth returns (V_y) and their correlation with financial asset returns ($Corr_{y,a}$) are good summary statistics of our findings. *Model 2* model does worse than the other two because the high volatility of human capital returns and their high correlation with innovations in financial asset returns impute too much volatility to consumption. The difference in the correlation moment is especially stark

[7]More precisely: $V_{h^y} = V[(E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j \Delta y_{t+1+j}]$. Note that $(E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j \Delta y_{t+1+j} \neq d^y$ because of the summation index that starts at 1 instead of 0.

using stock returns (panel B): $Corr_{y,a} = .93$ for *Model 2*, 0.49 for *Model 3*, and 0.07 for *Model 4*.

The same exercise using annual data produces similar results; the discrepancy between the model and the data increases at annual frequencies because the mean reversion in stock returns decreases. The lowest standard deviation for consumption news is 3.74% for *Model 4*, compared to .80 % in the data. The results are in Table 12 in appendix A.7.

Varying the IES and the Labor Income Share These results are robust to plausible changes in parameter values. Figure 9 in appendix A.7 plots the model-implied standard deviation of consumption innovations and the correlation of consumption innovations with innovations in financial market returns for different values of σ (the labor share $\bar{\nu}$ is .70). None of the models comes close to matching the variance and correlation, even for very low σ. Figure 10 in appendix A.7 shows that a labor income share of close to 1 is needed to match both consumption moments. For example, an increase in the average labor income share from 0.70 to .85 brings the standard deviation of consumption in *Model 4* down to 2.3 times its value in the data; the correlation is still much too high (0.78).

Consumption-Consistent Human Wealth Returns Sofar we have been unable to bring the model's moments closer to matching those in the data. We now treat the expected returns component of human wealth return innovations as a residual and we reverse-engineer a human wealth return process that can match the consumption data. We recall from equation 6 that innovations in current consumption growth can be recovered from the VAR residuals. Plugging these consumption innovations back in the household's linear policy rule (18), we can back out the implied news in future human capital returns:

$$(h^y)_{t+1} \equiv \frac{1}{\sigma\bar{\nu}}\left[(1-\bar{\nu})(a)_{t+1} + \bar{\nu}(d^y)_{t+1} + (1-\sigma)(1-\bar{\nu})(h^a)_{t+1} - (c)_{t+1}\right]. \tag{20}$$

From this (h^y) and the data on labor income growth, we form innovations in current human wealth returns $(y)_{t+1} = (d^y)_{t+1} - (h^y)_{t+1}$.

The fourth column of each panel of Table 2 reports the properties of human wealth returns implied by consumption data and the baseline parameter calibration $\bar{\nu} = .70$ and $\sigma = .28$ (label *Reverse*). In panel A, the implied variance of shocks to expected future returns on human wealth V_{h^y} is very high (107.4), its correlation with current asset return innovations $Corr_{a,h^y}$ is large and positive (.84), its correlation with innovations to future labor income growth $Corr_{h^y,d^y}$ is positive (.32), and its correlation with news in future returns $Corr_{h^a,h^y}$ is negative ($-.04$). Good news about expected future financial market returns implies bad news about future expected human wealth returns. This correlation structure implies that innovations in current financial asset and human wealth returns are **negatively** correlated; $\mathbf{Corr_{y,a} < 0}$ is the main finding of the paper. Intuitively, if good news in the stock market coincides with higher future risk premia on human wealth

($Corr_{a,h^y} > 0$) and lower expected future labor income growth ($Corr_{a,d^y} < 0$), the innovation to the current human wealth returns will be negative ($Corr_{a,y} < 0$), offsetting the effect of good news in the stock market on consumption. This is the only way to match the low volatility of consumption innovations and their low correlation with financial asset return innovations. In the data we found $Corr_{a,d^y} > 0$ instead (around 0.4), which works against a low consumption variance and a low correlation between (c) and (a). The correlation between financial asset return innovations and future risk premia on human wealth must then be high enough to dampen the cash-flow effect ($Corr_{a,h^y} = .84$).

The negative correlations between *current* and *future* human wealth and financial wealth return innovations are robust: regardless of the *EIS* and the labor income share, $Corr_{a,y} < 0$ and $Corr_{h^y,h^a} < 0$. Both correlations become more negative for larger σ. Looking back at the three benchmark models, only *Model 4* has the same correlation pattern for h^y as in column *Reverse*: $Corr_{a,h^y}$ and $Corr_{h^y,d^y}$ are positive and $Corr_{h^a,h^y}$ is negative, but none of them imply $Corr_{a,y} < 0$.

For the benchmark parameters and firm value returns, innovations to current and future human wealth returns V_y and V_{h^y} are highly volatile, 1.4 and 1.8 times as volatile as the innovations to current and future financial asset returns respectively. If we use stock returns instead, human wealth returns are less volatile because stock returns are more strongly mean reverting. The volatility proportionality factors are .85 and .75. Also, the implied volatility of human wealth returns declines with the *EIS*. For $\sigma = .73$ and firm value returns, $V_y = 14.5$, half as volatile as financial return innovations. In the next section we report more detailed comparative statics with respect to the *EIS*.

The Return on the Market Portfolio In the model with constant wealth shares, innovations in the current market return are $(m)_{t+1} = (1-\bar{\nu})(a)_{t+1} + \bar{\nu}(y)_{t+1}$ and news in future market returns are given by $(h^m)_{t+1} = (1-\bar{\nu})(h^a)_{t+1} + \bar{\nu}(h^y)_{t+1}$ (see equation 9). The bottom four rows of table 2 display the moments of the market return.

In the three benchmark models, innovations in the market return are positively correlated with innovations in financial asset returns and human wealth returns. In contrast, in column *Reverse*, good news in financial markets is bad news for the market return $Corr_{m,a} < 0$. The reason of course is that $Corr_{y,a} < 0$ and human wealth represents 70% of the market portfolio. The consumption-consistent market return is strongly positively correlated with human wealth returns and negatively correlated with firm value returns. In panel B, where we use stock returns instead, $Corr_{m,a}$ is slightly positive. In both cases, the market return is strongly mean reverting $Corr_{m,a} < -.99$. This can be traced back to the mean reversion in human wealth returns ($Corr_{y,h^y} = -.90$ or lower) and the mean reversion in financial asset returns (Table 1). We find the same results for annual data (Table 12 in appendix A.7). The only difference is that $Corr_{m,a}$ is now also negative for stock returns!

5.4 Results with Time-Varying Wealth Shares

In this section, we show that the previous results are preserved when the human wealth share moves over time (as described in section 5.2). We briefly revisit the three benchmark models, and show that accounting for time-varying wealth shares does not help much. Then, we estimate the vector C, which determines expected returns on human wealth, that most closely matches the moments of consumption. As before, the resulting human wealth returns are negatively correlated with financial asset returns.

Figure 3 plots the human wealth share over time for the three benchmark models, alongside the labor income share. *Models 3 & 4* imply quite some variation in the human wealth share, because the risk premia on human wealth and financial wealth are not correlated; e.g. in the 90's, the human wealth share is very low, while it is much higher in the 80's. In *Model 1*, the human wealth share follows the exact opposite pattern.

[Figure 3 about here.]

Columns 1-3 of Table 4 report the model-implied moments of consumption, human wealth returns and the market return for the three benchmark models. The table has the same structure as Table 2, but switches on time-varying wealth shares. As is clear from equations (11) and (12), the processes for news in future and current human wealth returns only depend on the vector C, and not the human wealth share (vector D). Since C is fixed for the benchmark models, the first seven rows of Table 4 are identical to the first seven rows of Table 2.[8] Model implied consumption innovations, specified in equation (17), do depend on the wealth shares. Rows 8 and 9 show that allowing for time-varying human wealth shares does not help to bring the benchmark models' consumption moments closer to the data. In panel A (firm value returns), V_c and $Corr_{c,a}$ are slightly lower, but in panel B V_c is slightly higher. As before, the reason is that all three models imply a high correlation between financial asset returns and the market return (row 11). Because financial market returns are so volatile, consumption ends up too volatile and too highly correlated with financial asset returns.

[Table 4 about here.]

Model 5: Consumption Growth Accounting As we did in section 5.3, we now ask what properties human wealth returns must have to imply consumption moments consistent with the data. When human wealth shares vary over time, the procedure of backing out those properties directly from consumption data (equation 20) is no longer available. Instead, we choose the vector C, which relates the expected return on human

[8] In *Model 2*, the conditional moments of future asset returns and human wealth returns are identical. As a result, $(h^y)_t = (h^a)_t$, which implies $W_t^1 - W_t^2 = 0$ for all t. The latter can be shown by applying the law of iterated expectations. In *Model 3*, $h^y = 0$ and $W_t^2 = 0$. In *Model 4* model, $W_2 = (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j \tilde{\nu}_{t+j} \Delta y_{t+1+j}$.

wealth to the state vector, $E_t[r^y_{t+1}] = C'z_t$, to minimize the distance between the model-implied consumption volatility and correlation moments and the same moments in the data. This vector then delivers human wealth return processes $\{h^y_t\}$ and $\{y_t\}$ from equations (11) and (12). Once we pinned down the vector C, we can also solve for the human wealth share from equations (13) and (15). For a given value of the *EIS*, equation (17) delivers the consumption innovations. We form the volatility of model-implied consumption innovations, and their correlation with financial asset return innovations.[9] We label the resulting model *Model 5*; its moments are reported in the fourth column of Table 4 for $\sigma = .28$.

Whereas time-varying wealth shares did not change the results for *Models 2, 3, & 4* much, the results for *Model 5* are somewhat different from the ones in column *Reverse* of Table 2. Time-variation in the human wealth share allows the model to match the moments of consumption (rows 8 and 9) for human wealth returns that are twenty percent less volatile in panels A and B. As a result, the market return processes are much less volatile as well. When the dividend yield on human wealth increases relative to the dividend yield on financial wealth, future returns on human wealth are predicted to be higher than future returns on financial wealth. But, this is counteracted by the lower human wealth share (ν_t decreases in $dp^y_t - dp^a_t$). Time variation in the human wealth share acts to reduce the volatility of the market return, and hence consumption. Figure 4 plots the model-implied human wealth share at the optimal parameter values, alongside the observed labor income share. The human wealth share is more than twice as volatile as the labor income share.

[Figure 4 about here.]

The main findings are further strengthened: The consumption-consistent human wealth return process is consistently negatively correlated with financial asset returns ($Corr_{h^y,h^a} < 0$ and especially $Corr_{y,a} < 0$). Good news on Wall street is bad news on Main street. These correlations are more negative than with constant wealth shares. Figure 5 plots the innovations in current asset returns $(a)_t$ and the innovations in current human wealth returns $(y)_t$. The two are strongly negatively correlated.

[Figure 5 about here.]

Long Run Restriction Introducing human wealth dramatically improves the match between the long-run response of consumption growth and the market return, compared to the no human wealth benchmark. We recall that in *Model 1* with financial wealth only, the correlation between $(d^c)_t$ and $(m)_t + (h^m)_t$ was negative for quarterly data and zero for annual data (see equation 5). For *Model 5*, the correlation between $(m)_t + (h^m)_t$ and $(d^c)_t$

[9] We use a non-linear least squares algorithm to find the vector C that minimizes the distance between the two model-implied and the two observed consumption moments. Because the moments are highly non-linear in the $N \times 1$ vector C, we cannot rule out that the C vector is not uniquely identified.

is .11 for firm value returns and .12 for stock returns in quarterly data, but the market response is about twice as volatile. This correlation is .39 at annual frequencies for firm value returns and .36 for stock returns over the 1947-2004 sample and even .69 for stock returns over the 1930-2004 sample (see figure 6). So, bringing in human wealth delivers a much better measure of long run risk, but we cannot completely eliminate the excess volatility of market returns in the long run.

[Figure 6 about here.]

Varying the *EIS* In Table 13 in appendix A.7, we investigate the sensitivity of the results to the choice of the *EIS* parameter σ. Reading across the columns, for each of the calibrations, we get a strong negative correlations between news about current and future financial and human wealth returns, as well as high and positive correlations $Corr_{a,h^y}$ and $Corr_{y,h^a}$. Good news about current financial asset returns raises risk premia on future human wealth returns and good news about current human wealth returns increases future risk premia on financial assets. These features enable *Model 5* to match the smooth consumption series and its low correlation with financial asset returns (rows 8 and 9). The volatility of human wealth returns decreases in σ; V_{h^y} and V_y are much lower than in Table for $\sigma = .28$.

What also changes across the columns are the properties of the market return. The correlation between innovations in the market return and innovations in the human wealth returns is 0.9 in the case of $\sigma = .5$ (column 1, row 12), whereas the correlation with innovations in financial asset returns is -.7 (row 11). The implied market returns are strongly mean-reverting, as shown by the correlation between m and h^m of -.95 (row 13). In column 2, $\sigma = 1$ and the consumption innovation equation (16) specializes to:

$$(c)_{t+1} = (1 - \nu_t)(a)_{t+1} + \nu_t(d^y)_{t+1} - \nu_t(h^y)_{t+1} = (1 - \nu_t)(a)_{t+1} + \nu_t(y)_{t+1} = (m)_t.$$

Indeed, we find that $V_c = V_a$ and $V_{c,a} = V_{m,a}$. When the agent is myopic, her consumption responds one-for-one to innovations in the market return.

In the more-than-log case ($\sigma = 1.5$ in column 3), the market return must displays mean aversion to match the consumption moments ($V_{m,h^m} > 0$). The algorithm accomplishes this by choosing a human wealth return process that implies large enough positive correlations $Corr_{a,h^y}$ and $Corr_{y,h^a}$ to overcome the mean reversion in financial asset returns and human wealth returns ($V_{a,h^a} < 0$ and $V_{y,h^y} < 0$). As σ increases, the negative correlation between future expected financial and human wealth returns needs to be larger in absolute value, implying in turn a more positive correlation between y and h^a. Intuitively, as the agent becomes more willing to substitute over time, only an increase in human wealth risk premia can prevent him from consuming more when risk premia on financial returns go down.

Robustness: Different Income Measures Our results are robust to including proprietor's income in the income measure and to excluding government and non-financial employees' wages (recall Table 11 in appendix A.7 for the moments of the data). The left column of table 14 shows the moments for (h^y) when proprietor's income is included in labor income. The right panel shows the moments for h^y using pay-outs to employees in the non-government non-financial sector. The financial asset returns are the returns on the total firm value. The main difference with our previous results is that innovations in current human wealth returns need only be about half as volatile for a given level of σ: $V_y = 22$ and 15 respectively versus $V_y = 61$ in the benchmark model, much less variable than financial asset return innovations: $V_a = 48.3$. The reason is that the average labor income share is much higher than in the benchmark case ($\bar{\nu} = .92$ in the left column and .84 in the right column compared to 0.73 in Table 4). A higher average human wealth share requires less volatility in human wealth returns to offset a given volatility in financial asset returns. Interestingly, a higher labor income share also lines up the long-run responses of consumption and the market return better.

