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The human capital of stockholders and the international diversification puzzle

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Abstract

This paper evaluates the extent of the international diversification puzzle when human capital is considered part of the wealth of nations. The analysis examines whether (i) the inclusion of human capital in the wealth of portfolio of individuals, (ii) the different human capital assets held by stockholders and non-stockholders, and (iii) frictions in human capital markets, can help explain the puzzle. The methodology consists of comparing Hansen–Jagannathan bounds on the stochastic discount factor (IMRS) implied by human capital and financial returns across different countries. The results suggest that the information contained in the human capital of stockholders can greatly contribute towards explaining the international diversification puzzle.

Keywords: International diversification; Human capital; Stockholders; Asset returns, Discount factors

JEL classification: F39; G12; G15; J24

1. Introduction

The ''international diversification puzzle'' observes that investors hold too little of their financial wealth in foreign securities and that potential benefits from diversification exist. U.S. investors hold more than 90 percent of their financial assets in the form of domestic securities. In the United Kingdom, Germany, and Japan, for instance, the share of domestic financial assets in investors' financial

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wealth portfolios exceeds 85 percent. Similar numbers are also observed for a variety of other countries. Using existing models of investment and portfolio diversification, the evidence reported in several studies indicates the existence of a significant ''home bias'' in international financial markets. Although these markets have experienced a very significant growth and a substantial increase in their levels of integration during the last few decades, the low existing levels of international diversification of financial wealth are still considered to be one of the most intriguing and elusive puzzles in international economics and finance.

Different classes of potential explanations have been discussed in the literature. Among these are institutional barriers, transaction costs and explicit limits on cross-border investments.[1] However, as French and Poterba (1991) discuss, all of these ''are unlikely to explain the low levels of cross-border equity investment today'' and the ''apparent tendency for portfolio *investors* to overweight *their* own equity market'' appears to be ''the result of *investors* choices, rather than constraints'' (italics added). Two recent papers by Baxter and Jermann (1997) and Bottazzi et al. (1996) suggest that one potentially crucial piece of this puzzle that has been consistently ignored in the literature is the role of human capital, an asset which is the largest component of the wealth portfolio of individuals and countries.[2] Given the dominant position of this asset in individual and aggregate wealth, it is important to evaluate how human capital affects the international diversification puzzle. The initial results that these authors obtain, however, are inconclusive and divergent for the role of human capital assets in this puzzle.[3]

A common procedure in the literature is to examine the home bias puzzle at the aggregate level. Interestingly enough, most individuals hold few or no stocks and, as French and Poterba (1991) remark, the puzzle appears to be the result of *investors'* choices. Given this heterogeneity in the population, this paper focuses on the analysis of the puzzle with human and financial assets at a basic disaggregated level. More precisely, the analysis evaluates whether the human capital of stockholders, rather than aggregate human capital, may help us understand the weak extent of international financial diversification of equity investments. The analysis initially examines the extent to which two aspects of the puzzle are important: the measurement of human capital returns and the asset

[1] See Lewis (1999) for a comprehensive review and assessment of the literature.

[2] Human capital assets account for more than two-thirds of the wealth of the United States and other developed countries. Indeed, only the share of labor in the compensation of the typical firm and in GNP already accounts for about 70 percent (see Becker (1993) and Jorgenson and Fraumeni(1989)).

[3] The first paper examines the extent of the puzzle in the United States, the United Kingdom, Germany and Japan considering human capital, as a nontradable asset, part of the wealth portfolio of these countries. They use fundamentals-based *physical* capital returns and find that the puzzle is *deepened*. The reason is that their measure of human capital returns are highly correlated with their physical capital returns and, hence, hedging human capital risk involves a short position in domestic physical capital. Bottazzi et al. (1996) obtain similar results using fundamentals-based returns but find that human capital *helps* to explain the home bias when using security market returns.

pricing empirical methodology used. It then examines the role of two novel, additional aspects: the extent to which the human capital assets and returns of stockholders are different from those of non-stockholders, and the extent to which the consideration of human capital as a purely nontradable asset is also important. The paper, therefore, accounts for a fundamental source of heterogeneity in the population, and offers the first analysis of the international diversification puzzle with human capital assets at a basic disaggregated level. These four aspects are briefly discussed next.

First, it is important to take into account whether the human capital assets and returns of stockholders differ from those of non-stockholders. From the analysis and data used, for instance, in Mankiw and Zeldes (1991); Blume and Zeldes (1994) and Vissing-Jørgensen (1998), and from the *Survey of Consumer Finances* and other similar surveys, the differences in the demographic characteristics of stockholders and non-stockholders (e.g., age, education and experience), as well as in their consumption behavior, indicate that their human capital asset holdings are also very different. If human capital assets are to be brought to bear on the international diversification puzzle, then these differences, in principle, are potentially important and need to be accounted for. The differentiation between stockholders and non-stockholders has already been fruitful in explaining part of the equity premium puzzle and may also play an important role in the international diversification puzzle.

Second, previous empirical analyses have approximated human capital returns by the growth rate in per capita labor income. This measure, however, ignores some of the fundamentals of three decades of work in human capital theory and labor economics, and assumes that labor income growth is unforecastable.[4] In this paper, we examine other approximations of human capital returns that can account for some shortcomings of the growth rate in per capita labor income.

Third, several specific models of investment under uncertainty and the valuation of risky assets do not seem to provide satisfactory explanations of the behavior of financial asset returns and the extent of efficient investments. For instance, the widely popular unconditional, static CAPM explains only an insignificant part of the cross-sectional variability of average financial returns.[5] It would then seem necessary to avoid addressing issues of portfolio diversification using or imposing a specific model, if at all possible. Research in asset pricing and portfolio theory, however, has experienced tremendous progress in the last few years by following the methodology suggested by Hansen and Jagannathan (1991) and Gallant et al.

[4]Furthermore, it is only plausible under strict econometric assumptions, which in fact appear to be rejected by the data (see Baxter and Jermann (1997)). See Becker (1993); Rosen (1987), and other references therein for a review of the literature on human capital.

[5]Fama and French (1992) present evidence that the static CAPM explains about 1 percent of the cross-sectional variability. The analysis in Jagannathan and Wang (1996) suggests that it may explain up to 30 percent. Their conditional CAPM, however, explains about 55 percent.

