Christian Julliard

The international diversification puzzle is not worse than you think

Working paper

THE INTERNATIONAL DIVERSIFICATION PUZZLE IS *NOT* WORSE THAN YOU THINK

Christian Julliard

Princeton University

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Abstract

This paper offers two main contributions. First, it shows how the Baxter and Jermann (1997) claim that, once we consider human capital risk, the international diversification puzzle is worse than we think, is based on an econometric misspecification rejected by the data. Second, it outlines how, once the misspecification is corrected, the results are reverted: considering the human capital risk does not unequivocally worsen the puzzle and in some cases helps explaining it. *JEL Classification*: F30, G11, G12

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Address correspondences to: julliard@Princeton.edu, Department of Economics, Princeton University, Princeton, NJ 08544. http://www.princeton.edu/~julliard/

I. Introduction

International finance emphasizes the effectiveness of global diversification strategies for cash-flow stabilization and consumption risk sharing.[1] However, empirical evidence on international portfolio positions concludes in favor of a widespread lack of diversification across countries, and consumption growth rates correlations are too low (and output correlations too high) to be consistent with the standard international business cycle models with complete markets[2].

The interpretation I investigate in this paper hinges upon the role of human capital. In the major industrialized countries, roughly two thirds of overall wealth consists of claims on non-traded labor incomes. To the extent that investors will attempt to hedge against adverse fluctuations in the returns to human capital when choosing their portfolio holdings of traded assets, the mere size of human capital in total wealth makes its potential impact on portfolios' composition self-evident.

Several contributions have argued that when the role of fluctuations in non-traded assets returns is explicitly taken into account, the effective discrepancy between theoretical predictions and observed portfolios' compositions is much wider than commonly assessed. The argument is well known. If the return to human capital is more correlated with the domestic stock market than with the foreign one, risk associated with non-traded labor income can be more efficiently hedged with foreign assets than with domestic ones. Therefore, equilibrium portfolios are expected to be skewed toward foreign securities (eventually involving short positions in the home market). Cole (1988), without attempting to address the question empirically, asserts that "this result is disturbing, given the apparent lack of international diversification that we observe." Brainard and Tobin (1992), illustrating their argument with a stylized example in which

[1] Nevertheless, the size of gains from international risk sharing continues to be a debated issue. Grauer and Hakansson (1987) suggest that an individual's gains from international stock-portfolio diversification are large. Cole and Obstfeld (1991) find small gains from perfect pooling of output risks. Obstfeld's (1994) calibration exercises imply that most countries reap large steady-state welfare gains from global financial integration.

[2] Remarkable, but yet not conclusive, works on what can help explain the apparent lack of international consumption risk sharing are, among others, Lewis (1996) and Obstfeld and Rogoff (2000).

productivity shocks produce a significant comovement in domestic labor and capital incomes, reach the same conclusion.

However, it has to be said that on a theoretical basis, optimal hedging could also go in the opposite direction, towards domestic assets. Domestic idiosyncratic shocks that lead to a redistribution of total income between capital and labor lower the correlation between return on physical and human capital. In this case, foreign assets become a less attractive hedge for labor income risk (especially if productivity shocks are highly correlated internationally). If the size of these random shocks is large enough, we can theoretically imagine a situation in which domestic assets are the best hedges against human capital risk, leading therefore to home country bias in portfolio positions. Many kinds of shocks are expected to have an effect on the dynamics of income distribution. Common examples are the political business cycle and changes in the bargaining power of unions relative to firms. [3] Moreover, if wages are less flexible than prices, positive demand shocks will have asymmetric effects on labor and capital real returns. Also a positive productivity shock could increase the wage rates and at the same time decrease the dividend rates if it leads to an increase in investments financed reducing the distributed earnings[4]. Bottazzi, Pesenti and van Wincoop (1996), in an analysis that is limited by the short sample period[5] and several strong but untested assumptions, find a negative correlation between wage and profit rates in many OECD countries, suggesting that these kinds of shocks may be strong enough to offset the positive comovement over the business cycle.

The often cited work of Baxter and Jermann (1997) (BJ from now on) address the question empirically and reach the same conclusion as Cole (1988) and Brainard and Tobin (1992): once we consider non-traded labor risk, "the international diversification puzzle is worse than you think." Moreover, their striking empirical result is that domestic investors should short sell domestic tradable assets. Since the claimed empirical evidence of BJ have strongly influenced the way we think about the international risk sharing

[3] Among others, the works of Bertola (1993) and Alesina and Rodrick (1994) suggest that changes in the time patterns of capital and labor returns may be the endogenous outcome of majority voting. Santa-Clara and Valkanov (2001) find that in the U.S. the average excess returns on the stock market are significantly higher under Democratic than Republican presidents.

[4] This should not reduce the return to capital, once we consider the capital gains, but could affect the degree of correlation shown in the data.

[5] 20 to 23 data points over the period 1970-92.

puzzle, it is worth checking the soundness of their results. My analysis shows that their emphasized result is based on an empirical misspecification strongly rejected by the data. This paper outlines how, once the misspecification is corrected, the results are reversed: considering the human capital risk does not unequivocally worsen the puzzle and in some cases helps explaining it. Moreover, in only one of the countries considered, efficient diversification requires short selling domestic assets in order to hedge human capital risk.

The remainder of the paper is organized as follows. Section II analyzes the role of human capital risk in portfolio choice paralleling Baxter and Jermann (1997). Section II.1 tests the econometric specifications. In section II.2 factor returns are measured and their estimates are used in section II.3 to compute the optimal hedging for human capital risk. Many questionable assumptions of BJ are kept in the present work for the sake of direct comparability. In section III these assumptions are extensively analyzed in how they affect the results and could be corrected. Conclusions are outlined in the final section. The data used and the methodology are described in the appendix. An extensive robustness analysis that confirms the main findings is provided in the appendix.

II. Non-traded human capital and the international diversification puzzle

In order to assess the role of non-traded labor income in forming internationally diversified portfolios, we have to correctly estimate the correlations of labor and capital returns within and between countries. The econometric specification undertaken by Baxter and Jermann in order to estimate these correlations relies on the block exogeneity of each country in a vector autoregressive framework. Their procedure of estimating a vector error correction model (VECM) for labor and capital income for each of the four countries considered is analogous to estimating a VECM for all the countries under the assumption that each country is block exogenous with respect to the other countries. In this approach is embedded the assumption of low international economic integration. This hypothesis seems to be in contrast with the evidence brought on by the dataset BJ used and is rejected under formal testing. Moreover, this assumption drives their key result that, once we consider the risk associated with non-traded human capital, the divergence between diversified portfolios and observed portfolios is much larger than is currently thought since domestic investors should short sell domestic assets.

II.1. Testing the econometric specification

Figure 1 reports the labor share of income for the seven major OECD countries. Several series show a large degree of comovement and convergence (with Italy as an exception). This suggests a vector autoregressive specification in which movements in capital and labor share are somehow related across countries. The BJ's vector error correction specification, instead, excludes a priori such relations. Their VECM, for each country i (the countries they consider are U.S., U.K., Germany and Japan[6]), takes the form[7]:

$$(1)\qquad \begin{bmatrix} \Delta d^i_{L,t+1} \\ \Delta d^i_{K,t+1} \end{bmatrix} = \begin{bmatrix} c^i_L \\ c^i_K \end{bmatrix} + \begin{bmatrix} \psi^i_{LL}(L) & \psi^i_{LK}(L) \\ \psi^i_{KL}(L) & \psi^i_{KK}(L) \end{bmatrix} \begin{bmatrix} \Delta d^i_{L,t} \\ \Delta d^i_{K,t} \end{bmatrix} + \begin{bmatrix} \eta^i_L \\ \eta^i_K \end{bmatrix} \left(d^i_{L,t} - d^i_{K,t} \right) + \begin{bmatrix} \varepsilon^i_{L,t+1} \\ \varepsilon^i_{K,t+1} \end{bmatrix}$$

