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ABSTRACT

Although international financial markets are highly integrated across the more well–developed countries, investors nevertheless hold portfolios that consist nearly exclusively of domestic assets. This violation of the predictions of standard theories of portfolio choice is known as the "international diversification puzzle." In this paper, we show that the presence of nontraded risk associated with variations in the return to human capital has dramatic implications for the optimal fraction of domestic assets in an individual's portfolio. Our analysis suggests that the returns to human capital are highly correlated with the returns to domestic financial assets. Hedging the risk associated with nontraded human capital involves a short position in national equities in an amount approximately 1.5 times the value of national stock market. Thus optimal and value–weighted portfolios very likely involve a short position in domestic marketable assets.

1. Introduction

It is widely agreed that investors hold too little of their financial wealth in foreign securities. In the past, this could be explained by the lack of international financial integration and national barriers to capital flows. However, the growth and integration of capital markets over the past twenty years has not led to similarly dramatic portfolio reallocations. In recent work, French and Poterba [1990, 1991] and Tesar and Werner [1992] have shown that portfolios are still overwhelmingly dominated by domestic assets, despite the rapidly growing volume of international financial trade. For example, French and Poterba [1991] report that U.S. investors hold about 94% of their financial assets in the form of U.S. securities. For Japan, U.K., and Germany, the share of domestic assets in each case exceeds 85%. Standard models of optimal portfolio choice cannot rationalize this pattern of asset holdings, even in the presence of unhedged foreign exchange risk.

We do not propose an explanation for this "international diversification puzzle." On the contrary: we argue that the divergence between optimal portfolios and observed portfolios is much larger than is currently thought. This claim is motivated by the observation that, for a nation as a whole, the largest component of wealth consists of nontraded human capital. We argue that the return to human capital is highly correlated with the return to domestic marketable assets (specifically, the return to the total marketable claim against domestic firms, the dominant part of which is domestic equities). Thus the domestic equity market can be used to hedge the risk associated with nontraded human capital. Because the share of human capital in total wealth exceeds any single country's share in the world equity market, a value-weighted portfolio will involve a short position in domestic marketable assets. For the same reason, the mean-variance optimal portfolio share held in domestic equities is likely to be negative.[1]

The paper is organized as follows. Section 2 presents a standard model of optimal portfolio choice. Section 3 develops a simple macroeconomic model linking unobserved human capital returns to observable economic variables. Recent U.S. data is used to explore the implications of nontraded human capital for the optimal portfolio of a prototypical U.S. investor. This section also explores the implications of nontraded human capital for the extent of "domestic optimism" needed to justify observed portfolio holdings, along the lines of French and Poterba [1990,1991].

Section 4 describes a more sophisticated general equilibrium macroeconomic model of two interacting economies, based on prior work by Baxter and Crucini [1991] and Baxter and Jermann [1992]. This analysis produces predictions broadly in line with those of the simpler model of section 3. Section 5 considers the Fama–Schwert [1977] approach to measuring the returns to human capital. We find that their approach leads to different implications of human capital for portfolio choice than the analyses of sections 3 and 4. With their approach, nontraded human capital is largely irrelevant for the optimal composition of the marketable component of a U.S. investor's portfolio. However, the data strongly reject the econometric restrictions necessary for their measure of human capital to be appropriate. Section 6 concludes with a summary of our results and proposed directions for future research.

2. Portfolio Choice with Nontraded Human Capital

Following French and Poterba [1990, 1991], we assume that the representative investor in each country has the following constant relative risk aversion utility function defined over terminal wealth, W: $U(W) = -\exp(-\lambda W/W_0)$, where W_0 is initial wealth, and λ is the coefficient of relative risk aversion.[2] The goal of the representative investor is to maximize expected utility. Letting μ denote the vector of expected mean returns, Σ denote the variance–covariance matrix of returns, and ω denote the vector of portfolio weights, expected utility is given by:

$$E[U(\omega)] = -\exp \{ -\lambda\omega'\mu + (\lambda^2/2)\omega'\Sigma\omega \} \quad . \tag{1}$$

Following French and Poterba, we set λ=3. Maximizing expected utility leads to the following first–order condition, which must be satisfied for the optimal portfolio weights, ω^*:

$$\mu' = \lambda\omega^{*\prime}\Sigma \quad . \tag{2}$$

Assuming that all assets are tradable and that short sales constraints are absent, equation (2) can be solved for the optimal portfolio shares ω^* given data on μ and Σ.

However, we argued above that human capital represents an important share of wealth for most investors, and that claims to human capital are not tradable on secondary markets. The existence of nontradable human capital means that there is one asset which has a portfolio share that cannot be altered by the investor. Before we can address the optimal investor response to nontraded human capital, we must specify the behavior of returns to human capital. This is the subject of the next section.