(1990). These authors provide a means of addressing the issues of portfolio diversification and efficient investments in a general way. They derive boundary conditions (respectively, unconditional and conditional on the set of available information) for the moments of a generally defined stochastic discount factor. Different assumptions about the parametrization of this discount factor lead to standard models of asset pricing used in finance.[6] A fundamental advantage of this methodology is that no specific parametrization needs to be assumed in order to address issues of portfolio diversification in a general, robust way. The only assumption that needs to be imposed is that portfolios with the same payoffs have the same price (the law of one price). In addition, empirical tests can be implemented using conditioning and unconditioning information, allowing the models to include different classes of frictions in human capital markets, and using the General Method of Moments, a method which requires very weak distributional assumptions about the observed data. Their methodological approach will be followed in this paper.

Fourth, as Jagannathan and Wang (1996) point out, the opinion that human capital is not tradable is largely correct, but needs to be qualified. First, active insurance markets exist for hedging some of the risks in human capital investments. Examples include life insurance, unemployment insurance, medical insurance, marriage, and certain forms of partnerships. Second, the market value of mortgage loans, consumer credit and bank loans to the household sector represent 80 percent of GNP. Since these ''can be viewed as borrowing against future income, it does not appear inappropriate to view human capital like any other form of capital, cash flows which are traded through issuance of financial assets'' (Jagannathan and Wang, 1996, p. 13). Clearly, however, ''frictions'' in financial markets typically appear to be negligible relative to those in human capital markets (see Becker, 1993).

The purpose of this paper is to take into account these four aspects *simultaneously* and examine the extent of the international diversification puzzle. The findings can be summarized as follows:

(i) when human capital assets are ignored, there are indeed significant benefits from international financial diversification;

(ii) if human capital assets are considered part of the wealth portfolio and returns are approximated by the growth rate in per capita labor income, the extent of the puzzle becomes smaller, not greater;

(iii) the puzzle is further reduced if, instead of using the growth rate in per capita labor income, other alternative measures of human capital returns are used;

[6] If it is specified as a linear function of the return on the market portfolio, the static CAPM is obtained. In consumption-based models, this factor is interpreted as the IMRS and can be parametrized in different ways. More generally, it can also be expressed as a function of observable factors as in Chen et al. (1986).

(iv) for the U.S., the puzzle becomes close to insignificant, in most cases, when the human capital assets of U.S. stockholders alone are taken into account;

(v) the previous results, from (i) to (iv), become stronger if, instead of considering human capital as a fully nontradable asset, it is assumed that it is subject to certain frictions (short-sale constraints and transaction costs) or, in the limit, fully tradable. The latter case, obviously, appears to be quite unrealistic.

These results suggest that the empirical methodology, the specific approximation of human capital returns, the role of frictions and, most importantly, the differentiation between the human capital of stockholders and non-stockholders all appear to play a significant role in determining the extent of the puzzle. These features differentiate the analysis in this paper from previous work in the literature.

An important ingredient of the analysis is the way human capital returns are measured. Unfortunately, while the availability of quality labor income data in the United States allows the calculation these measures of human capital, the data available for other countries do not. For this reason, these measures are calculated only for the United States. The period of analysis covers 1964–1996 and the countries considered are the ones in Baxter and Jermann (1997): the United States, the United Kingdom, Germany and Japan. These countries have actively traded stock markets, legal systems that enforce property rights, and few restrictions on movements of capital.

The paper is organized as follows. Section 2 briefly reviews the methodology and its advantages. Section 3 derives individual labor-income-based measures of human capital returns and discusses other approximations of human capital returns. Section 4 describes the sources of the data. Section 5 tests and estimates the significance of the increase in the expected return per unit of risk that mean-variance investors could achieve by diversifying their wealth into the financial assets of other countries. The section concludes by discussing additional empirical evidence and the robustness of the findings. Finally, Section 6 presents some concluding remarks.

2. Empirical methodology

The analysis follows the methodology of Hansen and Jagannathan (1991) and He and Modest (1995) to construct volatility bounds on the stochastic discount factor or, equivalently, mean-variance efficient frontiers for different sets of human and financial assets for different countries.[7] In particular, domestic bounds (mean-variance frontiers) are constructed from the asset returns of a given country and international bounds are constructed when foreign financial returns of another

[7] See Campbell et al. (1997); Cochrane (2001) and many references therein for further details of the methodology and several applications.

country are added as a third asset. Then, these two different volatility bounds are compared using a test that employs the covariance structure of human and financial returns in the empirical estimation of risk and risk-return differentials across countries. These tests are also extended to be conditional on the set of information available to investors. In addition, a statistic is computed that calculates the increase in expected return per unit of risk that the representative mean-variance investor of a country could achieve by diversifying his wealth into the financial assets of other country.

2.1. Boundary conditions for stochastic discount factors

2.1.1. Frictionless economies

The equilibrium conditions in most utility-based asset pricing models can be written as $u'(c_t) = E_t[\beta u'(c_{t+1})R^i_{t+1}]$, where $u'(c_t)$ denotes the marginal utility of consumption at time t, R^i_{t+1} the return of asset i from t to $t+1$, β the rate of time preference, and $E_t[.]$ the expectation conditional on information available at t. Consider an economy with n risky securities and a riskless bond. Let R_{t+1} denote the vector of the risky real returns and R^f_{t+1} the real return earned by the riskless bond. Under no market frictions the equilibrium conditions are:

$$\begin{aligned} E_t[R_{t+1}m_{t+1}] &= \mathbf{1}, \forall t \\ E_t[R^f_{t+1}m_{t+1}] &= 1, \forall t \end{aligned} \tag{1}$$

where $m_{t+1} = \beta u'(c_{t+1})/u'(c_t)$ and $\mathbf{1}$ is an n-dimensional vector of ones. In general, however, m is a random variable and, as discussed earlier, different assumptions about the parametrization of m lead to standard models of asset pricing used in finance.[8] No specific parametrization needs to be introduced here, so m can be generally interpreted as a stochastic discount factor satisfying (1). Hence the implications derived in what follows are as general as possible. Hansen and Jagannathan (1991) show that the candidate random variable $m_v = R_v' \ \beta_v = [R\ (1/v)]'[\beta\ \gamma] = R_v'[E(R_vR_v')]^{-1}\mathbf{1}$ with $R^f = 1/v$ can be used to set boundary values on the standard deviation of m: m and m_v have the same mean, as they both satisfy (1), and m_v has the minimum variance among all the possible variables that satisfy (1). Note that there is a dual relationship between the Hansen–Jagannathan bounds for m (henceforth HJ bounds), $\sigma(m) \geq \sigma(m_v)$, and the traditional mean-variance frontier for returns. Defining R^e as the difference between any two returns, Eq. (1) implies $E(R^e m) = 0$. Using the definition of covariance and the Cauchy–Schwartz inequality we have:

[8] Eq. (1) is derived as an implication of the law of one price. The results presented here are derived without imposing a positivity restriction on m. They are similar to those obtained with such a restriction. Time subscripts are omitted when unnecessary for the exposition.