6 The Consumption-Consistent CAPM

This section examines the time-series and cross-sectional asset pricing implications of using model-implied instead of actual consumption: For each model, we impose additional discipline by insisting on using the consumption innovations implied by the model. Only in our reverse-engineered model do these coincide exactly with those in the data.

6.1 Time-Series Properties of the SDF

Each of the models we considered implies a different time series for consumption innovations and the market return, and hence a different stochastic discount factor M:

$$M_{t+1} = \beta \exp\left(\frac{-\theta}{\sigma}\Delta c_{t+1} + (\theta - 1) r^m_{t+1}\right)$$

We compute the stochastic discount factor for each model and study the moments of the Euler equation errors for asset i

$$error^i_{t+1} = M_{t+1} \exp\left(r^i_{t+1}\right) - 1,$$

where r^i is either the real log gross return on the value-weighted CRSP stock market portfolio (r^s) or the real log gross return on a 3-month T-bill (r^f). Table 5 compares Euler equation errors across the different models presented in the previous section. The first column is *Model 1*, the model with financial wealth only $\nu_t = 0$. The market return is simply the financial asset return. The second and third columns are *Model 2 without* and *with* time-varying human wealth share. Columns four and five report *Model 3 without* and *with* time-varying human wealth share. Likewise, columns six and seven are for *Model 4* model, and the last two columns are for our model. Column 8 is our model with constant human wealth shares (in column 8, *Reverse*): here we use actual consumption data to back out a process for h^y.[10] For our model with time-varying wealth shares (last column), we choose the optimal vector C to match the variance of consumption innovations, the correlation of consumption innovations with financial asset return innovations, as well as the correlation between consumption innovations in the model and in the data.[11]

In all models, the financial asset return is the firm value return, and we consider two values for the *EIS*: $\sigma = .28$ (our benchmark) and $\sigma = 1.12$ (the value proposed by Vissing-Jorgensen & Attanasio (2003)). For each of these models, we find the value for γ that minimizes the root mean squared pricing error on the stock return and the risk-free rate. This value is reported in the first row of table 5. Clearly, the volatility of consumption growth is most volatile in *Model 1* without human wealth and, it declines monotonically from left to right. Not surprisingly, the value for γ increases from left to right, and it is highest in our two models (last two columns).

We start with the benchmark case of low EIS. In the reverse-engineered model (*Reverse*), consumption growth is identical to observed consumption growth, and the market return process, is the one implied by actual consumption. For that model, we find $\gamma = 11.64$. The return on stocks is predicted to be 60 basis points too low; i.e. 1.30% per quarter instead of the observed 1.90% per quarter. The risk-free rate error is 44 basis points; it is predicted to be 0.65% per quarter instead of 0.21% per quarter. While the model makes progress on the equity premium and the risk-free rate puzzle, it does not resolve it. For comparison, the pricing errors in Campbell's model (*Model 1* in first column) are only half the size, but the consumption process is about 5 times too volatile.

In the case of a high EIS, the pricing errors are much larger, except in *Model 5*, the model with time-varying wealth shares and human wealth discount rates chosen to match the actual consumption data. This case is very close to the general equilibrium model considered by Bansal & Yaron (2004), and, reassuringly, our model with time-varying wealth shares and a model-consistent market return replicates their results: it comes close to matching the risk-free rate and the equity premium rather well for γ of only seven, but, as will become apparent in the next section, this mean-averting market return fails in the cross-section.

[Table 5 about here.]

[10]In this procedure, we back out h^y from consumption data (equation 20). We form innovations in current human wealth returns from $y = d^y - h^y$. To form realized market returns $r^m = (1-\nu)r^a + \nu r^y$, we need realized human wealth returns r^y. Realized human wealth returns are the sum of innovations in current human wealth returns y and expected human wealth returns. Since this procedure does not identify expected human wealth returns, we assume that they are the same as in *Model 4*, the model the closest to ours. This choice does not affect the RMSE in column 7.

[11]The matching exercise is successful in that it yields a model-implied consumption growth process that has a correlation of 0.87 with consumption growth in the data. The downside is that consumption is now 3 times too volatile.

6.2 Cross-Section of Size and Value Portfolios

We start from the linearized Euler equation for asset i:

$$E_t r^i_{t+1} - r^f_t + \frac{V_{ii}}{2} = \frac{\theta}{\sigma} V_{ic} + (1-\theta) V_{im} \tag{21}$$

$$= \gamma V_{im} + (\gamma - 1) V_{ih^m} \tag{22}$$

In an Epstein-Zin asset pricing model, the expected excess return (corrected for one-half its variance) is determined by two risk factors: the covariance of return i with aggregate consumption growth V_{ic} and the covariance of return i with the market return V_{im} (equation 22). Campbell (1993) substitutes out consumption, replacing V_{ic} by $V_{im} + (1-\sigma)V_{ih^m}$, which leads to asset pricing equation (22). We have argued that the consumption processes in the three canonical models are very different from the observed consumption process. This will lead to a market return process, different from the one in our consumption-consistent model. Therefore, we stay with equation (21), and evaluate the performance of the three canonical models and our model in pricing the cross-section of stock returns.

Taking unconditional expectations of (21) delivers an unconditional asset pricing equation. Following Campbell, we define the excess returns on I assets $er^i_{t+1} = r^i_{t+1} - r^f_t$ with unconditional means μ_i. Both vectors have dimension $I \times 1$. We define demeaned returns $\eta^i_{t+1} \equiv er^i_{t+1} - \mu^i$. We estimate the market prices of risk, λ_k off the ex-post version of equation (21). The factor risk prices λ_c and λ_m depend on the coefficient of relative risk aversion γ and the intertemporal elasticity of substitution σ. We implement a Fama-MacBeth procedure (Fama & MacBeth (1973)): in the first stage we estimate the factor loadings β_{ic} and β_{im} for each of the 25 size and value portfolios from a time-series regression of the log excess returns on model-implied consumption growth and market return. In the second stage, we estimate the market prices of risk from a cross-sectional regression of variance-adjusted mean log excess returns on the factor betas from the first stage.

[Table 6 about here.]

The first two columns of Table 6 show the expected return and the expected return with a variance correction for the 25 size and book-to-market decile portfolios (quarterly data for 1947.II-2004.III from Kenneth French). Low book-to-market (growth) firms have lower average returns than high book-to-market (value) firms and small firms have higher average returns than large firms. The next two columns report our model's predicted adjusted return and the pricing error; the part of the return that is not explained by sample covariances with the factors and the sample estimates of the risk prices. The last three columns report the risk contribution to the expected excess return of each asset; the first one of which is the market price of risk on a constant (λ_0, $\lambda_c \times \beta_{ic}$ and $\lambda_m \times \beta_{im}$). We use the consumption measure and the market return measure of our model with time-varying human wealth share and the optimal vector C, i.e. the one that is consistent with aggregate consumption moments, for σ equal to .28. In all models, the financial asset return is the firm value return.

Our model does a reasonable job accounting for the value spread. In each size quintile, growth firms (B1) are predicted to give a lower return than value firms (B5), and just as in the data the value premium is stronger for small firms. To measure the pure value effect, we use book-to-market *decile* returns instead. Our model predicts a value spread of 1.1% per quarter, whereas in the data the spread is 1.4%.

There is an interesting cross-sectional pattern in the betas of the book-to-market decile returns with β_{im} and β_{ih}. The top panel of figure 7 shows that growth firms are more exposed to consumption risk than value firms (the second number in the horizontal axis index denotes the book-to-market quintile, 11 is small growth, 15 is small value). The bottom panel shows that growth firms form a better hedge against future market risk than value firms. This is confirmed in the last two columns of Table 6, which show that the risk contribution of the market factor is much lower for growth firms than for value firms.

[Figure 7 about here.]

For the low *EIS* case, Panel A in table 7 compares the estimates for the market prices of risk and their standard errors, the root mean-squared pricing error and the cross-section R^2 from the second stage of the Fama-MacBeth procedure across models. Each of the 9 columns denotes a different model, each with a different implied consumption growth and market return process. These are the same models as in 5.

[Table 7 about here.]

The market price of risk on the market return is positive and significant in our model, but it is negative in the model without human wealth and the three benchmark models with human wealth: 12 in *Model 5* versus -2.2, -3.1, -.7, and -.7 in columns *Model 1*, *Model 2*, *Model 3*, and *Model 4* respectively. Our models (last two columns) are the only one that deliver positive market prices of risk on both risk factors[12]. All other models imply that growth firms are exposed to more market risk than value firms, whereas the opposite is true when the market return is consistent with consumption data. Among the models with constant wealth shares, our model (column 8) has the lowest root mean-squared pricing error (RMSE is 0.7% per quarter) and the highest cross-sectional R^2 (65%). Among the models with time-varying wealth shares, our model also delivers the lowest RMSE. *Model 4*, whose market return process shares many of the features of our market return process, also prices the 25 Fama-French portfolios reasonably well ($R^2 = 45\%$). One failure of all models, is that the intercept λ_0 remains statistically different from zero.

The second panel in table 7 shows the asset pricing results for $\sigma = 1.12$, the value of the *EIS* estimated by Vissing-Jorgensen & Attanasio (2003) for stockholders. The market

[12]The market price of consumption risk should be positive according to the theory if $\gamma > 1$, because $1/\sigma > 1$.

price of risk is no longer significant for *Model 5* (last two columns) and the R^2 is much lower. While this model almost matched the risk-free rate and the equity premium, it cannot explain any of the cross-sectional variation in asset returns.

We conclude that the omission of human wealth returns in the calculation of the market return is significant for the CAPM's ability to explain the cross-section of stock returns. When human wealth returns are made consistent with observed consumption, an interesting pattern arises in firm's exposures to market returns: growth firms have lower risk premia because they provide a better hedge against market risk, and human capital risk is priced.

7 Other Explanations

The previous analysis attributed to human wealth returns the part of consumption innovations that could not be explained by financial wealth return innovations. In this section, we consider three potential explanations for the lack of correlation and the volatility puzzle. All three amount to richer versions of Model 1 with financial wealth only. We find that the usual fixes do not resolve the puzzle we are interested in.

First, we consider heteroscedastic returns on financial assets, and we develop a way of testing whether this effect drives our results. We find it does not. Second, we consider the effect of habit-style preferences. We rule out standard habits because, when reasonably specified, they cannot lower the correlation between consumption innovations and returns. Third, we consider heterogeneity across households. We argue this would only make the puzzle worse.

In addition, we consider a potential criticism of a different nature; that the human wealth return residual may proxy for housing wealth. We add housing wealth to the model, and find that the residual has very much the same properties as in the model without it.

7.1 Heteroscedastic Market Returns

Sofar we have abstracted from time-variation in the joint distribution of consumption growth and returns. In particular, we worry about time-varying variances (and covariances) in consumption growth and the market return. This is important, because recently Duffee (2005) found some evidence of time-variation in the covariance between stock returns and consumption growth. We denote the conditional variance term by μ_t^m. In this case, a third source of consumption innovations arises (equation (38) in Campbell (1993)), which reflects the influence of changing risk on the household's saving decisions:

$$\begin{aligned} c_{t+1} - E_t c_{t+1} = r_{t+1}^m - E_t r_{t+1}^m + (1-\sigma)(E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j r_{t+1+j}^m \\ -(E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j \mu_{t+1+j}^m, \end{aligned}$$

where $\mu_t^m = \sigma \log \beta + .5 \left(\frac{\theta}{\sigma}\right) Var_t[\Delta c_{t+1} - \sigma r_{t+1}^m]$. Campbell shows this last term drops out if either γ or σ are one. We refer to this last term as news about future variances, h^{μ}[13]. If this time-variation plays a role, our consumption growth accounting residual should *predict* the future variance of stock market returns, and/or the future variance of consumption and/or the conditional covariance between the two. So, we check whether the residual $(h^y)_t$ that comes out of our model with time-varying human wealth shares predicts $Var_t[\Delta c_{t+1} - \sigma r_{t+1}^m]$. We find that it does not.

More precisely, from the VAR innovations we construct the conditional variance of financial asset returns:

$$V_t^a \equiv V_t[r_{t+1}^a] = e_1' A z_t z_t' A' e_1 + e_1' \Sigma e_1,$$
$$V_t^c \equiv V_t[\Delta c_{t+1}] = e_7' A z_t z_t' A' e_7 + e_7' \Sigma e_7,$$
$$V_t^{a,c} \equiv Cov_t[\Delta c_{t+1}, r_{t+1}^a] = e_1' A z_t z_t' A' e_7 + e_1' \Sigma e_7.$$

We then regress $\sum_{j=1}^{H} \rho^h (V_{t+j}^c + \sigma^2 V_{t+j}^a - 2\sigma V_{t+j}^{c,a})$ on $(h^y)_t$. We vary j from 1 to 24 quarters. Using firm value returns, the regression coefficient is never statistically significant (we use Newey-West standard errors), and the R^2 of the regression never exceeds 1%. We only find statistical significance at the 10% level for $\sigma = .28$ when financial asset returns are stock returns and only for horizons beyond 12 quarters. However, the R^2 never exceeds 3%, and the marginal significance disappears for higher σ. We conclude that there is very weak evidence that our residual proxies for heteroscedasticity in returns and consumption growth.

7.2 Habits

Second, we consider the possibility that habit formation in the household's preferences is responsible for the discrepancy between consumption innovation moments in the model and the data. If the log surplus consumption ratio follows an AR (1) with coefficient $0 < \phi < 1$ and a constant sensitivity parameter[14] $\lambda > 0$ that multiplies the consumption growth innovations, then news about consumption is given by:

$$c_{t+1} - E_t c_{t+1} = \frac{1 - \phi\rho}{1 - \phi\rho + \lambda\rho(\phi - 1)} \left\{ \begin{array}{c} (r_{m,t+1} - E_t r_{m,t+1}) + \\ (1 - \sigma)(E_{t+1} - E_t) \sum_{j=1} \rho^j r_{m,t+j+1} \end{array} \right\}$$

[13] Assume we are in the plausible parameter range: $\gamma > 1$ and $\sigma < 1$. In this case, the last term can only resolve the *correlation puzzle* if $V_{m,h^{\mu}}$ is strongly positive -good news in the stock market today persistently increases the conditional volatility of future financial returns or consumption innovations or decreases their conditional correlation.

[14] We fix the sensitivity parameter, because we check for heteroscedasticity separately.