where $d^i_{L,t}$ denotes the log of labor income, $d^i_{K,t}$ denotes the log of capital income, c^i_L and c^i_K are constant terms, $\Delta d^i_{L,t+1} \equiv d^i_{L,t+1} - d^i_{L,t}$, $\Delta d^i_{K,t+1} \equiv d^i_{K,t+1} - d^i_{K,t}$, and the $\psi_{..}(L)$ terms are polynomials in the lag operator L. Equation (1) can be rewritten in more compact form as:

$$(2)\qquad \Delta D^i_{t+1} = C^i + \Psi^i(L)\Delta D^i_t + \Pi^i \left(d^i_{L,t} - d^i_{K,t} \right) + v^i_{t+1}$$

where

$$\Delta D^i_{t+1} = \begin{bmatrix} \Delta d^i_{L,t+1} \\ \Delta d^i_{K,t+1} \end{bmatrix},\ C^i = \begin{bmatrix} c^i_L \\ c^i_K \end{bmatrix},\ \Psi^i(L) = \begin{bmatrix} \psi^i_{LL}(L) & \psi^i_{LK}(L) \\ \psi^i_{KL}(L) & \psi^i_{KK}(L) \end{bmatrix},\ \Pi^i = \begin{bmatrix} \eta^i_L \\ \eta^i_K \end{bmatrix},\ v^i_{t=1} = \begin{bmatrix} \varepsilon^i_{L,t+1} \\ \varepsilon^i_{K,t+1} \end{bmatrix}$$

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[6] In the benchmark of BJ, the cumulative share of these four countries in the world portfolio is 93%.

[7] The cointegration vector assumed is [1,-1]. This is due to the fact that if labor and capital income are allowed to have independent trends (whether deterministic or stochastic), the labor share of income will reach 1 or 0 with probability 1.

Using this notation and defining ΔD_{t+1} and C as the vectors containing the ΔD^i_{t+1} and C^i relative to each of the four countries we consider, the four VECM estimated by BJ can be rewritten as a system of the form:

$$\Delta D_{t+1} = C + \begin{bmatrix} \Psi^1(L) & \underline{0} & \underline{0} & \underline{0} \\ \underline{0} & \Psi^2(L) & \underline{0} & \underline{0} \\ \underline{0} & \underline{0} & \Psi^3(L) & \underline{0} \\ \underline{0} & \underline{0} & \underline{0} & \Psi^4(L) \end{bmatrix} \Delta D_t + \begin{bmatrix} \Pi^1\left(d^1_{L,t} - d^1_{K,t}\right) \\ \Pi^2\left(d^2_{L,t} - d^2_{K,t}\right) \\ \Pi^3\left(d^3_{L,t} - d^3_{K,t}\right) \\ \Pi^4\left(d^4_{L,t} - d^4_{K,t}\right) \end{bmatrix} + \begin{bmatrix} v^1_{t+1} \\ v^2_{t+1} \\ v^3_{t+1} \\ v^4_{t+1} \end{bmatrix} \quad (3)$$

where the $\underline{0}$ elements are matrices of zeros with appropriate dimensions.

The first matrix on the right hand side of the equation has all the off-diagonal matrices restricted to be zero, i.e. given the supposed structure of the error correction component, each country is assumed to be block exogenous with respect to the other countries: the first differences of log labor and log capital income of each country are supposed not to Granger-cause the first differences of log labor and log capital income in other countries. Indeed, figure 2 reports the time series of the first differences of log capital income and log labor income, and they seem to show a fair degree of comovement and an high degree of convergence. Moreover, the simple analysis of the contemporaneous and lagged correlations (not reported but available upon request) seems to disagree with the BJ restriction.

The restrictions imposed in equation (3) can be formally tested by comparing the BJ's model against less restrictive models. Table 1 reports the likelihood ratio tests using two alternative models and summarizes the evidence against the BJ specification. The models I considered as main alternatives[8] are:

1. *VECM without block exogenity*: the same structure as reported in equation (3) is assumed but without restricting the off-diagonal elements of the first matrix on the right hand side to equal zero.

[8] I tested several other models against the BJ's specification and in each case the hypothesis of block exogeneity of all the countries was rejected by the data i.e. BJ's specification was always rejected when compared with a nested model assuming some degree of international integration.

2. *VECM with U.S., Japan and U.K. block exogenous*: the same cointegrating vector as in equation (3) is assumed, but United States, Japan and United Kingdom are assumed to be block exogenous with respect to Germany.

All the three specifications are estimated with only one lag on the right hand side in order to avoid overfitting due to the small sample size.[9]

Both the classical likelihood ratio tests and likelihood ratio tests with Sims' correction for small sample[10] (Sims, 1980, p. 17) reject BJ's specification at a significance level of 1% agianst both of the alternative specifications presented.

Since both the BJ specification and the alternative models I proposed have a one-to-one mapping to corresponding VAR models in levels of log of labor and capital income, I tested those models against a VAR in levels of log capital and labor income (with one lag and without the block exogeneity assumption). Differently from the previous specifications, the VAR in levels does not impose the cointegration relation expressed by the third term on the right hand side of equation (3).[11]

I, therefore, take a Bayesian approach, asking the VAR to fit the eventual unit roots and treating the parameters as random. In order to test the VAR in levels against other specifications, a testing procedure robust to unit roots is needed. Consequently, I compute the posterior odds of the four specification considered[12].

Under Gaussian approximation and rather general regularity conditions, the Bayes factor of a model i, with parameter $\theta_i \in \Theta_i$, given the data X, takes the form:

$$(4) \qquad BF_i = \int_{\Theta_i} g(\theta) p(X \mid \theta) d\theta \cong g_i(\hat{\theta}_i) p_i(X \mid \hat{\theta}_i)(2\pi)^{\frac{m}{2}} \mid \Sigma_{\theta_i} \mid^{\frac{1}{2}}$$

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[9] One is also the lag length chosen in BJ's article.

[10] The small sample correction consists of computing the test statistic as:

$$(T - c)(\log \mid \Sigma_r \mid - \log \mid \Sigma_u \mid)$$

where Σ_r and Σ_u are the restricted and unrestricted covariance matrices, T is number of observations and c is the correction factor equal to the number of variables in each unrestricted equation in the system.

[11] One reason to do so is the fact that most of the tests I performed (and most of the tests performed by Baxter and Jermann) do not give strong evidence of cointegration of capital and labor income at a country level.

[12] On this testing procedure see Gelman et al. (1995), Kim (1994), Shervish (1995).

where $p_i(X \mid \hat{\theta}_i)$ is the likelihood of the i model evaluated at its peak $\hat{\theta}_i$, $g_i(.)$ is the prior p.d.f. on Θ_i, m is the dimension of Θ_i, and Σ_{θ_i} is the usual asymptotically justified estimate of the covariance matrix of the MLE within the model's parameter space. Posterior odds for each model are then approximated by the ratio of model's Bayes factor multiplied by its prior probability, over the sum of all the models' Bayes factors times their prior probabilities. So, the posterior odd for the j-th model will be:

$$(5) \qquad PO_j = \frac{p_j BF_j}{\sum_i p_i BF_i}$$

where p_i is the prior probability of the i-th specification.

Table 2 reports the logs of the Bayes factor and the posterior probabilities defined by equation (5) for the models considered, under the assumption of flat priors and equal prior probability for each model. For sake of completeness two additional specifications are also considered: a VAR in levels with all the countries block exogenous; a VAR in levels with U.S., Japan and U.K. block exogenous with respect to Germany. The results are striking: the Baxter and Jermann specification again appears to be, by far, the worst among all models considered; the VAR in logs performs much better than all the other models that assume a cointegration relation at the country level and/or some sort of exogenity.[13]

Since the VECM specification of BJ is the starting point of their estimations of labor returns, capital returns, returns' correlations and hedging portfolios, it seems plausible to claim (and it will be later proved) that all the results of the paper are biased by the econometric misspecification.