$$\frac{\sigma(m)}{E(m)} \geq \frac{|E(R^e)|}{\sigma(R^e)}. \tag{2}$$

2.1.2. Economies with frictions

He and Modest (1995) and other authors extend the analysis to economies where trade in assets is subject to market frictions. Four classes of frictions are considered in this paper:

1. SHORT-SALE CONSTRAINTS. Let A be the subset of assets whose holdings cannot be negative, and A^C be its complement set. The equilibrium conditions are:

$$E_t[m_{t+1}R^i_{t+1}] = 1, \quad i \in A^c, \tag{3}$$

$$E_t[m_{t+1}R^i_{t+1}] \leq 1, \quad i \in A.$$

2. BORROWING CONSTRAINTS. When consumers are not allowed to consume more than their non-human current wealth, the first-order conditions become:

$$E_t[m_{t+1}(R^i_{t+1} - R^j_{t+1})] = 0, \quad \forall i, j \tag{4}$$

$$E_t[m_{t+1}R^i_{t+1}] \leq 1, \quad \forall i.$$

3. SOLVENCY CONSTRAINTS. When non-human wealth at some future date cannot be below some predetermined level, the first-order conditions become:

$$u'(c_t) = E_t[[\beta u'(c_{t+1}) + \varphi_{t+1})R^i_{t+1}], \quad \text{for } \varphi_{t+1} \geq 0. \tag{5}$$

4. TRANSACTION COSTS. If there are trading costs that are proportional to the amount traded, then the equilibrium conditions become:

$$\frac{1-\mu_j}{1+\mu_j} \leq E_t\left[\beta \frac{u'(c_{t+1})}{u'(c_t)} R^j_{t+1}\right] \leq \frac{1+\mu_j}{1-\mu_j}, \tag{6}$$

where μ_j denotes the proportional cost for asset j.[9]

2.2. The comparison of volatility boundaries

Investors can benefit from portfolio diversification if there is an asset or subset of assets such that their returns imply stricter volatility bounds on m than the ones implied by the assets to which this asset or subset of assets is added. This is

[9] Obviously, various frictions may operate simultaneously. The feasible region for the mean and standard deviation of m, Ω_λ, is obtained as the lowest possible bound for a given $E(m) = v$. This bound is found by choosing λ to minimize $\sigma(m_v) = [(\lambda - vE[R_{t+1}])'\Sigma^{-1}(\lambda - vE[R_{t+1}])]^{1/2}$, where Σ is the covariance matrix of R_{t+1}. The set of lowest volatility bounds is $\cup_\lambda \Omega_\lambda$.

equivalent to saying that the differences among the mean-variance frontiers associated with different subsets of assets are statistically significant. Formally, let R^A and R^B denote two different vectors of returns. Define $\wp^i$ as the return space spanned by R^i:

$$\wp^i \equiv \{\mathbf{1}'R^i : \mathbf{1} \in \mathbf{R}^{n(i)}\},$$

where $n(i)$ is the number of assets in set i, $i = A,B$, and $n(A) + n(B) = n$. Define R_v^i as the $(n(i)+1)$-dimensional vector obtained by augmenting R^i with the value $1/v = E(m)$. Then, (1) can be written as $E[R_v^i m] = \mathbf{1}$ and the candidate discount factor $m_v^i = R_v^{i'}\ \beta_v^i = R_v^{i'}[E(R_v^i\ R_v^{i'})]^{-1}\mathbf{1}$ that prices R^i for each possible value of v can be constructed as long as the matrix $E(R_v^i\ R_v^{i'})$ is not singular. Let $\wp$ denote the span of the returns obtained combining R^A and R^B:

$$\wp \equiv \wp^A + \wp^B = \{p^A + p^B : p^A \in \wp^A \text{ and } p^B \in \wp^B\}.$$

The question is whether or not a stochastic discount factor m exists that correctly prices all the assets in $\wp$. If R is the vector obtained by stacking R^A and R^B, and R_v is the $(n+1)$-dimensional vector obtained by augmenting R with the value $1/v$, then the discount factor that prices R for this given v is $m_v = R_v'[E(R_v R_v')]^{-1}\mathbf{1}$. To evaluate whether the distance between $\wp^i$ and $\wp$ is statistically significant, we need to test whether the variable m_v that prices *all* assets can be written as a function of the assets defined over $\wp^i$ *alone*. Formally, since m_v can be obtained as

$$m_v = R_v'\beta_v = [R^{A'} R^{B'}\, 1/v][\beta^A \beta^B \gamma]',$$

under the null hypothesis that R is priced by the $n(A)$ assets included in R^A, the $n(B)$ coefficients in β^B have to equal zero. If the null hypothesis cannot be rejected, then the assets associated with R^B do not carry any additional information (in terms of the restrictions imposed on $\sigma(m)$) that is not already contained in the assets associated with R^A and, hence, no potential gains derive from diversification.

Using the dual relationship between the frontier for admissible m's and the mean-variance frontier for asset returns, these tests establish whether the mean-variance frontiers associated with two different sets of assets (such that one set always contains the other) are tangent at the point with the highest Sharpe ratio. As a result, if the frontier spanned by the vector of asset returns R^A and R^B is different from the one spanned by the set of returns R^i alone, $i = A,B$, then a mean-variance investor would prefer to diversify his investments in both sets of capital assets, as opposed to investing only in the set of assets i (A or B).[10]

[10] In cases in which optimal portfolio strategies are not on the mean-variance frontier, the extent of the improvements in the frontier will not generally represent the same potential benefits from international diversification, but will still be informative of the extent of potential gains that investors may achieve by diversification.

Following these considerations, De Santis (1993) develops a χ^2 test of coincidence of boundaries (overidentifying restrictions). His test, which is used to evaluate the hypotheses of this study, is implemented by GMM for two values of v simultaneously and is extended to condition on the set of information available to investors.[11]

Lastly, in addition to evaluating whether the change in volatility bounds is *statistically* significant, it is also relevant to measure how much the bounds change when the new assets are included in the original set, that is whether the change is *economically* significant. An indicator of this change is the distance between the frontiers at the value of $E(m)$ that corresponds to the minimum of the frontier. This statistic is also equal to the change in the Sharpe ratio divided by the risk-free return that corresponds to the selected $E(m)$. Since the mean of m is typically very close to one, the change in the volatility bound is approximately equal to the increase in the expected return per unit of risk that the investor can achieve by diversification.

