

The Value of Human Capital Wealth*

Julian di Giovanni
International Monetary Fund

Akito Matsumoto
International Monetary Fund

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Abstract

The value of human capital wealth and its return process are important to quantify in order to study consumption behavior and portfolio allocation. This paper introduces a new approach to measure the value of an economy's total human capital wealth. By assuming that the consumption-to-wealth ratio is constant, we exploit aggregate consumption data to recover total wealth, and then use household non-human capital wealth data to recover the value of human capital wealth as a residual. Using U.S. data over the period 1952–2007, we find that human capital is approximately three-quarters of total wealth in the aggregate economy, and that this ratio is remarkably stable over time. Applying our methodology to a group of OECD countries yields similar results. We estimate the cointegrating relationship between our estimated measure of human wealth and labor compensation (income) to show that our consumption-based approach estimate of human capital is linked to one based on a labor-income approach. We next calculate the returns to human capital and find them to be as high as equity returns on average but much less volatile; positively correlated with returns on real estate and consumption growth, but negatively correlated to equity returns. Finally, we show that human capital returns are predictable by their dividend-to-price ratio.

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1 Introduction

The largest component of a private household's wealth is probably its human capital. This asset plays an important role in an agent's consumption and portfolio allocation decisions, among other economic choices. The relative contribution to total wealth, and the return process of human capital are therefore important to quantify in order to study consumption behavior in response to different shocks (e.g., to wealth), as well as the relationship between real and financial variables.

Modigliani (1971) emphasizes the important role of the wealth effect as a main linkage between monetary policy and consumption, while Lettau and Ludvigson (2004) revisit the empirical estimates of the consumption-wealth link. Studies have also examined the impact of shocks to specific components of wealth, such as housing or equity, on consumption.¹ Results have been mixed, but this is not surprising given that the reaction of private consumption to wealth shocks will depend on how each asset price comoves with the shadow price of human capital, which is difficult to control for. More generally, a household's consumption should be based on the value of its wealth, not its current income. In this sense, it is better to know the value of human capital rather than simply labor income in order to understand consumption behavior.² This point is also true for portfolio allocation. Without knowing the value and return process of each asset, it is very difficult to evaluate optimal asset allocation, and ignoring human capital can lead to incorrect conclusions, as first pointed out by Roll (1977).³ Providing a reliable series of the current value of human capital over time is therefore important to understand consumption behavior and portfolio decisions, yet few such measures exist.

We propose to fill this gap by providing a simple methodology. Our approach relies on the assumption that consumption decisions will be based on agents' current valuation of their human wealth and the market value of their non-human capital assets. In order to calculate total wealth using consumption data, we then rely on the stronger assumption that the consumption-to-wealth ratio is constant. Finally, we subtract total non-human capital assets from total wealth to recover the value of human capital wealth as a residual. The computed value of human capital can also be thought of as the expected discounted value of a stream of future labor income, just like a stock price captures the expected value of a future stream of dividends.

The assumption of a constant consumption-to-wealth ratio may be viewed as too simplistic.

¹See Case, Shiller and Quigley (2005), Dynan and Maki (2001), Carroll, Otsuka and Slacalek (2006), and Calomiris, Longhofer and Miles (2009) among others.

²Even expected future labor income is not enough to reveal the value of human capital as the value also depends on a (time varying) discount factor.

³Roll (1977) claims that the true 'market portfolio' cannot be measured without knowing human capital. In response, Campbell (1996), Jagannathan and Wang (1996), Lettau and Ludvigson (2001), Viceira (2001) and others explicitly include labor income in the model.

However, this assumption is a result of many commonly-used macroeconomic models.⁴ Furthermore, in making it, we can avoid several issues arising in traditional approaches to the estimation of the value of human capital, as well as problems faced by modern finance approaches. First, as with stock price valuation, discounting future labor income with a constant discount rate will probably not provide a good estimation of human capital wealth, since the discount rate fluctuates quite a lot (Campbell 1991). Second, getting reliable estimates of the expected labor income stream is not easy. Based on the assumption that the consumption decision is based on the valuation of human capital as well as non-human capital of households, our approach side-steps these difficulties by inferring the value of human capital directly. In addition, our methodology can be easily applied across countries or individuals. Finally, though it is simple, we are not aware of anyone applying our suggested approach in order to calculate the value of human capital. Thus, we provide one more set of human capital estimates, which look reasonable in many respects.

We apply our methodology to quarterly and annual U.S. data over the period 1952–2007. The approach yields some interesting results. First, the human capital to total wealth share is about three-quarters on average, which roughly corresponds to the share of labor compensation in national income. This result is surprising given that our methodology does not rely on any compensation data. Moreover, many existing estimates of human capital wealth shares do not match this simple metric. Second, we consider the relationship between human capital and its income stream, labor compensation. The two series are cointegrated. This finding is analogous to the relationship between dividends and stock prices, and provides empirical support for the *cay* approach introduced by Lettau and Ludvigson (2001), who argue that labor income is the only permanent component of human capital wealth.

We next investigate the basic properties of the returns to human capital and their joint behavior with other asset returns. Human capital returns are remarkably stable over time relative to other asset returns. They are positively correlated with some classes of non-human capital asset returns such as housing, real bonds, and T-bills, but negatively correlated with domestic equity returns.⁵

⁴For example, an elasticity of intertemporal substitution of unity under Epstein-Zin-Weil utility, which includes a log utility, yields a constant ratio. In this case, the ratio will equal one minus the subjective discount factor, so it is straightforward to calculate total wealth from consumption data given a discount factor. Alternatively, it is possible to generate a constant consumption-to-wealth ratio with a non-unitary elasticity of intertemporal substitution by assuming returns are i.i.d.. Though the assumption of i.i.d. returns is at odds with empirical evidence supporting predictability, we believe any approximation error from this mis-specification would be small. This concern of return predictability is smaller for lower frequency data, such as the quarterly and annual data we use. In addition, the consumption-to-wealth ratio is still quite stable as previous research has shown (Campbell 1993, Campbell and Koo 1997) under the assumption of an AR(1) return process.

⁵Interestingly, when we use nominal returns instead of real returns, the correlation between the long bond and human capital returns is negative, though it is positive when the sample is constrained to 1990–2007. Given that our human capital returns are negatively correlated with equity returns, this result corresponds to Campbell, Sunderam and Viceira (2009), who find that the covariance between U.S. Treasury bond returns and stock returns has moved

We interpret these results as evidence that human capital, like (real) bonds or housing, provides relatively reliable cash flows. The correlation between human capital and housing excess returns is striking: 0.42 at the quarterly frequency, and 0.82 at the annual frequency. This finding might potentially explain why studies often find that the wealth effect for housing is larger than that of equity, as changes in housing prices might also capture changes in the value of human capital wealth, which are not captured by labor income. We also examine whether human capital returns can be predicted by their dividend-to-price ratio (the wage-to-human capital wealth ratio) and find that they are indeed, and that the results are strongest for longer forecast periods. These results are akin to what Campbell and Shiller (1988) find for stock returns.

We also provide calculations for a group of ten OECD countries using a recently constructed database on household assets, and find that on average a country's human capital to total wealth ratio is 69.8 percent, with the Czech Republic having the highest ratio of 85.7 percent and Japan having the lowest ratio of 60.4 percent. The database only provides annual data for a maximum of eleven years, but we calculate human capital returns and compare them to domestic equity market and housing price returns. Results are heterogeneous across countries, but the correlation with equity (housing) returns is negative (positive) for the majority of countries.

One can think of our measure as being related to the quantity of human capital in an analogous manner as the market value of physical capital, the stock price, is related to its *book value*.⁶ Several approaches to estimate the quantity or book value of human capital have been proposed. For example, the number of years of education or educational spending are often used to proxy for human capital. By considering education spending or the cost of rearing for children, early work by Kendrick (1976) presents a time series of the book value of human capital in the United States using a cost-based approach. However, using cost-based measures is problematic when studying consumption or asset allocation decisions because these proxies ignores the cash flow streams that human capital can generate. Labor income is therefore often used to estimate the value of human capital in macroeconomics and finance. Jorgenson and Fraumeni (1989) estimate shadow values of human capital using an income-based approach, where income is broadly defined as all market and non-market activity.⁷ This approach would be a good one if the econometrician knows the path of the future labor income stream and the discount factor as accurately as economic agents; however, given the potential uncertainty of this stream and the difficulty in valuing long-lived assets, this methodology can also be problematic.⁸ In addition, the Jorgenson and Fraumeni's approach

considerably over time from positive to negative.

⁶We do not have a good measure of the quantity of human capital. Therefore, we cannot compute the "q" of human capital in a similar manner that the investment literature computes the average Tobin's Q for physical capital.

⁷See Le, Gibson and Oxley (2003) for a review of the cost- and income-based approaches.

⁸An analogous example exists in the asset pricing literature, when the level of current stock prices cannot be well

calculates the book-value of human capital rather than its current value, which is what is relevant for rational agents making consumption decisions (based on their current information set). We compare our estimates of human capital to these previous estimates. Our results match up with them surprisingly well in terms of average growth rates but correlations are not very high.⁹ This result is similar to the relationship between the market and book values of physical stock: they exhibit a strong long-run relationship, but differ in their short-run fluctuations.

Finally, our work complements some interesting recent research in the finance literature. Lustig and Van Nieuwerburgh (2008) also investigate the time series properties of human capital and stock market returns. They find a negative relationship between human capital and equity returns.¹⁰ We also find this negative correlation although our approach is quite different. A crucial difference is that Lustig and Van Nieuwerburgh use labor income data as a proxy for human capital assuming that labor income is the only permanent component of human capital process as in Lettau and Ludvigson (2001). They then decompose human capital returns into cash flow news and discount news by estimating a vector error correction model, using changes in log real financial wealth, real labor income growth, three return predictors (the log dividend price ratio, the relative T-bill return, and the yield spread), labor income share, and real consumption growth. In this paper, they estimate the share of human capital close to 80 percent.

In a paper more closely related to our work, Lustig, Van Nieuwerburgh and Verdelhan (2008) estimate the evolution of the consumption-to-wealth ratio. While their work also aims at understanding consumption behavior by seriously considering the role of human capital, they take the challenging approach of calculating human capital wealth as the discounted sum of future labor income, where labor income growth and the stochastic discount factor (SDF) are estimated using a structural vector autoregression (SVAR). This approach faces several technical challenges that can potentially undermine the reliability of the estimates. First, the estimates of human capital depend on many parameters estimated by the SVAR, which in turn assumes that the economic structure underlying the estimation remains constant over the sample period. However, the dynamic relationships in the data may have changed over time due to financial innovations, monetary policy regime shifts, and the regulatory changes in labor markets and government transfers.¹¹ Second, given market frictions – particularly affecting labor income – the intertemporal Euler equation may not hold exactly (He and Modest 1995). While this Euler equation wedge makes the SDF approach

explained by dividends or earnings without also including the lagged value of stock prices.

⁹We expect levels to differ given the different approaches taken.

¹⁰Boyd, Hu and Jagannathan (2005) also find that unemployment news is good news for the stock market on average.

¹¹As the state vector contains the short rate, real activity, and inflation, the potential shift of the monetary policy regime during Lustig et al.'s sample period is the biggest concern.

less desirable, and invalidates the no-arbitrage framework, Lustig et al.’s estimation may still be a good approximation as their approach admits a time-varying discount factor. Though the methodologies employed in these papers and our work differ substantially, the underlying definition of the value of human capital is similar, so we view our results as complementary to these papers.

The remainder of the paper is organized as follows. Section 2 provides a simple theoretical framework to motivate the assumption of a constant consumption-to-wealth ratio, and discusses under what conditions it is valid. Section 3 presents the methodology for constructing a measure of human capital, and the data we use. Section 4 presents the main results. Section 5 concludes.

2 Theoretical Motivation

Our empirical measure of human capital is derived from the assumption that the consumption-to-wealth ratio is constant. This assumption holds in models for several special cases, which are often studied by macroeconomists. We first review conditions for the consumption-to-wealth ratio to be constant, and then discuss the validity of our approach when the ratio is time varying. We base our discussion around the results derived by Campbell (1993).¹² Note, however, that our estimates of the value of human capital wealth do not depend on any particular assumption made in the model below; rather, we want to demonstrate that the constant consumption-to-wealth ratio is a reasonable assumption as a starting point.

2.1 The Consumption-to-Wealth Ratio

We study an infinitely lived representative agent framework to motivate cases when the consumption-to-wealth ratio is constant.¹³ This implies that our methodology is better thought of as an approximation for aggregate human capital rather than individual levels, although our methodology can potentially be used for the individual level.¹⁴

The household maximizes the following objective function (Epstein and Zin 1989, 1991, Weil 1989):

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

where C_t is consumption, σ is the elasticity of intertemporal substitution, and γ is the coefficient of relative risk aversion. If $\sigma = 1/\gamma$, then this Epstein-Zin-Weil utility function is simplified to a

¹²See also Campbell and Mankiw (1989) for a similar derivation.

¹³See Appendix A for a detailed derivation of the following results.

¹⁴Examining the individual level will be complicated by the fact that the consumption-to-wealth ratio may vary with age in a more realistic model. By adopting a representative agent (non-overlapping generation) model in the present paper, we are implicitly assuming that this demographic effect does not have a large impact on the aggregate estimates.

time-separable constant relative risk averse utility function.

The representative household's budget constraint is

$$W_{t+1} = R_{m,t+1}(W_t - C_t), \quad (2)$$

where W_t is total wealth at the beginning of period and $R_{m,t+1}$ is the gross simple return on total wealth from time t to $t + 1$. Log-linearizing (2) and taking conditional expectation yields

$$c_t - w_t = E_t \sum_{j=1}^{\infty} \rho^j (r_{m,t+j} - \Delta c_{t+j}) + \frac{\rho k}{1 - \rho}, \quad (3)$$

where lower cases denote the logarithm of the variable, $\rho = 1 - \exp\{\ln(\frac{C}{W})\} = \frac{W-C}{W}$ is the steady-state invested wealth (wealth after consumption, $W - C$) to total wealth (W) ratio, and $k = \ln \rho - \left(1 - \frac{1}{\rho}\right) \ln(1 - \rho)$.