The implicit hypothesis of block exogeneity of BJ supposes a low degree of economic integration among countries that is rejected by the data. Their procedure therefore overestimates the human capital's risk diversification opportunity given by short selling domestic assets because: it underestimates the correlation between domestic

[13] I also computed Bayes factors and posteriors probabilities by Monte Carlo integration (instead of Gaussian approximation) using conjugate priors (implemented by dummy observations). The priors do not seem to matter significantly: in all the cases considered Baxter and Jermann's specification appears to be the worse one and the VAR in level the best one.

returns on labor and foreign returns on capital; overestimates the correlation between domestic returns on labor and capital because of an omitted variables bias.

II.2. Measuring factors returns

Given the rejection of Baxter and Jermann's specification by the data, and the better performance of the VAR in levels, I proceed to estimate the labor and capital returns using the latter model[14] and the Campbell and Shiller (1988) procedure used by BJ.

Few remarks are worth making about the procedure and the underlying assumptions in the case under analysis. Define with $r_{t,t+1}$ the log one period return of a generic asset between the periods t and $t+1$, with Δd_t the dividend growth rate at time t, and with δ_t the time t log dividend-price ratio. The exact relationship between these variables is nonlinear:

(6) $$r_{t,t+1} = \log\left[\exp\left(\delta_t - \delta_{t+1}\right) + \exp\left(\delta_t\right)\right] + \Delta d_t$$

If the log dividend-price ratio has a stationary mean, we can linearize equation (6) around this point $\delta = \delta_t = \delta_{t+1}$. We will also define the interest rate implicit in the chosen δ as $r = g + \ln(1+\exp(\delta))$ where g is the mean Δd. The linearization delivers:

(7) $$r_{t,t+1} \cong \delta_t - \rho\delta_{t+1} + \Delta d_t + k$$

where $\rho = 1/(1+\exp(\delta))$ and k is a constant. If we assume that the expected one period return is constant ($E_t[r_{t,t+1}] = r$) and that $\lim_{j\to\infty} \rho^j E_t[\delta_{t+j}] = 0$, we obtain from (7) that:

(8) $$r_{t,t+1} - r \cong (E_{t+1} - E_t)\left(\sum_{j=0}^{\infty} \rho^j \Delta d_{t+1+j}\right)$$

This corresponds to the equations used by BJ to estimate the unexpected component of labor and capital returns and to compute their correlations. Equation (8) is

[14] In the appendix, the main results are shown to hold under different specification when the block exogeneity assumption of BJ is dropped.

computed by BJ, for both capital and labor income, by setting $\rho = 0.957$. This corresponds to assuming that the mean dividend price ratio of labor income and capital income are identical and the implied mean dividend-price ratio is 4.5%. Both assumptions are neither underlined nor justified by BJ and leave room for doubt. Moreover, the mean dividend-price ratio they use is not in line with what is considered a good long-run estimate of it for the capital returns (Campbell and Shiller (1987) used a mean ratio of 6.8%, that corresponds to $\rho = 0.936$ [15]). Furthermore, they use the same ρ value for each country.

Even if a more accurate calibration of the parameter would have been suitable, in what follows, the same assumptions on ρ are adopted in order to enable an analysis directly comparable to BJ's.

Table 3 reports the correlations between returns on capital and labor computed using equation (8) and the estimations of expected Δd's by the VAR in levels specification. Implementing equation (8) requires the computation of many out of sample forecasts. Forecasts made using unrestricted autoregressions often suffer from overparametrization of the model. Moreover, in the presence of (potential) unit roots the estimated slope coefficients have a strong downward bias in small sample.[16] To overcome these problems, the VAR is estimated using Bayesian prior information. The details, the methodology and a sensibility analysis to the prior are described in the appendix.

The correlations are both qualitatively and quantitatively different from the ones derived by BJ. The within countries correlations seem to be strongly overestimated by BJ: their estimates cover the range [0.78, 0.99], my estimates have a maximum of 0.88 and a minimum involving negative correlation in Japan[17].

The between countries correlations they derived appear to be extremely underestimated: their maximum correlation between returns on capital is 0.43 (U.S.-Germany), the maximum between returns on labor is 0.35 (U.S.-Germany), the maximum

[15] It has to be mentioned that the last decade has shown a relatively steady decline in the dividend price ratios, at least in the U.S., and this may justify the lower benchmark used by BJ.

[16] See Sims (2000).

[17] Bottazzi, Pesenti and van Wincoop (1996) estimate a negative correlation between wage rate and domestic profit rate. Their estimations are much more in line with the within country correlations reported in table 3 than with the ones reported by BJ.

correlation between domestic labor returns and foreign capital returns is 0.40 (Germany-U.S.).

In my estimation instead, the between countries correlations are much higher for both r^L, r^K and so are the cross correlations in returns (with the exception of Japan where the within country negative correlation between labor returns and capital returns, and the positive correlation between domestic and foreign capital returns, are paralleled by a negative correlation of national returns on labor and foreign returns on capital). The correlations between returns on capital, for example, cover the range [0.76, 0.98]. Moreover, the correlations between domestic returns on labor and foreign returns on capital are very similar to the correlation between domestic returns on labor and capital. These results strongly suggest the presence of productivity shocks effective at international level.

The differences are due to the assumption of block exogeneity undertaken by BJ (and rejected by the data). They fit a model where they restrict the countries not to be economically and technologically integrated. As an outcome, the level of between countries correlation is underestimated and the within country correlation is overestimated i.e. the countries appear not to be integrated. Once this restriction is removed, the effective degree of technological and economic integration becomes evident. This high degree of economic integration implies fewer opportunities to hedge the human capital risk investing in foreign marketable assets.

II.3. Hedging human capital

The divergence of results is even stronger if we look at the *hedge portfolios*. A hedge portfolio for human capital risk is a portfolio that is perfectly correlated with the human capital income. In order to compute the hedge portfolios, we have to assume (as in BJ) that the set of marketable assets provides perfect spanning i.e. there exists a linear combination of domestic and foreign marketable assets that is perfectly correlated with the return to domestic human capital. This is a strong assumption since we are considering only four marketable assets (one per each country) but, given the high absolute levels of correlations reported in table 3, it is not completely implausible.[18]

I choose the hedge portfolio such that it hedges \$1.00 of human capital income flow. Denote with h_{jk} the weight of the marketable asset of country k in the hedge portfolio of country j residents. Let $h_j = [h_{j1}, h_{j2}, h_{j3}, h_{j4}]'$ denote the vector of country weights in the hedge portfolio for country j, this is given by:

(9) $$h_j = \Sigma^{-1}\nabla_j$$

where Σ is the covariance matrix of returns of marketable assets in the world portfolio and ∇_j is the vector of covariances of marketable assets returns with human capital returns in country j.[19]

Table 4 shows the hedge portfolios, each row corresponds to the hedge portfolio for a given nation j. Again, the results dramatically disagree with BJ's. Only in the U.S. and in U.K. hedging human capital income requires short selling national capital income, and even in these cases the estimated values are, respectively, less than one half and one sixth of what is reported by BJ. They conclude that to hedge \$1.00 of U.S. human capital investors should short sell \$0.86 of U.S. stocks, my estimation is only \$0.34. Moreover, in two countries out of four, hedging human capital does not require to short sell domestic stocks (this is expressed by the values on the main diagonal of table 4), instead long positions on domestic assets are suggested (in BJ, Japanese and German investors should short sell, respectively, \$0.72 and \$0.53 per dollar of human capital, my estimations suggest instead long position of \$0.38 and \$0.29). This directly contradicts the claim of BJ: the international diversification puzzle is not unequivocally *worse than we think* once we take into account labor income risk, but is simply more complex. Whether or not it is necessary to short sell domestic tradable assets to hedge human capital is a country specific characteristic, probably because productivity shocks are highly correlated internationally and idiosyncratic shocks are likely to have a large redistributive component. If productivity shocks are highly correlated internationally

[18] Bottazzi, Pesenti and van Wincoop (1996) also assume perfect spanning in a similar framework.
[19] Notice that since the hedge portfolio is constructed to hedge \$1.00 of human capital there is no reason for the portfolio weights to add to one.

there are fewer opportunities to hedge the human capital risk investing in foreign marketable assets. Domestic idiosyncratic shocks that lead to a redistribution of total income between capital and labor lower the correlation between return on physical and human capital. In this case, foreign assets become a less attractive hedge for labor income risk and we can even imagine a situation in which domestic assets are the best hedges against human capital risk, leading therefore to home country bias in portfolio compositions. Moreover, investment cycles and retained earnings taxation at a country level may matter as well.