3. Measures of human capital returns

The method typically followed to calculate the rate of return on human capital was first presented by Mincer (1958) and later expanded by Becker (1993) to include interpersonal differences in abilities, talents, and family circumstances.[12] The same fundamental principles are considered here to construct a measure that is directly related to the equilibrium conditions examined in the previous section.

Consider, for instance, an individual at time t with $h-1$ units of human capital and preferences over consumption $E_t\Sigma_{j=0}^{\infty}\beta^j u(c_{t+j})$ that faces the trade-off between acquiring one unit of human capital today or acquiring it tomorrow. If he acquires this unit tomorrow, he will earn $w_{t,h-1}$ (net real wages or consumption goods) today and nothing tomorrow; that is, he obtains $w_{t,h-1}u'(c_t)$ utils today. If instead he acquires it today, he will earn no wages today and will expect to earn net earnings of $w_{t+1,h}$ units of consumption tomorrow, worth $w_{t+1,h}u'(c_{t+1})$ utils at $t+1$ and $E_t[\beta u'(c_{t+1})w_{t+1,h}]$ expected utils when evaluated today. Therefore, his first order conditions are:

[11] The test of the conditional version of the orthogonality conditions can be derived using ''scaled'' returns $R_{t+1}\otimes z_t$ following Hansen and Singleton (1982) and Hansen and Richard (1987), where z_t is an m-dimensional vector of instrumental variables belonging to the information set at t. See De Santis (1993); Palacios-Huerta (1997, 2001) and Cochrane (2001) for details of the tests.

[12] This method is based on the maximization of the present discounted value of wealth associated with some choice in the amount of schooling. As a result, after adjusting the income data for age and experience, a regression of the logarithm of income on years of schooling yields an estimate of the marginal internal rate of return to education as the regression coefficient on years of schooling. Much of the research in human capital has been organized around this conceptual framework.

$$w_{t,h-1}u'(c_t)=E_t[\beta u'(c_{t+1})w_{t+1,h}].$$

The return to human capital that emerges from the intertemporal choice is:

$$1+R_{h,t+1}=\frac{w_{t+1,h}}{w_{t,h-1}}.$$

Notice that this measure can be decomposed into two terms:

$$1+R_{h,t+1}=\frac{w_{t+1,h-1}}{w_{t,h-1}}\cdot\frac{w_{t+1,h}}{w_{t+1,h-1}}=R_t^{t+1}(h-1)\cdot R_{h-1}^{h}(t+1).$$

The first term, $R_t^{t+1}(h-1)$, is the *time* return to having $h-1$ units of human capital from t to $t+1$. It can also be interpreted as the ''capital gains'' of a given stock of human capital. This term, which is about 2 percent on average in the U.S., plays an important role in the structure of wages but it is generally ignored when regressing the logarithm of income (wages) on years of schooling and in other measures. The second term, $R_{h-1}^{h}(t+1)$, is the human capital return resulting from having one more unit of human capital at a given time. This important *skill premium* is ignored in the basic growth rate in per capita labor income measure.

Note also that if one defines $w_{t+j,h}=w_{t+j,h-1}+d_{t+j,h}$, then the typical present value expression is obtained by recursively substituting in the first order conditions: $w_{t,h-1}u'(c_t)=E_t\Sigma_{j=1}^{\infty}\beta^j u'(c_{t+j})d_{t+j,h}$. This expression indicates that the utils provided by net real wages today with human capital $h-1$, are equal to the expected discounted sum of utils provided by the *additional* wages (wages with human capital h minus wages with human capital $h-1$) that one more unit will provide for the rest of life, as in the traditional Becker–Mincer measures. In this sense labor income is forecastable. More importantly, this expression indicates that ''frictions'' such as transaction costs are to be interpreted as the costs of trading claims on the present discounted value of future additional wages $d_{t+j,h}$.[13]

The individual returns above can be aggregated according to their share or value in the distribution of wages $S_{t+1,h}^{g}$ as follows:

$$R_{t+1}^{I}=\sum_h\sum_g S_{t+1,h}^{g}\frac{w_{t+1,h}^{g}}{w_{t,h-1}^{g}}.$$

[13]This measure of human capital returns can be interpreted as the one-period premium obtained by having one additional unit of human capital for a given type of individual, that is conditioning on his *age*, sex, race and other demographic characteristics. Hence, it is the premium necessary to ''move'' a given individual from t to $t+1$ from his current life-cycle wage profile to that associated with one more unit of human capital. In this implicit model human capital is endogenous, and the rate of return captures trade-offs over time between the marginal productivities of human capital assets that are different in one unit. Clearly, the numerator of the growth rate in per capita labor income does not correspond to a representative person at $t+1$ with exactly 1 more year of education than the representative person in the denominator at t.

The variable g denotes an element of the set of demographic characteristics $\{g=1,\ldots,G\}$ which in this paper are sex, race and experience. In the empirical analysis h will be approximated by years of education.

Lastly, these human capital returns can also be calculated for stockholders and non-stockholders separately. From the *Survey of Consumer Finances,* the *Consumption Expenditure Survey* and other surveys, it is observed that households whose heads are white, male, with at least a college education and 40 years of age (about 15 years of experience) are much more likely than any other demographic group to be considered a ''stockholder'' during the period of study.[14] These individuals will be treated as stockholders.

3.1. Other human capital measures

The robustness of the empirical results obtained using the measure $R_{h,t+1}$ will be evaluated using tuition data as well as the measures suggested by Buchinsky and Leslie (1997) and Campbell (1996).

Buchinsky and Leslie (1997) develop a finite horizon dynamic model with endogenous labor supply in which, as in this paper, individuals decide in each period their current consumption and whether to obtain one more unit of human capital (e.g., education) or gain a year of work experience. They use a quantile regression approach. The novel feature of their model is the inclusion of evolving perceptions about future wages. Their approximation leads to similar rates of return across demographic groups (though slightly lower means and standard deviations).

Campbell (1996 p. 308, Eq. 12) has recently suggested another approximation to human capital returns that generalizes the growth rate in per capita labor income:

$$\begin{aligned} r_{hk,t+1} - E_t r_{hk,t+1} &= (E_{t+1} - E_t)\sum_{j=0}^{\infty}\rho^j\ \Delta\log w_{t+1+j} \\ &\quad - (E_{t+1} - E_t)\sum_{j=0}^{\infty}\rho^j\ \Delta r_{a,t+1+j}. \end{aligned}$$

His analysis essentially implies that revisions or innovations in expected future labor income $\Delta\log w$ and in expected future financial asset returns r_a should be added to the growth rate in per capita labor income. The reason is that labor income is not unforecastable and that increases in expected future labor income induce a positive return on human capital r_{hk}, whereas increases in expected future

[14] This is the case for the four measures of stock ownership used in Blume and Zeldes (1994): (1) = direct holdings of equities; (2) = (1) + equity and balanced mutual funds; (3) = (2) + stocks in IRAs + stocks in trusts; (4) = (3) + stocks in defined contribution pension plans.

financial returns induce a negative return because labor income is discounted at a higher rate.[15]

4. Data

4.1. United States data

4.1.1. Data on financial asset returns

Yearly data on the U.S. equity index and the T-Bill for the period March 1963–March 1996 were obtained from the *Center for Research in Security Prices* (CRSP) files. The index was computed with dividends reinvested, so that returns include both capital gains and dividend yields. The conditional version of the model is derived assuming the annual return on the U.S. T-Bill as the benchmark return to compute excess returns.