The intertemporal Euler equation can be written as

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

which Campbell (1993) shows can be approximated and rearranged as

$$E_t \Delta c_{t+1} = \mu_{m,t} + \sigma E_t r_{m,t+1}, \quad (4)$$

where $\mu_{m,t} = \sigma \ln \beta + \frac{1}{2} \frac{1-\gamma}{\sigma-1} \text{Var}_t [\Delta c_{t+1} - \sigma r_{m,t+1}]$.

Combining equations (3) and (4) yields the following expression for the (log-linearized) consumption-to-wealth ratio:

$$\begin{aligned} c_t - w_t &= E_t \sum_{j=1}^{\infty} \rho^j (r_{m,t+j} - \Delta c_{t+j}) + \frac{\rho k}{1 - \rho} \\ &= (1 - \sigma) E_t \sum_{j=1}^{\infty} \rho^j r_{m,t+j} - \sum_{j=1}^{\infty} \rho^j \mu_{m,t+j} + \frac{\rho k}{1 - \rho}. \end{aligned} \quad (5)$$

It can be shown that the consumption-to-wealth ratio is constant if either of the two following cases hold:

- **Case 1:** The elasticity of intertemporal substitution is unity ($\sigma = 1$), or
- **Case 2:** Asset returns are i.i.d..

When $\sigma = 1$ as in Case 1, the consumption-to-wealth ratio is constant as the first term drops out and $\mu_{m,t+j}$ becomes constant in (5). If returns are i.i.d., as in Case 2, then $\mu_{m,t}$ and $\sigma E_t r_{m,t+1}$

are constant, which implies that consumption follows a random walk with trend as studied by Hall (1978).

If either Case 1 or Case 2 hold then the constant ratio should be at its steady-state level, $1 - \rho$, at any t :

$$c_t - w_t = \ln(1 - \rho). \quad (6)$$

In particular, it is well known that when $\sigma = 1$, then $\rho = \beta$, or equivalently the consumption-to-wealth ratio, C_t/W_t , equals $1/(1 - \beta)$ without approximation. While the above assumptions may not always hold empirically, we believe that our method will at least provide a good approximation of the value of human capital, as we explain in the following section.

2.2 Empirical Strategy

To study conditions under which the assumption of a constant consumption-to-wealth ratio will be badly misspecified and how large errors will be, begin by writing total wealth as a constant multiple of consumption

$$W_t = \kappa C_t, \quad (7)$$

where κ is a positive constant. Further, note that total wealth is the sum of human and non-human capital wealth, which implies that

$$H_t \equiv W_t - K_t = \kappa C_t - K_t, \quad (8)$$

where H_t and K_t are human and non-human capital, respectively, at the beginning of time t . Equation (8) is the basis for all our human capital estimates. In particular, we build estimates of H_t assuming that the intertemporal rate of substitution is unity ($\sigma = 1$) and $\beta = 0.95$. This corresponds to Case 1 above, and implies that $\kappa = 1/(1 - \beta) = 20$. Estimates of the intertemporal elasticity range widely, but $\sigma = 1$ is frequently used in calibrations given the relative success that this parameter value has in helping models match macroeconomic data.

The first potential departure from our baseline estimation is that the elasticity of intertemporal substitution, σ , need not be unity, implying a potentially time-varying consumption-to-wealth ratio. However, as long as returns are i.i.d. (Case 2), κ will still equal some constant. This constant depends on various factors (e.g., the return process), so we investigate how large the deviations in our estimates of human capital are when $\sigma \neq 1$ but Case 2 holds by constructing two alternative estimates based on κ equal to 16.67 and 25. These values seem reasonable given that the mean optimal consumption ratio calibrated by Campbell (1993) and Campbell and Koo (1997) roughly translates into a range of $\kappa = 12$ to $\kappa = 24$ when the elasticity of intertemporal substitution is

below 2.¹⁵ Note that these values would imply (annualized) β 's = 0.94 and 0.96 if Case 1 held as $\kappa = 1/(1 - \beta)$ if σ is unity. Thus, these alternative values of κ also provide robustness checks for different values of β . As we show later, our main results are robust to these deviations.

Finally, we consider a general case of a time-varying consumption-to-wealth ratio, when neither Case 1 nor Case 2 need hold. To examine this case, we allow for the true consumption-to-wealth ratio to deviate from the measure implied by our assumption by some error, ϵ_t . Specifically, define the true time-varying consumption-to-wealth ratio as $C_t/W_t^* = \kappa_t = (1 + \epsilon_t)\kappa$, where ϵ_t is some deviation of κ from its constant value, and W_t^* is true total wealth. The true human capital is therefore $H_t^* = \kappa_t C_t - K_t$, while our estimate (under a constant consumption-to-wealth ratio) is $H_t = \kappa C_t - K_t$. Therefore, the log deviation of measured human capital from its true value will be

$$\ln(H_t) - \ln(H_t^*) \approx \frac{\overline{W}}{\overline{H}} \epsilon_t, \quad (9)$$

where an overbar indicates the mean of the variable. Unless the standard deviation of ϵ_t is large, our estimates of the level of human capital are reliable. We cannot assign a value to this variance, but even the consumption-to-non-human capital wealth ratio (that is C_t/K_t in our notation) is relatively smooth as its log standard deviation is 7.9 percent over our sample period. This standard deviation is most probably on the high side for ϵ_t , since it would take this value when human capital is perfectly correlated with non-human capital.

The growth rate of human capital might be less reliable than its level since $\Delta H_t - \Delta H_t^* \approx \frac{\overline{W}}{\overline{H}}(\epsilon_t - \epsilon_{t-1})$, which includes two noise terms. However, if ϵ_t is persistent this effect may be dampened. In particular, suppose that $\epsilon_t = \rho \epsilon_{t-1} + \xi_t$. Holding the variance of the time-varying ratio constant: $\text{Var}(\epsilon_t) = \sigma_\epsilon^2$, the variance of the errors of the growth rate is $\text{Var}(\Delta H_t - \Delta H_t^*) \approx \left(\frac{\overline{W}}{\overline{H}}\right)^2 \times 2(1 - \rho)\sigma_\epsilon^2$.¹⁶ This implies that the variance will be lower as ρ is larger (i.e., ϵ_t is more persistent), which implies that the estimated value of the human capital growth rate will not deviate from its true value dramatically.¹⁷

Turning to the statistical properties of estimated human capital, equation (9) also implies that the long-run properties of human capital, such as the average ratio, or tests based on the long-run properties, such as cointegration tests, will be reliable if ϵ_t is a zero-mean stationary process.¹⁸

¹⁵Campbell (1993) and Campbell and Koo (1997) also find values of κ well out of this range when assuming that the elasticity of intertemporal substitution is above 2. However, these values are most probably on the high side. See a recent study by Yogo (2004), for example, which indicates that the elasticity of intertemporal substitution is below unity.

¹⁶ $\text{Var}\{\epsilon_t - \epsilon_{t-1}\} = \text{Var}\{-(1 - \rho)\epsilon_{t-1} + \xi_t\} = (1 - \rho)^2\sigma_\epsilon^2 + \sigma_\xi^2 = 2(1 - \rho)\sigma_\epsilon^2$, since $\sigma_\xi^2 = (1 - \rho)^2\sigma_\epsilon^2$.

¹⁷If one uses C_t/K_t to estimate the process, ρ is 0.986 in quarterly data.

¹⁸We do not know any work suggesting that ϵ_t is nonstationary. Note that our wealth measure includes human capital that can include unemployment benefit or social security benefits, which make it less likely that ratio is nonstationary.

Given that a zero mean is not guaranteed, we use different values of κ to see if results are sensitive. The average growth rate of human capital will also be especially reliable if ϵ_t is persistent. However, correlations of this growth rate with other asset returns need to be interpreted cautiously if the error is systematically correlated with other variables (e.g., changes in the stock market systematically affect the consumption-to-wealth ratio over time).

3 Data and Human Capital Calculations

3.1 Human Capital Wealth

The measurement of human capital requires two variables and one parameter: (1) household consumption data, (2) total household non-human capital wealth data, and (3) a value of κ . We collect these data at a quarterly and annual levels for the U.S. for 1952–2007, and take the end-of-period for stock variables. The use of annual data is an important robustness check for our quarterly estimates given that it is possible that consumption will not adjust immediately to movements in wealth in a given quarter. Given data constraints, we can only collect these data for a shorter horizon (1995–2007), annually, for other OECD countries. We also collect returns of other domestic non-human capital assets. As OECD data are too short to estimate reliable relationships between human capital and other assets' returns, the majority of our analysis on returns is confined to U.S. data only.

U.S. consumption data are collected from NIPA, and we use total population to create per-capita measures. Following Lettau and Ludvigson (2001), we generate a consumption series by multiplying the sum of nondurable and service consumption by a constant scale factor, which is the average ratio of total consumption to nondurable and service consumption over the time series.¹⁹ We also generate values of human capital based on total consumption. The use of NIPA data constrains our human capital measure to consumption related only to market activity. Non-market activity related to human capital estimates might be significantly larger as Jorgenson and Fraumeni (1989) point out. In contrast, some of the consumption in NIPA, such as education spending, may be treated as investment to human capital. This would *reduce* consumption and in turn reduce total wealth and the value of human capital, as well as the share of human capital in total wealth.

We also follow Lettau and Ludvigson (2001) and use the net worth of households (and nonprofit organizations) from the Flow of Funds as our measure of non-human capital, K_t . We use the net worth series from the Flow of Funds as we want to cover a wide variety of assets and liabilities such as real estate, insurance, deposits, portfolio holdings, pensions, life insurance and mortgages. While some researchers question the quality of the Flow of Funds data because some accounts are

¹⁹We include all categories of services and nondurables.

measured at book value,²⁰ such as non-corporate business, this series accounts for roughly only 10 percent of household assets or 13 percent of net worth. Meanwhile, most of the other series including real estate and deposits, which are priced as market value, are important in our analysis. For our analysis it is essential to cover as much non-human capital asset data as possible, because underestimating these assets would correspond to overestimating human capital wealth.

Since the Flow of Funds data are end-of-period outstanding data, we use next period consumption to generate end-of-period estimate of total wealth. For example, the year-2000 estimate of human capital is κ times year-2001 consumption minus year-2000 net worth. As a result our annual and quarterly estimates do not match exactly, since human capital wealth corresponds to the end of period. Note that we continue using beginning of period notation in what follows.

For international comparison, we rely on OECD national accounts for consumption, population, and financial asset data, and merge these with an OECD households' asset database.²¹ The latter database is far from complete, but some countries provide non-financial (non-human) assets. Countries started to report to this database in 2007, with data going back to 1995 for most countries.²²

3.2 Construction of Returns on Human Capital and Other Assets

In order to calculate returns on human capital, we interpret human capital as a discounted sum of future human capital income, Y_{t+s} :

$$H_t = E_t \sum_{s=0}^{\infty} D_{t,t+s} Y_{t+s}, \quad (10)$$

where $D_{t,t+s}$ is the discount rate. Note that Y_t can include unemployment benefits and government transfers as well as labor income.

When evaluating the value of human capital, it is important to recognize that the discount rate is time-varying. In the past, the focus of the asset pricing literature was on cash flows; however, as Campbell (1991) points out, the source of stock price fluctuations are largely due to changes in the discount rate.

While the human capital wealth calculation does not require human capital income data, we do need them to calculate total returns. We use labor compensation from NIPA Table 2.1 and OECD national accounts. We adjust human capital income by adding net household transfers

²⁰For example, Lustig et al. (2008), who estimate a human capital to total wealth share of 87 percent, and that non-human wealth is 70 percent larger than that calculated using Flow of Funds data on average. In our case, any undervaluation of net worth would result in a lower share of human capital by construction.

²¹The country sample includes Austria, Canada, Czech Republic, Germany, France, the United Kingdom, Italy, Japan, Netherlands, and the United States.

²²See <http://stats.oecd.org/wbos/Index.aspx> for the household asset database.

to the government and subtracting taxes using NIPA data in order to arrive at a final value for human capital income.²³ In total, we present three different series for the total returns on human capital given different definitions of labor compensation: (1) compensation of employees received (W209RC1); (2) calculation (1) plus current transfers (A577RC1) less Contributions for government social insurance (A061RC1); and (3) calculation (2) less taxes.²⁴ Then, the total return to human capital is defined as

$$\ln(R_{t+1}^H) \equiv \ln(H_{t+1} + Y_t) - \ln(H_t), \quad (11)$$

where Y_t is human capital income (labor compensation). Note that our definition of total returns to human capital ignores investment, which would have to be netted out from total returns. However, undertaking this calculation is difficult given that there is a large component of *non-market* investment, which we are unable to measure. Therefore, to remain consistent with consumption data, and our concept of a market-based valuation of human capital, we abstract from human capital investment.²⁵ As we do not consider human capital investment decisions, the human capital wealth estimates should be viewed as claims on the cash flows of an average individual (like the equity of a firm, where shareholders leaves the firm's investment decision to the managers). Therefore, the estimated human capital returns cannot be compared to returns to education.²⁶

We also calculate the total returns on the non-human capital assets:

$$\ln(R_{t+1}^K) \equiv \ln([K_{t+1} - S_t] + Y_t^K) - \ln(K_t), \quad (12)$$

where S_t is savings and Y_t^K is after tax non-human capital income of households. $K_{t+1} - S_t$ is the value of non-human capital at the beginning of $t + 1$, which is carried over from time t and captures the capital gain at time t .²⁷ Again, in order to be consistent with national account data, we take households' investment in non-human capital, S_t , into account.

Finally, we calculate the total return on total wealth:

$$\ln(R_{t+1}^m) \equiv \ln(W_{t+1} + C_t) - \ln(W_t) = \ln(\kappa C_{t+1} + C_t) - \ln(\kappa C_t). \quad (13)$$

²³We did not have the necessary data to make adjustments to the OECD data.

²⁴Similar to Lettau and Ludvigson (2001, 2004), we create "after-tax income" as labor compensation plus current transfer - contributions for government social insurance - TAX, where TAX = Personal current taxes (W055RC1) \times [labor compensation/(labor compensation+ Proprietors' income (A041RC1) + Rental income (A048RC1) + Personal income receipts on assets (W210RC1))].

²⁵Adjusting human capital investment, by subtracting education spending from consumption, for example, would reduce total returns to human capital.

²⁶There are some papers that consider human capital investment and financial asset in an integrated manner. For example, Palacios-Huerta (2003) considers the risk and return of human capital investment together with financial asset returns. See also Card (1999) for a survey of papers that study the returns to human capital investment (e.g., education).