After computing the hedge portfolios, BJ proceed to form a diversified portfolio for each country. In doing this, they focus on value-weighted (diversified) portfolios because, they say, "mean-variance portfolios are sensitive to the historical time period used to compute expected mean and returns." The problem in estimating mean-variance portfolio is that, to be consistent with the theory of rational expectation and utility maximizer individuals, the expected means and covariance matrix should be constructed using conditional moments and not the simple sample means and covariance matrix. This error is present in a large share of International Economics literature (a well-known example is French and Poterba (1991)), and makes the results hardly comparable with the observed portfolios. Rational economic agents should make their portfolio choice at time t forecasting expected returns and covariance matrix using all information available at time t. Therefore, even if the returns are stationary variables, using the sample means and covariance matrix is not consistent as long as the returns have some degree of persistence or are partially forecastable (as they actually are). As a consequence, the efficient portfolios computed using this naive approach are not sensibly comparable to the observed portfolio allocations and can be misleading. Nevertheless, using a value-weighted portfolio is not the most suitable solution: the appropriate solution (as often) is to use good econometrics to estimate conditional moments.

The value-weighted portfolio approach, without considering the human capital hedging for the moment, is a simple application of the *two funds separation theorem*: it can be shown that in the presence of N risky assets and a risk-free asset, all rational individuals will hold a portfolio given by a linear combination of the risk free asset and the market portfolio (i.e. the value-weighted portfolio). As a consequence, the risky part of each individual's portfolio will have a composition identical to the market portfolio.

The extension of this to our international framework is straightforward: each country tradable asset is a risky asset and in equilibrium each investor, independently of his nationality, will hold a risky portfolio with a composition identical to the world portfolio, i.e. each country's asset will be in the portfolio with a share equal to the share of the country in the world portfolio of marketable (risky) assets.

This approach has two main weaknesses. First, two funds separation theorem is far from being supported by the data even at a country level. Second, it relies on the presence of a risk-free asset available to all investors. Even if we may agree that T-Bills are risk free assets for American investors, we must accept that they are not a risk-free asset for foreign investors (for a foreign investor there is both an exchange rate risk and a fiscal risk on it). Moreover, the American T-Bill has to be considered as a different asset in different countries (in terms of expected returns) if the costs of trading are different, and if this is the case, the two funds separation theorem no longer applies. Nevertheless, I undertake this approach for sake of comparability with BJ's work.

Let π_j denote the fraction of the world portfolio of marketable assets of country j. In absence of human capital risk, π_j would be the share of country j asset in each portfolio. Instead, to hedge the human capital risk, the net demand by a resident of country j for the asset of country k expressed as a fraction of home country (country j) marketable asset is given by:

$$(10) \qquad \pi_k \left(1 + \frac{\alpha_j}{1-\alpha_j} \left(\sum_{k=1}^{4} h_{jk} \right) \right) - \frac{\alpha_j}{1-\alpha_j} h_{jk}$$

where α_j is the labor share of income in country j.[20] The last term is the share of country k asset that has to be sold to hedge the human capital risk. The first term is given by the amount that would be invested in country's k asset in absence of human capital risk (π_k), plus the pro-quota adjustment due to the fact that country j investors will short sell exactly $(\alpha_j / 1-\alpha_j)(\sum_{k=1}^{4} h_{jk})$.

[20] As in BJ, we are working in a Cobb-Douglas production world.

It has to be outlined that BJ use U.S. as a benchmark for the labor share of income setting α_j = 0.6 for all the countries. This is clearly in contrast with the data as shown in figure 1 and overweights the human capital hedging motive inflating BJ's results. Furthermore, "U.S. represent a striking exception to the rule of large movements in the labor share, both at low and high frequencies"(Bottazzi, Pesenti and van Wincoop (1996))[21]. The values I used for α_j (reported in the appendix) are the country averages over the considered sample period.

Table 5 reports the computed diversified portfolios. Each row reports the portfolio shares as a fraction of the domestic marketable assets given the nationality of the investors. The last two rows report the share of each country in the world portfolio. The four countries considered represent 93% of the world portfolio, the national shares used in equation (10) to compute the diversified portfolios are rescaled to make them sum up to 1.

The portfolios reported strongly diverge from BJ's ones. In BJ, all the investors have to short sell their own country asset in the equilibrium portfolios: from a minimum short selling of -0.12 for U.S. to a maximum of -1.04 for U.K. (-0.72 for Germany and -0.47 for Japan). In my computation only British investors have to short sell domestic assets (and in the required short selling is only –0.03). Moreover, my estimation shows that only in two countries out of four, national investors should invest in domestic capital less than the country's relative share of the world portfolio (U.S. and U.K.). The investors of the two other countries (Japan and Germany) should instead strongly increase the share of domestic assets relative to their world portfolio's share (Japanese investors should invest 99% of their portfolio in Japanese stocks, i.e. the home country bias seems to be completely justified in this case).[22]

[21] This is also outlined by the summary statistics of the series reported table A1 in the appendix. For example the standard deviation of the U.S. labor share of income is one fifth of the Japanese one.

[22] In the appendix the diversified portfolios are computed using different econometric specification and different priors. The main results seem to be robust to all the modeling alternatives considered. Moreover, the priors do not seem to strongly influence the results both qualitatively and quantitatively suggesting that the likelihood of the data strongly dominates the prior.

Therefore, the paradoxical result is that the same framework used by BJ, once corrected the econometric misspecification, helps explaining, at least for some countries, the international diversification puzzle.[23]

III. Final Remarks

Indeed, the shares of domestic assets in the diversified portfolios reported in table 5 (except for Japan) are far too low to match the observed portfolios of the real world, but this is not due to the human capital hedging motive but mainly to the assumptions of BJ that I have maintained.

According to the value-weighted portfolio approach, in the absence of human capital hedging, the shares of domestic asset in domestic portfolio should be equal to the domestic share of the world portfolio. For example, in table 5, the share of domestic assets in German investors' portfolios should be only 4%.[24]

Furthermore, several elements that may reduce the human capital hedging motive and effect are not considered in the approach we have undertaken.

Stock markets are characterized by *limited participation*. Direct and indirect participation of households to the financial market is only in the order of 19% in Germany, 49% in U.S., 45% in U.K., 23% in France (Guiso, Haliassos and Jappelli (2001)). Only households that both participate in the market and earn labor income have the opportunity, and are interested, in hedging human capital. It is empirical evidence that the participation in the financial market is concentrated in the highest quantiles of wealth distribution. People belonging to those quantiles are more likely to have a much lower

[23] This is in line with Bottazzi, Pesenti and van Wincoop (1996). They find that considering human capital helps explaining the home country bias. Nevertheless, their results have to be taken with caution. First, they have only 20-23 data points over the period 1970-92. They de-trend the data by removing a quadratic time trend before estimation. Given the very short sample period the squared term in the trend may have been given credit for important dynamics of labor and capital income. Also the excessive (and persistent) real wage growth beginning at the end of the 1960s and the profit squeeze following the oil shocks in the 70s in Europe is likely to overweight the role of redistributive shocks in their sample. Second, they impose block exogeneity of each country with respect to the others, i.e. the same restriction of BJ that I show to be strongly by the data. Third, the correctness of their measure of the "optimal bias" depends upon the strong assumptions on the stochastic processes of wages and profits.