See appendix section A.3 for the derivation. The implied covariance between consumption innovations and return innovations is:

$$V_{c,m} = \frac{1-\phi\rho}{1-\phi\rho+\lambda\rho(\phi-1)} \left(V_{m,m} + (1-\sigma)V_{m,h^m} \right).$$

Clearly, the habit cannot fix the correlation puzzle because $\phi < 1$, which makes the first term larger than 1. Rather, the puzzle in a model with habits is even larger.

7.3 Heterogeneity

Finally, allowing for heterogeneity across agents might even make these puzzles worse. When households have the same EIS, and if each household's Euler equation is satisfied, aggregation reproduces exactly equation (4) for aggregate consumption innovations under fairly mild conditions, described in section A.4 of the appendix. All the previous results go through trivially.

However, if household wealth and the EIS are positively correlated, then the aggregate EIS that shows up in the aggregate consumption innovation expression exceeds the average EIS across households. Vissing-Jorgensen (2002) indeed finds higher *EIS* for wealthier stock- and bond-holders. A higher aggregate *IES* worsens the consumption volatility and correlation puzzles.

Two Agents To illustrate this with a simple example, consider an economy with two agents. Both face the same aggregate state variables. The first agent holds all human wealth, and the second agent holds all financial wealth. We compute the model-implied consumption innovations for each. Aggregate consumption innovations are the weighted sum of the two individual innovations, weighted by the wealth shares. For comparison with table 2, we hold the human wealth share fixed at .70. If both agents have a $\sigma = .28$, the aggregate consumption moments for the benchmark models are exactly as reported in rows 8 and 9 of table 2. If instead the financial wealth holder has a higher *EIS*, his consumption innovations are more volatile and more highly correlated with financial asset returns, and so are the aggregates. For $\sigma = 1.1$, the value estimated by Vissing-Jorgensen (2002) for stock holders, the volatility of aggregate consumption innovations is 41%, 29% and 28% higher in *Models 2, 3, & 4* than in the case where both agents have $\sigma = .28$.[15] The correlation between aggregate consumption innovations and financial asset returns are .87, .93 and .94; the latter two are again higher than in the homogeneity case.

This argument readily extends to more households and to households with both financial and human wealth. If the *EIS* and ratio of financial wealth to total wealth are positively

[15] In the data, financial wealth holders' consumption is more volatile than average consumption, but not nearly as high as in the model. Vissing-Jorgensen (2002) finds a 6% consumption growth volatility for stock holders, compared to a 3.4% volatility for all households. However, the model-implied volatility of consumption growth for the agent with only financial wealth and $\sigma = 1.1$ is 15% per year!

correlated, the consumption puzzles will be worse than in the economy with a stand-in agent with the average *EIS*.

Borrowing Constraints What about borrowing constraints? Binding constraints add a third component to aggregate consumption innovations, news about future average multipliers on these constraints:

$$c_{t+1} - E_t c_{t+1} = r^m_{t+1} - E_t r^m_{t+1} + (1-\sigma)(E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j r^m_{t+1+j} - (E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j \lambda_{t+1+j},$$

where λ_{t+j} denotes the cross-sectional weighted-average multiplier at $t+j$ (see appendix A.5 for a derivation). Clearly, it does not help to have very binding constraints all the time. For model-implied consumption innovations to be smooth and only mildly correlated with financial asset returns, a positive innovation in financial returns must be associated with more binding constraints in the future. The collateral constraints of Lustig & Van-Nieuwerburgh (2004) have this feature.

7.4 Housing Wealth

As a last robustness check, we include a third source of wealth besides financial wealth and human wealth: housing wealth. Consumption c is now non-durable and services consumption *excluding* housing services. The stand-in consumer has non-separable preferences over c and housing consumption. We solve the model with constant and time-varying human wealth shares. Appendix A.6 describes the derivation and data in more detail. We find that the human wealth 'residual' does not proxy for housing wealth. Rather, the properties of consumption-consistent human wealth returns look very similar in the models with and without housing wealth. Our main conclusions go through: To match consumption moments, human wealth returns must be negatively correlated with financial wealth returns (see Table 9 in appendix A.6). Since human wealth is such a large share of total wealth, the implied market return remains negatively correlated with financial asset returns. In addition, human wealth returns and the market return are also negatively correlated with housing returns.

8 Discussion

From the perspective of a standard growth model, the volatility of consumption innovations relative to that of return innovations and their correlation with return innovations are much too small, even if the representative agent is very reluctant to substitute consumption over time. We propose that the resolution of these puzzles lies in the behavior of human wealth returns.

In a standard single agent model with financial wealth and human wealth, returns on human wealth need to be negatively correlated with returns on financial assets in order to generate a consumption process that is consistent with the data. This reflects negative correlation in news about the future discount rates and the cash flows for these two assets. The latter is strongly at odds with the predictions of the neoclassical growth model with a standard production technology.

A key question remains: what drives this negative correlation? The data suggest a *cash-flow channel.* Our firm value data show a negative correlation between both current and expected future growth rates of pay-outs to employees and to securities holders (last two rows of panel A in Table 1). Dividend growth on stocks has only a small positive correlation with labor income growth (panel B).

Where does this low or even negative correlation between pay-outs to employees and securities' holders come from? Shocks to labor reallocation may play a key role. To illustrate its effects, we include the National Association of Purchasing Managers' employment diffusion index in our VAR. This measure reflects future job creation. Malloy, Moskowitz, & Vissing-Jorgensen (2005) show this measure predicts labor income growth. Indeed, table 15 in appendix A.7 shows that the R^2 on the Δy equation increases from 25% to 44%. We compute the innovations to the diffusion index and find that they have a correlation of 0.6 with news about future labor income growth. In contrast, the correlation coefficient between the diffusion index and news about future dividend growth is around -.3. Clearly, an increase in the rate of job creation increases future labor income growth, but has a negative effect on future dividend growth. Lustig, VanNieuwerburgh, & Syverson (2005) develop a model that can deliver these stylized facts. The model is motivated by a closely related piece of empirical evidence, that the labor revenue share increases and the capital revenue share decreases when the total factor productivity dispersion increases within an industry. In our model, such an increase in dispersion leads to labor reallocation.

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A Appendix

A.1 Data Appendix: Returns on Firm Value

This computation is based on Hall (2001). The data to construct our measure of returns on firm value were obtained from the Federal Flow of Funds (Federal Reserve Board of Governors, downloadable at www.federalreserve.gov/ releases/z1/current/data.htm). The data are for non-farm, non-financial business. We extracted the stock data from ltabs.zip. The Coded Tables provide more information about the codes used in the Flow of Funds accounts. A complete description is available in the Guide to the Flow of Funds Accounts. We calculated the value of all securities as the sum of financial liabilities (144190005), the market value of equity (1031640030) less financial assets

(144090005), adjusted for the difference between market and book for bonds. The subcategories unidentified miscellaneous assets (113193005) and liabilities (103193005) were omitted from all of the calculations. These are residual values that do not correspond to any financial assets or liabilities. We correct for changes in the market value of outstanding bonds by applying the index of corporate bonds to the level of outstanding corporate bonds at the end of the previous year. The Dow Jones Corporate Bond Index is available from Global Financial Data. We measured the flow of pay-outs as the flow of dividends (10612005) plus the interest paid on debt (net interest series from NIPA, see Gross Product of non-financial,corporate business.) less the increase in the volume of financial liabilities (10419005), which includes issues of equity (103164003).

A.2 Notation and Model Details

$$
\begin{aligned}
V_a &= V[r^a_{t+1} - E_t[r^a_{t+1}]] \\
V_{d^y} &= V[(E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j \Delta y_{t+1+j}] \\
V^a_h &= V[(E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j r^a_{t+1+j}] \\
Corr_{a,h^a} &= Corr[r^a_{t+1} - E_t[r^a_{t+1}], (E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j r^a_{t+1+j}] \\
Corr_{a,d^y} &= Corr[r^a_{t+1} - E_t[r^a_{t+1}], (E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j \Delta y_{t+1+j}] \\
Corr_{h^a,d^y} &= Corr[(E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j \Delta y_{t+1+j}, (E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j r^a_{t+1+j}]
\end{aligned}
$$

News to future expected returns on human wealth, $(h^y)_t$, is an unobservable to the econometrician. The following moments of $(h^y)_t$ will play a crucial role in the exercise:

$$
\begin{aligned}
V_{h^y} &= V[(E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j r^y_{t+1+j}] \\
Corr_{a,h^y} &= Corr[r^a_{t+1} - E_t[r^a_{t+1}], (E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j r^y_{t+1+j}] \\
Corr_{d^y,h^y} &= Corr[(E_{t+1} - E_t)\sum_{j=0}^{\infty} \rho^j \Delta y_{t+1+j}, (E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j r^y_{t+1+j} \\
Corr_{h^a,h^y} &= Corr[(E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j r^a_{t+1+j}, (E_{t+1} - E_t)\sum_{j=1}^{\infty} \rho^j r^y_{t+1+j}]
\end{aligned}
$$

A.2.1 Moments of Consumption Innovations with Constant Wealth Shares

We denote the innovations to current consumption growth using $(c)_t$. Using the symbols defined in the text, we get:

$$
(c)_t = (1 - \bar{\nu})(a)_t + \bar{\nu}(d^y)_t + (1 - \sigma)(1 - \bar{\nu})(h^a)_t - \sigma\bar{\nu}(h^y)_t. \tag{23}
$$

The variance of consumption innovations is readily found as:

$$\begin{aligned}
V_c = (1-\bar{\nu})^2 V_a + \bar{\nu}^2 V_{d^y} \\
+(1-\sigma)^2(1-\bar{\nu})^2 V_{h^a} \\
+\sigma^2\bar{\nu}^2 V_{h^y} + 2(1-\bar{\nu})\bar{\nu}Corr_{a,d^y}\sqrt{V_a}\sqrt{V_{d^y}} \\
+2(1-\sigma)(1-\bar{\nu})^2 Corr_{a,h^a}\sqrt{V_a}\sqrt{V_{h^a}} \\
-2\sigma(1-\bar{\nu})\bar{\nu}Corr_{a,h^y}\sqrt{V_a}\sqrt{V_{h^y}} + 2(1-\sigma)(1-\bar{\nu})\bar{\nu}Corr_{h^a,d^y}\sqrt{V_{d^y}}\sqrt{Vh^a} \\
-2\sigma\bar{\nu}^2 Corr_{h^y,d^y}\sqrt{V_{d^y}}\sqrt{V_{h^y}} - 2\sigma(1-\sigma)(1-\bar{\nu})\bar{\nu}Corr_{h^a,h^y}\sqrt{V_{h^a}}\sqrt{(V_{h^y})}.
\end{aligned} \tag{24}$$

Similarly, we derive an expression for $V_{c,a}$, the covariance of consumption with asset return innovations:

$$\begin{aligned}
V_{c,a} = (1-\bar{\nu})V_a + \bar{\nu}Corr_{a,d^y}\sqrt{V_a}\sqrt{V_{d^y}} \\
+(1-\sigma)(1-\bar{\nu})Corr_{a,h^a}\sqrt{V_a}\sqrt{V_{h^a}} - \sigma\bar{\nu}Corr_{a,h^y}\sqrt{V_a}\sqrt{h^y}.
\end{aligned} \tag{25}$$

Note that $Corr_{a,h^y} > 0$, $Corr_{d^y,h^y} > 0$, and $Corr_{h^a,h^y} > 0$ keep the variance of consumption innovations and the covariance of consumption innovations with financial asset return innovations low. Likewise, a low variance of news in future human capital returns (V_{h^y}) keeps consumption volatility low.

Log Utility The variance of consumption innovations reduces to:

$$\begin{aligned}
V_c = (1-\bar{\nu})^2 V_a + \bar{\nu}^2 V_{d^y} + \bar{\nu}^2 V_{h^y} + 2(1-\bar{\nu})\bar{\nu} \\
\left(Corr_{a,d^y}\sqrt{V_a}\sqrt{V_{d^y}} - Corr_{a,h^y}\sqrt{V_a}\sqrt{V_{h^y}}\right) - 2\bar{\nu}^2 Corr_{h^y,d^y}\sqrt{V_{d^y}}\sqrt{V_{h^y}},
\end{aligned} \tag{26}$$

while the covariance is given by:

$$V_{c,a} = (1-\bar{\nu})V_a + \bar{\nu}\left(Corr_{a,d^y}\sqrt{V_a}\sqrt{V_{d^y}} - Corr_{a,h^y}\sqrt{V_a}\sqrt{h^y}\right). \tag{27}$$

More moments Another moment of interest is the correlation between the innovations in human wealth returns (y) and either innovations in financial asset returns (a) or news in future financial asset returns (h^a). Now go back to equation (10) and take the covariance with current financial asset return innovations:

$$V_{a,y} = Corr_{a,d^y}\sqrt{V_a}\sqrt{V_{d^y}} - Corr_{a,h^y}\sqrt{V_a}\sqrt{V_{h^y}}$$

Likewise, take the covariance with news to future stock market returns:

$$V_{h^a,y} = Corr_{d^y,h^a}\sqrt{V_{d^y}}\sqrt{V_{h^a}} - Corr_{h^a,h^y}\sqrt{V_{h^a}}\sqrt{V_{h^y}}$$

Finally, note that the variance of human capital return innovations is

$$V_y = V_{d^y} + V_{h^y} - 2V_{d^y,h^y}$$

A.2.2 Time-Varying Wealth Share

Because dp_t^y is a function of the entire state space, so is ν_t. ν_{t+1} is not a linear, but a logistic function of the state. We use a linear specification:

$$\tilde{\nu}_t \equiv \nu_t - \bar{\nu} = D' z_t$$

and we pin down D $(N \times 1)$ using a first order Taylor approximation. Let s_t be the labor income share with mean $\bar{s}$ and $w_t = dp_t^y - dp_t$ with mean zero. (The mean of w_t must be zero to be able to use the same linearization constant ρ for human wealth and financial wealth.) We can linearize the logistic function for the human wealth share ν_t from equation (14) using a first order Taylor approximation around $(s_t = \bar{s}, w_t = 0)$. We obtain:

$$\begin{aligned}
\nu_t(s_t, w_t) &\approx \nu_t(\bar{s}, 0) + \frac{\partial \nu_t}{\partial s_t}|_{s_t=\bar{s}, w_t=0}(s_t - \bar{s}) + \frac{\partial \nu_t}{\partial w_t}|_{s_t=\bar{s}, w_t=0}(w_t), \\
&\approx \bar{s} + (s_t - \bar{s}) - (\bar{s}(1-\bar{s}))w_t, \\
&\approx s_t - \bar{s}(1-\bar{s})dp_t^y + \bar{s}(1-\bar{s})dp_t
\end{aligned} \tag{28}$$