²⁷For calculation purposes, we use $C_t - Y_t$ in the place of $-S_t + Y_t^K$. Observe that $-S_t + Y_t^K = -(Y_t + Y_t^K - C_t) + Y_t^K$.

We also calculate returns for categories of non-human capital assets. These returns are based on indices of total returns or asset price increases; therefore, the tight link with returns calculated from the national accounts is broken for these series. We use CRSP (AMEX+NYSE) for domestic equities,²⁸ MSCI-EAFE dollar total return index for foreign equity, and the Barclays (Lehman) treasury long-bond index for the long-term bond.²⁹ We calculate returns on real estate based on the Office of Federal Housing of Enterprise Oversight housing price index (classic). Housing price returns are understated compared to other assets. Due to data limitations, we cannot estimate the total return, which would require a reliable series of imputed rents to calculate the dividend component of housing.

4 Results

This section presents estimates of the human capital wealth series, both in levels and in returns, and compares the series with other assets in the economy. We first give three pieces of evidence that our measures of human capital, although simple to construct, are indeed reasonable and economically meaningful. First, the average share of human capital in total wealth is between two-thirds and three-quarters, which is close to the labor share of national income. Second, the average growth rate of human capital is close to existing measures of human capital growth rates estimated by Kendrick (1976) and Jorgenson and Fraumeni (1989). Finally, our measure is cointegrated with labor income, with a cointegrating vector close to $(1, -1)$, while the correlation between their growth rates is low.³⁰ Total returns to human capital are then compared to other asset returns. The returns to human capital are high on average with low volatility: the average return is almost as high as equity, and its volatility is almost as low as that of treasury bills. Furthermore, the average return's correlation to consumption growth is similar to that of non-human capital, and it is positively correlated with housing price growth and real bond returns, but negatively correlated with equity returns. Finally, human capital returns can be predicted by their dividend-to-price ratio, which is similar to the result found in the literature on stock returns.

4.1 Estimates of Human Capital Wealth

4.1.1 U.S. Estimates

Table 1 presents estimates of the ratios of human capital to total wealth (Panel I), the labor share to national income (Panel II), and the average growth rate of real per-capita human capital (Panel

²⁸We also used the MSCI U.S. index, whose returns are slightly lower than CRSP on average, but we find that there is no significant difference qualitatively in our results.

²⁹Data Stream mnemonic: LHTRYLG(IN).

³⁰The correlation is about 0.20 for quarterly data and about 0.50 for annual data.

III) using quarterly and annual data. Human capital wealth estimates are based on non-durable consumption and different values of κ . Quarterly estimates of the human capital to total wealth ratio range from 67.3 to 78.4 percent on average, while annual estimates vary from 68.7 to 79.2 percent.³¹ Obviously, a higher value of κ yields larger estimates of total wealth, and higher shares of human capital to total wealth. It is striking how stable the human capital to wealth share is over time; whether it is calculated at a quarterly or annual frequency.³² Overall, the share of human capital in total wealth is in line with the share of labor compensation share in national income. Figure 1 plots the human capital and labor income shares (simple labor compensation over national income). While the shares are not exactly the same in levels and they do not comove perfectly, they are quite close (the correlation coefficient for the whole sample is 0.36, and rises to 0.58 for the post-1970 sample).

One reason that the human capital share is slightly higher than the labor income share is the impact of risk on the agent's discounting when calculating the expected value of its wealth. In particular, since non-human capital cash flows are more volatile than those of human capital, and the correlation with consumption of the two cash flow series does not differ greatly, the expected discounted sum of future cash flows is more heavily discounted for human capital than it would be if the volatility of the two series were equal.³³ Another reason for the higher share of human capital wealth than labor income is the existence of potential human capital investment (e.g., educational spending) in the consumption data we use. In this case, given our concept of human capital, we may be overestimating the value of human capital wealth as consumption is overstated conceptually. One other reason for the discrepancy in the ratios is that the wealth-to-consumption ratio, κ , is lower than our baseline value measure of $\kappa = 20$. Indeed, a $\kappa = 16.67$ generates a human capital wealth share of 67.3, which is closer to the labor income share.

The average growth rate of real per-capita human capital is not much affected by the value of κ (Table 1, Panel III). It grows on average at 2.23 percent per annum, with a standard deviation of 1.83 given $\kappa = 20$ over 1952–2007. These numbers are in line with labor compensation growth rates. More broadly, average real-per capita GDP growth is 2.03, with a standard deviation of 2.12 over the same period, so human capital wealth tracks the growth of the economy quite closely on average in the long-run. We compare the growth of non-human capital to other growth rates later in detail. However, note that human capital's growth rate is not sensitive to particular values of κ

³¹Note that quarterly and annual estimates do not match up exactly because of our end-of-period data concept.

³²The total consumption-based human capital is more volatile than the one based on non-durable consumption primarily because durable goods consumption tends to be more volatile than non-durable consumption. Results based on total consumption are available in Appendix Tables A1 and A2.

³³In essence, this result follows from Jensen's inequality, where the crucial assumption is that human capital income is less volatile than non-human capital income.

when κ is large because human capital's growth rate converges to consumption growth as κ goes to infinity.

4.1.2 OECD Estimates

Table 2 presents results for OECD countries. Most countries tend to have shares of human capital to total wealth similar to their labor to national income shares, with an average of about three-quarters. This cross-country evidence helps provide support of our approach. We find that on average a country's human capital to total wealth ratio is 69.8 percent, with the Czech Republic having the highest ratio of 85.7 percent. The Czech Republic is also a notable exception given that its human capital share is much higher than its labor share. On the one hand, this may be due to underestimated net worth data, which would result in higher estimated shares of human capital given a value of consumption. On the other hand, the high share might be due to the fact that the Czech Republic is the only transition country in the sample, where obsolete physical capital might still be receiving a higher rental cost now, but future cash flows may not be so great due to high depreciation. Japan is also an exception in a sense that it is the only country where the human capital share is lower than the labor share (when the wealth-to-consumption ratio is 20). However, the difference is not so large.

4.1.3 Comparison of U.S. Estimates with Previous Studies

We next evaluate the U.S.-based human capital wealth series by comparing it with existing measures. While the level of our estimated human capital wealth is different from Kendrick (1976) and Jorgenson and Fraumeni (1989), the average growth rate of the three measures are actually quite similar as one can see from Figure 2.

Kendrick (1976) bases his estimates on the cost of rearing and education; therefore, they do not include gains from education. As a result, his estimates are 3.7 times smaller than ours. Another potential reason for this difference is that the cost-based approach may not be able to capture monopoly power or rents associated with human capital. If labor income includes rents, then the cost-based approach will be an inappropriate one to evaluate human capital wealth.

The income-based approach of Jorgenson and Fraumeni (1989) appears to be quite different from ours at first sight, but the difference may not be so large. Jorgenson and Fraumeni first estimate a wage function, which depends on age, sex, education attainment. They then impute after-tax labor compensation for market activity. To estimate future labor income, they assume a 2 percent increase in real terms and discount rate of 4 percent annually. So, in terms of methodology, their approach differs substantially from ours, though we both consider the value of human capital

to be a generator of future income. In particular, though their approach is income-based, Jorgenson and Fraumeni's measure is a book-value one since they do not adjust for future human capital gains (e.g., due to further education), and treat the discount rate as fixed.

However, the main reason why our estimates differ in levels from those of Jorgenson and Fraumeni is that their's include non-market activity, such as household production and leisure time. Therefore, their human capital estimates are on average four times as large as our market-activity based estimates, and their share of human capital to total wealth is also higher than our estimates. But, since Jorgenson and Fraumeni's estimates of market labor income is on average slightly less than 20 percent of total income, their measure of human capital wealth related to market activity would therefore be slightly less than 80 percent of our current-value estimation. This difference is reassuring since our human capital also includes non-labor income, which is not associated with net worth, such as unemployment benefits or social security benefits.³⁴ Given these considerations, our level estimate may not be so different from the market-related part of Jorgenson and Fraumeni's estimates.

While our level estimates appear to lie between the two other measures, all three estimates grow at a similar rate. When all three estimates overlap for the period 1952–1969, Kendrick's estimate of the average annual per-capita human capital growth rate is 5.3 percent, Jorgenson and Fraumeni's is 4.8 percent, and ours is 4.6 percent.³⁵ The correlation of our estimated growth rate and Kendrick's is 0.82, 0.34 with Jorgenson and Fraumeni, while Kendrick's and Jorgenson and Fraumeni's estimates have a correlation of 0.46. For the period 1952–1984, Jorgenson and Fraumeni's average growth rate is 6.0 percent, whereas ours is 6.5 percent and the correlation between the two series 0.53. Overall, while the three approaches are obviously different, the values of human capital based on cost, imputed labor income, or households' valuation have some common trend embedded. Moreover, as one can see from Figure 2, the low frequency deviation from the trend in Jorgenson and Fraumeni's estimate is similar to what our measure indicates, even though the short run fluctuations of the two measures are not very strongly correlated. These relationships are similar to those of the valuation of firms based on book value, profit, or market valuation (Hall 2001).

In a recent study, Lustig et al. (2008) find that the share of human capital in total wealth is 90 percent on average. Note that their non-human capital is on average 1.7 times larger than flow of funds net worth; thus, their estimate of human capital is much larger than ours. Their

³⁴Jorgenson and Fraumeni (1989) assign a zero hourly wage for people over 74 years old, while our concept would imply that government social security benefits counts as part of their human capital income because the accumulation of these benefits are not part of 'net worth' in the Flow of Funds account.

³⁵We took the number from Jorgenson and Fraumeni's Table 5.

estimated wealth-to-consumption ratio is 87 when using quarterly data, and 151 using annual data. We think that both the share of human capital and the wealth-to-consumption ratio are too high. We believe that this is probably due to an under-estimated discount factor on average, and that this mismeasurement arises from their use of the treasury bill rate in a no-arbitrage framework. Households cannot borrow at the risk-free rate and typically face lower a rate on their ‘safe’ asset than T-bill rate. We conjecture that once the average discount factor is adjusted somewhat upwards, Lustig et al.’s estimates will provide more precise estimates.

Finally, Lustig and Van Nieuwerburgh (2008) find that the share of human capital is 77.6 percent using a broad firm-value measure for non-human capital, and that the share of human capital is 79.2 percent when using stock market wealth. These numbers are slightly higher than our estimates, but within the range of approximation errors. They also find a negative correlation between stock market and human capital returns as we do.

4.1.4 Long-Run Relationship Between Human Capital and Labor Income

A third way to assess the validity of our human capital measure is to estimate its long-run relation with human capital income. Lettau and Ludvigson (2001) assume that the non-stationary component of human capital can be well described by labor income in their *cay* approach. They show a few cases that this assumption can be rationalized, including one where labor income is considered to be a dividend of human capital.

In order to see if labor income is the non-stationary component of human capital, we conduct a cointegration test between the log of our human capital measure and the log of labor income over the period 1952–2007. Trace statistics from the Johansen’s log likelihood test are presented in Table 3, Panel I. We can reject the null of no cointegration at the 1 or 5 percent significance levels in most cases regardless of the specification, and fail to reject the null of only one cointegrating vector at the 5 percent significance level when using a nominal human capital per capita measure, and at the 1 percent level in most other cases. The information criteria also suggests that there exists only one cointegrating vector rather than no cointegration.³⁶ Moreover, the cointegration vectors, presented in Panel II of Table 3, are very close to $(1, -1)$ as theory suggests. This evidence supports the notion that our measure of human capital reflects a discounted sum of future labor income.

³⁶We use two lags following the BIC. We use eight lags for robustness and results are similar.

4.1.5 Implications for Wealth Effect of Shocks to Non-Human Capital Assets

Our methodology provides a simple relationship between each asset and consumption. Recall that we assumed a constant consumption-to-wealth ratio. While portfolio shares do not have to be constant, they are relatively stable in our estimates and the data. Roughly speaking, the share of non-human capital wealth in total wealth is between 25–30 percent, and the share of real estate in non-human capital is roughly 30 percent on average. This implies that housing wealth represents approximately 7 to 9 percent of total wealth. Therefore, given a unit elasticity between consumption and total wealth, a one unit shock to housing wealth will translate to roughly a 7 to 9 percent change in consumption, *ceteris paribus*. The magnitude of this wealth effect is slightly smaller than the estimate of Carroll et al. (2006).³⁷ In addition to the housing wealth effect, the share of corporate equities is between 10 to 15 percent of non-human capital, implying that the wealth effect of equities is between 2.5 to 4.5 percent, which is slightly lower than typical estimates.³⁸ However, these lower estimates seem reasonable given that the equity measure we use from the Flow of Funds omits other equity invested via mutual funds, pension funds and other investment vehicles. Though not conclusive, these results provide further evidence that the assumption of a constant consumption-to-wealth ratio is a good approximation.

4.2 Human Capital Growth and Returns

We next characterize the growth and returns of per-capita human capital relative to other assets.³⁹ The growth rate is measured as the log first difference of the value of human capital, whereas the return is calculated using labor compensation as the dividend, as defined in (11).⁴⁰

4.2.1 Growth Rate of the Value of Human Capital Wealth

Tables 4 and 5 present the nominal and real growth rates of per-capita human capital, non-human capital (Net Worth in the Flow of Funds), gross non-human capital (Total Assets in the Flow of Funds), and consumption at quarterly and annual frequency, respectively. Panel I considers the 1952–2007 period, while Panel II examines 1973–2007, and Panel III considers a more recent period (1990–2007).

³⁷The significance of the housing wealth effect is still in debate. In a general equilibrium model, changes in the housing price have offsetting effect among agents and it hard to generate a significant wealth effect. As labor or disposable income is not perfectly correlated with human capital, housing wealth may proxy for the value of human capital in empirical work to some degree.

³⁸See Lettau and Ludvigson (2004) for some numbers.

³⁹We discuss per-capita measures, but national level growth rates and total returns are available in Appendix Tables A1 and A2. Obviously, average growth rates are higher for national level data, but other characteristics are similar to per-capita measures.

⁴⁰We use the third measure of compensation (compensation plus net transfers less taxes) as our baseline.