[24] The benchmark I used for the domestic shares of the world portfolio underestimate the share of Germany because it is the same benchmark used by BJ: the world shares reported by French and Poterba (1991). I did not use a more recent estimate for sake of comparability with BJ.

share of their income coming from labor than people in lower quantiles[25] (it is well known that the degree of inequality tends to be greater in the wealth distribution than in the labor income one). It is clear in equation (10) that the demand for hedging is positively correlated with $\alpha_j / 1-\alpha_j$. Therefore, using the labor shares of income observable in the aggregate data may severely overestimate the human capital hedging motive of stockholders. Moreover, the labor share of income having a nonlinear role in equation (10), even small differences between the α_j observable in aggregated data and the one of the households that participate in the stock market, may generate large effects. This is shown in figure 3. The figure reports the joint effect of the country size (measured by the country's size in the world portfolio) and of the α_j parameter on the domestic demand for domestic marketable assets (the domestic demand is expressed as the share of domestic tradable assets in the equilibrium portfolio). The graph reported is obtained in the benchmark case of perfect correlation between domestic returns on capital and labor.

Another element that should be taken into account is the presence of s*hort selling constraints*. Typically, households cannot short sell assets as easily as financial institution and firms,[26] and the one interested in hedging the human capital risk are precisely the households that receive labor incomes. In a previous work with Jappelli and Pagano (2001), considering a sample of 1080 households that participate in the Italian financial market, we pointed out that individuals' portfolios are hardly reconcilable with the mean-variance efficiency criterion. We have also shown that computing the market efficient frontier imposing short selling constraints helps reconcile individual portfolio choices with the ones predicted by economic theory. Figure 4 (form Jappelli, Julliard and Pagano (2001)) shows efficient frontiers computed with and without short selling constraint and a scatter plot that reports individuals' portfolios. The effect of the short selling constraint is striking: for most households the null hypothesis of mean-variance efficiency cannot be rejected once the constraint is imposed on the construction of the efficient frontier.

[25] See, for example, Mankiw and Zeldes (1991).

[26] Borrowing to invest in the stock market is typically an unfeasible operation for families, even if the equity premia suggest that they should do it. Moreover, even for small to medium-size firms and financial institution short sell is typically not easy.

All these elements, once introduced in our framework, are likely to attenuate the incentive to reduce domestic assets holdings in favor of foreign marketable assets and therefore to reduce the divergence between theory and empirical evidences on portfolio diversification.

IV. Conclusions

Human capital risk does not seem to be a compelling reason to reduce the share of domestic assets in the portfolios of domestic investors. Baxter and Jermann's empirical result that the risk sharing puzzle is *worse than we think* once we consider human capital risk, is the outcome of an econometric misspecification strongly rejected by the data. The economies under analysis (U.S., U.K., Japan and Germany) show a high level of international correlation in labor and capital rates of return. Idiosyncratic shocks seem to reduce the correlation between returns on human and physical capital at a country level. Possible explanations of these finding are redistributive shocks, political business cycles, investment behaviors and different degree of flexibility of prices and wages. All these hypotheses should be the object of formal testing.

The joint effect of the findings is that considering human capital risk does not unequivocally worsen the puzzle and in some cases helps explaining it. Moreover, in only one of the countries considered (U.K.), efficient portfolio diversification requires short selling domestic assets in order to hedge human capital. In two countries (Japan and Germany) the efficient diversification implies a larger share of investment in domestic assets than what is recommended by the value-weighted portfolio approach (virtually solving the home bias puzzle for Japan).

The analysis presented in support of these conclusions seems extremely sound, nevertheless could be improved: using a more appropriate data set than the OECD one;[27] estimating labor and capital returns with a different econometric approach;[28] using a

[27] Using stock market and labor income data, instead of GDP figures, would be a more appropriate choice.

[28] Returns on labors capital could be directly estimated from market data, and returns on human capital could be estimated applying Kalman Filtering techniques on labor income data.

conditioned mean-variance approach to the portfolio choice.[29] Those improvements have not been done in the present work for sake of direct comparability to the influential Baxter and Jermann's analysis, but could be undertaken to strengthen the results. Moreover, limited market participation and short selling constraints should be explicitly taken into account.

[29] This would make the analysis robust to the rational expectation critique and possible heterosckedasticity of the of the underlying stochastic processes. Moreover, it would avoid the unpleasant assumptions implied by the value-weighted portfolio approach.

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APPENDIX

A1. Data Sources

The data used for the analysis of the role of non-traded human capital in relation to the international diversification puzzle are annual data on labor income and capital income from the OECD National Accounts for Japan, Germany, United Kingdom and the United States over the period 1960-97. The measure of labor income used is total employee compensation paid by resident producers. The measure of capital income is GDP at factor cost minus the employee compensation. The dataset is the same one used by Baxter and Jermann except for the slightly longer sample period. The data are publicly available trough Data Resources International (DRI). The summary statistics of the series are reported in table A1. The sample averages of the labor shares of income reported in the table are the values for α_j used in equation (10).

A2. Robustness Analysis and Methodology

The use of equation (8) to compute the unexpected component of capital and income returns requires the computation of many out of sample forecast. Forecast made using unrestricted autoregressions often suffer from overparametrization of the model. To overcome this problem the VAR in levels of log capital and labor income (with one lag and without the block exogeneity assumption) is estimated using Bayesian prior information. The results reported in the paper are obtained under using Minnesota prior (Doan, Litterman and Sims, 1984).

In this section the methodology is presented and the main results are compared with the ones obtained under "dummy initial observation" prior (Sims and Zha, 1998) and flat prior. These results are coherent with the ones presented in the paper, thus we can conclude that the likelihood of the data strongly dominates the prior.

Finally the diversified portfolios are constructed using as econometric specification a vector error correction model (VECM) without block exogenity (i.e. the same specification as in BJ except for the block exogeneity assumption). The analysis shows that the BJ's results are driven by the block exogeneity assumption and not by the VECM specification.

In all this cases the main results of the present paper are confirmed suggesting robustness of our findings: once BJ econometric misspecification of block exogeneity is corrected considering the human capital risk does not unequivocally worsen the puzzle and in some cases helps explaining it.

A2.1 Minnesota Prior

I take as prior the hypothesis that the dynamics of log labor incomes and log capital incomes have, as most important explanatory variable, their own lags. The prior means and variances take the following form:

$$\text{(A.1)} \quad \begin{aligned} \beta_i &\sim N(1, \sigma^2_{\beta_i}) \\ \beta_j &\sim N(0, \sigma^2_{\beta_j}) \end{aligned}$$

where β_i denotes the coefficient associated with the lagged dependent variable in each equation of the VAR and β_j represent any other coefficient. Following Doan, Litterman and Sims (1984), I generate the standard deviations as a function of a small number of hyperparameters: θ, φ and a weighting matrix W with elements $w(i,j)$. The standard deviation of the prior imposed on the k-th lag of the variable j in equation i is given by:

$$\text{(A.2)} \quad \sigma_{ijk} = \theta w(i,j) k^{-\varphi} \left(\frac{\hat{\sigma}_{ui}}{\hat{\sigma}_{uj}} \right)$$

where $\hat{\sigma}_{ui}$ is the estimated standard error from a univariate autoregression for the i variable. Since the VAR model I use has only one lag, the rate of decay φ does not need to be specified. I set the *overall tightness* parameter at the loose value of $\theta = 0.2$. The weighting matrix I use is:

$$
\text{(A.3)} \quad W = \begin{bmatrix} 1 & 1 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 \\ 1 & 1 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 \\ 0.5 & 0.5 & 1 & 1 & 0.5 & 0.5 & 0.5 & 0.5 \\ 0.5 & 0.5 & 1 & 1 & 0.5 & 0.5 & 0.5 & 0.5 \\ 0.5 & 0.5 & 0.5 & 0.5 & 1 & 1 & 0.5 & 0.5 \\ 0.5 & 0.5 & 0.5 & 0.5 & 1 & 1 & 0.5 & 0.5 \\ 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 1 & 1 \\ 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 0.5 & 1 & 1 \end{bmatrix}
$$

The effect of the weighting matrix and of the parameter θ is to impose the prior very loosely, especially on the parameters associated to the variables that are 'domestic' in the considered regression equation (this is given by the 2x2 matrixes of ones along the main diagonal of the W matrix).