3. The Portfolio Implications of Nontraded Human Capital

Since human capital is nontraded, there is no direct measure of returns to this asset. Obtaining an empirical measure of human capital returns under these circumstances requires a model which links unobservable human capital returns to observable economic variables. This section develops a simple, one–sector macroeconomic model which provides the required link between theory and data. The implications of this model for optimal portfolio composition are explored and are compared with the implications of standard theory which omits consideration of human capital.

3.1 A simple model

There is one produced good in the economy, (Y), which is produced using two inputs: capital (K) and labor (L). For simplicity, the stocks of capital and labor are taken to be exogenous (although not necessarily fixed over time), and capital neither depreciates nor requires investment of additional units of Y. The production function is assumed to exhibit constant returns to scale, and is subject to variations in total factor productivity (A). Since labor's share is approximately constant over time, the production function is further specialized to a Cobb–Douglas form:

$$Y_t = A_t K_t^{1-\alpha} L_t^{\alpha} \quad . \tag{3}$$

We define the expected present value of the output stream as:

$$V_{Yt} = E_t \sum_{j=1}^{\infty} Y_{t+j}/(1+r_{t,t+j}) \tag{4}$$

where $r_{t,t+j}$ is the period t interest rate appropriate for discounting cash flows at date t+j. In general, $r_{t,t+j}$ will depend in a complicated way on interactions between investors' preferences (especially their attitudes toward risk) and the stochastic processes for the exogenous variables which drive the model. However, it will turn out that these need not be specified in order to measure human capital returns in this simple model, although they will become important in the model of Section 4 below.

The ex–dividend value of the stock of capital at time t is the expected present value of cash flows generated by the capital stock:

$$V_{Kt} = E_t \sum_{j=1}^{\infty} (1-\alpha)Y_{t+j}/(1+r_{t,t+j}) = (1-\alpha)V_{Yt} \quad . \tag{5}$$

Similarly, the value of the labor input at date t is given by:

$$V_{Lt} = E_t \sum_{j=1}^{\infty} \alpha Y_{t+j}/(1+r_{t,t+j}) = \alpha V_{Yt} \quad . \tag{6}$$

The period t payment, or 'dividend' to the capital stock, D_{Kt}, is just $(1-\alpha)Y_t$, and the labor 'dividend' is $D_{Lt} = \alpha Y_t$. The returns to capital and labor are defined as:

$$\begin{aligned} r^K_{t-1,t} &\equiv (V_{Kt} + D_{Kt} - V_{K,t-1})/V_{K,t-1} \\ r^L_{t-1,t} &\equiv (V_{Lt} + D_{Lt} - V_{L,t-1})/V_{L,t-1} \end{aligned} \quad . \tag{7}$$

Using these definitions together with equations (4)–(6), a little algebra shows that:

$$r^K_{t-1,t} = r^L_{t-1,t} = (V_{Yt} + Y_t - V_{Y,t-1})/V_{Y,t-1} \quad . \tag{8}$$

In this model, the return to labor (or human capital) is perfectly correlated with the return to capital. Many authors (e.g., Black [1987], page 79) have argued that the stock market is the best available measure of the return to capital.[3] This model therefore predicts that the return to human capital is perfectly correlated with the return to domestic assets, as well as having the same mean and variance.[4]

3.2 Implications for portfolio choice

The analysis of section 3.1 showed that the return to human capital is perfectly correlated with the return to domestic traded assets. Thus domestic traded assets can be used to construct a perfect hedge for the nontraded human capital. Since the two assets' returns are equally volatile, the hedge is constructed by selling short the domestic market in an amount equal to labor's share in national income. For example, if labor's share is two–thirds and capital's share is one–third, then the stock market represents claims to one–third of total wealth. Hedging the risk associated with human capital involves a short position in national equities equal to twice the value of the national stock market.

Having hedged the risk associated with nontraded human capital, the investor can then construct an optimal (utility–maximizing) portfolio in standard fashion. Alternatively, he may wish to establish a value–weighted portfolio, defined as a claim to the world portfolio of traded assets. For most countries, labor's share exceeds one–half, and is closer to about two–thirds. Since labor's share exceeds the country's share in world equity markets for all countries, the portfolio weight on an individual's home country in a value–weighted portfolio must be negative. That is: the "hedging motive" outweighs the "diversification motive" for holding domestic assets, so that investors should hold negative positions in the marketable assets of their own country.

3.3 Empirical implications for a U.S. investor

For comparability with earlier studies, we focus on equities as the only traded assets.[5] Our sample consists of four countries: the U.S., Japan, the U.K., and Germany. Quarterly, unhedged real equity returns for the period 1970:1–1991:2 were constructed using data from Morgan Stanley on stock market indexes and dividends. Table 1 presents summary statistics on unhedged, U.S. dollar equity returns for the four countries. U.S. equities have the smallest mean return over this period, as well as having the smallest standard deviation (the latter fact is partly due to the absence of foreign exchange risk for dollar–denominated returns on the U.S. market). While there is no significant serial correlation in the equity returns, there is substantial cross–country contemporaneous correlation in equity returns.