The average human wealth share is the average labor income share: $\bar{\nu} = \bar{s}$. If dp_t is the third element of the VAR, $dp_t = e_3' z_t$, and $s_t - \bar{s}$ the sixth, and if $dp_t^y = B' z_t$, then we can solve for D from equation (28) and $\tilde{\nu}_t = D' z_t$:

$$D = e_6 - \bar{s}(1-\bar{s})B + \bar{s}(1-\bar{s})e_3. \tag{29}$$

A.2.3 Sylvester Equations

With the portfolio weights ν_t we can construct consumption innovations according to equation (17). The difficulty is to calculate the terms W_1 and W_2. We use value function iteration to pin down W_1 and W_2. Let

$$\begin{aligned}
\widetilde{W}_1(z_{t+1}) &= E_{t+1} \sum_{j=1}^{\infty} \rho^j \tilde{\nu}_{t+j} r^a_{t+1+j} \\
\widetilde{W}_1(z_{t+1}) &= \tilde{\nu}_{t+1} E_{t+1} \rho r^a_{t+2} + E_{t+1} \sum_{j=2}^{\infty} \tilde{\nu}_{t+j} \rho^j E_{t+j} r^a_{t+1+j} \\
\widetilde{W}_1(z_{t+1}) &= \tilde{\nu}'_{t+1} \rho e_1' A z_{t+1} + \rho E_{t+1} \sum_{j=2}^{\infty} \tilde{\nu}_{t+j} \rho^{j-1} E_{t+j} r^a_{t+1+j} \\
&= z'_{t+1} D \rho e_1' A z_{t+1} + \rho E_{t+1} \widetilde{W}_1(z_{t+2})
\end{aligned} \tag{30}$$

We can compute a solution to this recursive equation by iterating on it. We posit a quadratic objective function:

$$\widetilde{W}_1(z_{t+1}) = z'_{t+1} P z_{t+1} + d$$

where P solves a matrix Sylvester equation, whose fixed point is found by iterating on:

$$P_{j+1} = R + \rho A' P_j A, \tag{31}$$

starting from $P_0 = 0$, and $R = \rho D e_1' A$. The constant d in the value function equals

$$d = \frac{\rho}{1-\rho} tr(P\Sigma)$$

We are interested in:

$$\begin{aligned} W_1(z_{t+1}) = (E_{t+1} - E_t)\widetilde{W}_1(z_{t+1}) &= (E_{t+1} - E_t)[z_{t+1}' P z_{t+1} + d] \\ &= \varepsilon_{t+1}' P \varepsilon_{t+1} - E_t[\varepsilon_{t+1}' P \varepsilon_{t+1}] \\ &= \varepsilon_{t+1}' P \varepsilon_{t+1} - \sum_{i=1}^{N} \sum_{j=1}^{N} \Sigma_{ij} P_{ij} \end{aligned}$$

which turns out to be a simple quadratic function of the VAR shocks and the matrix P.

In the same manner we calculate W_2, replacing R in equation (31) by $S = \rho D C'$. C takes on different values for the three canonical models.

A.2.4 Market Return

We can now compute innovations to the total market return (m):

$$\begin{aligned} (m)_{t+1} &\equiv r_{t+1}^m - E_t[r_{t+1}^m] \\ &= (\tilde{\nu}_t + \bar{\nu})(r_{t+1}^y - E_t[r_{t+1}^y]) + (1 - \tilde{\nu}_t - \bar{\nu})(r_{t+1}^a - E_t[r_{t+1}^a]) \\ &= (\tilde{\nu}_t + \bar{\nu}) ICYR_{t+1} + (1 - \tilde{\nu}_t - \bar{\nu}) ICAR_{t+1} \\ &= \left[(\tilde{\nu}_t + \bar{\nu})(e_2' - \rho C')(I - \rho A)^{-1} + (1 - \tilde{\nu}_t - \bar{\nu}) e_1'\right] \varepsilon_{t+1} \end{aligned}$$

and also news in future market returns (h^m):

$$\begin{aligned} (h^m)_{t+1} &\equiv (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j r_{t+1+j}^m \\ &= (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j \left[(\tilde{\nu}_{t+j} + \bar{\nu}) r_{t+1+j}^y + (1 - \tilde{\nu}_{t+j} - \bar{\nu}) r_{t+1+j}^a\right] \\ &= \bar{\nu} NFYR_{t+1} + W_{2,t+1} + (1 - \bar{\nu}) NFAR_{t+1} - W_{1,t+1} \\ &= \rho\left[\bar{\nu} C' + (1 - \bar{\nu}) e_1' A\right] (I - \rho A)^{-1} \varepsilon_{t+1} - (\varepsilon_{t+1}'(P - Q)\varepsilon_{t+1}) - q \end{aligned}$$

where the constant $q = \sum_{i=1}^{N} \sum_{j=1}^{N} \Sigma_{ij}(P_{ij} - Q_{ij})$.

¿From the innovations, we back out *realized* human wealth returns and market returns:

$$\begin{aligned} r_{t+1}^y &= (y)_{t+1} + C' z_t \\ r_{t+1}^m &= (m)_{t+1} + (\tilde{\nu}_t + \bar{\nu}) C' z_t + (1 - \tilde{\nu}_t - \bar{\nu}) e_1' A z_t \end{aligned}$$

A.2.5 Asset Pricing

Using the definition of $(m)_t$ in equation (32),

$$V_{im} = \sum_{k=1}^{N} \left[(\tilde{\nu}_t + \bar{\nu})(e_2' - \rho C')(I - \rho A)^{-1} + (1 - \tilde{\nu}_t - \bar{\nu}) e_1'\right]_k V_{ik} \qquad (32)$$

Likewise, we can define V_{ih} as a linear combination of V_{ik} terms. Recalling the definition of $(h^m)_t$ in equation (32), we note that it contains both linear and quadratic terms in ε. The covariance of return innovations in asset i with the quadratic terms involves third moments of normally distributed variables. They are all zero. The expression for V_{ih} becomes:

$$V_{ih} = \sum_{k=1}^{N} \left[\rho\left[\bar{\nu}C' + (1-\bar{\nu})e_1' A\right](I-\rho A)^{-1}\right]_k V_{ik} \tag{33}$$

A.3 Habits

Denote the log surplus consumption ratio by sp_t, and assume it follows an AR(1) as in Campbell & Cochrane (1999):

$$sp_{t+1} = \phi sp_t + \lambda(sp_t)\left(c_{t+1} - E_t c_{t+1}\right),$$

where $\lambda, \phi > 0$ and $\phi < 1$. Lowercase letters denote logs. The consumption Euler equation is standard for $\theta = 1$:

$$1 = E_t\left[\beta\left\{\left(\frac{C_{t+1}}{C_t}\frac{Sp_{t+1}}{Sp_t}\right)^{-1/\sigma} R_{m,t+1}\right\}^{\theta}\right]$$

where Sp_{t+1} is the surplus consumption ratio in levels. We do not allow for non-separability of utility in current and future consumption goods.

Taking logs and assuming log-normality produces the following equation:

$$0 = \frac{\theta}{\sigma}\mu_{m,t} - \frac{\theta}{\sigma}\left(E_t\Delta c_{t+1} + E_t\Delta sp_{t+1}\right) + \theta E_t r_{m,t+1}$$

where the intercept is time-varying because of sp_t:

$$\begin{aligned}
\mu_{m,t} &= \sigma\log\beta + \frac{1}{2}\frac{\theta}{\sigma} var_t[\Delta c_{t+1} + \Delta sp_{t+1} - \sigma r_{m,t+1}] \\
&= \sigma\log\beta + \frac{1}{2}\frac{\theta}{\sigma} var_t[\Delta c_{t+1} + (\phi-1)\, sp_t + \lambda(sp_t)\Delta c_{t+1} - \sigma r_{m,t+1}] \\
&= \sigma\log\beta + \frac{1}{2}\frac{\theta}{\sigma}\left\{\begin{array}{c} (1+\lambda(sp_t))^2 \;\; var_t[\Delta c_{t+1}] \\ -\sigma\,(1+\lambda(sp_t))\, cov_t\left(\Delta c_{t+1}, r_{m,t+1}\right) \\ +\sigma^2 var_t r_{m,t+1} \end{array}\right\}
\end{aligned}$$

This implies expected consumption growth can be restated as:

$$E_t\Delta c_{t+1} = \mu_{m,t} + \sigma E_t r_{m,t+1} - E_t\Delta sp_{t+1}$$

Since we have already discussed heteroscedasticity in the previous section, we assume that $\lambda(sp_t) = \lambda$ is constant. In that case the the intercept is constant:

$$\mu_m = \sigma\log\beta + \frac{1}{2}\frac{\theta}{\sigma}\left\{(1+\lambda)^2 \;\; V_c - \sigma\,(1+\lambda)\, V_{cm} + \sigma^2 V_m\right\}$$

This can be substituted back into the consumption innovation equation to produce the following expression:

$$\begin{aligned} c_{t+1} - E_t c_{t+1} &= r_{m,t+1} - E_t r_{m,t+1} + (1-\sigma)\left(E_{t+1} - E_t\right) \sum_{j=1} \rho^j r_{m,t+j+1} \\ &\quad - \left(E_{t+1} - E_t\right) \sum_{j=1} \rho^j \Delta sp_{t+1+j} \end{aligned}$$

First, note that $(E_{t+1} - E_t)\,\Delta sp_{t+1+j} = (\phi - 1)\,(E_{t+1} - E_t)\, sp_{t+j}$. Second, note that

$$\left(E_{t+1} - E_t\right) sp_{t+1+j} = \lambda \phi^{j-1} \left(c_{t+1} - E_t c_{t+1}\right).$$

All of this implies in turn that:

$$\begin{aligned} c_{t+1} - E_t c_{t+1} &= r_{m,t+1} - E_t r_{m,t+1} + (1-\sigma)\left(E_{t+1} - E_t\right) \sum_{j=1} \rho^j r_{m,t+j+1} \\ &\quad -(\phi - 1)\left(E_{t+1} - E_t\right) \sum_{j=1} \phi^{j-1} \rho^j \lambda \left(c_{t+1} - E_t c_{t+1}\right), \end{aligned}$$

which can be simplified further into:

$$\begin{aligned} c_{t+1} - E_t c_{t+1} &= r_{m,t+1} - E_t r_{m,t+1} + (1-\sigma)\left(E_{t+1} - E_t\right) \sum_{j=1} \rho^j r_{m,t+j+1} \\ &\quad -\frac{(\phi - 1)\lambda\rho}{1 - \phi\rho} \left(c_{t+1} - E_t c_{t+1}\right). \end{aligned}$$

Finally, note that

$$1 + \frac{(\phi-1)\lambda\rho}{1-\phi\rho} = \frac{1 - \phi\rho + (\phi-1)\lambda\rho}{1-\phi\rho},$$

so that

$$c_{t+1} - E_t c_{t+1} = \frac{1-\phi\rho}{1 - \phi\rho + \lambda\rho(\phi-1)} \left\{ \begin{array}{c} \left(r_{m,t+1} - E_t r_{m,t+1}\right) + \\ (1-\sigma)\left(E_{t+1} - E_t\right) \sum_{j=1}^{\infty} \rho^j r_{m,t+j+1} \end{array} \right\}$$

The implied covariance between consumption innovations and return innovation follows immediately from this expression.

A.4 Aggregation

Our objective is start from the household consumption innovations and aggregate these innovations to get an expression for aggregate consumption innovations. To keep it simple, we assume all households share the same IES and the same mean log consumption/wealth ratio, and hence, the same ρ.

We assume each household's consumption Euler equation is satisfied. If this is the case, each household $i's$ consumption innovations can be stated as follows:

$$c^i_{t+1} - E^i_t c^i_{t+1} = r^m_{t+1} - E^i_t r^{m,i}_{t+1} + (1-\sigma)(E^i_{t+1} - E^i_t) \sum_{j=1}^{\infty} \rho^j r^{m,i}_{t+1+j},$$

where E^i denotes the conditional expectation operator, conditional on household $i's$ information set. We use E to denote expectations conditional on the econometrician's (smaller) information set. We let $\widetilde{E}$ denote the cross-sectional expectation operator: $\widetilde{E}(x^i) = \frac{1}{I}\sum_i x^i$.

First, note that the weighted consumption innovations are (roughly) equal to the aggregate consumption innovations:

$$\widetilde{E}\left(\frac{C_t^i}{C_t}\right)\left(c_{t+1}^i - E_t c_{t+1}^i\right) \simeq \left(c_{t+1} - E_t c_{t+1}\right),$$

and, that the weighted household return innovations are equal to the market return innovations:

$$\widetilde{E}\left(\frac{W_t^i}{W_t}\right)\left(r_{t+1}^{m,i} - E_t r_{t+1}^{m,i} + (1-\sigma)(E_{t+1}-E_t)\sum_{j=1}^{\infty}\rho^j r_{t+1+j}^{m,i}\right) \simeq$$
$$r_{t+1}^{m} - E_t r_{t+1}^{m} + (1-\sigma)(E_{t+1}-E_t)\sum_{j=1}^{\infty}\rho^j r_{t+1+j}^{m}.$$

To aggregate the household consumption innovations and obtain an expression in terms of the market return on the right hand side, we need to weight these household return innovations by the wealth shares of each household:

$$\widetilde{E}\left(\frac{W_t^i}{W_t}\right)\left(c_{t+1}^i - E_t^i c_{t+1}^i\right) =$$
$$\widetilde{E}\left(\frac{W_t^i}{W_t}\right)\left(r_{t+1}^{m,i} - E_t^i r_{t+1}^{m,i} + (1-\sigma)(E_{t+1}^i-E_t^i)\sum_{j=1}^{\infty}\rho^j r_{t+1+j}^{m,i}\right)$$

On the left hand side, however, we want an expression in terms of aggregate consumption. So, we split the wealth share into a consumption wealth ratio term and a consumption share term:

$$\widetilde{E}\left(\frac{W_t^i/C_t^i}{W_t/C_t}\right)\left(\frac{C_t^i}{C_t}\right)\left(c_{t+1}^i - E_t c_{t+1}^i\right) + \widetilde{E}\left(\frac{W_t^i/C_t^i}{W_t/C_t}\right)\eta_t^i\left(c_{t+1}^i\right) =$$
$$\widetilde{E}\left(\frac{W_t^i}{W_t}\right)\left(r_{t+1}^{m,i} - E_t r_{t+1}^{m,i} + (1-\sigma)(E_{t+1}-E_t)\sum_{j=1}^{\infty}\rho^j r_{t+1+j}^{m,i}\right)$$
$$+\widetilde{E}\left(\frac{W_t^i}{W_t}\right)\left(\eta_t^i(r_{t+1}^{m,i}) + (1-\sigma)\left(\eta_{t+1}^i - \eta_t^i\right)\sum_{j=1}^{\infty}\rho^j r_{t+1+j}^{m,i}\right),$$

where $\eta_{t+1}^i(x_{t+1}^i)$ denote the econometrician's prediction errors for some random variable x_{t+1}^i:

$$\eta_{t+1}^i(x_{t+1}^i) = (E_t^i - E_t)(x_{t+1}^i).$$

We make the following assumptions we need to obtain the aggregation result:

Assumption 1. *The average consumption-wealth ratio equals the aggregate consumption-wealth ratio:*

$$\widetilde{E}\left(\left(\frac{W_t^i/C_t^i}{W_t/C_t}\right)\right) = 1. \tag{34}$$

Assumption 2. *The consumption/wealth ratio deviations at t are orthogonal to weighted consump-*

tion innovations at $t+1$:

$$\widetilde{E}\left(\left(\frac{W_t^i/C_t^i}{W_t/C_t}-1\right)\left(\frac{C_t^i}{C_t}\right)\left(c_{t+1}^i-E_t c_{t+1}^i\right)\right)=0. \tag{35}$$

Assumption 3. *The cross-sectional average of the econometrician's prediction errors are zero:*

$$\widetilde{E}\left(\left(\frac{W_t^i}{W_t}\right)\eta_t^i\left(x_{t+1}^i\right)\right)=0$$

and

$$\widetilde{E}\left(\left(\frac{W_t^i/C_t^i}{W_t/C_t}\right)\left(\frac{C_t^i}{C_t}\right)\eta_t^i\left(x_{t+1}^i\right)\right)=0. \tag{36}$$

Given the assumptions in (35) and (34), it is immediate that the cross-sectional average of the weighted consumption innovations satisfies:

$$\widetilde{E}\left(\left(\frac{W_t^i/C_t^i}{W_t/C_t}\right)\left(\frac{C_t^i}{C_t}\right)\left(c_{t+1}^i-E_t c_{t+1}^i\right)\right) = \widetilde{E}\left(\left(\frac{C_t^i}{C_t}\right)\left(c_{t+1}^i-E_t c_{t+1}^i\right)\right)\simeq\left(c_{t+1}-E_t c_{t+1}\right)$$

On the right hand side, we know that:

$$\begin{aligned}\widetilde{E}&\left(\left(\frac{W_t^i}{W_t}\right)\left(r_{t+1}^{m,i}-E_t r_{t+1}^{m,i}+(1-\sigma)(E_{t+1}-E_t)\sum_{j=1}^{\infty}\rho^j r_{t+1+j}^{m,i}\right)\right)\\ &\simeq r_{t+1}^m-E_t r_{t+1}^m+(1-\sigma)(E_{t+1}-E_t)\sum_{j=1}^{\infty}\rho^j r_{t+1+j}^m.\end{aligned}$$

Combining this result with the zero average prediction error assumption in (36), produces the desired result. The expression in equation (34) simplifies to the aggregate consumption innovation in the text:

$$c_{t+1}-E_t c_{t+1}=r_{t+1}^m-E_t r_{t+1}^m+(1-\sigma)(E_{t+1}-E_t)\sum_{j=1}^{\infty}\rho^j r_{t+1+j}^m$$

What do these assumption imply? In logs, the consumption/wealth ratio deviations are:

$$(c_t^i-w_t^i)-(c_t-w_t)=(1-\sigma)\left(E_t^i\sum_{j=1}^{\infty}\rho^j r_{t+1+j}^{m,i}-E_t\sum_{j=1}^{\infty}\rho^j r_{t+1+j}^m\right).$$

The second assumption implies that these deviations cannot be correlated with consumption-weighted household consumption innovations at $t+1$. The assumption can be somewhat weakened by having the right-hand side of 35 be a constant instead of zero. The aggregation consumption innovation equation then also contains a constant, but this does not affect the consumption variance and correlation moment of interest. The third assumption implies that for (cross-sectional) average variables, the econometrician does as well at forecasting consumption and returns as the household.

A.5 Borrowing Constraints

If the households were to encounter some binding constraints, the household's consumption innovations would be determined by:

$$c^i_{t+1} - E^i_t c^i_{t+1} = r^m_{t+1} - E^i_t r^{m,i}_{t+1} + (1-\sigma)(E^i_{t+1} - E^i_t)\sum_{j=1}^{\infty}\rho^j r^{m,i}_{t+1+j} - (E^i_{t+1} - E^i_t)\sum_{j=1}^{\infty}\rho^j \lambda^i_{t+1+j},$$

where λ^i_t is the Lagrange multiplier on household i's constraint at time t. Repeating the same aggregation exercise produces the following result:

$$c_{t+1} - E_t c_{t+1} = r^m_{t+1} - E_t r^m_{t+1} + (1-\sigma)(E_{t+1} - E_t)\sum_{j=1}^{\infty}\rho^j r^m_{t+1+j} - (E_{t+1} - E_t)\sum_{j=1}^{\infty}\rho^j \lambda_{t+1+j},$$

where the aggregate multiplier at $t+j$ is the cross-sectional weighted-average of the individual multipliers: $\lambda_{t+j} = \widetilde{E}\left(\left(\frac{W^i_t}{W_t}\right)\lambda^i_{t+j}\right)$.

A.6 Model with Housing Wealth

This appendix augments the model to include housing wealth. We re-derive the consumption innovation equations in the case of constant and time-varying wealth shares. The moments of the data are somewhat changed when the returns on housing are included into the VAR. However, our main results continue to hold. We conclude that the residual does not capture housing wealth, rather it captures human wealth.

Budget Constraint The representative agent's budget constraint is:

$$W_{t+1} = R^m_{t+1}\left(W_t - C_t - P^h_t H_t\right) = R^m_{t+1}\left(W_t - \frac{C_t}{A_t}\right). \tag{37}$$

where P^h_t is the relative price of housing services, C is non-housing consumption, and $A_t = \frac{C_t}{C_t + P^h_t H_t}$ is the non-housing expenditure share. This can be rewritten in logs, denoted by lowercase variables:

$$\Delta w_{t+1} = r^m_{t+1} + \log\left(1 - \exp(c_t - a_t - w_t)\right).$$

We follow Campbell (1993) and linearize the budget constraint:

$$\Delta w_{t+1} = k + r^m_{t+1} + \left(1 - \frac{1}{\rho}\right)(c_t - a_t - w_t),$$

where $\rho = 1 - \exp(\overline{c - a - w})$ and k is a linearization constant. A second way of writing the growth rate of wealth is by using the identity:

$$\Delta w_{t+1} = \Delta c_{t+1} - \Delta a_{t+1} + (c_t - a_t - w_t) - (c_{t+1} - a_{t+1} - w_{t+1}).$$

Combining these two expressions, iterating forward, and taking expectations, we obtain the linearized budget constraint (Campbell, 1991):

$$c_{t+1} - E_t c_{t+1} = (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j r^m_{t+1+j} + (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j \Delta a_{t+1+j} - (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j \Delta c_{t+1+j} \tag{38}$$

Preferences The representative household has non-separable preferences over housing and non-housing consumption. We model the period utility kernel as CES with intratemporal substitution parameter ε:

$$u(C_t, H_t) = \left[(1-\alpha) C_t^{\frac{\varepsilon-1}{\varepsilon}} + \alpha H_t^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}$$

Intertemporal preferences are still of the Epstein-Zin type:

$$U_t = \left((1-\beta) u(C_t, H_t)^{(1-\gamma)/\theta} + \beta \left(E_t U_{t+1}^{1-\gamma} \right)^{1/\theta} \right)^{\theta/(1-\gamma)},$$

where γ is the coefficient of relative risk aversion and σ is the intertemporal elasticity of substitution, henceforth IES. Finally, θ is defined as $\theta = \frac{1-\gamma}{1-(1/\sigma)}$. Special cases obtain when $\varepsilon = 1$ (Cobb-Douglas) and $\varepsilon = \sigma$.

The Euler equation with respect to the market return takes on the form

$$1 = E_t[\exp(sdf_{t+1} + r^m_{t+1})],$$

where the log stochastic discount factor is:

$$sdf_{t+1} = \theta \log \beta - \frac{\theta}{\sigma} \Delta c_{t+1} - \frac{\theta}{\sigma} \left(\frac{\sigma - \varepsilon}{\varepsilon - 1} \right) \Delta a_{t+1} + (\theta - 1) r^m_{t+1}$$

We then assume that non-housing consumption growth, non-housing expenditure share growth and the market return are conditionally homoscedastic and jointly log-normal. This leads to the consumption Euler equation:

$$E_t \Delta c_{t+1} = \mu_m + \sigma E_t r^m_{t+1} - \left(\frac{\sigma - \varepsilon}{\varepsilon - 1} \right) E_t \Delta a_{t+1}, \tag{39}$$

where μ_m is a constant that includes the variance and covariance terms for non-housing consumption, non-housing expenditure share, and market innovations, as well as the time preference parameter.

Substituting out Consumption Growth We can now substitute equation (39) back into the consumption innovation equation in (38), to obtain an expression with only returns on the right hand side:

$$\begin{aligned} c_{t+1} - E_t c_{t+1} \quad = \quad & r^m_{t+1} - E_t r^m_{t+1} + (1-\sigma)(E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j r^m_{t+1+j} + \\ & \left(\frac{\sigma - 1}{\varepsilon - 1} \right) (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j \Delta a_{t+1+j}, \end{aligned} \tag{40}$$

Innovations to the representative agent's non-housing consumption are determined by (1) the unexpected part of this period's market return (2) the innovation to expected future market returns, and (3) innovations to current and future expenditure share changes. In the realistic parameter region $\sigma < 1$, $\varepsilon < 1$, the last term is more important the more $\sigma < \varepsilon$.

Housing Return Data We construct data on the log change in the value of the aggregate housing stock (Δp^h_{t+1}) and the log change in the dividend payments on the aggregate housing stock (Δd^h_{t+1}). The aggregate housing stock is measured as the value of residential real estate of the household sector (Flow of Funds, series FL155035015). The dividend on aggregate housing is measured as housing services consumption (quarterly flow, from NIPA Table 2.3.5). We construct a log price index p^h by fixing the 1947.I observation to 0, and using the log change in prices in each quarter. Likewise, we choose an initial log dividend level, and construct the dividend index using log dividend growth. The log dividend price ratio $d^h - p^h$ is the difference of the log dividend and the log price index. The initial dividend index level is chosen to match the mean log dividend price ratio to the one on stocks (-4.6155).(In the model the mean dividend price ratios are the same on all assets.) We construct housing returns from the Campbell-Shiller decomposition:

$$r^h_{t+1} = k + \Delta d^h_{t+1} + (d^h_t - p^h_t) - \rho(d^h_{t+1} - p^h_{t+1})$$

where ρ and k are Campbell Shiller linearization constants. In the model, these constants must be the same for all assets (financial wealth, housing wealth and human wealth). We use stock market data to pion down ρ and k: $\rho = \frac{1}{1+\overline{d^a - p^a}} = .9901$ and $k = -\log(\rho) - (1-\rho)\log(\rho^{-1} - 1) = .0556$. To get the log real return, we deflate the nominal log return by the personal income price deflator, the same series used to deflate all other variables. The procedure results in an average quarterly housing return of 2.22% with a standard deviation of 1.30%. For comparison, the log real value weighted CRSP stock market return is 1.92% on average with a standard deviation of 8.26%. the correlation between the two return series is .076.[16]

VAR Additions To keep the state space as small as possible, we define a new variable, $\tilde{r}^a = \varphi r^a + (1-\varphi) r^h$, which denotes the return on a portfolio of financial assets and housing. The portfolio weight φ is the ratio of financial income (dividends, interest and proprietor's income) to financial income plus housing income (measured by housing services). This weight is varies over time and is 0.67 on average. Likewise, we define the log dividend-price ratio $\widetilde{dp}^a = \varphi dp^a + (1-\varphi) dp^h$. The variables $\tilde{r}^a$ and $\widetilde{dp}^a$ take the place of r^a and dp^a in the VAR. The labor income share s is defined as the ratio of labor income to total income, where total income consists of labor income, financial income and housing income. To the 7 elements in the VAR without housing we add the log growth rate in the non-housing expenditure share (Δa, element 8). Once the VAR has been estimated, we can construct the new series for news about current and future growth rates on the non-housing

[16]Those numbers are broadly consistent with the small literature on housing returns. Case and Shiller (1989) find that the volatility of house price changes is mostly idiosyncratic. The regional component of housing prices only explains between 7 and 27 percent of individual house price variation for the four cities in their study. They also report a zero correlation between housing returns and stock returns. Regional repeat sales price indices from Freddie Mac for 50 US states between 1976 and 2002 show a low volatility. The median region has a real annual house price appreciation (ex-dividend return) with a standard deviation of 5.1%. Across regions, the volatility varies between 2.4% and 12.8% per year (own calculations). For nation-wide data, the annual volatility of the ex-dividend return is 3.3%.

expenditure share $\{(d^a)_t\}$:

$$(d^a)_{t+1} = (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j \Delta a_{t+1+j} = e_8'(I - \rho A)^{-1} \varepsilon_{t+1}.$$

The procedure with time-varying wealth shares goes through as in the main text. The expression for consumption innovations with time-varying human wealth share is identical to equation (17), except for the additional term $\frac{\sigma-1}{\varepsilon-1}(d^a)_{t+1}$.

Moments of the Data Table 8 summarizes the moments from the data using the firm value returns and stock returns. The main change with the model without housing is that the combined financial asset - housing return innovations $\tilde{r}^a$ are 33% less volatile than financial assets alone. News about changes in the non-housing expenditure share d^a has a very low variance ($V_{d^a} = 0.08$ compared to $V_c = .34$). This term will play a negligible role in the analysis.

[Table 8 about here.]

Consumption Growth Accounting The results with time-varying wealth shares are close to the results without housing (9). Matching the moments of consumption requires financial-housing wealth returns and human wealth returns to be negatively correlated. The resulting market return is negatively correlated with returns on financial-housing wealth, and strongly positively correlated with returns on human wealth. This is true for both measures of financial assets (both panels).

The failure of the benchmark models to match the consumption moments derives from a failure to generate $Corr_{a,y} < 0$. Consumption is still much too highly correlated with financial asset returns, but the failure in the consumption variance is less pronounced than before. In sum, the properties of the human wealth process in the model with housing are virtually unaffected, relative to the model without housing.

[Table 9 about here.]

A.7 Additional Figures and Tables

[Figure 8 about here.]

[Figure 9 about here.]

[Figure 10 about here.]

[Table 10 about here.]

[Table 11 about here.]

[Table 12 about here.]

[Table 13 about here.]

[Table 14 about here.]

[Table 15 about here.]