A2.2 Flat Prior and Dummy Observation Prior

For completeness, table A2 reports the equilibrium portfolios computed using flat priors. Comparing the values reported with the ones in table 5 outlines the soundness of the results. The priors do not seem to strongly influence the results both qualitatively and quantitatively.

An alternative way of modeling prior information is to use dummy observation prior (Sims and Zha, 1998). This is equivalent to using a conjugate prior, that is, a pdf for the parameters that has the same shape as the likelihood function of a sample generated by the model. This is extremely helpful as it means that we can formalize the prior as a set of 'dummy observations' that are added at the beginning of the sample. Intuitively, this is adding extra data to the sample that express the prior beliefs about the parameters. The prior take the form of the likelihood of the dummy observation under the given model.

As in the Minnesota prior case we want to introduce the prior belief of the presence of unit root. Indicating with $\mathbf{y}(t)$ the vector of data at time t used in the VAR in level specification, we introduce data for the artificial date t^* in which

$$
\text{(A.4)} \quad \mathbf{y}(\mathrm{t}^*) = \mathbf{y}(\mathrm{t}^*-1) = \ldots = \mathbf{y}(\mathrm{t}^*-p) = \bar{\mathbf{y}}\lambda
$$

where p is the number of `lags used and the vector of 1's that corresponds to the constant term in the data matrix is set to λ in the t^*-th observation. The vector of $\bar{\mathbf{y}}$ is set to the sample mean of the initial observations, that is,

$$\text{(A.5)} \quad \bar{\mathbf{y}} = \frac{1}{p}\sum_{s=1}^{p}\mathbf{y}(s-1)$$

In our model with one lag this formulation correspond to adding one dummy observation per each of the eight variables (such that $\bar{\mathbf{y}} = \mathbf{y}(0)$) and choosing the scale factor λ. Notice that this prior does not postulate the absence of cointegration.

Table A3 reports the equilibrium portfolios computed using dummy observation prior with $\lambda = 1$ and $\lambda = 10$. For $\lambda = 1$ (and for close values) the results are extremely similar to the ones obtained in the baseline case of Minnesota prior and reported in table 5. With $\lambda = 10$ (and for higher values) the tendency of hedging domestic human capital investing in domestic assets is reinforced for Germany and Japan and appears significant for UK too. For US instead, in this case, a low level of short selling appears to be optimal.

A2.3 Vector Error Correction Model

Table 2 shows that the VECM without block exogeneity has a much lower posterior probability than the specification in levels considered (even tough it performs significantly better than BJ specification[30]). Nevertheless it is of interest to compute the diversified portfolios under this specification in order to asses if the difference in findings between the present paper and BJ one is due to our having relaxed the VECM specification (instead than because of BJ block exogeneity assumption rejected by the data even in a VECM setting).

Using the same notation introduced in section II.1, the VECM without block exogenity can be written as:

[30] See also the LR-tests reported in table 1.

$$(A.6)\ \Delta D_{t+1} = C + \begin{bmatrix} \Psi^{11}(L) & \Psi^{12}(L) & \Psi^{13}(L) & \Psi^{14}(L) \\ \Psi^{21}(L) & \Psi^{22}(L) & \Psi^{23}(L) & \Psi^{24}(L) \\ \Psi^{31}(L) & \Psi^{32}(L) & \Psi^{33}(L) & \Psi^{34}(L) \\ \Psi^{41}(L) & \Psi^{42}(L) & \Psi^{43}(L) & \Psi^{44}(L) \end{bmatrix} \Delta D_t + \begin{bmatrix} \Pi^1\left(d^1_{L,t} - d^1_{K,t}\right) \\ \Pi^2\left(d^2_{L,t} - d^2_{K,t}\right) \\ \Pi^3\left(d^3_{L,t} - d^3_{K,t}\right) \\ \Pi^4\left(d^4_{L,t} - d^4_{K,t}\right) \end{bmatrix} + \begin{bmatrix} v^1_{t+1} \\ v^2_{t+1} \\ v^3_{t+1} \\ v^4_{t+1} \end{bmatrix}$$

Comparing equation (A.6) with equation (3), it is clear that the only difference between this specification and the one of BJ is that the of diagonal elements of the first matrix on the right hand side are not restricted to be equal to zero.

The diversified portfolios computed using this specification are reported in table A4. The portfolio shares of domestic assets for US and Germany differ from the previous estimations (an almost insignificant short selling for Germany, and a strong one for US are estimated to be optimal in this case). Nevertheless, for Japan and UK is confirmed the optimality of holding domestic assets in order to hedge human capital risk. Therefore, even this last estimation is in stark contrast with BJ claimed evidences and shows that the driving force of their empirical results is the assumption of block exogeneity that we have shown to be strongly rejected by the data.

The results provided by all the alternative specification considered in this appendix suggest soundness of our main finding: once BJ misspecification is corrected, the results are reverted i.e. considering the human capital risk does not unequivocally worsen the puzzle and in some cases helps explaining it.

Table A1. Summary statistics

		Labor Income	Capital Income	Labor Share of Income
Japan (billions of yen)	Sample Mean:	123672.4474	105203.5658	0.505823691
	Standard Deviation:	95694.17063	74267.76626	0.057799552
Germany (millions of marks)	Sample Mean:	729570.2857	593411.1429	0.542324579
	Standard Deviation:	449823.3381	365072.6952	0.031433831
United Kingdom (millions of pounds)	Sample Mean:	151415.2105	117071.7895	0.580562337
	Standard Deviation:	134536.3809	110715.5242	0.024948225
United States (millions of dollars)	Sample Mean:	1817031.579	1205189.474	0.597361096
	Standard Deviation:	1388433.01	913194.4883	0.011589921

Table A2. Forming a diversified portfolio under flat prior (portfolio shares as a fraction of domestic marketable assets).

Shares invested in marketable asset of:

Flat Prior:

Investor Nationality:	U.S.	U.K.	Japan	Germany	Total
U.S	0.130467	0.336332	0.657200	-0.123999	1
U.K.	0.368130	-0.069489	0.391751	0.309608	1
Japan	-0.650790	0.284932	1.075832	0.290027	1
Germany	0.477481	0.097329	0.203180	0.222011	1
Rescaled World Share	0.516129	0.150538	0.290323	0.043011	1

Table A3. Forming a diversified portfolio under dummy observation prior (portfolio shares as a fraction of domestic marketable assets).

Dummy Observation Prior: $\lambda = 1$

Shares invested in marketable asset of:

Investor Nationality:	U.S.	U.K.	Japan	Germany	Total
U.S	0.044999	0.342169	0.655902	-0.04307	1
U.K.	0.250565	-0.06412	0.354003	0.45955	1
Japan	-0.62666	0.091959	0.89481	0.639894	1
Germany	0.190583	0.108276	0.158406	0.542735	1

Dummy Observation Prior: $\lambda = 10$

Shares invested in marketable asset of:

Investor Nationality:	U.S.	U.K.	Japan	Germany	Total
U.S	-0.14027	0.415983	0.715027	0.009264	1
U.K.	0.095317	0.218134	0.757336	-0.07079	1
Japan	0.080106	0.171947	1.131618	-0.38367	1
Germany	-0.1208	0.226402	0.346124	0.548276	1

Rescaled World Share	0.516129	0.150538	0.290323	0.043011	1

Table A4. Forming a diversified portfolio under VECM specification (portfolio shares as a fraction of domestic marketable assets).