The empirical implications of nontraded human capital for a U.S. investor over the recent period are summarized in Table 2. This table shows the composition of actual, ex post optimal, and value–weighted portfolios with and without nontraded human capital. Value–weighted portfolios are presented since ex post optimal portfolios are highly sensitive to realized mean returns over a particular sample period. In the value–weighted portfolio the portfolio weights are given by adjusted market value for each equity market.[6]

Looking first at actual portfolios, we verify that U.S. investors hold the overwhelming majority of their assets in the form of U.S. securities. Of equities held by U.S. investors, 93.8% are held in the U.S. When we include nontraded human capital, the domestic portfolio bias necessarily becomes worse. We estimated that labor's share in the U.S. is 0.58.[7] Thus, according to the model of section 3.1, human capital represents 58% of total investor wealth, with all other assets representing the remaining 42%. Of this, 39.4% (.420*93.8) is held in the form of U.S. equities. When we include nontraded human capital, we find that U.S. investors hold 58.0 + 39.4 = 97.4% of their assets in the form of domestic securities! (Foreign equity shares are correspondingly reduced.)

What would an optimal portfolio look like? Recall that the optimal portfolio weights ω^* satisfy equation (2) in the absence of additional constraints. Thus with no human capital, the optimal weights satisfy $\omega^{*\prime} = (1/\lambda)\mu'\Sigma^{-1}$. In the presence of nontraded human capital, the optimal portfolio weights are found by choosing ω^* to maximize (1) subject to the constraint that the weight on the human capital asset equal labor's share. Table 2 compares the optimal weights with and without human capital. Not surprisingly, the high mean return on the Japanese equity market over the sample period means that the optimal portfolio in the absence of risk associated with nontraded human capital would have been highly concentrated in the Japanese market, with a portfolio share of 62.7%. The optimal holdings of the U.S. market would have been negative, at –7.6%.

How does the presence of nontraded human capital change this analysis? Recall that, in this case, constructing the optimal portfolio involved a two–step procedure. First, the risk associated with human capital is hedged by selling short the U.S. market in an amount equal to labor's share: 58% of total investor wealth, or .58/(1–.58)=138% of the domestic equity market. Then, the optimal portfolio is purchased using the total available pool of funds. The outcome of this two–step process means that the optimal shares of non–U.S. assets held by a U.S. investor are the same with and without nontraded human capital, although the dollar amounts are different. Correspondingly, the share of U.S. assets is the same with and without human capital, although the composition is different. In the presence of human capital, the investor constructs the optimal –7.6% share of wealth in U.S. assets by combining a 58.0% share in human capital with a short position in the U.S. equity market of 65.6% of total wealth (i.e., a short position about 156% of the value of the domestic equity market). Compared with the actual portfolio held by U.S. investors, the optimal portfolio had a mean return about 80% higher, with a (quarterly) standard deviation only 8% larger.

Since mean returns are notoriously difficult to predict, a value–weighted portfolio may be a more reasonable alternative to observed portfolios than the ex post optimal portfolio. Table 2 presents results for value–weighted portfolios, with and without human capital. In June 1990, the U.S. equity market represented 52.0% of our four equity markets; Japan was second with a 28.9% share. Suppose that a U.S. investor wishes to construct a value–weighted portfolio. The combined U.S. share, including human capital and equities, must equal 52.0%. Since human capital alone represents 58.0% of his portfolio, he must sell short the U.S. equity market in an amount equal to 6.0% of his total assets (or 14% of the equity market). As with the optimal portfolio, the value–weighted portfolio would have had a substantially higher mean return and only slightly higher standard deviation than the actual portfolio held by U.S. investors.

The lesson from this section is quite general. Labor's share across countries exceeds .50 (and is closer to two–thirds), while only the U.S. and Japan represent significant fractions of the world stock of marketable assets, and neither exceeds one–half. For all countries, therefore, the value–weighted portfolio would involve a short position in national markets. Investors who live in countries representing a small share of world capitalization should have larger short positions in their national markets. Of course, institutional or other constraints may prevent individual investors from establishing large short positions in traded assets. In this case, however, we should observe that individuals hold none of their country's traded assets in their portfolios.[8]

3.4 Implied expected returns

Recently, French and Poterba [1990, 1991] have approached the international diversification puzzle from a different angle, by posing the following question: what is the degree of optimism about returns in the domestic market that is needed to justify observed portfolio shares? The answer to this question is computed from equation (2) by using actual portfolio weights, ω, and solving for the implied mean vector, μ. French and Poterba find that individuals must forecast returns in their own country that are higher than realized returns in their country, and are also higher than those forecast for their country by foreigners. However, for their sample period the difference between implied and actual returns is typically not large. French and Poterba argue that, given the high volatility of realized returns, investors may never learn of the national bias in their beliefs.