4.1.2. Data on human capital returns

These data come from a series of 33 consecutive *March Current Population Surveys* (CPS) for survey years 1964 to 1996. The CPS data provide information on earnings and weeks worked in the calendar year preceding the March survey for approximately 1.4 million workers. The data are first divided into 2,880 distinct groups, distinguished by sex, race (white, black), years of education (1 to 18), and potential years of experience (from 0 to 40), defined as min $\{age - years\ of\ schooling - 7,\ age - 17\}$, where *age* is the age at the survey date. The average weekly wage of full-time workers is computed within each gender-race-education-experience cell as total annual earnings deflated by the personal consumption expenditure deflator from the national income and product accounts divided by total weeks worked. Then, five education groups are considered (less than high school, high school, some college, college, and more than college) and eight experience groups (0–5, 6–10, . . . , 35–40 years of experience). The average weekly wage of full-time workers is computed within these 160 cells (sex, race, education group, experience groups) in a value-weighted fashion. These five education groups will then serve as the ‘units’ of human capital.[16]

Stockholders represent about 30 percent of the population in the CPS data. Their returns, and those of non-stockholders, are computed in a value-weighted fashion.

[15] Other authors have used some components of this measure. Shiller (1993) discounts aggregate income at a constant rate. Jagannathan and Wang (1996) and Baxter and Jermann (1997), in addition, assume that labor income growth is unforecastable and work with the growth rate in per capita labor income.

[16] The large size of the CPS dataset guarantees an adequate demographic weighting. Because of the change in questions relating to educational attainment in 1992, the recent questions are reconciled with the previous ones following Jaeger (1997). See Juhn et al. (1993), Katz and Murphy (1992) and Murphy and Welch (1992) for analyses of the structure of wages in the U.S.

4.2. Data from the United Kingdom, Germany and Japan

These data come from *Morgan Stanley Capital International* (MSCI). The combined market value of the companies included in the indices equals approximately 77% percent of the total market capitalization. The companies are selected on the basis of national and industry representation, and most of the stocks are actually available to non-national investors (see Cumby and Glen (1990)).

4.3. Hedged financial returns

Financial returns are computed assuming that investors have covered their exposure to exchange rate risk. The return from their hedged strategy is computed as $R^{hg}_{i,t+1} = R_{i,t+1} + (F_{i,t} - S_{i,t+1})/S_{i,t+1}$ where $R_{i,t+1}$ is the uncovered return on the market index for country i, $F_{i,t}$ is the forward price at time t of the currency of country i, $S_{i,t}$ is the spot price of that currency, and $(F_{i,t} - S_{i,t+1})/S_{i,t+1}$ is the normalized return on a short position in the forward contract. The spot exchange rates are obtained from the MSCI data set and the forward prices are from *Data Resources Incorporated*.[17]

5. Empirical Evidence

Unconditional and conditional χ^2 tests of coincidence of boundaries have been implemented. The selected values for v are 0.995 and 1.015. The instrumental variables in the conditional tests are a vector of ones and the lagged returns on the original human capital and domestic financial assets that are considered. Tables 2–5 show the results of the tests. For each test, the tables also include the indicator of the estimated increase in expected returns per unit of risk that a mean-variance investor could achieve by diversification into foreign equity returns. This indicator is evaluated at the minimum of the bounds and is denoted as ''HJ bounds change.'' All estimates are expressed in annual terms.

Table 1 describes the general features of the human capital and financial returns. One of the main features to be noted is that human capital returns are, first, less correlated with domestic equity returns than what foreign equity assets are and, second, much less correlated with domestic equity returns than previously literature believed. The main reason for this second observation is that the skill premium $R^h_{h-1}(t+1)$, previously ignored in the literature, is generally negatively

[17] Forward prices are missing previous to 1973 and are approximated using the covered interest rate parity: $F_{i,t} = (1 + r_t)/(1 + r^*_t)S_{i,t}$, where r_t is the domestic interest rate and r^*_t is the foreign interest rate. Interest rate data are taken from the *International Financial Statistics* of the International Monetary Fund. The correlation between the estimated forward rates and the true ones after 1973 is greater than 0.95 for these countries.

Table 1
Human capital and financial returns summary statistics 1964–1996[a]

Human capital returns	Mean	Std. dev.	Unconditional correlations				
			R^I	R^I-st.	R^I-nst	LIGR	U.S. equity
R^I	9.82	2.46	1.00	0.15	0.52	0.20	0.09
Stockholders (R^I-st)	1.16	4.07		1.00	0.27	0.07	−0.11
Non-stockholders (R^I-nst)	9.07	3.82			1.00	0.24	0.17
Campbell							
Stockholders	10.27	3.18		0.83			−0.09
Nonstockholders	8.17	3.91			0.82		0.21
Buchinsky-Leslie							
Stockholders	10.72	4.03		0.77			−0.10
Nonstockholders	8.66	3.44			0.80		0.18

Home equity returns	Mean	Std. dev	U.S.	U.K.	Germany	Japan
United States	12.48	18.27	1.00	0.642	0.378	0.336
United Kingdom	19.92	21.30		1.00	0.380	0.278
Germany	12.36	19.16			1.00	0.321
Japan	12.72	18.72				1.00

[a] *Notes*: LIGR denotes per capita labor income growth rate. Financial hedged returns are computed assuming that investors have covered their exposure to exchange rate risk. *Data Sources*: Equity returns for the US come from the Center for Research in Security Prices (CRSP); equity returns for the United Kingdom, Germany and Japan from Morgan Stanley Capital International ((MSCI), wage data from the March Current Population Surveys (CPS), and interest rate data from the International Financial Statistics (International Monetary Fund).

correlated with the returns to domestic capital.[18] Moreover, the human capital returns of stockholders are notably less correlated with domestic equity returns than what aggregate human capital returns are, and these in turn are less correlated than non-stockholders' returns. The differences across these two groups arise from the fact that $R_t^{t+1}(h-1)$ is less correlated with returns to equities for equity holders than for the public as a whole. The second reason is that the skill premium $R_{h-1}^h(t+1)$ for equity holders has a lower (and negative) correlation with equity returns than the skill premium for non-equity holders. As a result, the correlation for stockholders, who also tend to have more human capital than non-stockholders, is *negative* for the measure R_{t+1}^I, and for the Buchinsky–Leslie and Campbell measures as well.