Figure 1: Dividend Yield on CRSP Value-Weighted Stock Market Index and Payout-Yield on Total Firm Value

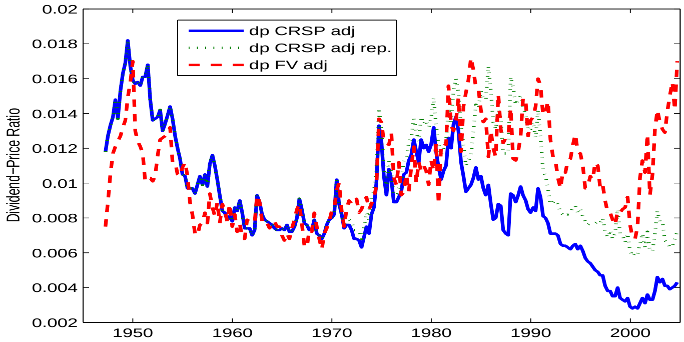

Figure 2: Matching Moments of Consumption Innovations

The first panel plots the quarterly model-implied standard deviation of consumption innovations against the *EIS* σ, while the second panel plots the model-implied correlation of consumption innovations . We use the returns on total firm value. The sample is 1947-II-2004.III.

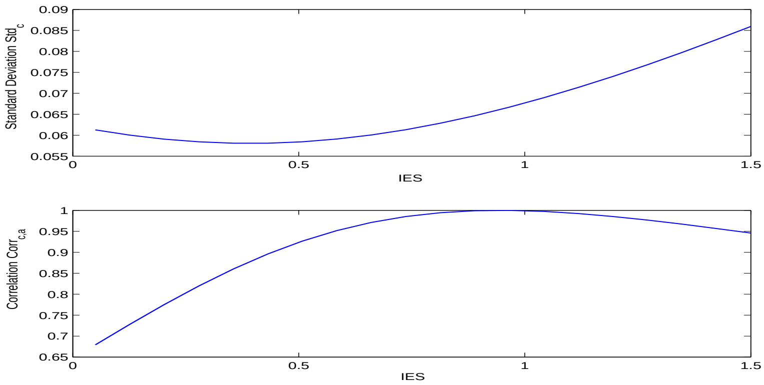

Figure 3: Labor Income Share and Human Wealth Share for Models 2, 3, and 4
The return on financial assets is return on Firm Value.

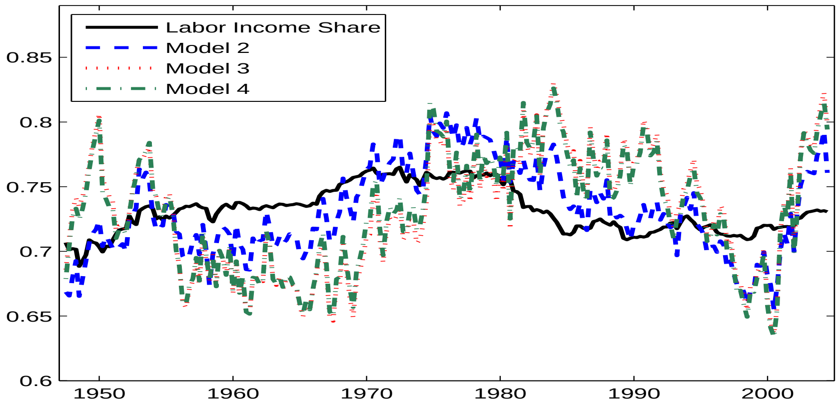

Figure 4: Human Wealth Share in Model 5.
The return on financial assets is the return on firm value.

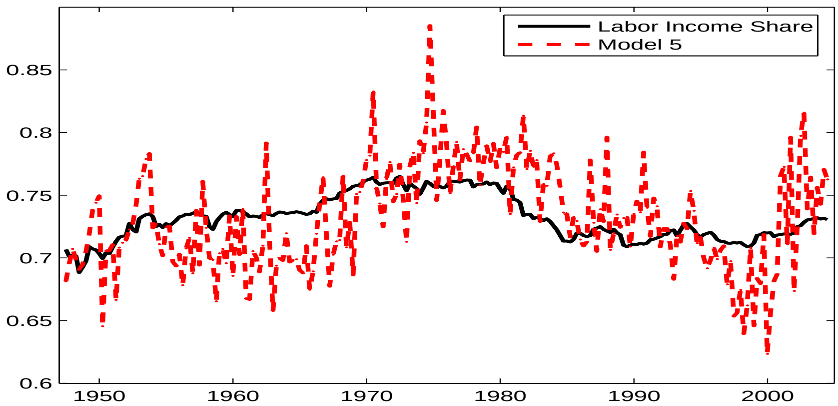

Figure 5: Innovations in Current Financial Asset and Human Wealth Returns Implied by Consumption Moments.
The return on financial assets is the return on firm value.

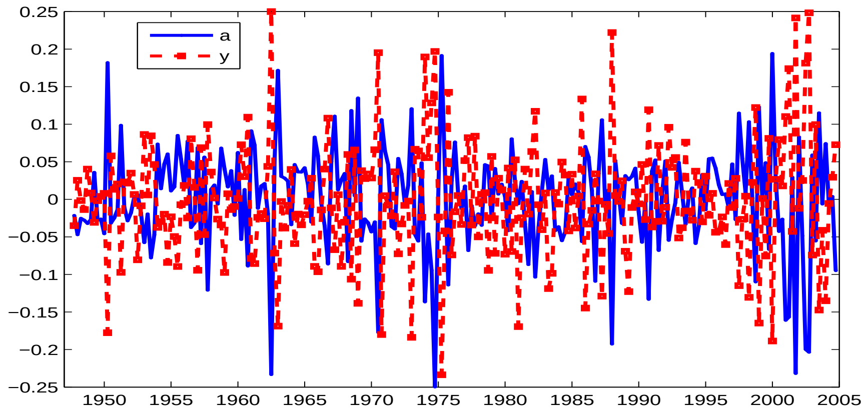

Figure 6: Long-Run Response of the Market Return and Consumption Growth
The return on financial assets is the return on stocks. The sample is 1930-2004. The figure plots the long-run response of consumption (d^c) as implied by the VAR, and the long-run response of the market return $(m) + (h^m)$ as implied by the model. The correlation between the two series is 0.69. The EIS is $\sigma = .2789$.

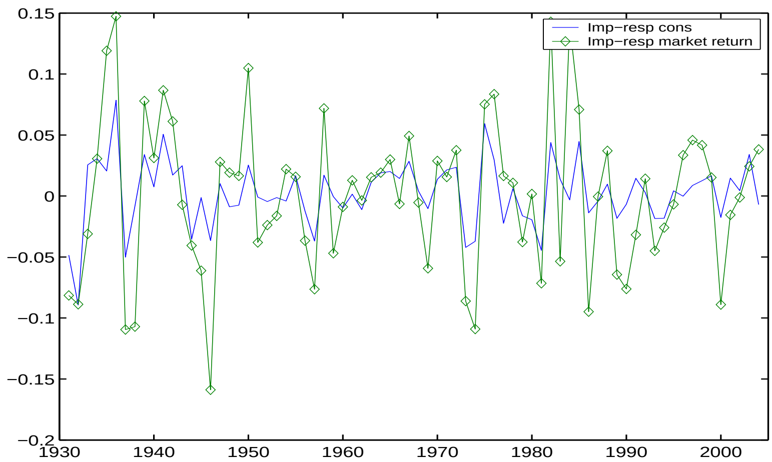

Figure 7: Value Portfolios: Risk Contributions of c and m

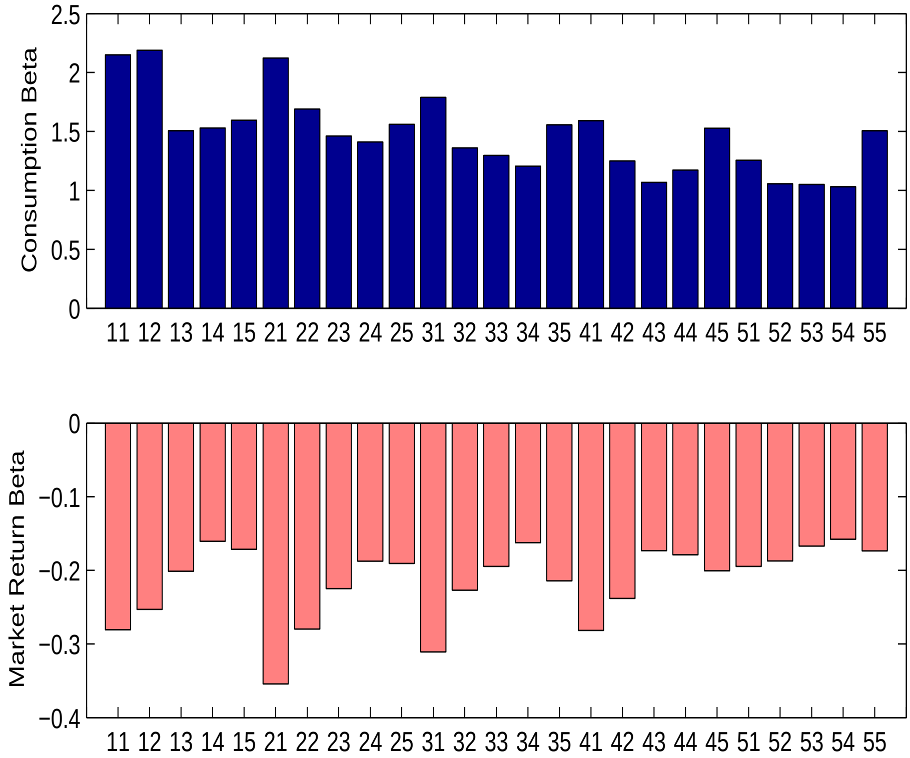

Figure 8: Matching Moments of Consumption Innovations: Annual Stock Returns
The first panel plots the annual model-implied standard deviation of consumption innovations against the *EIS* σ, while the second panel plots the model-implied correlation of consumption innovations. The sample is 1947-2004, at annual frequencies. We use the returns on stocks.

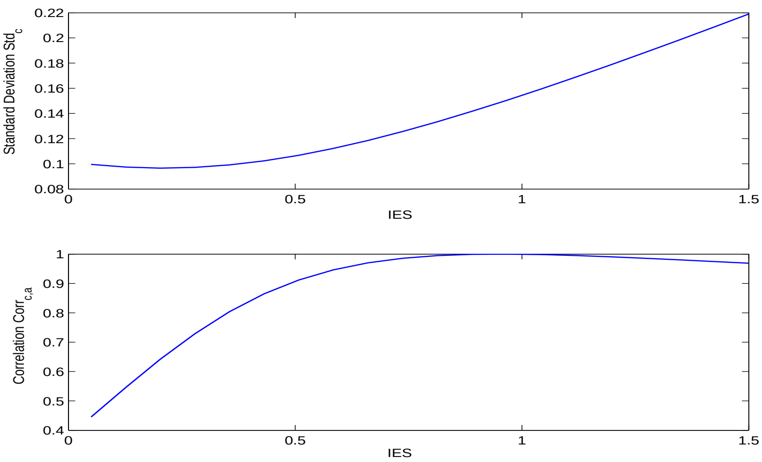

Figure 9: The *EIS* and Consumption Innovation Volatility and Correlation
Using Returns on Firm Value, Quarterly Data 1947-2003. The labor share $\bar{s} = \bar{\nu}$ is .70.

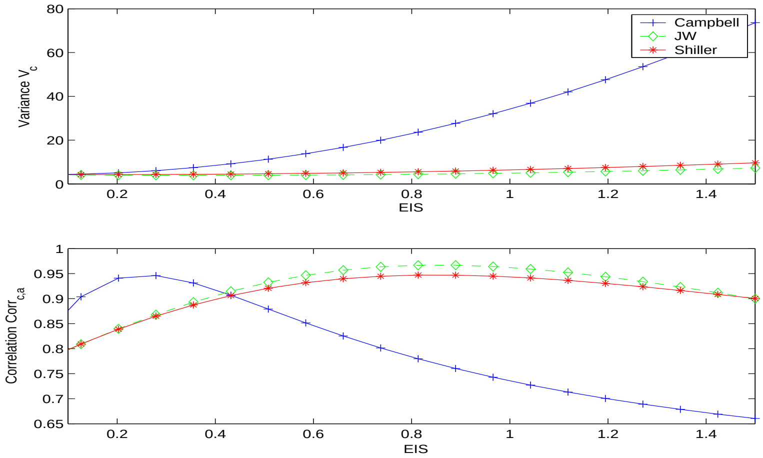

Figure 10: The Labor Share and Consumption Innovation Volatility and Correlation
Using Returns on Firm Value, Quarterly Data 1947-2003. The *EIS* σ is .28.

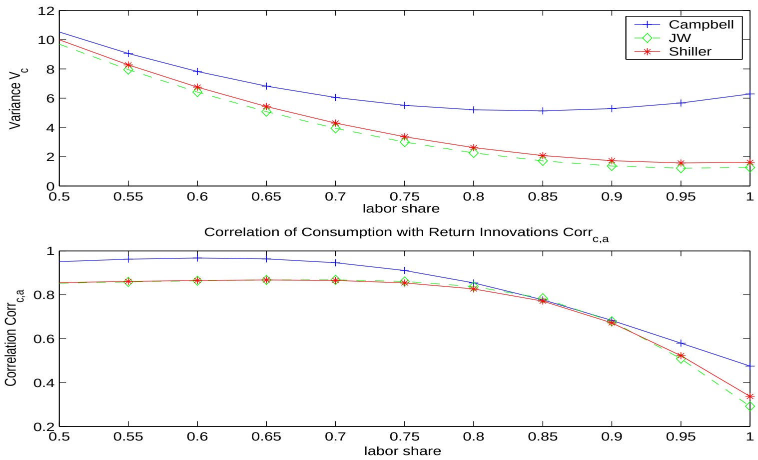

Table 1: Moments from Data: Returns on Firm Value

The table reports variances (V) and correlations $Corr$ in the data. The sample covers 1947.II-2004.III. In the left panel, the asset return is the return on firm value (own computation). In the right panel, it is the return on the value-weighted CRSP stock index. The first column reports results for a 1-lag VAR with quarterly data. The second column reports results for a 2-lag VAR with quarterly data. The third column reports the results for annual data over the same period 1947-2004. The subscript a denotes innovations in current financial asset returns; d^y denotes news in current and future labor income growth; h^a denotes news in future financial market returns,; d^d denotes news in current and future financial dividend growth; and c denotes innovations to non-durable and services consumption.