We undertake the French–Poterba analysis for our sample period, and compare the results with and without nontraded human capital. The results of this analysis are summarized in Table 3. Our findings are qualitatively similar to those of French and Poterba. To rationalize observed portfolio holdings, U.S. investors must have expected to receive higher returns on the U.S. market than were subsequently realized. At the same time, U.S. investors underpredicted returns on the foreign stock markets. The implied expected returns in the presence of nontraded human capital risk do not differ importantly from expected returns without human capital.

A moment's reflection shows that this is not surprising. Without human capital, the U.S. investor holds 93.8% of his assets in the form of U.S. securities; with human capital, this share is 97.7%. Both of these portfolios are heavily distorted in favor of U.S. securities, and the difference in the shares is rather small. The higher share with human capital means that domestic optimism will be stronger in the presence of human capital, but not much stronger.

In summary, the main finding of this subsection is that inclusion of human capital does not alter in an important way the implications for the extent of domestic optimism implied by observed portfolio holdings. Actual portfolios are so heavily distorted in the absence of human capital, that the additional distortion implied by consideration of nontraded human capital leads to minor changes in investors' implied expectations.

4. Portfolio implications of a two–country general equilibrium model

The macroeconomic model of section 3 had the implication that the returns to human capital were perfectly correlated with the returns to domestic equity. However, that simple model omitted many features thought to be important to the determination of macroeconomic aggregates. First, that model abstracted from the dynamics of optimal capital accumulation by intertemporally optimizing agents. Second, the model abstracted from the labor–leisure choice.

This section describes a two–country, one–sector general equilibrium model developed by Baxter and Crucini [1991]. This model has also been used to study aspects of international asset pricing, as described in Baxter and Jermann [1992]. In this model, the single consumption–investment good is freely tradable across countries, but international asset trade is limited to a noncontingent, real bond. Investment is subject to small, convex costs of adjustment. As shown in Baxter and Crucini [1991], this model is capable of replicating the broad features of business–cycles, within and across countries.[9]

The particular model we study here is driven by productivity shocks. Backus, Kehoe, and Kydland [1992] estimated the stochastic process for productivity between the U.S. and several other countries, and they found that this process was a highly persistent, trend–stationary process with substantial international "spillovers" of productivity from one country to the other, with a one–period lag. The innovations to productivity in the two countries are positively correlated. This is the stochastic process that we use to drive our model.

We measure the return to human capital within our model as follows. The period t value of human capital is defined as the expected present value of labor income. The discount factors appropriate at each date depend in a fairly complicated way on the specification of utility and the stochastic process for productivity; see the discussion in Baxter and Jermann [1992]. The period t return to human capital is defined as in equation (7), where the period t dividend is period t labor income, just as in our earlier model.[10]

The value of a country's "stock market" is defined as the expected present value of the flow of dividends paid to capital, where the dividend is defined as the payment to capital, minus depreciation and new investment. Leverage is incorporated into the model, with debt securities accounting for 40% of the total claims on the firm's capital stock. The stock market returns are then computed using equation (7). We used simulation methods to compute the model's predictions for the mean and standard deviation of the human capital return, and the correlation between human capital returns and the two countries' stock market returns. To generate data constructs comparable with the model, we aggregated the equity returns of Japan, Great Britain, and Germany into one "foreign" equity market, using the market value weights described earlier.

Table 4 provides summary statistics for these new constructs, together with the model's predictions for all statistics involving human capital. Because this model shares with other equilibrium asset-pricing models difficulties in replicating observed levels of returns and volatilities, we extract from the model its predictions concerning the mean and standard deviation of human capital returns relative to those of domestic equity, together with the model's predictions for the correlation between human capital returns and domestic and foreign equity markets. Our model predicts a mean return for human capital which is 1.0038 times as large as the return on domestic equities, with a standard deviation 1.963 times as large. Thus the implied mean return on human capital is 1.43% per quarter, with a standard deviation of 17.71%. This model, like the model of section 3, predicts that the return to human capital is strongly positively correlated with both domestic and foreign returns. The correlation between human capital and domestic equity returns is .7621, while the correlation between human capital and foreign equity returns is .7524.[11]

The model's predictions for optimal portfolio composition are summarized in Table 5, in the column labeled "w/HC (1)." In the absence of human capital, the U.S. share in the optimal portfolio is –13.2%, with 89.9% in foreign assets. With human capital, the optimal portfolio involves a short position in the U.S. equity market equal to 67.2% of the investor's assets, with a 58.9% portfolio share in the foreign equity market.[12]

We were concerned about the model's implication that the mean return on human capital was approximately the same as for domestic equities, while being twice as volatile. We therefore explored the implications of setting the mean and standard deviation of human capital returns equal to those of domestic equity (as was true in the model of section 3), while preserving the correlation structure implied by the model. The implications for portfolio choice are reported in the last column of the top panel of Table 5. The lower volatility of human capital returns relative to case (1) results in a smaller hedge ratio — a smaller short position in U.S. equities is necessary to hedge the nontraded human capital risk.