Table 2 examines the extent to which the asset pricing methodology *alone,* where no specific pricing model is imposed, is helpful to explain the international diversification puzzle for equity assets. The tests evaluate whether the HJ bounds

[18] These effects are well documented in the labor and business cycle literatures (see, for instance, Keane et al. (1988) and Rubinstein and Tsiddon (2000)).

Table 2
Exact p values of the χ^2 statistic and changes in the Hansen–Jagannathan bounds for financial assets[a]

	S(A^F) versus S($A^F + B^F$) Unconditional Tests (HJ bounds change)	Conditional Tests (HJ bounds change)						
Country B	United States		Japan		United Kingdom		Germany	
United States			0.00	0.01	0.32	0.51	0.00	0.00
			(16.32)	(9.60)	(1.37)	(1.17)	(4.91)	(3.77)
Japan	0.00	0.00			0.00	0.00	0.00	0.00
	(19.31)	(12.11)			(12.96)	(10.60)	(7.21)	(5.50)
Country A								
United Kingdom	0.46	0.65	0.00	0.01			0.03	0.05
	(1.52)	(1.40)	(12.10)	(7.81)			(4.80)	(3.29)
Germany	0.00	0.02	0.00	0.00	0.04	0.05		
	(5.21)	(4.01)	(9.82)	(8.11)	(5.11)	(5.00)		

[a] These tests compare the HJ bounds S(.) spanned by financial assets of country A (A^F) versus those spanned by the financial assets of countries A and B ($A^F + B^F$) using unconditioning and conditioning information (a vector of ones and the vector of lagged returns for country A). Under the null hypothesis the bounds are identical. In parentheses, for each test, is the distance between the frontiers at the minimum of the bounds for A^F (HJ bounds change), that is, the change in the Sharpe ratio divided by the ''shadow'' risk-free rate at that point.

spanned by the equity assets of one country are identical to those spanned by the equity assets of that country and those of a second country. The equilibrium conditions for equity assets are (1) and (2) in Section 2. First, it can be observed that the U.S. and the U.K. are the only pair of countries in which, in a statistical sense, there seems to be no international diversification puzzle as the null hypothesis of coincidence of boundaries cannot be rejected in any case. However, gains from diversification per unit of risk are about 1.20% to 1.40% and can be considered non-negligible. The tests of coincidence of boundaries are clearly rejected in all other cases. These results are, therefore, consistent with an international diversification puzzle. Other relevant features can be noted. First, the tests of the U.S. with other countries are qualitatively similar to those of the U.K.. Japan seems to induce a greater effect upon the bounds spanned by U.S. (and U.K.) assets than what Germany does. The bounds spanned by either Germany or U.K. are statistically different than those spanned by both countries. However, their p values are either 0.05 or closer to 0.05 than for any other pair of countries where the hypothesis is rejected. Note also that it is more difficult to reject the null hypothesis in the conditional tests than in the unconditional ones. As to the increase in expected returns per unit of risk that investors can achieve by diversification in one other country, the tests indicate that it ranges between 1% and 2% for the pair U.S.–U.K. (where, in statistical terms, there is no diversification puzzle) and between 3% and 19% for all the other pairs. This increase is greatest for the U.S.–Japan unconditional tests, followed by the U.K.–Japan tests. These results are consistent with the findings in De Santis (1993); French and Poterba (1991) and other studies (see Lewis, 1999), and support the argument of an international diversification puzzle when equity assets alone are considered.

In Table 3, the same tests are implemented as in Table 2 except that now human capital assets are considered part of the domestic wealth portfolio. As in previous studies, human capital returns are initially approximated by the growth rate in per capita labor income. In addition, they are assumed to be subject to short-sale constraints and to be nontradable (that is, they satisfy Eqs. (3) and (6) for $\mu = 1$). The results clearly indicate that the p values tend to *increase* in all cases and, therefore, it is more difficult to reject the hypothesis of coincidence of boundaries. In some cases, the p values do not increase much (e.g., Japan–Germany tests), but they greatly increase in others (e.g., Germany (A)—U.K. (B)). Note that the statistic that measures the increase in expected returns per unit of risk that investors can achieve by diversification decreases as the p value increases, but it decreases relatively more than the increase in p value. The reason is that the

Table 3
Exact p values of the χ^2 statistic and changes in the Hansen–Jagannathan bounds for growth rates in labor income and financial asset returns[a]

		$S(A^{HK}+A^F)$ versus $S(A^{HK}+A^F+B^F)$							
		Unconditional Tests (HJ bounds change)	Conditional Tests (HJ bounds change)						
Country B									
		United States		Japan		United Kingdom		Germany	
	United States			0.01 (10.07)	0.03 (8.21)	0.44 (1.20)	0.66 (1.02)	0.01 (4.01)	0.05 (3.70)
	Japan	0.01 (16.81)	0.03 (12.11)			0.02 (8.39)	0.06 (7.22)	0.00 (6.66)	0.00 (4.23)
Country A									
	United Kingdom	0.61 (1.27)	0.82 (0.92)	0.01 (9.66)	0.04 (6.09)			0.03 (3.36)	0.05 (2.80)
	Germany	0.03 (4.23)	0.04 (2.82)	0.00 (8.00)	0.00 (7.31)	0.04 (4.29)	0.05 (3.50)		

[a] These tests compare the HJ bounds S(.) spanned by the human capital and financial assets of country A ($A^{HK}+A^F$) versus those spanned by the financial and human capital assets of countries A and the financial asset of country B (B^F) using unconditioning and conditioning information (a vector of ones and the vectors of lagged returns in country A). Human capital returns are approximated by the growth rate in per capita labor income. Human capital is assumed to be subject to short-sale constraints and to be non-tradable (transaction costs = one hundred percent). Under the null hypothesis the bounds are identical. In parentheses, for each test, is the distance between the frontiers at the minimum of the bounds for $A^{HK}+A^F$, that is, the change in the Sharpe ratio divided by the ''shadow'' risk-free rate at that point.

original bounds to which the financial assets of country B are added now include a second asset (human capital), and hence are more ‘‘stringent’’ than the ones spanned only by the financial assets of country A. The results, therefore, indicate that labor income growth *does* have some information on the stochastic discount factor not contained in equity assets and, most importantly, that this information reveals a *smaller*, not greater, international diversification puzzle (so far except in the U.S.–U.K. cases, as in Table 2). However, there is still a puzzle in many cases. Indeed, *all* the conditional tests (except the U.S.–U.K. cases) continue to indicate that there is a puzzle.