In looking at the longer time period of Panel I, one sees that the the average quarterly (annual) growth rate of nominal per-capita human capital is 1.43 (5.70) percent, which is slightly lower than consumption growth.⁴¹ Gross non-human capital wealth is growing fastest, which can be partly explained by financial deepening over time. As households were able to borrow more easily, they increased both assets and liabilities. Real growth rates obviously exhibit the same ranking of average nominal growth rates. The value of per-capita human capital wealth grows at 0.56 (2.25) percent quarterly (annually). Examining the volatility of the growth rates of human and non-human capital wealth reveals an intriguing finding. The standard deviation of human capital decreases when measured in real terms, while the opposite is true for non-human capital. This finding can be explained by the fact that as labor income, arguably the largest components of human capital income, is typically cointegrated with inflation, the value of human capital is more stable in real terms. Turning to Panel II, one sees that human capital is growing at a slightly slower pace than non-human capital, and that its growth rate drops off in the latter half of the sample (Panel III). This is the case both in nominal and real terms. Turning to the volatility of human capital, it is stable in quarterly data across sub-samples in nominal terms, though it slightly increases in real terms in the 1990-2007 sample. However, the standard deviation of nominal and real growth drops substantially in the latter sample for annual data.

In sum, the value of human capital wealth grows steadily, as fast as consumption and slightly lower than non-human capital. We think that the growth rate difference between human and non-human capital wealth is not significant once we factor in the financial crisis in the latter part of the sample, as the latest sample period for non-human capital is the end of 2007. Including 2008 would reduce non-human capital growth rate to almost equal to the human capital growth rate.⁴²

There is one further accounting issue that can explain this discrepancy, and should also be kept in mind when comparing human and non-human capital returns in the next section. In particular, we use non-human capital income data collected from the household sector of the national accounts, which is roughly the sum of dividend and interest payments. This income is lower than the economy-wide capital income that is reported in the national accounts (national income minus labor compensation), since firms invest part of their profits rather than pay out dividends to households. Therefore, part of the economy's capital income in a given year will not be fully reflected in our measure of non-human capital income of the household, thus understating its value by the value of investment made by firms. However, firms' investment increases the value of non-human capital

⁴¹The reason why the growth rates of annual estimates are not exactly four times the value of quarterly estimates is that our estimation of human capital relies on the combination of flow (consumption) and stock data (non-human capital).

⁴²The value of non-human capital (net worth) declined about 18 percent in 2008.

from the household's point of view, thus increasing the growth rate of the non-human capital stock.

4.2.2 Human Capital Wealth Risk-Return Profile

Tables 6 and 7 present total returns for various assets in nominal, real, and excess terms, as described in section 3.2, at the quarterly and annual frequency, respectively. Panel I considers the whole period where we have detailed returns data (1973–2007), while Panel II examines data since 1990.⁴³

First, turning to Panel I, the average total return on human capital, 6.9 (10.6) percent annually in real (nominal) terms, is higher than that of non-human capital, 6.3 (10.0) percent annually in real (nominal) terms, although the average growth rate of non-human capital is higher than that of human capital wealth. This small difference in part mechanically reflects the accounting issue discussed at the end of the previous section. However, it may also be partly due to measurement error. For example, non-human capital may be lower due to underestimated imputed rents. Furthermore, recall that capital gains on human capital should be interpreted carefully since we omit investment. However, the difference in growth rates are not statistically significant, so we conclude that the average growth rate and total return of human capital and non-human capital are almost identical.

Next, comparing human capital returns for finer categories of assets, one sees that the average total return on the human capital is slightly lower than total returns on equity and higher than other assets. The average total return on the CRSP portfolio is about 10.1 (13.8) percent a year in real (nominal) terms for 1973–2007 while MSCI-EAFE (non-North American 21 developing countries) has real (nominal) total returns of 8.1 (11.8) percent.⁴⁴ Real (nominal) total return on bonds, 5.1 (8.8) percent, is slightly lower than total returns on human capital. Real (nominal) average short-term rates, 2.8 (6.6) percent, are much lower than total returns on human capital. The average nominal growth rate of housing prices is 2.2 (5.9) percent, which is very similar to the growth rate of human capital, which is 1.8 (5.5) percent for 1973–2007. The 1990–2007 sample depicts a similar picture. Given that non-human capital returns are very similar to those of human capital, it is not surprising to see that the average total return for the major components of non-human capital are similar to those of human capital as well.

What makes human capital wealth special is its low risk (variability). The standard deviation of the nominal total returns on human capital, 1.0 percent quarterly, is slightly higher than that of the three month treasury rate, and the standard deviation of the real returns is 0.9 percent, which

⁴³The total returns data for sub-categories of assets are available from the authors.

⁴⁴Again, note that the end-date matters significantly for equity returns when comparing quarterly and annual returns.

is much smaller than those of equity indices and the long-bond index. Turning to annual returns, the standard deviation of nominal human capital returns (2.5 percent) is smaller than other assets' returns, and the standard deviation of the real return (1.9 percent) is the same as that of a one-year treasury. In contrast, the standard deviation of quarterly domestic (foreign) equity returns are roughly 7.2 (8.7) percent either in nominal, excess, or real terms. At the annual frequency, they are 14 (18) percent. Returns on other assets are more stable than equities but much higher than human capital wealth. Therefore, human capital appears to have a low risk-return profile.⁴⁵

4.2.3 Correlation with Other Assets

How does the return on the human capital wealth comove with other asset returns? Table 8 presents correlations among three different measures of returns on various assets, where returns are measured in nominal, real and excess (quarterly excess returns are based on the short-term T-bill, while annual returns are based on a one year T-note).⁴⁶

Total returns on human capital and non-human capital tend to be negatively correlated if we use nominal or real returns. One might believe that this result is systematic as consumption is very smooth and household net worth (i.e., non-human capital) is more volatile. However, this need not be the case. Indeed, the correlation is close to zero (-0.03) for annual nominal returns for the period 1973-2007. Moreover, if we look at excess returns, the correlation is positive for annual data, while the correlation for real returns is negative. Given these various results, we focus on the results which are either robust, or in line with other studies in terms of changes in the sign of the correlation over sample periods.

First, despite the fact real estate occupies the largest share in non-human capital wealth, the growth rate of house prices is almost always positively correlated with total returns on human capital wealth, and the correlation is very high for excess returns 0.42 (0.82) at the quarterly (annual) frequency.⁴⁷ This finding is interesting as total returns on non-human capital is negatively correlated with human capital wealth.⁴⁸ Moreover, the fact that the real estate price comoves with returns on human capital might explain the strong wealth effects of movements in housing prices. Specifically, it is hard to generate a wealth effect from housing in a representative agent general equilibrium model, but empirical studies typically finds a relatively strong wealth effect using U.S. data. Obviously, agents are heterogenous but the wealth effect from housing should

⁴⁵Again, note that this profile may be overstating the return profile because calculations ignore human capital investment.

⁴⁶See Appendix Tables A3-A8 for the full correlation matrices of asset returns.

⁴⁷One exception is for nominal returns at the annual frequency in 1990–2007, where the correlation is -0.02 .

⁴⁸Note that the sign and magnitude of the correlation varies across the OECD sample in Table 9 when looking at nominal returns. However, the sample is very short for this comparison.

still offset among agents at the aggregate level (i.e., a gain for a buyer is a loss for a seller, and vice versa). If house prices are correlated with returns to human capital wealth, however, then the empirical findings may in fact reflect omitted variable bias, since consumption and human capital wealth growth rates are positively correlated. Moreover, labor (or disposable) income is not a perfect description of human capital as labor income does not contain information on the stochastic discount factor, which may result in further bias.

Second, the correlation between total returns on domestic equities and on human capital is always negative. For example, the correlations between real returns on two assets are -0.66 (-0.23) at the quarterly (annual) frequency in 1973–2007 and -0.78 (-0.54) in 1990–2007. Note that the negative relationship also holds for excess returns, where human capital and non-capital wealth returns are positively correlated. This negative correlation is also found by Lustig and Van Nieuwerburgh (2008).⁴⁹ In a general equilibrium setting, this observation can be explained by sticky prices (Engel and Matsumoto 2009). When prices are sticky output is demand determined. Without a demand shock, productivity shocks increase firms' profits by reducing labor input, which implies lower labor income, thus a potentially lower human capital return. A strong negative correlation implies that the equity premium puzzle could be worse than previous estimates. In addition, this correlation is always more negative than the correlation between total returns on foreign equities and on human capital. This observation provides a potential solution for the equity home bias puzzle.

Third, the correlation between total returns on the human capital and bonds is also interesting as the results indicate some similarity of bonds and human capital, as also noted by Lustig et al. (2008). Figure 3 shows this correlation for a rolling window of 10 years. Looking at nominal returns, the correlation is either negative or very small for the earlier sample period when inflation was quite high due to oil shocks. However, in the later period, when inflation stabilized, the correlation turns positive. Alternatively, if we look at real returns, correlations are all positive irrespective of frequency or sample periods. Compared to other assets, the cash flows from long-term bonds and human capital are quite stable, but there are subtle differences. The cash flows for long-term bonds are predetermined in nominal terms and higher inflation reduces the real return, as well as the total nominal return as inflation raises nominal short-term interest rates. On the other hand, human capital cash flows (wages) are tightly linked to inflation as wages and prices tend to be cointegrated. So, the fact that the correlation turns to positive as inflation stabilizes provides a nice contrast between two similar assets. The changing correlation between bonds and equities has been pointed out by Campbell et al. (2009). As our estimated correlation between human capital

⁴⁹We also find that correlations between total returns on human capital and equity in ten OECD countries are mostly negative as shown in Table 9.

and equities is always negative, and the correlation between human capital and bonds turns to positive during recent sample periods, the results are in line with their estimates.⁵⁰ The fact that households often hold short positions of debt, by taking out mortgages, seems reasonable because the short position provides a nice hedge against human capital returns.

4.2.4 Predictability of Human Capital Wealth Returns

Finally, we consider the behavior of returns on human capital wealth from a different point of view. We ask whether the labor compensation-to-human capital wealth ratio predicts long-run returns on human capital. This exercise is in the spirit of Campbell and Shiller (1988), who ask a similar question when considering whether the dividend-to-price ratio is able to predict long-run returns on equity. We follow Campbell and Shiller (1988) and use simple OLS regressions. We regress the m -period cumulative total return on the current labor compensation-to-human capital wealth ratio, the annual growth rate of labor compensation, and a combination of them to see if returns on human capital wealth behaves like stock returns. Indeed, we find that the predictability of human capital returns looks similar to the findings of Campbell and Shiller (1988). The R-square of the model increases the longer the forecasting period (up to 10 years). Moreover, this result holds when only including our “dividend-to-price ratio” (i.e., labor compensation to human capital wealth), while adding information, such as changes in “dividends” (labor compensation) does not improve the predictive power substantially.

Table 10 presents the R-squares of the estimated forecasting equation using quarterly and annual data. Panel I presents the quarterly and annual results for real returns, while Panel II presents the results for excess returns. Quarterly estimates are presented for $m = \{1, 4, 20, 40\}$, while annual results are based on regressions for $m = \{1, 3, 5, 10\}$. The first column only includes labor compensation growth (ΔW); column two only includes the labor compensation-to-human capital wealth ratio (W/H), while column three includes both regressors. Including only W/H dominates only including ΔW at all horizons, for both real and excess returns. The fit of the model improves at longer horizons in general, though this is not uniform for quarterly or annual estimates. However, the fit of the model does improve uniformly for annual estimates when both regressors are included. The improved forecasting ability of the model at longer horizons matches what Campbell and Shiller (1988) find in the case of stock returns. Given this finding, and that our measure of human capital wealth is arguably best approximated in the long-run, we find these regression results to be further evidence that our measure of human capital wealth is a good one.

⁵⁰Obviously, if we compare directly the correlation between bonds and equities, we find results in line with Campbell et al. (2009).

5 Conclusion

We propose a simple methodology to recover the value of human capital based on the assumption of a constant consumption-to-total wealth ratio. Total wealth consists of non-human capital and human capital. Given an assumed value of a consumption-to-wealth ratio, it is straightforward to recover the value of human capital wealth when non-human capital data is available.

We apply the methodology to the U.S. and ten OECD countries. While our assumption may be viewed as overly restrictive, our estimates of the value of human capital wealth look quite reasonable in many respects. We find that human capital wealth represents approximately 75 percent of total wealth, which is almost the same as the labor share to national income ratio. Because labor income is more stable than capital income, our finding seems reasonable. Moreover, the value of human capital and labor compensation are cointegrated, which also provides support of the assumption underlying the *cay* approach proposed by Lettau and Ludvigson (2001). Average growth rates of human capital are in line with those found in existing literature, while level estimates differ. However, our estimates and Jorgenson and Fraumeni (1989)'s may not be so different once we remove non-market activity from their estimates. These findings provide support that our estimates are quite reasonable, and the notion that human capital is a discounted sum of future labor income.

We then characterize the basic properties of the total returns to human capital wealth using U.S. data. We find that human capital wealth is best characterized as low risk and high return. Furthermore, human capital is positively correlated with housing and long-term bonds, but negatively correlated with equity returns. The positive correlation with housing can provide a potential explanation for the relatively strong wealth effect of housing found in empirical work (given the theoretical ambiguity of the relationship), as housing prices may proxy for the value of human capital wealth. In addition, human capital's positive correlation with long-term bonds can help justify observed households borrowing behavior, and the negative correlation with equity can help to explain the home bias in equity portfolio. While our characterization of human capital returns is based on simple statistics, it already provides some interesting facts.

Future work will consider these relationships in more detail in light of our results, and examining the value of human capital wealth at the individual level also seems to be a fruitful line of research to pursue. Furthermore, our estimates of human capital can be also used to examine what type of shocks are driving innovations in human capital returns.

Appendix A Detailed Derivations of Log-Linearized System of Equations

A.1 Budget Constraint

The budget constraint can be written as

$$W_{t+1} = R_{m,t+1}(W_t - C_t), \quad (\text{A.1})$$

where $R_{m,t+1}$ is the gross return on total assets from time t to time $t + 1$, and W_t is total assets including human capital wealth and non-human capital wealth. Non-human capital wealth includes both financial assets and non-financial assets such as housing.