What are the implications of this model for "domestic optimism," *a la* French and Poterba? The lower panel of Table 5 gives implied expected mean returns for this model, with and without human capital. As we found in Section 3, in the absence of nontraded human capital risk U.S. investors overpredict U.S. returns and underpredict foreign returns. When we use relative means and standard deviations computed from the model (case 1), we find that investors overpredict all returns by a substantial amount. However, with the equal mean and variance assumption (case 2), we once again obtain the result that U.S. investors overpredict U.S. equity returns and underpredict foreign returns. Interestingly, in this case the implied expected returns are nearly the same across the different assets.

The model developed in this section relaxed many of the stringent assumptions of the simple model of section 3, by incorporating dynamics associated with optimal investment and labor–leisure choice. This model nevertheless delivers results that are qualitatively similar to the simpler model. Specifically, this model also predicts that that human capital returns are strongly correlated with domestic equity returns. Given this strong correlation, the optimal portfolio in the presence of risk associated with nontraded human capital involves a short position in the domestic equity market as a partial hedge against this nontraded risk.

5. The Approach of Fama and Schwert

Fama and Schwert [1977] investigated whether extensions of the basic capital market equilibrium model to include human capital along the lines suggested by Mayers [1972,1973] would result in significant changes in the empirical descriptions of the expected return–risk relationships between marketable securities. Their analysis is one of the few empirical finance studies to undertake the construction of an empirical measure of the return to human capital. In discussing the difficulties of measuring the return to a nontraded asset, Fama and Schwert argue as follows (page 97):

> "Whereas the payoff on a marketable asset includes both dividend and capital gain, the concept of a capital gain has no meaning for an asset which is completely non–marketable. Such an asset has no market value..., and its return at t is just the income it produces at t."

To us, this view seems incorrect. The capital gain component of the return to human capital is important for asset pricing so long as individuals choose consumption over time (optimally or otherwise) in response to market incentives. In the model of Section 4, for example, individuals have a nontrivial decision concerning working (in order to consume the produced consumption good) versus not working (in order to consume leisure). The expected value of the wage rate will affect this decision. The investment decision, in turn, is affected by capitalists' forecasts of the future productivity of capital, which depends directly on the amount of labor input supplied to the market.

However, Fama and Schwert note that there is one special case in which the growth rate of labor income is the correct measure of the return to human capital; this case requires that the following conditions are satisfied. First, labor income (i.e., the labor 'dividend' D_{Lt}, using the notation of Section 3), must follow a multiplicative random–walk process:

$$D_{Lt} = D_{L,t-1}(\gamma + \epsilon_t) \tag{9}$$

where γ is the average (gross) growth rate of labor income, and ϵ_t is white noise which cannot be predicted from past data. Second, the interest rate used to discount future labor income, $\beta^{-1}-1$ must be constant through time. The expected value at time t an infinitely–lived individual's lifetime labor income is then:

$$V_{Lt} = \sum_{k=1}^{\infty} \beta^k E_t(D_{L,t+k}) \quad . \tag{10}$$

The period t gross return to human capital is defined as:

$$R^L_{t-1,t} \equiv (V_{Lt} + D_{Lt}) \;/\; V_{L,t-1} \quad . \tag{11}$$

Substituting for V_t from equation (3), and defining the net return $r^L_{t-1,t} \equiv \log(R^L_{t-1,t})$, we have:

$$r^L_{t-1,t} = \log(D_{Lt}) - \log(D_{L,t-1}) - \log(\beta\gamma) \quad . \tag{12}$$

Thus the return to human capital is just the growth rate of labor income, up to a constant.[13]

How reasonable are the assumptions embodied in (9) and (10)? It is unlikely that the discount factor β appropriate for discounting labor income is constant through time, although it is not possible to directly verify this empirically. It is certainly not true in neoclassical macroeconomic models (such as the one presented in Section 4) which combine optimal investment decisions with a nontrivial labor–leisure decision. Even if such an economy were driven by random–walk shocks, the equilibrium response involves predictable changes over time in the marginal utility of consumption which is used to discount future cash flows.

What about the assumption that the log of labor income follows a random walk? Fama and Schwert present summary statistics for the growth rate of labor income, and report a first–order serial correlation coefficient of 0.06, with a standard error of 0.06. Since tests for unit roots have notoriously low power, all that can be said in this case is that the growth rate of labor income is a near–random–walk process.