In Table 4, human capital returns are approximated for the U.S. by R^I_{t+1}. Human capital is still assumed to be subject to short-sale constraints and to be non-tradable. Then, short-sale constraints are maintained but different assumptions about the tradability of claims to future wages (extent of transaction costs μ) are considered. The results show the following:

(i) First, p values increase, thereby making it more difficult to reject the hypothesis that there is no international diversification puzzle, although the puzzle still exists in most cases. The increase in expected returns per unit of risk that US investors can achieve by diversification are reduced accordingly. It ranges from 3.61% to 3.82% for Germany, from 7.60% to 8.91% for Japan, and from 0.86% to 0.93% for the U.K.. These results indicate that the measure R^I_{t+1} contains greater information than the growth rate in per capita labor income to help explain the extent of the puzzle.

(ii) When the assumption that no claims on future wages can be traded is relaxed, then in *no case* it is possible to reject the hypothesis that there is no diversification puzzle (i.e., that the boundaries coincide). The gain in expected returns per unit of risk that can be achieved by diversification decreases (and the p values increase) as transaction costs are assumed to be smaller. They amount to no more than 6% (4%) in the unconditional (conditional) tests when transaction costs are 50 percent, between 0.29% and 4.33% when transaction costs are 20 percent and between 0.0% and 2% when they are 5 percent or less. Obviously, transaction costs as low as 0, 1, 5 or even 20 percent may seem unrealistic. However, more importantly, these results show that relaxing the assumption about the complete inability of trading claims on future wages helps explaining the diversification puzzle.

Lastly, perhaps the main aspect of the paper is examined in Table 5. In this table the tests are implemented separately for stockholders and non-stockholders. The pattern of the results turns out to be strikingly different for these groups. The first important result is that p values are consistently greater for stockholders—and, correspondingly, the statistics that measure the increase in expected returns per unit of risk that can achieved by diversification are consistently smaller—than those found at the aggregate level in Table 4. The converse (smaller p values and greater statistics) is true for non-stockholders. For stockholders, the null hypothesis of coincidence of boundaries cannot be rejected *in any case* and, as in Table 4, the

Table 4
Exact p values of the χ^2 statistic and changes in the Hansen–Jagannathan bounds for human capital and financial asset returns in the United States[a]

	$S(US^{HK}+US^F)$ versus $S(US^{HK}+B^F)$ Unconditional tests (HJ bounds change)	Conditional tests (HJ bounds change)				
Human capital measure: Growth rate in per capita income						
Transaction costs for human capital = 100 percent						
Country B:	Japan		United Kingdom		Germany	
	0.01	0.03	0.44	0.66	0.01	0.05
	(10.07)	(8.21)	(1.20)	(0.02)	(4.01)	(3.70)
Human capital measure: R^I						
Country B:	Japan		United Kingdom		Germany	
Transaction costs for human capital						
100%:	0.03	0.06	0.40	0.68	0.02	0.07
	(8.91)	(7.60)	(0.93)	(0.86)	(3.82)	(3.61)
50%:	0.05	0.10	0.59	0.73	0.06	0.19
	(6.23)	(4.02)	(0.52)	(0.37)	(2.66)	(2.27)
20%:	0.10	0.27	0.59	0.70	0.18	0.33
	(4.33)	(3.00)	(0.50)	(0.29)	(1.72)	(1.21)
5%:	0.21	0.42	0.72	0.89	0.27	0.58
	(2.21)	(0.63)	(0.20)	(0.11)	(1.37)	(1.28)
1%:	0.57	0.36	0.89	11.00	0.70	0.76
	(0.01)	(0.90)	(0.01)	(0.00)	(0.81)	(0.91)
0%:	0.37	0.59	0.93	1.00	0.70	0.81
	(0.09)	(0.00)	(0.00)	(0.00)	(0.14)	(0.20)

[a] These tests compare the HJ bounds S(.) spanned by the human capital and financial assets of the United States ($US^{HK}+US^F$) versus those spanned by the human and financial assets of the United States and the financial assets of country B (B^F), using unconditioning and conditioning information (a vector of ones and the vector of lagged returns in the US). Human capital is approximated by the R^I and is assumed to be subject to short-sale constraints and transaction costs. Under the null hypothesis the bounds are identical. In parentheses, for each type of test, is the distance between the frontiers at the minimum of the bounds for $US^{HK}+US^F$, that is, the change in the Sharpe ratio divided by the ''shadow'' risk-free rate at that point.

p values increase as transaction costs decrease. In other words, it appears that there is no *statistically* significant international diversification puzzle for stockholders once their human capital is taken into account. In any event, even though the null hypothesis cannot be rejected, it appears that diversification in Japanese financial assets for U.S. stockholders can increase their expected returns per unit of risk between 3 and 4%, between 1 and 2% in German assets and less than 1% in U.K.

Table 5
Exact p values of the χ^2 statistic and change in the Hansen–Jagannathan bounds for human capital and financial asset returns for US stockholders and non-stockholders[a]

	Stockholders $S(US\text{-}S^{HK}+US^F)$ versus $S(US\text{-}S^{HK}+US^F+B^F)$						Non-Stockholders $S(US\text{-}NS^{HK}+US^F)$ versus $S(US\text{-}NS^{HK}+US^F+B^F)$					
Transaction costs for human capital	Country B						Country B					
	Japan		United Kingdom		Germany		Japan		United Kingdom		Germany	
100%:	0.14	0.17	0.59	0.80	0.12	0.17	0.00	0.01	0.12	0.14	0.00	0.00
	(4.22)	(3.50)	(0.83)	(0.50)	(2.00)	(1.77)	(21.20)	(20.89)	(2.96)	(2.82)	(20.75)	(20.34)
50%:	0.24	0.29	0.74	0.76	0.31	0.50	0.01	0.01	0.14	0.26	0.02	0.02
	(3.33)	(3.27)	(0.32)	(0.21)	(1.81)	(1.53)	(17.15)	(16.67)	(2.46)	(2.50)	(15.62)	(12.51)
20%:	0.28	0.40	0.69	0.82	0.40	0.52	0.03	0.05	0.14	0.20	0.05	0.05
	(2.67)	(2.60)	(0.25)	(0.14)	(1.22)	(1.09)	(9.24)	(8.00)	(2.00)	(2.09)	(9.89)	(8.48)
5%:	0.44	0.52	0.80	1.00	0.41	0.58	0.05	0.08	0.17	0.30	0.07	0.08
	(0.90)	(1.81)	(0.10)	(0.03)	(1.07)	(1.06)	(8.90)	(7.38)	(1.80)	(1.63)	(7.70)	(6.56)
1%:	0.72	0.70	1.00	1.00	0.73	0.87	0.17	0.16	0.17	0.31	0.15	0.21
	(0.01)	(0.50)	(0.00)	(0.00)	(0.21)	(0.11)	(5.02)	(5.41)	(1.01)	(0.80)	(4.94)	(4.30)
0%:	0.69	0.81	1.00	1.00	0.98	1.00	0.17	0.19	0.20	0.33	0.19	0.20
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(3.63)	(2.57)	(1.17)	(0.41)	(2.14)	(1.21)