	Firm Value Returns			Stock Return Returns		
Moments	*1 Lag*	*2 Lags*	*Annual*	*1 Lag*	*2 Lags*	*Annual*
V_a	48.31	47.74	185.12	63.54	62.74	242.96
V_{d^y}	1.61	1.90	6.67	1.65	1.92	6.95
V_{h^a}	32.67	32.97	47.44	103.07	98.37	231.85
$Corr_{a,h^a}$	-.477	-.625	-0.487	-.918	-.805	-0.760
$Corr_{a,d^y}$	.337	.377	0.599	.491	.473	0.329
$Corr_{d^y,h^a}$	-.525	-.656	-0.818	-.336	-.208	-0.196
V_c	.333	.325	0.681	.328	.321	0.642
$Corr_{c,a}$	.168	.168	0.163	.185	.175	0.208
$Corr_{d^y,d^d}$	-.101	-.209	0.166	.118	.286	0.200
$Corr_{f^y,f^d}$	-.092	-.081	-0.259	.173	.114	0.139

Table 2: Moments for Consumption Growth and Human Capital Returns - Constant Wealth Shares.

The left panel uses firm value returns, the right panel uses stock returns. All results are for the full sample 1947.II-2004.III. In each panel, the first column is *Model 2*, with human capital returns implied by $C' = e_1' A$. The second column represents the constant discounter *Model 2* ($C' = 0$), and the third column represents *Model 4* ($C' = e_2' A$). The last column gives the moments of human wealth returns that are consistent with consumption data (equations 6 and 20). Computations are done for $\bar{\nu} = .70$ and $\sigma = .28$. In the data, $V_c = .33$ and $Corr_{c,a} = 0.168$ in panel A and $V_c = .33$ and $Corr_{c,a} = 0.185$ in panel B.

Moments	*Model 2*	*Model 3*	*Model 4*	*Reverse*	*Model 2*	*Model 3*	*Model 4*	*Reverse*
	Panel A: Firm Value Returns				*Panel B: Stock Returns*			
V_{h^y}	32.67	0	.54	107.38	103.7	0	.79	58.37
$Corr_{a,h^y}$	-.477	0	.485	.839	-.918	0	.644	.476
$Corr_{d^y,h^y}$	-.525	0	.752	.324	-.336	0	.735	.704
$Corr_{h^a,h^y}$	1.000	0	-.306	-.037	1.000	0	-.453	-.137
V_y	41.91	1.61	.75	100.46	113.48	1.65	.76	46.22
$Corr_{y,a}$	.487	.337	.081	-.825	.934	.491	.065	-.443
$Corr_{y,h^a}$	-.986	-.525	-.511	-.029	-.994	-.336	-.032	.091
V_c	6.05	4.30	3.95	0.33	7.61	2.49	2.10	.33
$Corr_{c,a}$	.946	.865	.868	.168	.955	.518	.486	.185
V_m	34.52	5.51	4.07	29.45	96.47	7.43	5.16	18.29
$Corr_{m,a}$	.710	.928	.950	-.682	.959	.954	.960	.066
$Corr_{m,y}$	.961	.664	.389	.976	.997	.730	.342	.865
$Corr_{m,h^m}$	-.946	-.587	-.436	-.994	-.988	-.836	-.790	-.991

Table 3: Matching Consumption Moments when $\sigma < 1$

In the first panel, the entries show the sign of the effect of the variance/covariance of (i, j) on the variance of consumption V_c. In the second panel, the entries show the sign of the effect of the variance/covariance of (i, j) on the covariance of consumption $V_{c,a}$.

	a	d^y	h^a	h^y
		V_c		
a	$+$	$+$	$+$	$-$
d^y		$+$	$+$	$-$
h^a			$+$	$-$
h^y				$+$
		$V_{c,a}$		
a	$+$	$+$	$+$	$-$

Table 4: Moments for Consumption Growth and Human Capital Returns - Time-Varying Wealth Shares

This table has the same structure as Table 2,but here computations are done for a time-varying human wealth share ν_t and $\sigma = .28$.

Moments	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 2*	*Model 3*	*Model 4*	*Model 5*
	Panel A: Firm Value Returns				*Panel B: Stock Returns*			
V_{h^y}	32.67	0	.54	69.05	103.07	0	.79	36.38
$Corr_{a,h^y}$	-.477	0	.485	.897	-.918	0	.644	.504
$Corr_{d^y,h^y}$	-.525	0	.752	.452	-.336	0	.735	.874
$Corr_{h^a,h^y}$	1.000	0	-.306	-.152	1.000	0	-.453	-.209
V_y	41.91	1.61	.75	61.13	113.48	1.65	.76	24.50
$Corr_{y,a}$	.487	.337	.081	-.880	.934	.491	.065	-.487
$Corr_{y,h^a}$	-.986	-.525	-.511	.076	-.994	-.336	-.032	.168
V_c	5.65	3.84	3.46	.52	8.00	2.77	2.41	.47
$Corr_{c,a}$	.922	.848	.853	.168	.955	.511	.473	.185
V_m	34.62	5.69	4.21	18.92	96.09	7.75	5.46	10.10
$Corr_{m,a}$	.707	.917	.937	-.759	.961	.939	.937	.067
$Corr_{m,y}$	.961	.667	.392	.971	.996	.736	.353	.825
$Corr_{m,h^m}$	-.948	-.584	-.430	-.987	-.987	-.810	-.748	-.980

Table 5: Euler Equation Errors

The table shows the coefficient of risk aversion γ (first row) that minimizes the root mean squared pricing error on the CRSP value-weighted stock returns and a T-bill return (RMSE in row four). It also shows the average Euler equation errors on the stock return ($error^{st}$) and the T-bill return ($error^{rf}$). For each model, rows five and six report the correlation between model-implied consumption growth and actual consumption growth, and the standard deviation of model-implied consumption growth. The time discount factor is held constant throughout the table at $\beta = .99$. The value for γ is held fixed at the value reported in the first row. In panel A (first six rows), we fix $\sigma = 0.28$. In panel B (the last five rows set), we set $\sigma = 1.12$. The estimation uses the firm value return for r^a. The Euler equation errors are multiplied by 100; they report a percentage error per quarter. A star in the table denotes entries larger than 1000.

	Model 1	*Model 2*	*Model* 2_{TV}	*Model 3*	*Model* 3_{TV}	*Model 4*	*Model* 4_{TV}	*Reverse*	*Model 5*
				Panel A: EIS .28					
γ	3.67	8.74	9.25	9.08	9.77	9.25	10.06	11.64	8.16
$error^{st}$	0.34	0.47	0.50	0.48	0.51	0.48	0.50	0.60	0.81
$error^{rf}$	−0.26	−0.36	−0.39	−0.36	−0.38	−0.36	−0.38	−0.44	−0.73
$RMSE$	0.30	0.42	0.45	0.43	0.45	0.42	0.44	0.53	0.77
$Corr(\Delta c^m, \Delta c^d)$	0.03	0.33	0.35	0.26	0.29	0.24	0.28	1.00	0.87
$Std(\Delta c^m)$	6.17	2.48	2.40	2.09	1.99	2.01	1.89	0.65	1.84
				Panel A: EIS .1.12					
γ	14.64	17.38	17.39	$\sim 1/\sigma$	$\sim 1/\sigma$	$\sim 1/\sigma$	$\sim 1/\sigma$	$\sim 1/\sigma$	7.26
$error^{st}$	−2.62	−0.66	−1.12	0.93	0.93	0.93	0.94	1.01	0.38
$error^{rf}$	2.41	0.65	1.08	−0.95	−0.96	−0.95	−0.97	−1.00	−0.38
$RMSE$	2.52	0.65	1.10	0.94	0.94	0.94	0.95	1.00	0.38
$Corr(\Delta c^m, \Delta c^d)$	0.18	0.30	0.30	0.33	0.35	0.28	0.30	1.00	0.93
$Std(\Delta c^m)$	7.30	6.48	6.54	2.67	2.52	2.33	2.15	0.65	1.36

Table 6: Risk Contributions From c and m - 25 Size and Value Portfolios

The first column gives the average log excess return per quarter, in excess of a 3-month T-bill return (er^{data}). The second column adjusts for the Jensen effect by adding 1/2 times the variance of the log excess return (er^{data}_{adj}). Columns 3-4 give the model's predicted adjusted return ((er^{pred}_{adj})) and the pricing error ($error$). The last three columns give the risk contribution (price of risk times quantity of risk) to the expected excess return of each asset; the first one of which is the market price of risk on a constant (p_0). The assets are the 25 size and book-to-market decile portfolios from Kenneth French. The return measure r^a in the VAR is the firm value return. All numbers are multiplied by 100. Our model is computed for $\sigma = .28$ and time-varying human wealth share.

Portfolio	er^{data}	er^{data}_{adj}	er^{pred}_{adj}	$error$	λ_o	$\lambda_c\beta_{ic}$	$\lambda_m\beta_{im}$
S1B1	0.073	1.296	1.547	−0.251	3.775	1.138	−3.366
S1B2	1.841	2.704	1.900	0.805	3.775	1.158	−3.034
S1B3	2.154	2.800	2.160	0.640	3.775	0.797	−2.412
S1B4	2.792	3.381	2.661	0.720	3.775	0.810	−1.924
S1B5	3.137	3.826	2.566	1.261	3.775	0.845	−2.054
S2B1	0.642	1.602	0.651	0.951	3.775	1.123	−4.247
S2B2	1.813	2.470	1.315	1.156	3.775	0.894	−3.355
S2B3	2.432	2.947	1.854	1.093	3.775	0.773	−2.694
S2B4	2.605	3.103	2.272	0.832	3.775	0.747	−2.250
S2B5	2.975	3.572	2.316	1.256	3.775	0.826	−2.285
S3B1	1.123	1.903	0.995	0.908	3.775	0.947	−3.727
S3B2	1.998	2.505	1.774	0.731	3.775	0.720	−2.721
S3B3	2.105	2.545	2.127	0.418	3.775	0.686	−2.334
S3B4	2.519	2.953	2.465	0.488	3.775	0.638	−1.948
S3B5	2.724	3.261	2.031	1.230	3.775	0.824	−2.568
S4B1	1.425	2.049	1.243	0.806	3.775	0.843	−3.375
S4B2	1.580	2.035	1.581	0.453	3.775	0.662	−2.856
S4B3	2.366	2.758	2.262	0.496	3.775	0.565	−2.078
S4B4	2.331	2.721	2.251	0.470	3.775	0.621	−2.144
S4B5	2.524	3.062	2.178	0.884	3.775	0.808	−2.405
S5B1	1.415	1.824	2.105	−0.280	3.775	0.665	−2.335
S5B2	1.538	1.861	2.088	−0.227	3.775	0.560	−2.246
S5B3	1.925	2.195	2.326	−0.131	3.775	0.556	−2.005
S5B4	1.854	2.149	2.429	−0.280	3.775	0.546	−1.892
S5B5	1.911	2.323	2.490	−0.167	3.775	0.797	−2.082

Table 7: Model Comparison

The table shows the market prices of risk obtained from the cross-sectional regression $\overline{er}^i = \lambda_0 + \lambda_c \beta_{ic} + \lambda_m beta_{im} + \epsilon^i$. The risk exposures (β_{ic}, β_{im}) are obtained from a first step time series regression. Standard errors are Shanken-corrected. The last two lines report the root mean squared pricing error across all portfolios, and the R^2 from the second step regression. The test asset returns are the log real excess returns on the 25 Fama-French size and value portfolios. The estimation uses the firm value return for r^a and $\sigma = .28$ in the upper panel, $\sigma = 1.12$ in the lower panel. All numbers are multiplied by 100.

MPR	*Model 1*	*Model 2*	*Model 2_{TV}*	*Model 3*	*Model 3_{TV}*	*Model 4*	*Model 4_{TV}*	*Reverse*	*Model 5*
					Panel A: EIS .28				
λ_0	4.73	3.73	3.36	3.39	3.22	3.21	3.20	4.26	3.78
σ_{λ_0}	0.83	0.68	0.75	0.82	0.90	1.03	1.10	1.17	0.92
λ_c	-3.24	-0.60	-0.51	0.09	0.32	0.47	0.58	0.58	0.53
σ_{λ_c}	1.51	0.37	0.40	0.55	0.68	0.67	0.78	0.31	0.88
λ_m	-2.25	-2.11	-3.11	-0.70	-0.66	-0.74	-0.73	6.37	11.99
σ_{λ_m}	1.03	1.47	1.73	0.38	0.42	0.39	0.43	2.41	4.75
RMSE	0.82	0.84	0.84	0.83	0.83	0.81	0.80	0.72	0.76
adj. R^2	36.91	30.44	31.13	32.87	35.06	42.67	45.87	63.77	47.33
					Panel B: EIS 1.12				
λ_0	4.29	3.83	3.96	4.25	4.46	4.08	4.69	3.55	2.47
σ_{λ_0}	0.84	0.73	0.81	1.00	1.09	0.82	0.99	0.92	0.65
λ_c	-1.33	-1.44	-0.72	-0.18	-0.00	-0.69	-0.59	0.55	0.22
σ_{λ_c}	1.25	1.27	1.54	0.59	0.65	0.34	0.34	0.30	0.56
λ_m	-2.05	-2.00	-1.71	-0.72	-0.65	-0.60	-0.71	0.89	-0.92
σ_{λ_m}	1.03	1.06	1.13	0.43	0.47	0.30	0.31	0.32	0.96
RMSE	0.83	0.84	0.83	0.81	0.78	0.83	0.83	0.72	0.85
adj. R^2	35.96	30.94	32.02	37.42	45.54	34.70	36.93	64.44	-4.24

Table 8: Moments from Data - Model With Housing

This Table has the same structure as Table 1, except that a and h^a pertain to the return on a portfolio of financial asset returns and housing returns. In the left panel, the financial asset returns in the portfolio are firm value returns; in the right column they are stock returns.

Moments	*Firm Value Returns*	*Stock Returns*
V_a	21.69	28.81
V_{d^y}	1.82	1.79
V_{h^a}	12.99	49.31
$Corr_{a,h^a}$	-.511	-.910
$Corr_{a,d^y}$	.280	.411
$Corr_{d^y,h^a}$	-.463	-.210
V_c	0.343	0.337
$Corr_{c,a}$	0.175	0.186
$Corr_{d^d,d^y}$	-.087	.236
$Corr_{f^d,f^y}$	-.076	.184

Table 9: Moments for Consumption Growth, Human Capital Returns, and the Market Return - Model With Housing.

This Table has the same structure as Table 5.4, except that a and h^a pertain to the return on a portfolio of financial asset returns and housing returns. Computations are done for the model with time-varying human wealth share. The *EIS* is $\sigma = .2789$ and the intratemporal elasticity of substitution between housing and non-housing consumption is $\varepsilon = 0.5$.