We constructed the Fama–Schwert measure of labor income, using seasonally–adjusted data on wages and proprietors' income, deflated using the CPI. Since their data were sampled at the monthly frequency, we examined the properties of the monthly time series.[14] Our results are shown in Table 6. If labor income followed a random walk, the growth rate of labor income should show zero autocorrelation at all leads and lags. Following Fama and Schwert, we regressed the growth rate of labor income on a constant and twelve lags of labor income. The data strongly reject the hypothesis that the coefficients on all twelve lags are zero (the p–value for the F–statistic is $3\text{x}10^{-6}$): labor income does not follow a simple random walk process.[15]

Table 7 presents summary statistics for the quarterly growth rate of labor income, together with its covariance properties with equity returns. Labor income growth has a lower mean and is less volatile than equity returns, and is significantly autocorrelated at lags 1–3, which is not the result of time–aggregation of a white noise process at the monthly frequency (see Table 6). The growth rate of labor income appears to be generally uncorrelated with equity returns — in particular, labor income growth is not significantly correlated with U.S. equity returns. Table 7 also reports the cross–correlations between the growth rate of labor income and stock market returns. We found that past returns in all four equity markets had significant (positive) predictive power for human capital returns; the strongest correlation was at a lag of two quarters.

The portfolio implications of the Fama–Schwert measure of human capital returns are as follows. Recall that, absent human capital, the optimal U.S. portfolio share was –7.6% of total investor wealth (see Table 2 and the accompanying discussion). With the Fama–Schwert measure of human capital returns, the optimal U.S. portfolio share is –6.7% — virtually no change, relative to the no–human–capital case. The optimal shares of foreign equities also change only slightly: the Japanese share becomes 60.8%, the U.K. share is 13.4%, and the German share is 11.3%. When human capital returns are uncorrelated with equity returns, including human capital has essentially no effect on the composition of the marketable component of the optimal portfolio. This is undoubtedly related to the Fama–Schwert finding that human capital considerations do not significantly affect the estimated 'betas' for marketable assets.

6. Summary and Conclusions

This paper investigated the implications of nontraded human capital risk for optimal portfolio choice. We noted that human capital represents a large share of national wealth, and argued that the returns to human capital are likely to be highly correlated with the returns to domestic marketable assets. This intuition was developed within the context of two macroeconomic models which linked unobservable human capital returns to observable economic variables.

Since the domestic marketable assets can be used to partially hedge the nontraded human capital risk, we showed that optimal portfolio choice implies that U.S. investors should hold a short position in domestic marketable assets. In fact, even a value–weighted portfolio will involve a short position in domestic marketable assets, since labor's share in national income (i.e., the share of human capital in total wealth) exceeds any individual nation's share in the world marketable portfolio.

We investigated whether the presence of nontraded human capital altered the findings of French and Poterba [1991] concerning the extent of "domestic optimism" in expected returns. Like French and Poterba, we found that U.S. investors tended to overpredict U.S. returns while underpredicting foreign returns. We found that incorporating nontraded human capital made little difference to the implied expected returns. The reason is that the additional portfolio distortion in favor of domestic assets in the presence of nontraded human capital is small relative to the pre–existing distortion.

We further investigated an alternative approach to measuring human capital returns using data on labor income alone, following earlier work by Fama and Schwert [1977]. Since their measure of human capital returns is uncorrelated with domestic and foreign equity returns, we found that incorporating human capital with these stochastic properties led to essentially no change in optimal portfolios, relative to the standard analysis without human capital. However, this approach to measuring human capital returns is valid only under particular econometric restrictions, and the data strongly reject these restrictions. Thus we concluded that the Fama–Schwert measure of human capital returns is inappropriate.

The main lesson from this paper is that investors who have large components of nontraded human capital in their portfolios should hold a short position in their domestic equity markets, or a zero position if they are constrained against establishing short positions. And, in fact, most individuals in the U.S. do not hold any equity at all (see, for example, Mankiw and Zeldes [1991]). Those individuals who do own equity tend to be higher–income individuals; these individuals also have more volatile consumption streams. The analysis of this paper could potentially rationalize this pattern of equity holdings if the human capital returns to the equity–holders were less highly correlated with equity returns than the returns to the human capital of the lower–income groups which do not hold equity. Alternatively, the presence of nontraded goods as in Stockman and Dellas [1989] may account for part of investors' failure to diversify internationally. Investigating these possibilities are interesting avenues for future research into the "international diversification puzzle."

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Endnotes

[1] Previous analyses have addressed the implications of nontraded assets for asset pricing, building on the seminal work of Mayers [1972,1973]; one important contribution is that of Fama and Schwert [1977]. There is little research investigating the implications of nontraded assets for portfolio choice; however, a recent paper by van Wincoop [1991] considers the welfare implications of nontraded assets.