First, rewrite (A.1) as

$$\frac{W_{t+1}}{W_t} = R_{m,t+1} \left(1 - \frac{C_t}{W_t} \right)$$

and take logarithms of both sides to get

$$\Delta w_{t+1} = r_{m,t+1} + \ln \left[1 - \exp \left(\ln \left(\frac{C_t}{W_t} \right) \right) \right]. \quad (\text{A.2})$$

Taking the first-order Taylor approximation of (A.2) we obtain:

$$\Delta w_{t+1} = r_{m,t+1} + \ln \left[1 - \exp \left(\ln \left(\frac{C}{W} \right) \right) \right] - \frac{\exp \left(\ln \left(\frac{C}{W} \right) \right)}{1 - \exp \left(\ln \left(\frac{C}{W} \right) \right)} \left[c_t - w_t - \ln \left(\frac{C}{W} \right) \right], \quad (\text{A.3})$$

where $\ln\left(\frac{C}{W}\right)$ is the logarithm of the steady-state consumption-to-wealth ratio. Define

$$\begin{aligned} \rho &\equiv 1 - \exp \ln \left(\frac{C}{W} \right) = \frac{W - C}{W} \\ k &\equiv \ln(\rho) - \left(1 - \frac{1}{\rho} \right) \ln(1 - \rho) \end{aligned}$$

and substitute ρ and k into (A.3) to arrive at

$$\Delta w_{t+1} = r_{m,t+1} + \left(1 - \frac{1}{\rho} \right) (c_t - w_t) + k. \quad (\text{A.4})$$

Using the fact that $\Delta w_{t+1} = (c_t - w_t) - (c_{t+1} - w_{t+1}) + \Delta c_{t+1}$, we can rearrange (A.4) as:

$$c_t - w_t = \rho[(c_{t+1} - w_{t+1}) + r_{m,t+1} - \Delta c_{t+1} + k]. \quad (\text{A.5})$$

Taking time t conditional expectations of both sides of (A.5) and solving forward, we arrive at (3):

$$c_t - w_t = E_t \sum_{j=1}^{\infty} \rho^j (r_{m,t+j} - \Delta c_{t+j}) + \frac{\rho k}{1 - \rho}, \quad (\text{A.6})$$

the linearized budget constraint for any utility function.

A.2 Euler Equation with Epstein-Zin-Weil Preferences

Assume a Epstein-Zin-Weil utility function:

$$U_t = \left\{ (1 - \beta)C_t^{1-1/\sigma} + \beta \left(E_t U_{t+1}^{1-\gamma} \right)^{\frac{1-1/\sigma}{1-\gamma}} \right\}^{\frac{1}{1-1/\sigma}}, \quad (\text{A.7})$$

where σ is the elasticity of intertemporal substitution and γ is the coefficient of relative risk aversion. Following Epstein and Zin (1991), we write $U_t^* = \max U_t = \phi_t W_t$, that is utility value with optimal consumption behavior.⁵¹ Note that we can write the function this way due to the homogeneity of the maximization problem. Using this fact, re-write (A.7) as

$$\begin{aligned} U_t^* = \phi_t W_t &= \left\{ (1 - \beta)C_t^{*1-1/\sigma} + \beta \left(E_t[\phi_{t+1} R_{m,t+1} (W_t - C_t^*)]^{1-\gamma} \right)^{\frac{1-1/\sigma}{1-\gamma}} \right\}^{\frac{1}{1-1/\sigma}} \\ &= \left\{ (1 - \beta)C_t^{*1-1/\sigma} + \beta \left(E_t[\phi_{t+1} R_{m,t+1}]^{1-\gamma} \right)^{\frac{1-1/\sigma}{1-\gamma}} (W_t - C_t^*)^{1-1/\sigma} \right\}^{\frac{1}{1-1/\sigma}}. \end{aligned} \quad (\text{A.8})$$

The first-order conditions for optimal consumption spending then imply that

$$(1 - \beta)C_t^{*-1/\sigma} = \beta \left(E_t[\phi_{t+1} R_{m,t+1}]^{1-\gamma} \right)^{\frac{1-1/\sigma}{1-\gamma}} (W_t - C_t^*)^{-1/\sigma}. \quad (\text{A.9})$$

Plugging (A.9) into (A.8) yields

$$\phi_t = \left\{ (1 - \beta) \left(\frac{C_t^*}{W_t} \right)^{-1/\sigma} \right\}^{\frac{1}{1-1/\sigma}} = \left\{ (1 - \beta)^{-\sigma} \left(\frac{C_t^*}{W_t} \right) \right\}^{\frac{1}{1-\sigma}}. \quad (\text{A.10})$$

Claim 1 *When $\sigma = 1$, that is the elasticity of intertemporal substitution is unity, the optimal consumption-to-wealth ratio is $1 - \beta$.*

Proof: when $\sigma = 1$, equation (A.10) yields

$$(1 - \beta)^{-1} \frac{C_t^*}{W_t} = 1. \quad \blacksquare$$

Substituting the expression for ϕ_t of (A.10) into (A.9) and re-arranging terms yields

$$1 = E_t \left[\beta \left(\frac{C_{t+1}^*}{C_t^*} \right)^{-1/\sigma} R_{m,t+1} \right]^{\frac{1-\gamma}{1-1/\sigma}}, \quad (\text{A.11})$$

the Euler equation.⁵²

⁵¹See Epstein and Zin (1989) for more detail.

⁵²When $\sigma = 1$, $C_{t+1}^* = \beta C_t^* R_{m,t+1}$.

Next, take a second-order approximation of the terms inside the expectation sign:

$$1 = E_t \exp \left\{ \frac{1-\gamma}{1-1/\sigma} \left(\ln \beta - \frac{1}{\sigma} \Delta c_{t+1} + r_{m,t+1} \right) \right\}$$

$$\approx \exp \left\{ \frac{1-\gamma}{1-1/\sigma} \left(\ln \beta - \frac{1}{\sigma} E_t \Delta c_{t+1} + E_t r_{m,t+1} \right) + \frac{1}{2} \left(\frac{1-\gamma}{1-1/\sigma} \right)^2 \text{Var}_t \left(-\frac{1}{\sigma} \Delta c_{t+1} + r_{m,t+1} \right) \right\},$$

and next take logs and divide by $\frac{1-\gamma}{1-1/\sigma}$ to arrive at

$$\left(\ln \beta - \frac{1}{\sigma} E_t \Delta c_{t+1} + E_t r_{m,t+1} \right) + \frac{1}{2} \frac{1-\gamma}{1-1/\sigma} \text{Var}_t \left(-\frac{1}{\sigma} \Delta c_{t+1} + r_{m,t+1} \right) = 0$$

or

$$E_t \Delta c_{t+1} = \mu_{m,t} + \sigma E_t r_{m,t+1}, \tag{A.12}$$

where

$$\mu_{m,t} = \sigma \ln \beta + \frac{1-\gamma}{\sigma-1} \frac{1}{2} \text{Var}_t (\Delta c_{t+1} - \sigma r_{m,t+1})$$

. Note that $\mu_{m,t} = \ln \beta$ when $\sigma = 1$.

Combining (A.12) with (A.6), we arrive at (5)

$$c_t - w_t = E_t \sum_{j=1}^{\infty} \rho^j (r_{m,t+j} - \Delta c_{t+j}) + \frac{\rho k}{1-\rho}$$

$$= (1-\sigma) E_t \sum_{j=1}^{\infty} \rho^j r_{m,t+j} - \sum_{j=1}^{\infty} \rho^j \mu_{m,t+j} + \frac{\rho k}{1-\rho}. \tag{A.13}$$

Note that this equation holds when $\sigma = 1$ as well.

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Table 1. Summary Statistics of Human Capital to Total Wealth Ratios and Growth Rates for the United States: Quarterly and Annual Estimates

I. Human Capital Share of Total Wealth				
	<i>Quarterly Estimates</i>		<i>Annual Estimates</i>	
	Mean	St.Dev.	Mean	St.Dev.
$\kappa = 16.67$	67.3	2.6	68.8	2.6
$\kappa = 20$	72.9	2.1	74.0	2.2
$\kappa = 25$	78.4	1.7	79.2	1.8
II. Labor Share of National Income				
	<i>Quarterly Estimates</i>		<i>Annual Estimates</i>	
	Mean	St.Dev.	Mean	St.Dev.
Compensation ¹	64.4	1.9	64.4	1.9
Compensation ²	68.1	3.1	68.1	3.0
Compensation ³	60.1	2.5	60.1	2.4
III. Real per-capita Human Capital Growth				
	<i>Quarterly Estimates</i>		<i>Annual Estimates</i>	
	Mean	St.Dev.	Mean	St.Dev.
H.C., $\kappa=16.67$	0.56	1.11	2.20	2.06
H.C., $\kappa=20$	0.56	0.91	2.23	1.83
H.C., $\kappa=25$	0.57	0.76	2.26	1.69
IV. Real per-capita Compensation Growth				
	<i>Quarterly Estimates</i>		<i>Annual Estimates</i>	
	Mean	St.Dev.	Mean	St.Dev.
Compensation ¹	0.53	0.95	2.12	2.38
Compensation ²	0.56	0.81	2.24	1.87
Compensation ³	0.55	0.91	2.22	1.71

Notes: Human capital estimates based on nondurable consumption and net worth quarterly data from 1952–2007. Labor compensation is defined as follows: (1) total labor compensation; (2) total labor compensation plus net transfers; (3) total labor compensation plus net transfers less taxes. See text for NIPA Series ID. Data sources are NIPA and the Flow of Funds.

Table 2. Summary Statistics of Human Capital to Total Wealth Ratios for OECD Country Sample: Annual Estimates

	Non-Durable Consumption			Total Consumption			
	H.C. ($\kappa=16.67$)	H.C. ($\kappa=20$)	H.C. ($\kappa=25$)	H.C. ($\kappa=16.67$)	H.C. ($\kappa=20$)	H.C. ($\kappa=25$)	L.C.
Austria	65.2 (3.56)	71.0 (2.96)	76.8 (2.37)	64.7 (3.78)	70.6 (3.15)	76.5 (2.52)	62.1 (2.39)
Canada	64.6 (1.28)	70.5 (1.07)	76.4 (0.85)	64.5 (1.19)	70.4 (0.99)	76.3 (0.79)	62.5 (1.76)
Czech Republic	82.9 (0.51)	85.8 (0.43)	88.6 (0.34)	82.9 (0.55)	85.7 (0.46)	88.6 (0.37)	55.2 (1.42)
Germany	—	—	—	68.0 (2.12)	73.4 (1.77)	78.7 (1.42)	63.4 (2.52)
France	64.3 (5.50)	70.3 (4.58)	76.2 (3.67)	61.7 (6.91)	68.1 (5.76)	74.5 (4.61)	59.7 (2.48)
Italy	—	—	—	52.6 (2.93)	60.5 (2.44)	68.4 (1.95)	52.5 (3.82)
Japan	52.6 (2.40)	60.5 (2.00)	68.4 (1.60)	52.5 (1.77)	60.4 (1.48)	68.3 (1.18)	63.0 (3.73)
Netherlands	64.8 (1.94)	70.7 (1.61)	76.5 (1.29)	63.9 (1.82)	69.9 (1.52)	75.9 (1.21)	61.5 (2.57)
United Kingdom	58.7 (4.45)	65.6 (3.71)	72.5 (2.97)	56.8 (4.25)	64.0 (3.54)	71.2 (2.83)	64.5 (3.54)
United States	69.3 (2.17)	74.4 (1.81)	79.5 (1.45)	69.1 (2.09)	74.3 (1.74)	79.4 (1.40)	65.6 (0.82)
Total	65.9 (8.70)	71.6 (7.25)	77.2 (5.80)	63.7 (8.96)	69.8 (7.47)	75.8 (5.97)	58.7 (8.54)

Notes: ‘H.C.’ is the Human Capital to Total Wealth ratio, and ‘L.C.’ is the Labor Compensation to National Income ratio. Means reported in first row and standard deviations in parentheses in second row. ‘Total’ estimates are based on pooling across countries and time. Human capital estimates based on nondurable or total consumption and net worth annual data from 1995–2007. Data sources are from the OECD.

Table 3. Cointegration Tests of Human and Labor Income for the United States

I. Cointegration Test: Trace Statistics						
	<i>(A) Nominal</i>			<i>(B) Real</i>		
	$\kappa=16.67$	$\kappa=20$	$\kappa=25$	$\kappa=16.67$	$\kappa=20$	$\kappa=25$
Compensation ¹	22.41	30.34	38.39	20.18	18.63	15.72
	1.39	1.43	1.56	3.33	3.38	3.27
Compensation ²	26.41	37.53	47.69	20.92	18.15	14.14
	1.39	1.59	1.99	3.85	4.18	4.33
Compensation ³	29.70	44.98	58.23	25.02	23.38	19.03
	2.00	2.23	2.74	4.88	5.30	5.44
II. Cointegrating Coefficients						
	<i>(A) Nominal</i>			<i>(B) Real</i>		
	$\kappa=16.67$	$\kappa=20$	$\kappa=25$	$\kappa=16.67$	$\kappa=20$	$\kappa=25$
Compensation ¹	-1.018	-1.021	-1.024	-1.027	-1.038	-1.048
	(0.006)	(0.005)	(0.004)	(0.017)	(0.017)	(0.018)
Compensation ²	-1.002	-1.005	-1.008	-0.989	-1.000	-1.011
	(0.005)	(0.004)	(0.003)	(0.015)	(0.015)	(0.017)
Compensation ³	-1.008	-1.011	-1.013	-1.005	-1.016	-1.026
	(0.004)	(0.003)	(0.002)	(0.012)	(0.011)	(0.013)
III. Cointegrating Coefficients (per capita)						
	<i>(C) Nominal per capita</i>			<i>(D) Real per capita</i>		
	$\kappa=16.67$	$\kappa=20$	$\kappa=25$	$\kappa=16.67$	$\kappa=20$	$\kappa=25$
Compensation ¹	-1.025	-1.028	-1.031	-1.058	-1.073	-1.088
	(0.007)	(0.005)	(0.004)	(0.025)	(0.024)	(0.025)
Compensation ²	-1.006	-1.009	-1.012	-1.002	-1.016	-1.031
	(0.006)	(0.004)	(0.003)	(0.020)	(0.020)	(0.023)
Compensation ³	-1.012	-1.015	-1.017	-1.022	-1.035	-1.048
	(0.005)	(0.003)	(0.003)	(0.016)	(0.015)	(0.017)

Notes: Human capital estimates based on nondurable consumption and net worth quarterly data from 1952–2007. Panel (I) presents the trace statistics from the Johansen Cointegration test, where the number of observations is 222. For each labor compensation variable, the statistic for rank(0) and rank(1) is in the first and second row, respectively. The critical values for rank(0) are 15.41 (5 percent) and 20.04 (1 percent); and for rank(1) are 3.76 (5 percent) and 6.65 (1 percent). Panel (II) presents the coefficient on labor compensation from the estimated cointegrating vector. (A) Nominal, (B) Real, (C) Nominal per capita, and (D) Real per capita refer to the construction of both human capital and labor compensation. Labor compensation is defined as follows: (1) total labor compensation; (2) total labor compensation plus net transfers; (3) total labor compensation plus net transfers less taxes. Data sources are NIPA and the Flow of Funds.