Vector Error Correction Model

	Shares invested in marketable asset of:				
Investor Nationality:	U.S.	U.K.	Japan	Germany	Total
U.S	-0.64233	0.239661	0.313359	1.08931	1
U.K.	-1.91411	0.386128	0.415432	2.112554	1
Japan	-0.22219	0.237746	0.789135	0.195305	1
Germany	0.368273	0.225184	0.408333	-0.00179	1
Rescaled World Share	0.516129	0.150538	0.290323	0.043011	1

Table 1. Likelihood ratio tests (significance levels reported in parenthesis).

	LR statistic	LR statistic with Sims correction
VECM without block exogenity vs. Baxter and Jermann's specification	111.71136 (5.42419e-07)	77.85943 (0.00412)
VECM with U.S., Japan and U.K. block exogenous vs. Baxter and Jermann's specification	94.94230 (3.28941e-07)	71.92599 (3.47339e-04)
VECM without block exogenity vs. VECM with U.S., Japan and U.K. block exogenous	16.76905 (0.15849)	11.68752 (0.47109)

Table 2. Logs of Bayes Factors and posterior probabilities.

	Log of Bayes Factor	Posterior Probability*
VECM without block exogenity	715.57033	4.04075e-25
VECM with U.S., Japan and U.K. block exogenous	722.14290	2.88996e-22
Baxter and Jermann's specification	617.29820	8.46092e-68
VAR in levels	771.73853	1.00000
VAR in levels with U.S., Japan and U.K. block exogenous	755.91294	1.33978e-07
VAR in levels with all the countries block exogenous	620.43137	1.94150e-66

* The posterior probabilities do not sum up to 1 because of rounding error.

Table 3. Correlation of factors returns*.

	U.S.: r^K	Japan: r^L	Japan: r^K	U.K.: r^L	U.K.: r^K	Germany: r^L	Germany: r^K
U.S.: r^L	**0.88108**	-0.43888	0.86451	0.7887	0.92071	0.80027	0.9023
U.S.: r^K		-0.29697	0.76325	0.753	0.8346	0.65104	0.81129
Japan: r^L			**-0.73565**	-0.23729	-0.55177	-0.63706	-0.66814
Japan: r^K				0.72319	0.93808	0.83219	0.98167
U.K.: r^L					**0.84795**	0.70964	0.76104
U.K.: r^K						0.80891	0.96379
Germany: r^L							**0.8053**

* r^K = one period return on capital, r^L = one period return on labor

Table 4. Hedging Human Capital.

Investor Nationality:	Shares in each country traded asset: U.S.	U.K.	Japan	Germany
U.S.	**0.34668**	0.03217	-0.0119	0.07932
U.K.	0.21512	**0.15761**	-0.02023	-0.19189
Japan	1.40674	0.18865	**-0.37876**	-0.13934
Germany	0.03596	0.05352	0.11614	**-0.29399**

Table 5. Forming a diversified portfolio (portfolio shares as a fraction of domestic marketable assets).

Shares invested in marketable asset of:

Investor Nationality:	U.S.	U.K.	Japan	Germany	Total
U.S	**0.343515**	0.202480	0.500198	-0.046192	1
U.K.	0.333111	**-0.034152**	0.382865	0.318176	1
Japan	-0.354641	0.123436	**0.998143**	0.233062	1
Germany	0.420162	0.071921	0.123501	**0.384417**	1
Rescaled World Share	0.516129	0.150538	0.290323	0.043011	1
World Share	0.48	0.14	0.27	0.04	0.93

Figure 1. Labor share of income in the seven major OECD countries.

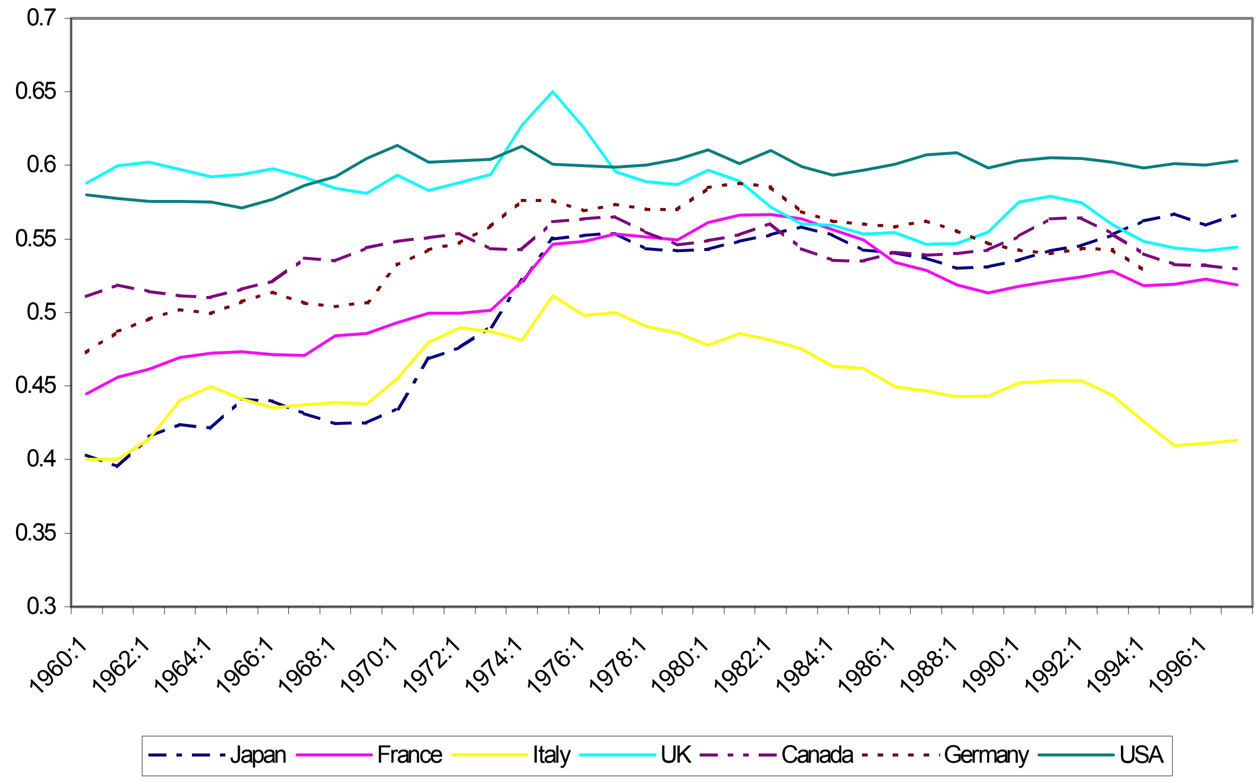
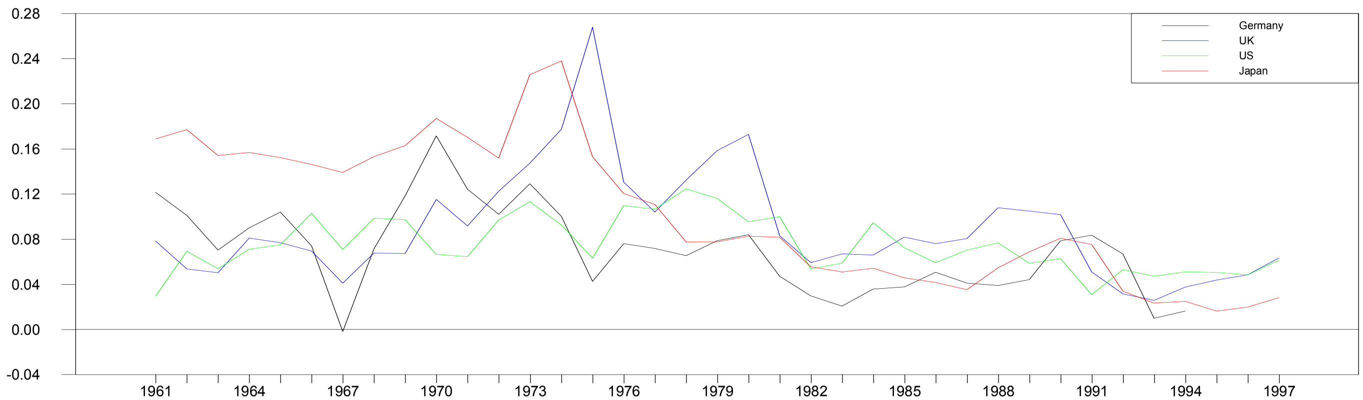


Figure 2. First differences of log labor income and log capital income.