[2] This utility function is a 'constant relative risk aversion' function in an unusual sense — it contains W_0 as a scaling factor so that all demands are proportional to W_0. Without this modification, this function is the standard 'constant absolute risk aversion' utility function.

[3] Like Black, we are being somewhat imprecise in equating the stock market with the value of the firm, since this ignores the presence of debt instruments in the firm's capital structure.

[4] Black [1987, pages 78–80] also argues that human capital returns are likely to be highly correlated with the returns on equity markets, and that human capital represents the lion's share of national wealth.

[5] Ideally one would like to include other assets such as debt instruments, real estate, gold, etc. Initially, we planned to include long–term bonds in our analysis, but lack of data availability prevented us from constructing adequate measures of returns for non–U.S. bonds. However, note that the portfolio choice problem described in section 2 implicitly assumes the existence of a risk–free asset, since the optimal portfolio weights ω^* which solve equation (2) need not sum to one.

[6] Adjusted market values are from Table 1 of French and Poterba [1991]. The original sources for these data are the U.S. Treasury Bulletin and Howell and Cozzini [1990]. Portfolio holdings are for December 1989. The adjusted market values exclude intercorporate cross–holdings from market value, and correspond to June 1990 values. The weights sum to one, since our analysis assumes that the four countries' equity markets comprise the world portfolio.

[7] We computed labor's share as the sample average of wage and salary income plus proprietor's income, divided by GNP. Other researchers have defined labor's share somewhat differently, and have arrived at values in the vicinity of 0.64. Our lower value for labor's share will lead to conservative estimates of the size of the required short position in domestic equity markets, since the "hedge ratio" $\alpha/(1-\alpha)$ is larger, the larger is α.

[8] In fact, if individuals were constrained against short sales of any asset, the model of section 3.1 would imply that individuals would be forced to bear idiosyncratic risk since they would be prevented from hedging the risk associated with their nontradable human capital. This could explain why consumption movements are not highly correlated across countries.

[9] The full specification of the model is in Baxter and Crucini [1991]; asset–pricing considerations are discussed in Baxter and Jermann [1992].

[10] To be precise, in this model the period t value of human capital is computed as:

$$V_{Lt} = E_t \sum_{s=0}^{\infty} \beta^s \Lambda_{t+s} w_{t+s} n_{t+s} / \Lambda_t$$

where β is the discount factor, Λ_t is the period t marginal utility of wealth, w_t is the period t utility–denominated wage rate, and n_t is the period t labor supply.

[11] To the extent that the model has overpredicted the correlation between human capital and foreign equities (as seems likely, given the fact that the correlation between the two equity markets is only 0.57), the model will overstate the optimal share held in the domestic equity market. Thus the results which follow are probably somewhat conservative.

[12] Because the returns to human capital and the domestic equity market are not perfectly correlated in the present model, the domestic equity market cannot act as a perfect hedge for the risk associated with human capital. Thus the combined shares of human capital and U.S. equity are not the same, with and without human capital, as they were previously (see Table 2).

[13] Real business cycle models are generally calibrated with a discount factor $\beta \cong 0.99$, and real quarterly growth $\gamma \cong 1.004$. For these values, $-\log(\beta\gamma) = .0061$. Omitting this term underpredicts the mean value of human capital returns by .61% per quarter, or 2.44% per year. However, we will follow Fama and Schwert in omitting this term, which was irrelevant for their analysis.

[14] Our data is from Citibase [1992]. The mnemonics for the series we used are as follows: wages and salaries, GMW; proprietors' income, GMPRO; consumer price index, PRNEW; civilian labor force, LHC. For Table 7, monthly data were converted to the quarterly frequency using quarterly averages.

[15] The individually–significant coefficients occur at lags 2 and 4, so the rejection of the random walk hypothesis is not solely due to a significant seasonal component. We also tested the random walk hypothesis for the sample period studied by Fama and Schwert, and it was still rejected.

Table 1

Summary Statistics for Equity Returns

(quarterly data, 1970:1 - 1991:2)

I. Univariate statistics

	mean %/qtr	s.d. %/qtr	autocorrelations 1	2	3	4
USA	1.42	9.05	0.12	-0.16	-0.07	0.01
Japan	3.70	13.19	0.06	0.15	0.14	0.15
UK	2.44	14.01	0.06	-0.10	0.02	-0.16
Germany	1.93	11.63	0.17	-0.04	0.05	0.13

II. Contemporaneous correlation

	USA	Japan	UK	Germany
USA	1.00	0.51	0.60	0.49
Japan	0.51	1.00	0.47	0.46
UK	0.60	0.47	1.00	0.42
Germany	0.49	0.46	0.42	1.00

Note: Standard error for autocorrelations and contemporaneous correlations = 0.11.