Table 4. Summary Statistics of Human Capital and Other Growth Rates for the United States: Quarterly Estimates

I. 1954–2007				
	<i>Nominal Growth</i>		<i>Real Growth</i>	
	Mean	St.Dev.	Mean	St.Dev.
Human Capital	1.43	1.04	0.56	0.91
Non-Human Capital	1.53	2.02	0.67	2.08
Gross Non-Human Capital	1.59	1.76	0.72	1.82
Total Consumption	1.44	0.77	0.58	0.76
Non-durable Consumption	1.46	0.66	0.59	0.55
II. 1973–2007				
	<i>Nominal Growth</i>		<i>Real Growth</i>	
	Mean	St.Dev.	Mean	St.Dev.
Human Capital	1.52	1.08	0.51	0.92
Non-Human Capital	1.65	2.15	0.64	2.22
Gross Non-Human Capital	1.71	1.85	0.69	1.93
Total Consumption	1.52	0.75	0.51	0.73
Non-durable Consumption	1.56	0.66	0.54	0.54
III. 1990–2007				
	<i>Nominal Growth</i>		<i>Real Growth</i>	
	Mean	St.Dev.	Mean	St.Dev.
Human Capital	1.04	1.03	0.45	1.03
Non-Human Capital	1.32	2.54	0.73	2.60
Gross Non-Human Capital	1.38	2.16	0.79	2.22
Total Consumption	1.08	0.43	0.49	0.59
Non-durable Consumption	1.12	0.38	0.53	0.49

Notes: Total Wealth and human capital estimates based on nondurable consumption and net worth data, with $\kappa = 20$. All growth rates are per capita. Data sources are NIPA, the Flow of Funds, MSCI, CRSP, HPI Classic.

Table 5. Summary Statistics of Human Capital and Other Growth Rates for the United States: Annual Estimates

I. 1952–2007				
	<i>Nominal Growth</i>		<i>Real Growth</i>	
	Mean	St.Dev.	Mean	St.Dev.
Human Capital	5.68	2.58	2.25	1.85
Non-Human Capital	6.11	4.26	2.68	4.33
Gross Non-Human Capital	6.33	3.82	2.90	3.94
Total Consumption	5.75	2.27	2.32	1.90
Non-durable Consumption	5.82	2.20	2.38	1.63
II. 1973–2007				
	<i>Nominal Growth</i>		<i>Real Growth</i>	
	Mean	St.Dev.	Mean	St.Dev.
Human Capital	5.98	2.78	1.93	1.93
Non-Human Capital	6.60	4.58	2.55	4.71
Gross Non-Human Capital	6.83	4.06	2.78	4.25
Total Consumption	6.02	2.26	1.97	1.74
Non-durable Consumption	6.16	2.27	2.11	1.59
III. 1990–2007				
	<i>Nominal Growth</i>		<i>Real Growth</i>	
	Mean	St.Dev.	Mean	St.Dev.
Human Capital	4.04	1.26	1.68	1.43
Non-Human Capital	5.26	5.15	2.91	5.36
Gross Non-Human Capital	5.52	4.40	3.16	4.64
Total Consumption	4.26	0.95	1.90	1.50
Non-durable Consumption	4.39	0.81	2.04	1.30

Notes: Total Wealth and human capital estimates based on nondurable consumption and net worth data, with $\kappa = 20$. All growth rates are per capita. Data sources are NIPA, the Flow of Funds, MSCI, CRSP, HPI Classic.

Table 6. Summary Statistics of Human Capital and Other Asset Returns for the United States: Quarterly Estimates

	I. 1973–2007					
	<i>Nominal Return</i>		<i>Excess Return</i>		<i>Real Return</i>	
	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
Total Wealth	2.80	0.65	1.31	0.75	1.79	0.53
Human Capital	2.92	1.09	1.42	1.10	1.90	0.92
Non-Human Capital	2.47	2.13	0.98	2.24	1.46	2.23
Housing	1.50	1.02	0.00	1.32	0.48	1.08
Equity (CRSP)	2.95	8.01	1.45	8.03	1.93	8.12
Foreign Equity (MSCI)	2.63	9.19	1.13	9.26	1.62	9.30
Long-term Bond	2.11	5.39	0.62	5.38	1.10	5.53
3-Month T-bill	1.49	0.73	–	–	0.48	0.62
	II. 1990–2007					
	<i>Nominal Return</i>		<i>Excess Return</i>		<i>Real Return</i>	
	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
Total Wealth	2.37	0.38	1.34	0.58	1.78	0.48
Human Capital	2.42	1.03	1.39	1.07	1.83	1.03
Non-Human Capital	2.25	2.52	1.22	2.61	1.66	2.59
Housing	1.25	0.89	0.22	1.15	0.66	0.97
Equity (CRSP)	2.82	6.72	1.79	6.72	2.23	6.78
Foreign Equity (MSCI)	1.59	8.74	0.56	8.84	1.00	8.81
Long-term Bond	2.05	4.27	1.02	4.25	1.46	4.31
3-Month T-bill	1.01	0.42	–	–	0.42	0.45

Notes: Total Wealth and human capital estimates based on nondurable consumption and net worth data, with $\kappa = 20$. All wealth growth rates are per capita. Data sources are NIPA, the Flow of Funds, MSCI, CRSP, HPI Classic.

Table 7. Summary Statistics of Human Capital and Other Asset Returns for the United States: Annual Estimates

	I. 1973–2007					
	<i>Nominal Return</i>		<i>Excess Return</i>		<i>Real Return</i>	
	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
Total Wealth	10.70	2.17	4.06	3.05	6.66	1.58
Human Capital	11.01	2.76	4.37	3.34	6.96	1.92
Non-Human Capital	9.74	4.40	3.10	5.20	5.69	4.77
Housing	5.98	3.21	-0.66	5.01	1.93	3.42
Equity (CRSP)	12.46	16.32	5.82	16.01	8.41	16.68
Foreign Equity (MSCI)	10.51	19.29	3.87	19.48	6.46	19.69
Long-term Bond	8.45	10.17	1.81	9.77	4.41	11.01
1-Year T-note	6.63	3.04	–	–	2.58	2.21
	II. 1990–2007					
	<i>Nominal Return</i>		<i>Excess Return</i>		<i>Real Return</i>	
	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
Total Wealth	9.01	0.78	4.26	2.36	6.65	1.24
Human Capital	9.07	1.26	4.33	2.15	6.72	1.44
Non-Human Capital	8.83	5.04	4.09	5.94	6.48	5.25
Housing	5.01	3.18	0.26	4.66	2.65	3.45
Equity (CRSP)	11.94	14.60	7.20	14.70	9.58	14.68
Foreign Equity (MSCI)	6.37	18.17	1.63	19.23	4.01	18.41
Long-term Bond	8.20	9.20	3.46	9.04	5.84	9.21
1-Year T-note	4.52	1.69	–	–	2.16	1.57

Notes: Total Wealth and human capital estimates based on nondurable consumption and net worth data, with $\kappa = 20$. All wealth growth rates are per capita. Data sources are NIPA, the Flow of Funds, MSCI, CRSP, HPI Classic.

Table 8. Correlation of Human Capital and Other Returns: Nominal, Excess and Real Returns for the United States, Quarterly and Annual Estimates

	I. 1973–2007					
	<i>Quarterly Estimates</i>			<i>Annual Estimates</i>		
	Nominal	Excess	Real	Nominal	Excess	Real
Total Wealth	0.62	0.65	0.50	0.82	0.90	0.68
Non-Human Capital	-0.58	-0.42	-0.66	-0.03	0.37	-0.23
Total Cons.	0.53	0.59	0.44	0.77	0.87	0.62
Non-durable Cons.	0.61	0.65	0.50	0.82	0.90	0.67
Housing	0.16	0.42	0.11	0.39	0.82	0.37
Equity (CRSP)	-0.52	-0.49	-0.55	-0.25	-0.24	-0.39
Foreign Equity (MSCI)	-0.38	-0.30	-0.38	-0.06	0.09	-0.04
Long-term Bond	0.01	-0.01	0.11	-0.14	-0.19	0.16
3-Month T-bill (1-Year T-note)	0.31	–	0.05	0.51	–	-0.09
	II. 1990–2007					
	<i>Quarterly Estimates</i>			<i>Annual Estimates</i>		
	Nominal	Excess	Real	Nominal	Excess	Real
Total Wealth	0.22	0.37	0.26	-0.39	0.73	0.18
Non-Human Capital	-0.87	-0.70	-0.78	-0.86	0.08	-0.54
Total Cons.	0.16	0.34	0.25	-0.55	0.66	0.12
Non-durable Cons.	0.20	0.36	0.25	-0.39	0.72	0.19
Housing	0.05	0.28	0.12	-0.02	0.73	0.21
Equity (CRSP)	-0.77	-0.73	-0.70	-0.82	-0.36	-0.65
Foreign Equity (MSCI)	-0.62	-0.49	-0.54	-0.58	0.20	-0.33
Long-term Bond	0.18	0.17	0.22	0.04	0.04	0.07
3-Month T-bill (1-Year T-note)	0.04	0.00	0.06	-0.07	0.00	-0.05

Notes: Total Wealth and human capital estimates based on nondurable consumption and net worth data, with $\kappa = 20$. All wealth and consumption growth rates are per capita. Data sources are NIPA, the Flow of Funds, MSCI, CRSP, HPI Classic.

Table 9. Correlation of Nominal Human Capital and Equity and Housing Returns for the OECD Country Sample: Annual Estimates

Country	<i>Equity Returns</i>		<i>Housing Returns</i>	
	Non-durable Consumption	Total Consumption	Non-durable Consumption	Total Consumption
Australia	-0.40	-0.44	0.19	0.19
Canada	-0.66	-0.64	0.07	-0.08
Czech Republic	0.29	0.25	–	–
Germany	–	-0.04	–	0.21
France	-0.01	-0.12	-0.56	-0.47
Italy	–	0.08	0.00	-0.64
Japan	-0.92	-0.54	0.29	-0.32
Netherlands	-0.46	-0.22	0.58	0.67
United Kingdom	-0.66	-0.67	-0.03	-0.06
United States	-0.93	-0.91	0.36	0.26

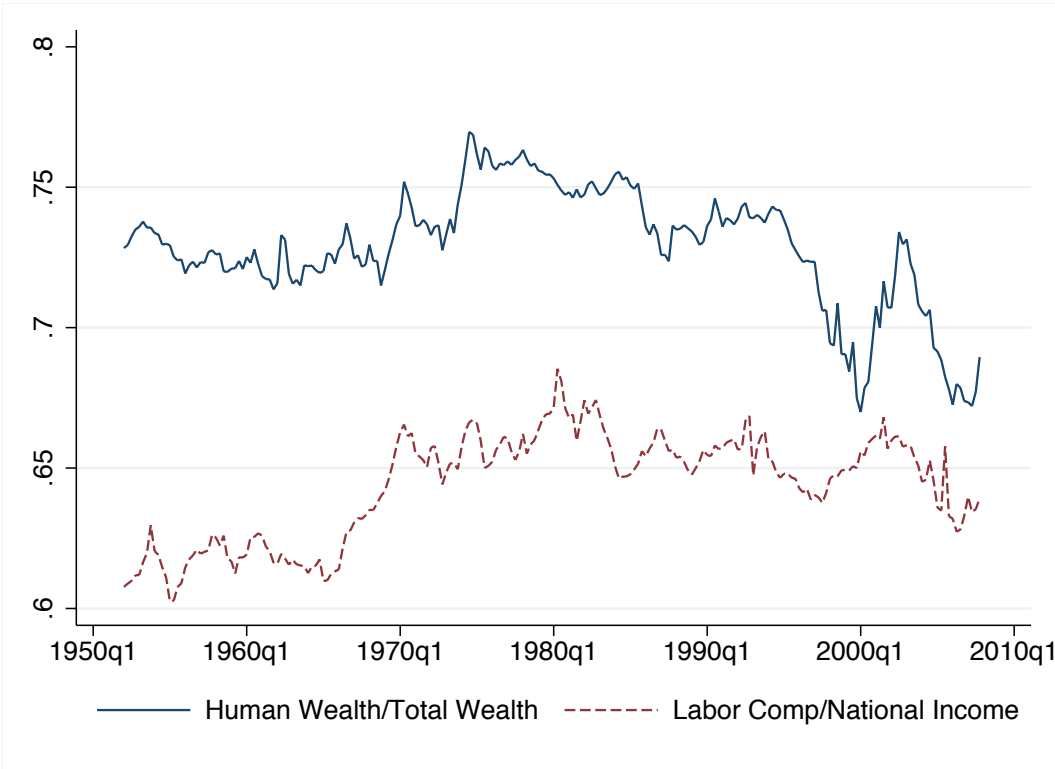
Notes: Human capital estimates based on nondurable or total consumption and net worth annual data from 1995–2007, so that first return is 1996. All wealth and consumption growth rates are per capita. Human capital returns based on data sources are OECD, equity returns are total returns from MSCI, housing returns based on housing price indices from the OECD.