	Panel A: Firm Value Returns				*Panel B: Stock Returns*			
Moments	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 2*	*Model 3*	*Model 4*	*Model 5*
V_{h^y}	12.99	0	.53	59.28	49.31	0	.64	35.58
$Corr_{a,h^y}$	-.511	0	.400	.888	-.910	0	.598	.640
$Corr_{d^y,h^y}$	.463	0	.817	.446	-.210	0	.782	.869
$Corr_{h^a,h^y}$	1.000	0	-.296	-.215	1.000	0	-.368	-.328
V_y	19.32	1.82	.75	51.82	55.05	1.79	.75	23.51
$Corr_{y,a}$	.505	.280	.101	-.897	.936	.411	.081	-.673
$Corr_{y,h^a}$	-.962	-.463	-.474	.143	-.984	-.210	.016	.345
V_c	3.73	2.73	2.44	.343	4.78	2.16	1.81	.337
$Corr_{c,a}$	.908	.856	.869	.175	.930	.597	.583	.186
V_m	15.67	4.04	2.94	12.93	44.12	5.40	3.80	6.12
$Corr_{m,a}$	.765	0.896	.935	-.799	.966	.928	.940	-.213
$Corr_{m,y}$	.941	0.671	.435	.980	.995	.709	.387	.857
$Corr_{m,h^m}$	-.916	-.603	-.432	-.991	-.976	-.774	-.718	-.984

Table 10: VAR Estimation - Using Returns on Value-weighted Stock Market Index

This table reports the results from the VAR estimation for the sample 1947.II-2004.III. The asset return is the return on firm value in panel A and the return on the CRSP value-weighted stock market index in panel B. The rows describe the time t variables and the columns the time $t-1$ variables). Newey-West HAC standard errors are in parentheses. The VAR contains 7 elements.

	Firm Value Returns							
Variable	r^a_{t-1}	Δy_{t-1}	dp^a_{t-1}	rtb_{t-1}	ysp_{t-1}	s_{t-1}	Δc_{t-1}	R^2
r^a_t	0.0586	−0.2325	0.0290	−0.9373	−0.1186	−0.1222	−1.1222	6.06
se	(0.0729)	(0.4656)	(0.0216)	(0.5541)	(0.6325)	(0.3086)	(0.8427)	
Δy_t	0.0225	0.2690	−0.0051	0.0752	0.0871	−0.0342	0.3565	27.08
se	(0.0070)	(0.1372)	(0.0034)	(0.0748)	(0.0728)	(0.0462)	(0.1224)	
dp^a_t	0.1024	−1.4521	0.9061	2.2013	0.5850	−0.2164	1.0603	83.01
se	(0.1195)	(0.8278)	(0.0315)	(1.0297)	(0.8820)	(0.4355)	(1.4612)	
rtb_t	0.0125	0.1120	−0.0047	0.5667	0.1514	0.0799	0.0775	33.91
se	(0.0081)	(0.0648)	(0.0029)	(0.1718)	(0.0675)	(0.0494)	(0.0727)	
ysp_t	−0.0045	−0.1037	0.0057	0.0708	0.8058	−0.0522	−0.0190	73.09
se	(0.0084)	(0.0506)	(0.0022)	(0.1488)	(0.0504)	(0.0430)	(0.0694)	
s_t	−0.0010	0.0447	−0.0012	−0.0436	−0.0114	0.9731	0.0153	97.10
se	(0.0027)	(0.0278)	(0.0010)	(0.0319)	(0.0224)	(0.0150)	(0.0313)	
Δc_t	0.0161	0.1972	−0.0023	−0.0581	0.1074	0.0714	−0.0251	20.49
se	(0.0054)	(0.0541)	(0.0024)	(0.0468)	(0.0373)	(0.0323)	(0.1239)	
	Stock Returns							
Variable	r^a_{t-1}	Δy_{t-1}	dp^a_{t-1}	rtb_{t-1}	ysp_{t-1}	s_{t-1}	Δc_{t-1}	R^2
r^a_t	0.0336	−0.0317	0.0479	−0.8253	0.4970	−0.1364	−0.6616	7.31
se	(0.0665)	(0.5057)	(0.0209)	(0.7921)	(0.6978)	(0.3721)	(0.8083)	
Δy_t	0.0206	0.2844	−0.0018	0.0598	0.0450	−0.0246	0.3577	25.97
se	(0.0067)	(0.1330)	(0.0025)	(0.0771)	(0.0640)	(0.0464)	(0.1255)	
dp^a_t	0.0532	0.5213	0.9728	1.3571	−0.0181	0.0971	0.5055	93.17
se	(0.0635)	(0.5221)	(0.0170)	(0.8219)	(0.6439)	(0.3537)	(0.8258)	
rtb_t	0.0153	0.1316	0.0008	0.5591	0.1232	0.1013	0.0956	33.38
se	(0.0082)	(0.0659)	(0.0024)	(0.1686)	(0.0549)	(0.0494)	(0.0710)	
ysp_t	−0.0074	−0.1295	−0.0014	0.0854	0.8384	−0.0776	−0.0495	72.47
se	(0.0076)	(0.0541)	(0.0020)	(0.1486)	(0.0445)	(0.0443)	(0.0679)	
s_t	0.0001	0.0484	−0.0011	−0.0481	−0.0238	0.9722	0.0082	97.11
se	(0.0022)	(0.0272)	(0.0008)	(0.0317)	(0.0215)	(0.0149)	(0.0321)	
Δc_t	0.0140	0.1996	−0.0033	−0.0669	0.0782	0.0652	−0.0473	21.68
se	(0.0046)	(0.0545)	(0.0017)	(0.0478)	(0.0372)	(0.0276)	(0.1260)	

Table 11: Moments from Data: Different Income Measures

The left column uses labor income plus proprietors' income to all employees (BEA). When we include proprietor's income to y, the average labor income share is 0.84 (compared to 0.73 without proprietor's income). The right column uses pay-outs to employees of non-farm, non-financial corporate firms as the measure of labor income. The labor income share is defined as the ratio of pay-outs to employees to the sum of pay-outs to employees and pay-outs to securities holders. The mean in the sample 1947.II-2004.III is 0.92. In both columns, the financial asset return is the return on firm value. The moments for quarterly data are from own calculations for the 1947.II-2004.III. All other symbols are as in Table 1.

Moments	*With Proprietor's Income*	*Non-Fin. Business*
V_a	48.33	47.22
V_{d^y}	2.02	4.18
V_{h^a}	22.71	27.82
$Corr_{a,h^a}$	-.532	-.622
$Corr_{a,d^y}$	.280	.334
$Corr_{d^y,h^a}$	-.467	-.625
V_c	.340	.346
$Corr_{c,a}$	.157	.196
$Corr_{d^y,d^d}$	-.047	-.184
$Corr_{f^y,f^d}$	-.058	-.016

Table 12: Moments for Consumption Growth and Human Capital Returns - Constant Wealth Shares - Annual Data

Same as table 2, but the computations are done for *annual data* over the same period 1947-2004. The parameters are $\bar{\nu} = .7000$ and $\sigma = .2789$.

Moments	*Model 2*	*Model 3*	*Model 4*	*Reverse*	*Model 2*	*Model 3*	*Model 4*	*Reverse*
	Panel A: Firm Value Returns				*Panel B: Stock Returns*			
V_{h^y}	47.44	0	2.83	513.56	231.85	0	1.94	375.48
$Corr_{a,h^y}$	-.487	0	.861	.956	-.760	0	.693	.690
$Corr_{d^y,h^y}$	-.818	0	.676	.529	-.196	0	.767	.579
$Corr_{h^a,h^y}$	1.000	0	-.501	-.307	1.000	0	-.285	-.114
V_y	83.20	6.67	3.62	458.28	254.55	6.95	3.25	323.25
$Corr_{y,a}$	.526	.559	-.003	-.945	.780	.329	-.055	-.696
$Corr_{y,h^a}$	-.987	-.818	-.666	.226	-.987	-.196	-.066	.095
V_c	27.19	20.07	17.55	.68	28.54	15.99	14.04	.64
$Corr_{c,a}$	.963	.975	.975	.163	.943	.695	.691	.208
V_m	83.50	24.63	15.25	125.62	229.92	26.54	18.65	98.37
$Corr_{m,a}$	.784	.949	.934	-.899	.876	.935	.952	-.411
$Corr_{m,y}$	.940	.792	.354	.993	.985	.641	.252	.941
$Corr_{m,h^m}$	-.915	-.670	-.169	-.997	-.969	-.691	-.587	-.997

Table 13: Moments for Consumption Growth and Human Capital Returns - Model 5 - Sensitivity to *EIS*.

The table reports the same moments as Table 2. All results are for Model 5 with time-varying human wealth share. The first column is for $\sigma = .5$, the second column is for $\sigma = 1$, and the last column is for $\sigma = 1.5$. The sample is 1947.II-2004.III. Financial asset returns are firm value returns in panel A and stock returns in panel B.

Moments	$\sigma = .5$	$\sigma = 1$	$\sigma = 1.5$	$\sigma = .5$	$\sigma = 1$	$\sigma = 1.5$
	Panel A: Firm Value Returns			*Panel B: Stock Returns*		
V_{h^y}	24.36	8.59	5.91	18.10	12.58	11.81
$Corr_{a,h^y}$	.941	.967	.914	.791	.956	.978
$Corr_{d^y,h^y}$	.466	.561	.604	.751	.704	.643
$Corr_{h^a,h^y}$	-.280	-.588	-.757	-.512	-.809	-.905
V_y	20.14	6.02	3.79	11.55	7.82	7.79
$Corr_{y,a}$	-.940	-.980	-.922	-.805	-.987	-.978
$Corr_{y,h^a}$	.159	.430	.603	.515	.872	.960
V_c	.33	.33	.33	.33	.33	.41
$Corr_{c,a}$	.168	.168	.168	.185	.185	.185
V_m	3.12	.33	.82	2.21	.33	.66
$Corr_{m,a}$	-.719	.168	.614	.032	.185	.188
$Corr_{m,y}$	.895	-.036	-.318	.546	-.116	-.056
$Corr_{m,h^m}$	-.947	.199	.779	-.925	-.052	.625

Table 14: Moments for Consumption Growth and Human Capital Returns - Model 5 - Sensitivity to Income Measures

The left column includes proprietor's income. The right column uses pay-outs to employees of non-financial corporate business. See Table 11. All results are for the full sample 1947.II-2004.III. Computations are done for time-varying wealth share and $\sigma = .2789$. Financial asset returns are returns on total firm value.

Moments	*model*	*data*	*model*	*data*
	With Proprietor's Income		*Non-Fin. Business*	
V_{h^y}	30.58		33.44	×
$Corr_{a,h^y}$	.828		.628	×
$Corr_{d^y,h^y}$	.643		.937	×
$Corr_{h^a,h^y}$	-.346		-.720	×
$Corr_{y,a}$	-.882		-.751	×
$Corr_{y,h^a}$	.264		.733	×
V_y	22.49		15.46	×
V_c	.340	.340	.346	.346
$Corr_{c,a}$	.157	.157	.196	.196
V_m	9.49		10.29	×
$Corr_{m,a}$	-.783		-.654	×
$Corr_{m,y}$	.981		.988	×
$Corr_{m,h^m}$	-.984		-.992	×

Table 15: VAR Estimation with Job Reallocation

This table reports the results from the VAR estimation for the sample 1947.II-2004.III. The asset return is the return on firm value in panel A and the return on the CRSP value-weighted stock market index in panel B. The rows describe the time t variables and the columns the time $t-1$ variables. Newey-West HAC standard errors are in parentheses. The VAR contains 7 elements. The 7th element is the employment NAPM diffusion index ($Diff^{NAPM}$).

	Firm Value Returns							
Variable	r^a_{t-1}	Δy_{t-1}	dp^a_{t-1}	rtb_{t-1}	ysp_{t-1}	s_{t-1}	$Diff^{NAPM}_{t-1}$	R^2
r^a_t	0.042	−0.276	0.027	−0.735	−0.144	−0.206	−0.076	5.70
	[0.071]	[0.605]	[0.024]	[0.579]	[0.643]	[0.315]	[0.103]	
Δy_t	0.026	0.029	−0.003	−0.182	0.036	−0.057	0.087	43.29
	[0.008]	[0.129]	[0.003]	[0.072]	[0.063]	[0.039]	[0.016]	
dp^a_t	0.124	−0.028	0.899	3.074	0.922	0.078	−0.271	83.41
	[0.119]	[0.914]	[0.033]	[1.115]	[0.864]	[0.404]	[0.136]	
rtb_t	0.014	−0.030	−0.003	0.415	0.112	0.077	0.046	39.15
	[0.008]	[0.061]	[0.003]	[0.193]	[0.074]	[0.049]	[0.018]	
ysp_t	−0.005	0.015	0.004	0.188	0.839	−0.047	−0.035	74.87
	[0.008]	[0.055]	[0.002]	[0.177]	[0.055]	[0.042]	[0.015]	
s_t	−0.001	0.014	−0.001	−0.072	−0.022	0.960	0.009	97.33
	[0.003]	[0.034]	[0.001]	[0.044]	[0.022]	[0.016]	[0.006]	
$Diff^{NAPM}_t$	0.195	0.447	−0.013	−0.250	0.897	0.423	0.759	64.81
	[0.053]	[0.499]	[0.020]	[0.546]	[0.404]	[0.252]	[0.072]	
	Stock Returns							
Variable	r^a_{t-1}	Δy_{t-1}	dp^a_{t-1}	rtb_{t-1}	ysp_{t-1}	s_{t-1}	$Diff^{NAPM}_{t-1}$	R^2
r^a_t	0.031	0.177	0.049	−0.484	0.536	−0.138	−0.110	7.65
	[0.066]	[0.665]	[0.022]	[0.837]	[0.702]	[0.379]	[0.110]	
Δy_t	0.020	0.037	−0.002	−0.195	0.008	−0.054	0.086	41.98
	[0.007]	[0.130]	[0.002]	[0.070]	[0.063]	[0.040]	[0.015]	
dp^a_t	0.052	0.102	0.973	0.799	−0.103	0.101	0.166	93.18
	[0.063]	[0.649]	[0.018]	[0.834]	[0.630]	[0.357]	[0.104]	
rtb_t	0.015	−0.018	0.001	0.409	0.098	0.093	0.047	38.99
	[0.008]	[0.061]	[0.002]	[0.185]	[0.060]	[0.049]	[0.018]	
ysp_t	−0.007	−0.002	−0.002	0.207	0.860	−0.069	−0.038	74.57
	[0.007]	[0.055]	[0.002]	[0.174]	[0.048]	[0.044]	[0.016]	
s_t	−0.001	0.016	−0.001	−0.078	−0.032	0.960	0.010	97.33
	[0.002]	[0.034]	[0.001]	[0.044]	[0.022]	[0.016]	[0.006]	
$Diff^{NAPM}_t$	0.189	0.486	−0.006	−0.204	0.791	0.477	0.751	65.23
	[0.037]	[0.476]	[0.014]	[0.506]	[0.296]	[0.250]	[0.066]	