Table 2

Portfolio Shares with and without Human Capital

	Actual portfolio		Optimal portfolio		Value-weighted portfolio	
	no HC	w/ HC	no HC	w/ HC	no HC	w/ HC
Human capital	--	.580	--	.580	--	.580
USA	.938	.394	-.076	-.656	.520	-.060
Japan	.031	.013	.627	.627	.289	.289
UK	.011	.005	.128	.128	.150	.150
Germany	.005	.002	.112	.112	.042	.042
Portfolio mean	1.49	1.45	2.74	2.74	2.25	2.25
Portfolio s.d.	8.82	8.95	9.56	9.56	9.15	9.15

Note: Portfolio means and standard deviations are expressed as percent per quarter.

Table 3

Expected Real Returns Implied by

Actual Portfolio Holdings

(percent per year)

	actual returns	expected returns	
		no hc	with hc
USA	5.69	9.57	9.72
Japan	14.81	7.65	7.44
UK	9.74	9.22	9.19
Germany	7.72	6.20	6.17

Table 4

Human Capital Returns in a Two-Country General Equilibrium Model

I. Means and standard deviations

(percent per quarter)

Asset	Mean	Standard Deviation
Human Capital	1.430	17.71
Domestic Equity	1.425	9.05
Foreign Equity	3.153	11.24

II. Contemporaneous Correlation

	Human Capital	Domestic Eq.	Foreign Eq.
Human Capital	1.0000	0.7621	0.7524
Domestic Eq.	0.7621	1.0000	0.6376
Foreign Eq.	0.7524	0.6376	1.0000

Note: Statistics computed from the model are unshaded; statistics computed from the data are shaded. See the text for details.

Table 5

Implications of a Two-Country

General Equilibrium Model

I. Optimal Portfolio Choice

Asset	Actual portfolio		Optimal Portfolio		
	no HC	with HC	no HC	w/HC (1)	w/HC (2)
Human Capital	--	.580	--	.580	.580
Domestic Equity	.938	.394	-.132	-.672	-.408
Foreign Equity	.062	.026	.899	.589	.690

II. Implied Expected Returns

(percent per year)

	Actual returns	Implied expected returns		
		No HC	w/HC (1)	w/HC (2)
Human Capital	5.72	--	27.95	8.83
Domestic equity	5.69	9.58	12.52	8.37
Foreign equity	12.61	8.01	13.79	8.69

Note: **w/HC (1)** denotes the case in which relative means and standard deviations are computed from the model; **w/HC (2)** denotes the case in which the mean and variance of the human capital return are equal to those of the domestic stock market.

Table 6

Stochastic Properties of the Growth Rate of Real Labor Income

(monthly data, 1949:2 - 1992:7)

Results of a regression of the growth rate of real labor income, DLOGI, on a constant and twelve lags of real labor income.

Variable	Coefficient	Std. Error
constant	0.0005	0.0003
DLOGI(-1)	0.0502	0.0441
DLOGI(-2)	0.1966*	0.0439
DLOGI(-3)	-0.0124	0.0447
DLOGI(-4)	0.1228*	0.0446
DLOGI(-5)	0.0172	0.0449
DLOGI(-6)	0.0528	0.0447
DLOGI(-7)	0.0315	0.0445
DLOGI(-8)	-0.0366	0.0446
DLOGI(-9)	0.0022	0.0442
DLOGI(-10)	0.0560	0.0438
DLOGI(-11)	0.0019	0.0421
DLOGI(-12)	0.0130	0.0421

* coefficient is significant at 1% level

R-squared: 0.089

Durbin-Watson: 2.002

F-Statistic: 4.131

p-value (F-stat): 3×10^{-6}

Table 7

Summary Statistics for the Fama-Schwert Measure

of the Return to Human Capital

(quarterly data, 1970:1 - 1991:2)

I. Univariate Statistics

	mean % (qtr)	s.d. % (qtr)	autocorrelations 1	2	3	4
Human Capital	0.43	1.24	0.49	0.25	0.29	0.19

II. Contemporaneous correlation

	USA	Japan	UK	Germany	HC
Human Capital	-0.01	0.26	-0.03	0.04	1.00

III. Cross-correlation of human capital with equity returns

	Correlation{Human Capital(t), Equity(t+i)}								
	-4	-3	-2	-1	0	1	2	3	4
USA	0.22	0.19	0.33	0.21	-0.01	-0.08	0.01	-0.14	-0.18
Japan	0.28	0.22	0.36	0.43	0.26	0.17	0.20	0.10	-0.05
UK	0.18	0.25	0.36	0.19	-0.03	-0.06	-0.04	-0.11	-0.15
Germany	0.18	0.15	0.31	0.28	0.04	0.07	0.08	-0.07	0.04

Note: standard error of autocorrelations, contemporaneous correlations, and cross-correlations = 0.11.