Table 10. R^2 of m -step Ahead Cumulative Return Projection

I. Real Returns			
<i>Quarterly Estimates</i>			
m	ΔW	W/H	ΔW & W/H
1	0.006	0.073	0.069
4	0.043	0.251	0.253
12	0.036	0.435	0.432
20	0.050	0.393	0.392
40	0.018	0.262	0.259
<i>Annual Estimates</i>			
m	ΔW	W/H	ΔW & W/H
1	0.131	0.286	0.291
3	0.088	0.492	0.482
5	0.094	0.484	0.473
10	0.051	0.499	0.493
II. Excess Returns			
<i>Quarterly Estimates</i>			
m	ΔW	W/H	ΔW & W/H
1	0.098	0.110	0.152
4	0.185	0.265	0.332
12	0.158	0.381	0.415
20	0.142	0.392	0.413
40	0.110	0.283	0.298
<i>Annual Estimates</i>			
m	ΔW	W/H	ΔW & W/H
1	0.341	0.195	0.400
3	0.233	0.370	0.451
5	0.186	0.463	0.501
10	0.156	0.585	0.607

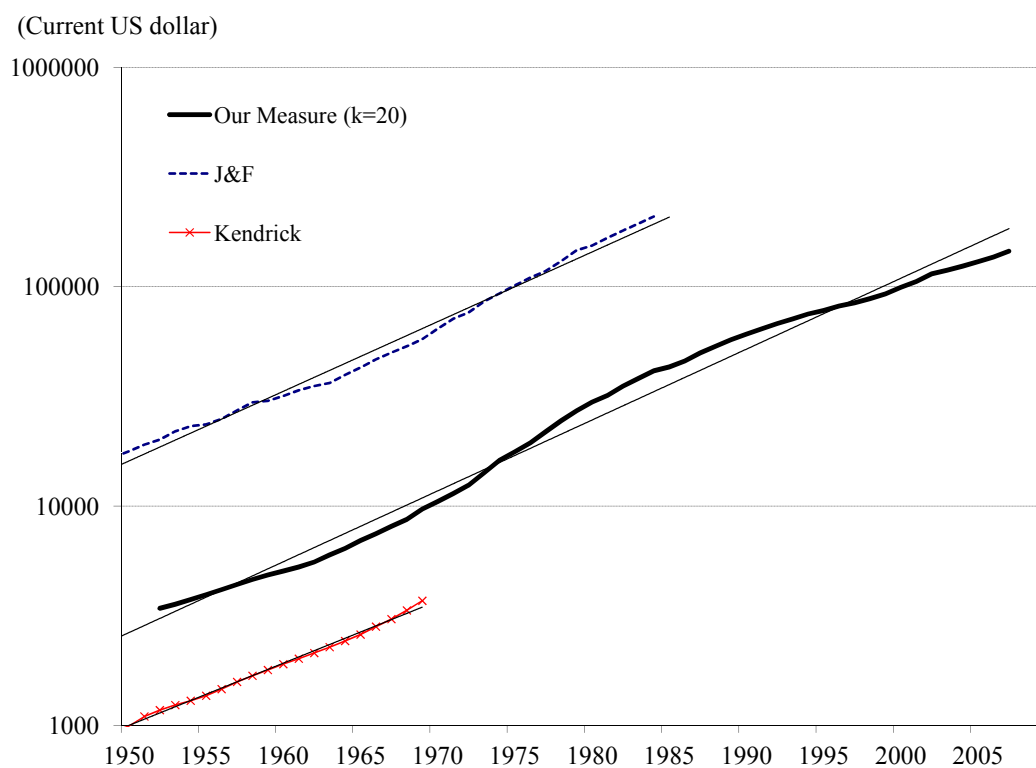
Notes: This table presents the R^2 s of m -step forecasting regression of total human capital returns, where the predicting variables are (1) change in wages (ΔW), (2) the wage-to-human capital ratio (W/H), or (3) change in wages and the wage-to-human capital ratio. Human capital estimates (H) based on nondurable consumption and net worth data from 1952–2007, with $\kappa = 20$. W is total labor compensation plus net transfers less taxes. Data sources are NIPA and the Flow of Funds.

Figure 1. Human Capital to Total Wealth and Labor Compensation to National Income for the United States



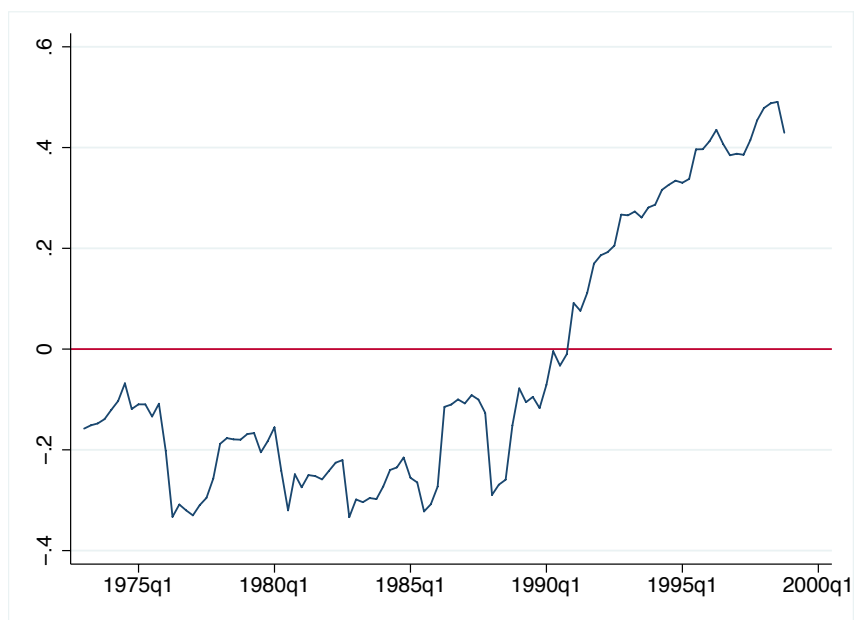
Notes: Human capital estimates based on nondurable consumption and net worth data. $\kappa=20$. The correlation coefficient between the two series for the whole sample is 0.36, and rises to 0.58 for the post-1970 sample. Data sources are NIPA and the Flow of Funds.

Figure 2. Aggregate Human Capital Wealth Comparison



Notes: This figure plots three estimates of human capital over time: (1) H based on nominal nondurable consumption and net worth data, with $\kappa=20$, (2) Jorgenson and Fraumeni (1989)'s income-based measure (J&F), and (3) Kendrick (1976)'s cost-based measure.

Figure 3. Rolling Correlation of Nominal Returns on Human Capital and Long Term Bonds



Notes: The figure plots the rolling correlation of the growth rate of nominal returns of per-capita human capital and long-term bond returns. The correlations are constructed using a rolling window of 10 years. Human capital estimates are based on nondurable consumption and net worth data from 1952–2007, with $\kappa = 20$.

Table A1. Summary Statistics and Correlations of Human Capital Growth Rates for the United States: Quarterly Estimates

I. Nominal per-capita Growth rates											
			H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	L.C. ¹	L.C. ²	L.C. ³
	Mean	St.Dev.	NDC	NDC	NDC	TOTC	TOTC	TOTC			
H.C., $\kappa=16.67$, NDC	1.40	1.23	1.00								
H.C., $\kappa=20$, NDC	1.41	1.04	0.99	1.00							
H.C., $\kappa=25$, NDC	1.42	0.90	0.96	0.99	1.00						
H.C., $\kappa=16.67$, TOTC	1.38	1.35	0.88	0.88	0.86	1.00					
H.C., $\kappa=20$, TOTC	1.39	1.16	0.85	0.86	0.86	0.99	1.00				
H.C., $\kappa=25$, TOTC	1.40	1.02	0.81	0.83	0.85	0.97	0.99	1.00			
L.C. ¹	1.38	0.99	0.29	0.33	0.38	0.27	0.31	0.35	1.00		
L.C. ²	1.40	0.88	0.32	0.37	0.43	0.30	0.35	0.39	0.92	1.00	
L.C. ³	1.40	0.95	0.30	0.35	0.40	0.32	0.36	0.40	0.75	0.85	1.00
II. Nominal Growth rates											
			H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	L.C. ¹	L.C. ²	L.C. ³
	Mean	St.Dev.	NDC	NDC	NDC	TOTC	TOTC	TOTC			
H.C., $\kappa=16.67$, NDC	1.70	1.22	1.00								
H.C., $\kappa=20$, NDC	1.71	1.02	0.99	1.00							
H.C., $\kappa=25$, NDC	1.71	0.87	0.97	0.99	1.00						
H.C., $\kappa=16.67$, TOTC	1.68	1.33	0.88	0.88	0.85	1.00					
H.C., $\kappa=20$, TOTC	1.69	1.14	0.85	0.86	0.85	0.99	1.00				
H.C., $\kappa=25$, TOTC	1.69	1.00	0.80	0.83	0.84	0.97	0.99	1.00			
L.C. ¹	1.67	0.97	0.26	0.31	0.36	0.25	0.29	0.32	1.00		
L.C. ²	1.70	0.87	0.30	0.35	0.40	0.28	0.32	0.37	0.92	1.00	
L.C. ³	1.70	0.94	0.28	0.33	0.37	0.30	0.34	0.37	0.74	0.84	1.00
III. Real per-capita Growth rates											
			H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	L.C. ¹	L.C. ²	L.C. ³
	Mean	St.Dev.	NDC	NDC	NDC	TOTC	TOTC	TOTC			
H.C., $\kappa=16.67$, NDC	0.56	1.11	1.00								
H.C., $\kappa=20$, NDC	0.56	0.91	0.99	1.00							
H.C., $\kappa=25$, NDC	0.57	0.76	0.96	0.99	1.00						
H.C., $\kappa=16.67$, TOTC	0.53	1.29	0.87	0.88	0.86	1.00					
H.C., $\kappa=20$, TOTC	0.54	1.10	0.83	0.85	0.85	0.99	1.00				
H.C., $\kappa=25$, TOTC	0.55	0.97	0.76	0.80	0.83	0.96	0.99	1.00			
L.C. ¹	0.53	0.95	0.15	0.20	0.26	0.20	0.24	0.28	1.00		
L.C. ²	0.56	0.81	0.16	0.21	0.27	0.21	0.26	0.31	0.91	1.00	
L.C. ³	0.55	0.91	0.17	0.21	0.27	0.25	0.29	0.33	0.72	0.83	1.00
IV. Real Growth rates											
			H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	L.C. ¹	L.C. ²	L.C. ³
	Mean	St.Dev.	NDC	NDC	NDC	TOTC	TOTC	TOTC			
H.C., $\kappa=16.67$, NDC	0.85	1.11	1.00								
H.C., $\kappa=20$, NDC	0.86	0.91	0.99	1.00							
H.C., $\kappa=25$, NDC	0.87	0.76	0.96	0.99	1.00						
H.C., $\kappa=16.67$, TOTC	0.83	1.29	0.87	0.88	0.86	1.00					
H.C., $\kappa=20$, TOTC	0.84	1.10	0.83	0.85	0.85	0.99	1.00				
H.C., $\kappa=25$, TOTC	0.85	0.97	0.76	0.80	0.83	0.96	0.99	1.00			
L.C. ¹	0.83	0.95	0.16	0.21	0.26	0.20	0.24	0.28	1.00		
L.C. ²	0.86	0.82	0.16	0.21	0.28	0.22	0.26	0.31	0.92	1.00	
L.C. ³	0.85	0.91	0.17	0.22	0.27	0.25	0.29	0.33	0.72	0.83	1.00

Notes: Human capital estimates based on either nondurable (NDC) or total consumption (TOTC) and net worth quarterly data from 1952–2007. ‘H.C.’ is the Human Capital, and ‘L.C.’ is the Labor Compensation. Growth rates are calculated as the log first difference. Labor compensations are defined as follows: (1) total labor compensation; (2) total labor compensation plus net transfers; (3) total labor compensation plus net transfers less taxes. Data sources are NIPA and the Flow of Funds.

Table A2. Summary Statistics and Correlations of Human Capital Growth Rates for the United States: Annual Estimates

I. Nominal per-capita Growth rates											
	Mean	St.Dev.	H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	L.C. ¹	L.C. ²	L.C. ³
			NDC	NDC	NDC	TOTC	TOTC	TOTC			
H.C., $\kappa=16.67$, NDC	5.59	2.80	1.00								
H.C., $\kappa=20$, NDC	5.63	2.59	0.99	1.00							
H.C., $\kappa=25$, NDC	5.65	2.44	0.97	0.99	1.00						
H.C., $\kappa=16.67$, TOTC	5.47	2.80	0.93	0.93	0.92	1.00					
H.C., $\kappa=20$, TOTC	5.51	2.61	0.91	0.93	0.93	0.99	1.00				
H.C., $\kappa=25$, TOTC	5.55	2.48	0.88	0.91	0.93	0.97	0.99	1.00			
L.C. ¹	5.51	2.80	0.62	0.66	0.68	0.47	0.50	0.52	1.00		
L.C. ²	5.63	2.53	0.68	0.72	0.75	0.56	0.59	0.61	0.96	1.00	
L.C. ³	5.61	2.39	0.74	0.77	0.79	0.64	0.67	0.68	0.88	0.95	1.00
II. Nominal Growth rates											
	Mean	St.Dev.	H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	L.C. ¹	L.C. ²	L.C. ³
			NDC	NDC	NDC	TOTC	TOTC	TOTC			
H.C., $\kappa=16.67$, NDC	6.78	2.67	1.00								
H.C., $\kappa=20$, NDC	6.81	2.45	0.99	1.00							
H.C., $\kappa=25$, NDC	6.84	2.29	0.97	0.99	1.00						
H.C., $\kappa=16.67$, TOTC	6.66	2.68	0.92	0.92	0.91	1.00					
H.C., $\kappa=20$, TOTC	6.70	2.48	0.90	0.92	0.92	0.99	1.00				
H.C., $\kappa=25$, TOTC	6.74	2.34	0.87	0.90	0.92	0.97	0.99	1.00			
L.C. ¹	6.70	2.70	0.59	0.62	0.65	0.43	0.45	0.47	1.00		
L.C. ²	6.82	2.42	0.65	0.69	0.72	0.51	0.54	0.56	0.96	1.00	
L.C. ³	6.80	2.27	0.71	0.74	0.76	0.61	0.63	0.65	0.86	0.95	1.00
III. Real per-capita Growth rates											
	Mean	St.Dev.	H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	L.C. ¹	L.C. ²	L.C. ³
			NDC	NDC	NDC	TOTC	TOTC	TOTC			
H.C., $\kappa=16.67$, NDC	2.20	2.06	1.00								
H.C., $\kappa=20$, NDC	2.23	1.83	0.99	1.00							
H.C., $\kappa=25$, NDC	2.26	1.69	0.94	0.99	1.00						
H.C., $\kappa=16.67$, TOTC	2.07	2.24	0.88	0.89	0.88	1.00					
H.C., $\kappa=20$, TOTC	2.12	2.05	0.84	0.88	0.89	0.99	1.00				
H.C., $\kappa=25$, TOTC	2.15	1.93	0.78	0.84	0.88	0.95	0.99	1.00			
L.C. ¹	2.12	2.38	0.41	0.46	0.50	0.23	0.26	0.29	1.00		
L.C. ²	2.24	1.87	0.42	0.47	0.51	0.26	0.29	0.32	0.96	1.00	
L.C. ³	2.22	1.71	0.49	0.54	0.57	0.39	0.42	0.44	0.83	0.91	1.00
IV. Real Growth rates											
	Mean	St.Dev.	H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	H.C. $\kappa = 16.67$	H.C. $\kappa = 20$	H.C. $\kappa = 25$	L.C. ¹	L.C. ²	L.C. ³
			NDC	NDC	NDC	TOTC	TOTC	TOTC			
H.C., $\kappa=16.67$, NDC	3.38	2.04	1.00								
H.C., $\kappa=20$, NDC	3.42	1.81	0.99	1.00							
H.C., $\kappa=25$, NDC	3.45	1.66	0.94	0.98	1.00						
H.C., $\kappa=16.67$, TOTC	3.26	2.23	0.88	0.89	0.88	1.00					
H.C., $\kappa=20$, TOTC	3.30	2.04	0.84	0.88	0.89	0.99	1.00				
H.C., $\kappa=25$, TOTC	3.34	1.92	0.78	0.84	0.88	0.95	0.99	1.00			
L.C. ¹	3.30	2.39	0.40	0.46	0.50	0.23	0.26	0.29	1.00		
L.C. ²	3.42	1.88	0.41	0.46	0.50	0.25	0.29	0.31	0.96	1.00	
L.C. ³	3.40	1.73	0.49	0.54	0.57	0.39	0.42	0.44	0.83	0.91	1.00

Notes: Human capital estimates based on either nondurable (NDC) or total consumption (TOTC) and net worth annual data from 1952–2007. ‘H.C.’ is the Human Capital, and ‘L.C.’ is the Labor Compensation. Growth rates are calculated as the log first difference. Labor compensations are defined as follows: (1) total labor compensation; (2) total labor compensation plus net transfers; (3) total labor compensation plus net transfers less taxes. Data sources are NIPA and the Flow of Funds.