[a] These tests compare the HJ bounds S(.) spanned by the human capital and financial assets of U.S. stockholders ($US\text{-}S^{HK}+US^F$) on the left panel, and of U.S. non-stockholders ($US\text{-}NS^{HK}+US^F$) on the right panel, versus those spanned when adding the financial assets of country B (B^F). The tests use unconditioning and conditioning information (a vector of ones and the vectors of lagged returns in the US). White male household heads with at least a college education and more than 15 years experience are considered stockholders. Human capital is approximated by R^I and is assumed to be subject to short-sale constraints and various transaction costs. Under the null hypothesis the bounds are identical. In parentheses, for each test, is the distance between the frontiers at the minimum of the original bounds, that is, the change in the Sharpe ratio divided by the ''shadow'' risk-free rate at that point.

securities, for transaction costs between 20 percent and 100 percent. These gains of diversification are approximately *half* of the gains found in Table 4 for all individuals. Note also that the gains from diversification are on average *at least twice as large* for non-stockholders than for all individuals, and that in most instances (except for the U.K.) the tests of coincidence of boundaries are rejected, even with low transaction costs. For Japan these gains range from 7 to 21% for transaction costs at or above 5 percent. Similar estimates are found for Germany. These strikingly different patterns for stockholders and non-stockholders strongly suggest that the differences between the human capital of these two groups is an important source for the resolution of the home bias puzzle.

A number of additional analyses have been implemented to evaluate the robustness of these notable findings (see Palacios-Huerta, 2001). First, using the Campbell measures both the *p*-values and the ''HJ bounds change'' statistic exhibit very similar patterns across stockholders and non-stockholders groups. If anything, *p*-values are slightly smaller, and the corresponding statistics slightly greater, for both groups. This suggest that labor income growth is not unforecastable and that revisions in future labor income and financial asset returns are not only the main source of the time-variations in returns and correlations with the domestic stock market, but in fact do capture the expected discounted sum of *additional* wages that human capital investments provide over time.[19] Using the Buchinsky–Leslie measures results in similar patterns across the two groups: the null hypothesis of no gains from international diversification is rejected for stockholders and not rejected for non-stockholders. *P*-values tend to be slightly smaller than those found for R^I.

The tests were also conducted: (i) accounting for tuition fees with data from the *State of Washington Higher Education Coordinating Board* in the cost of human capital, (ii) accounting for selectivity and ability biases in wages by following Buchinsky and Hahn (1998), and (iii) introducing other frictions, such as borrowing constraints and solvency constraints (equilibrium conditions (4) and (5)). None of these extensions change the basic results. Lastly, the tests are found to have reasonable power and have been implemented for the U.S. using an European index of financial returns, a Pacific index and the return on the world portfolio from MSCI. The different patterns across stockholders and non-stockholders remain unchanged.

These results testify to the robustness of the previous findings and indicate that the differentiation between the human capital of stockholders and non-stockholders

[19]The tests were implemented for the growth rates in per capita labor income for stockholders and non-stockholders. Interestingly, the results are very similar across groups (though they reflect a slightly lower puzzle for stockholders) and similar to those found in Table 3 at the aggregate level. These results, available on request, testify to the fact that individual heterogeneity is not as important for the growth rate in per capita labor income as it is for the *additional* wages (the skill premium) that one additional unit of human capital provides for each of these groups over time.

is a fundamental source for the resolution of the international diversification puzzle. The strikingly different patterns for these two groups also support the argument, first introduced in the literature on the equity premium puzzle, that financial asset pricing puzzles should be evaluated at basic disaggregate levels.

6. Summary and concluding remarks

Building upon recent insights in the asset pricing and the international finance literatures the analysis in this paper finds that if human capital is considered part of the wealth of nations, as it must be, gains from international financial diversification for a mean-variance investor appear to be smaller than previously reported and, in some cases, close to negligible.

We approached the question of international asset diversification in a novel way by using the methodology proposed by Hansen and Jagannathan (1991). While the use of equity returns, instead of fundamentals-based measures of capital returns, does contribute towards explaining the international diversification puzzle, the key features of the analysis are the use of measures of human capital returns that account for skill premiums and, most importantly, the extent to which the human capital of stockholders is different from that of non-stockholders.

The results show that all these aspects are important and indicate that the information contained in the human capital returns of stockholders can greatly contribute towards explaining the international diversification puzzle. The vastly different results obtained for stockholders and non-stockholders also suggest that access to international investments through 401K and similar plans will mostly benefit less educated and less wealthy individuals.

The analysis in this paper may be extended in various directions. First, it may be possible to implement it with data on wages and asset holdings for other countries (e.g., the *Family Expenditure Survey* in the United Kingdom), and other conditioning methodology (e.g., Beckaert and Liu, 1999). Second, as mentioned in the introduction, some human capital risks may also be hedged by life insurance, unemployment insurance, medical insurance, marriage or other forms of partnerships. Knowing how individuals hedge some human capital risks in these or other ways should prove useful in examining the extent of the puzzle in further detail. Similarly, a close examination of the limitations on the extent to which human capital portfolios may be adjusted both downward (because of irreversibility) and upward at different frequencies deserves careful consideration. Lastly, further disaggregated data of the demographic characteristics of stockholders (e.g., occupation and industry), and of the mix between stocks and other financial assets that they actually hold, will provide valuable information about the covariance structure of risk-return differentials of human and financial assets for this and other asset pricing puzzles. Data currently available, however, may not be detailed enough to implement this idea anytime soon.

In conclusion, the roles of human capital, market segmentation, and heterogeneity in the international diversification puzzle examined in this paper along with the robustness of the patterns of the findings are perhaps best interpreted as one more glimpse of the promise of multidisciplinary inquiry (human capital, labor economics and asset pricing) to meet the challenges and puzzles of modern capital theories.

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