Panel A. First differences of log labor income.



Panel B. First differences of log capital income.

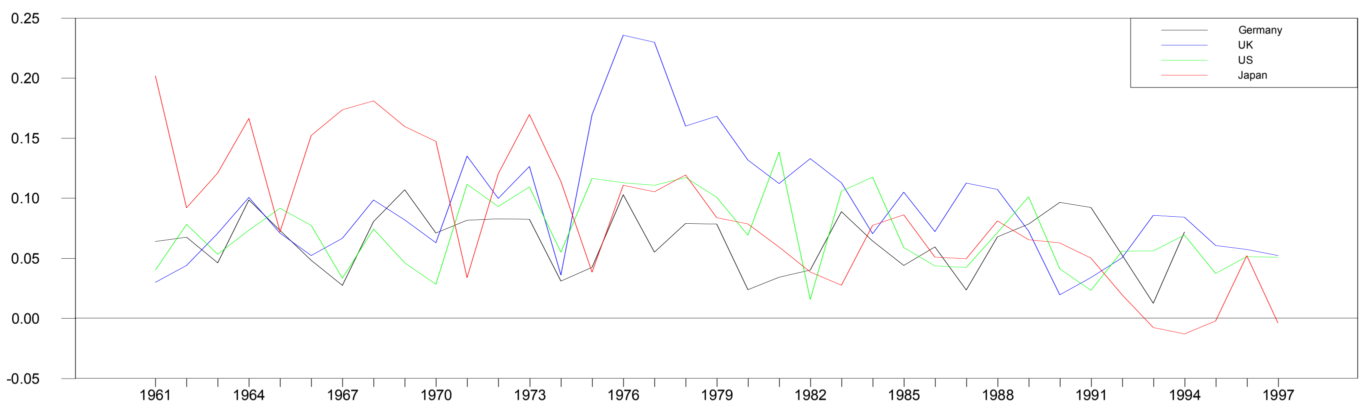


Figure 3. Effects of labor shares and world portfolio share on the domestic demand of domestic assets, under the value-weighted portfolio approach, in the case of perfect correlation between returns on capital and labor at the country level. The domestic demand is expressed as a share of the domestic portfolio.

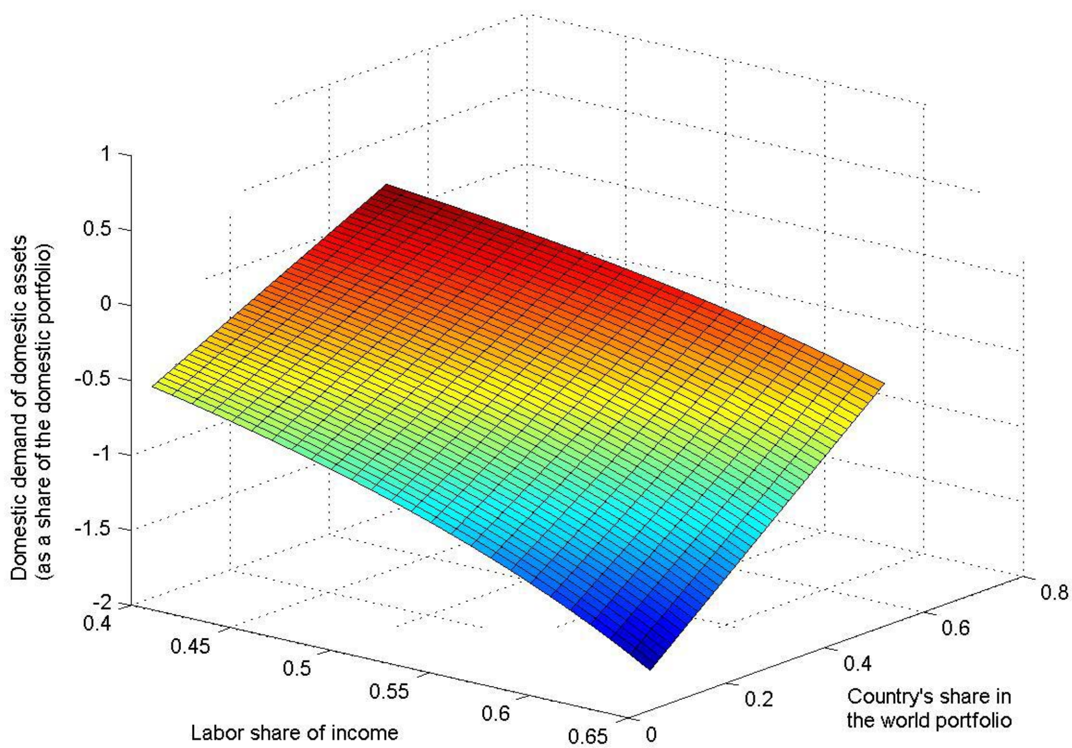
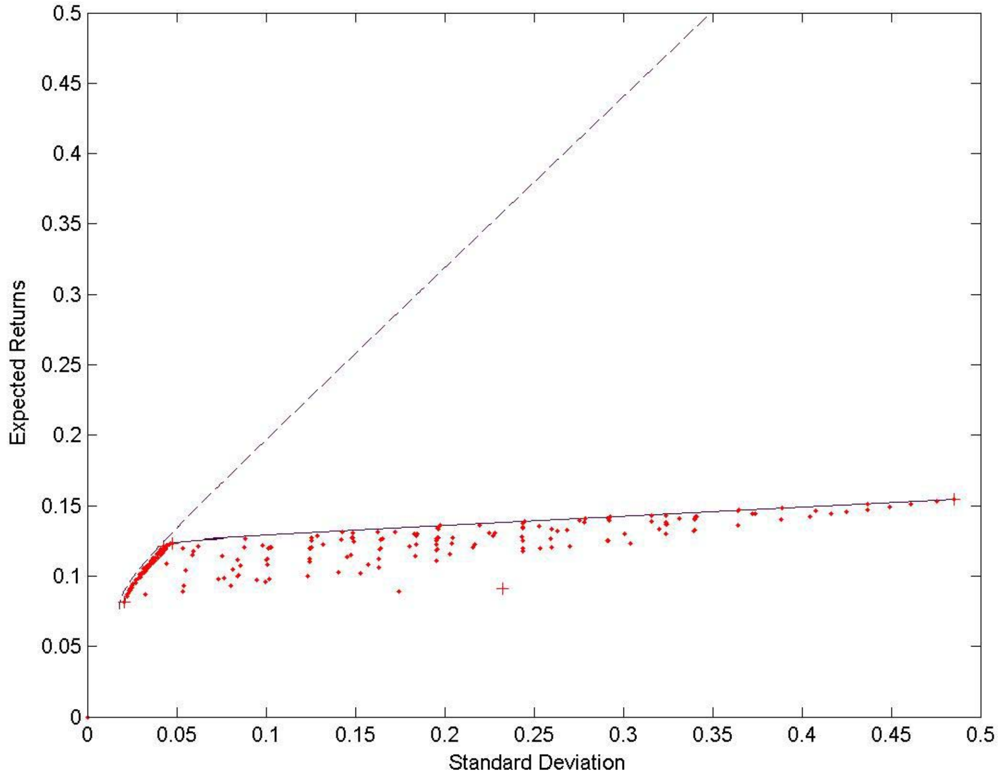


Figure 4. Efficient frontiers with and without short selling constraint and households' portfolios.



The dotted line represents the efficient frontier computed without imposing short selling constraints. The solid line is the efficient frontier computed with short selling constraints. The scatter plot represents the households' portfolios. Source: Jappelli, Julliard and Pagano (2001).