Table A3. Correlation of Nominal Returns for the United States: Quarterly Estimates

	I. 1975–2007									
	Total Wealth	Human Capital	Net Worth	Total Cons.	Non-durable Cons.	Housing Equity	Foreign Equity	Long-term Bond	3-Month T-bill	
Total Wealth	1.00									
Human Capital	0.62	1.00								
Non-Human Capital	0.28	-0.58	1.00							
Total Cons.	0.87	0.53	0.25	1.00						
Non-durable Cons.	1.00	0.61	0.28	0.87	1.00					
Housing	0.37	0.16	0.20	0.30	0.37	1.00				
Equity (CRSP)	0.14	-0.52	0.82	0.19	0.14	0.01	1.00			
Foreign Equity (MSCI)	0.17	-0.38	0.66	0.23	0.18	0.08	0.67	1.00		
Long-term Bond	-0.07	0.01	-0.06	0.11	-0.07	-0.14	0.19	0.14	1.00	
3-Month T-bill	0.45	0.31	0.08	0.32	0.45	-0.06	0.01	-0.07	-0.12	1.00
II. 1990–2007										
	II. 1990–2007									
	Total Wealth	Human Capital	Net Worth	Total Cons.	Non-durable Cons.	Housing Equity	Foreign Equity	Long-term Bond	3-Month T-bill	
Total Wealth	1.00									
Human Capital	0.22	1.00								
Non-Human Capital	0.29	-0.87	1.00							
Total Cons.	0.80	0.16	0.25	1.00						
Non-durable Cons.	1.00	0.20	0.31	0.80	1.00					
Housing	0.30	0.05	0.10	0.26	0.30	1.00				
Equity (CRSP)	0.23	-0.77	0.89	0.22	0.24	-0.05	1.00			
Foreign Equity (MSCI)	0.25	-0.62	0.75	0.28	0.27	-0.01	0.78	1.00		
Long-term Bond	-0.10	0.18	-0.22	0.00	-0.09	-0.02	-0.06	-0.07	1.00	
3-Month T-bill	0.00	0.04	-0.04	-0.13	-0.01	-0.40	0.07	-0.16	0.00	1.00

Notes: Total Wealth and human capital estimates based on nondurable consumption and net worth data, with $\kappa = 20$. All wealth and consumption growth rates are per capita. Data sources are NIPA, the Flow of Funds, MSCI, CRSP, HPI Classic.

Table A4. Correlation of Excess Returns for the United States: Quarterly Estimates

I. 1973–2007							
	Total Wealth	Human Capital	Net Worth	Total Cons.	Non-durable Cons.	Housing Equity	Long-term Bond
Total Wealth	1.00						
Human Capital	0.65	1.00					
Net Worth	0.41	-0.42	1.00				
Total Cons.	0.91	0.59	0.38	1.00			
Non-durable Cons.	1.00	0.65	0.41	0.91	1.00		
Housing	0.71	0.42	0.36	0.62	0.70	1.00	
Equity (CRSP)	0.15	-0.49	0.79	0.19	0.15	0.06	1.00
Foreign Equity (MSCI)	0.24	-0.30	0.67	0.29	0.25	0.14	0.68
Long-term Bond	-0.07	-0.01	-0.05	0.09	-0.07	-0.07	0.19
							1.00
II. 1990–2007							
	Total Wealth	Human Capital	Net Worth	Total Cons.	Non-durable Cons.	Housing Equity	Long-term Bond
Total Wealth	1.00						
Human Capital	0.37	1.00					
Net Worth	0.40	-0.70	1.00				
Total Cons.	0.91	0.34	0.37	1.00			
Non-durable Cons.	1.00	0.36	0.41	0.92	1.00		
Housing	0.69	0.28	0.24	0.64	0.69	1.00	
Equity (CRSP)	0.17	-0.73	0.87	0.17	0.18	-0.01	1.00
Foreign Equity (MSCI)	0.35	-0.49	0.77	0.36	0.36	0.10	0.79
Long-term Bond	-0.06	0.17	-0.20	0.01	-0.05	0.02	-0.06
							1.00

Notes: Total Wealth and human capital estimates based on nondurable consumption and net worth data, with $\kappa = 20$. All wealth and consumption growth rates are per capita. Data sources are NIPA, the Flow of Funds, MSCI, CRSP, HPI Classic.

Table A5. Correlation of Real Returns for the United States: Quarterly Estimates

	I. 1975–2007									
	Total Wealth	Human Capital	Net Worth	Total Cons.	Non-durable Cons.	Housing Equity	Foreign Equity	Long-term Bond	3-Month T-bill	
Total Wealth	1.00									
Human Capital	0.50	1.00								
Non-Human Capital	0.32	-0.66	1.00							
Total Cons.	0.87	0.44	0.28	1.00						
Non-durable Cons.	1.00	0.50	0.32	0.87	1.00					
Housing	0.39	0.11	0.23	0.33	0.37	1.00				
Equity (CRSP)	0.21	-0.55	0.82	0.23	0.21	0.05	1.00			
Foreign Equity (MSCI)	0.28	-0.38	0.68	0.30	0.29	0.13	0.68	1.00		
Long-term Bond	0.11	0.11	0.00	0.27	0.12	-0.02	0.21	0.16	1.00	
3-Month T-bill	0.12	0.05	0.05	0.11	0.12	-0.22	0.04	-0.03	0.01	1.00
II. 1990–2007										
	Total Wealth	Human Capital	Net Worth	Total Cons.	Non-durable Cons.	Housing Equity	Foreign Equity	Long-term Bond	3-Month T-bill	
Total Wealth	1.00									
Human Capital	0.26	1.00								
Non-Human Capital	0.39	-0.78	1.00							
Total Cons.	0.90	0.25	0.34	1.00						
Non-durable Cons.	1.00	0.25	0.40	0.90	1.00					
Housing	0.46	0.12	0.19	0.44	0.47	1.00				
Equity (CRSP)	0.32	-0.70	0.90	0.29	0.33	0.03	1.00			
Foreign Equity (MSCI)	0.35	-0.54	0.76	0.34	0.36	0.07	0.79	1.00		
Long-term Bond	0.02	0.22	-0.18	0.09	0.03	0.04	-0.04	-0.05	1.00	
3-Month T-bill	0.27	0.06	0.12	0.26	0.27	-0.15	0.21	0.01	0.09	1.00

Notes: Total Wealth and human capital estimates based on nondurable consumption and net worth data, with $\kappa = 20$. All wealth growth and consumption rates are per capita. Data sources are NIPA, the Flow of Funds, MSCI, CRSP, HPI Classic.

Table A6. Correlation of Nominal Returns for the United States: Annual Estimates

	I. 1975–2007							II. 1990–2007											
	Total Wealth	Human Capital	Net Worth	Total Cons.	Non-durable Cons.	Housing Equity	Foreign Equity	Long-term Bond	1-Year T-note	Total Wealth	Human Capital	Net Worth	Total Cons.	Non-durable Cons.	Housing Equity	Foreign Equity	Long-term Bond	1-Year T-note	
Total Wealth	1.00									1.00									
Human Capital	0.82	1.00								-0.39	1.00								
Non-Human Capital	0.54	-0.03	1.00							0.80	-0.86	1.00							
Total Cons.	0.96	0.77	0.55	1.00						0.86	-0.55	0.83	1.00						
Non-durable Cons.	1.00	0.82	0.54	0.97	1.00					1.00	-0.39	0.79	0.88						
Housing	0.55	0.39	0.39	0.47	0.55	1.00				0.49	-0.02	0.29	0.42	1.00					
Equity (CRSP)	0.19	-0.25	0.73	0.24	0.19	-0.05	1.00			0.44	-0.82	0.80	0.57	0.45	-0.01	1.00			
Foreign Equity (MSCI)	0.32	-0.06	0.65	0.35	0.32	0.24	0.48	1.00		0.68	-0.58	0.76	0.70	0.70	0.14	0.62	1.00		
Long-term Bond	-0.18	-0.14	-0.09	-0.09	-0.18	-0.23	0.31	-0.01	1.00	-0.23	0.04	-0.12	-0.10	-0.21	0.03	0.24	-0.16	1.00	
1-Year T-note	0.53	0.51	0.19	0.52	0.53	-0.10	0.15	0.01	0.05	-0.28	-0.07	-0.11	-0.32	-0.31	-0.53	0.13	-0.30	0.09	1.00

Notes: Total Wealth and human capital estimates based on nondurable consumption and net worth data, with $\kappa = 20$. All wealth and consumption growth rates are per capita. Data sources are NIPA, the Flow of Funds, MSCI, CRSP, HPI Classic.

Table A7. Correlation of Excess Returns for the United States: Annual Estimates

I. 1973–2007							
	Total Wealth	Human Capital	Net Worth	Total Cons.	Non-durable Cons.	Housing Equity	Long-term Bond
Total Wealth	1.00						
Human Capital	0.90	1.00					
Net Worth	0.73	0.37	1.00				
Total Cons.	0.98	0.87	0.75	1.00			
Non-durable Cons.	1.00	0.90	0.73	0.98	1.00		
Housing	0.91	0.82	0.67	0.88	0.90	1.00	
Equity (CRSP)	0.10	-0.24	0.62	0.14	0.11	0.03	1.00
Foreign Equity (MSCI)	0.36	0.09	0.63	0.39	0.36	0.29	0.49
Long-term Bond	-0.19	-0.19	-0.08	-0.15	-0.19	-0.08	0.27
							1.00
II. 1990–2007							
	Total Wealth	Human Capital	Net Worth	Total Cons.	Non-durable Cons.	Housing Equity	Long-term Bond
Total Wealth	1.00						
Human Capital	0.73	1.00					
Net Worth	0.74	0.08	1.00				
Total Cons.	0.98	0.66	0.78	1.00			
Non-durable Cons.	1.00	0.72	0.75	0.98	1.00		
Housing	0.86	0.73	0.55	0.84	0.86	1.00	
Equity (CRSP)	0.26	-0.36	0.75	0.33	0.26	0.10	1.00
Foreign Equity (MSCI)	0.70	0.20	0.83	0.73	0.71	0.37	0.66
Long-term Bond	-0.03	0.04	-0.04	0.01	-0.02	0.12	0.24
							1.00

Notes: Total Wealth and human capital estimates based on nondurable consumption and net worth data, with $\kappa = 20$. All wealth and consumption growth rates are per capita. Data sources are NIPA, the Flow of Funds, MSCI, CRSP, HPI Classic.

Table A8. Correlation of Real Returns for the United States: Annual Estimates

	I. 1975–2007							II. 1990–2007											
	Total Wealth	Human Capital	Net Worth	Total Cons.	Non-durable Cons.	Housing Equity	Foreign Equity	Long-term Bond	1-Year T-note	Total Wealth	Human Capital	Net Worth	Total Cons.	Non-durable Cons.	Housing Equity	Foreign Equity	Long-term Bond	1-Year T-note	
Total Wealth	1.00									1.00									
Human Capital	0.68	1.00								0.18	1.00								
Non-Human Capital	0.56	-0.23	1.00							0.73	-0.54	1.00							
Total Cons.	0.95	0.62	0.54	1.00						0.95	0.12	0.74	1.00						
Non-durable Cons.	1.00	0.67	0.56	0.95	1.00					1.00	0.19	0.72	0.96						
Housing	0.60	0.37	0.40	0.49	0.59	1.00				0.59	0.21	0.37	0.54	1.00					
Equity (CRSP)	0.20	-0.39	0.73	0.26	0.20	-0.05	1.00			0.37	-0.65	0.79	0.44	0.37	1.00				
Foreign Equity (MSCI)	0.47	-0.04	0.68	0.47	0.48	0.27	0.48	1.00		0.63	-0.33	0.78	0.62	0.64	0.21	0.63	1.00		
Long-term Bond	0.17	0.16	0.08	0.25	0.15	0.00	0.34	0.04	1.00	-0.09	0.07	-0.09	0.00	-0.08	0.05	0.25	-0.13	1.00	
1-Year T-note	-0.12	-0.09	-0.07	-0.03	-0.12	-0.51	0.12	-0.01	0.28	-0.05	-0.05	0.00	-0.02	-0.06	-0.41	0.19	-0.18	0.09	1.00

Notes: Total Wealth and human capital estimates based on nondurable consumption and net worth data, with $\kappa = 20$. All wealth and consumption growth rates are per capita. Data sources are NIPA, the Flow of Funds, MSCI, CRSP, HPI Classic.