Human Capital and International Portfolio Diversification: A Reappraisal

Lorenzo Bretscher[◇] Christian Julliard[◇] Carlo Rosa[†]

[◇]London School of Economics

[†]Federal Reserve Bank of New York

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The views expressed in this paper are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

The Big Picture

- returns on domestic equity suggest substantial benefits from international diversification (e.g. Grubel (1968), Solnik (1974), etc.)

But individuals in most countries have very small foreign equity holdings (e.g. French and Poterba (1991), Coeurdacier and Rey (2013), etc.)

$\Rightarrow$ International Diversification Puzzle (IDP)

- Human Capital (HC) $\approx$ twice financial wealth.
- Canonical view: r_L should be highly correlated with domestic equity, hence hedging should skew holdings toward foreign equity (e.g. Brainard and Tobin (1992), Cole (1988), etc.)

  $\Rightarrow$ raising the bar for rationalising the IDP.

$\Rightarrow$ Baxter and Jermann (BJ) (1997) seminal empirical findings: households should short domestic assets.

Note: new finding: the home country **bias is increasing** (and portfolio diversification decreasing) **in labor income** (Figure 1)

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We show that:

1. The canonical view is fragile: given the high international GDP correlations, very small rent-shifting shocks (of a size consistent with the data) make the domestic equity a better hedge for human capital than foreign equity.
2. Previous empirical findings are: i) largely driven by an econometric misspecification rejected by the data; ii) characterised by very large statistical uncertainty; iii) biased by not focusing on publicly tradable equities.
3. Correcting the above, in a buffer-stock saving model with both idiosyncratic and aggregate labor income risk:
   i) investors that enter the stock market initially specialize in domestic assets, and portfolios become gradually more diversified only as the level of asset wealth increases;
   ii) the implied aggregate portfolio of domestic investors shows a large degree of home bias.

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Outline

Rent-Shifting Shocks and Hedging

- Rent-shifting shocks can make domestic equity a better hedge for HC than foreign equity (e.g. Bottazzi, Pesenti and van Wincoop (1996)).

But: how large should these shock be? Depends on international GDP correlations.

- With international GDP growth correlations of about .7 (.43), these shocks need a variance that is about 6% (11%) of output variance, i.e. few basis points. (Figure 1)

Data: suggest variance of these shocks ≈ 6%–48% of GDP variance.

(see also, e.g., Palacios-Huerta(2001), Lustig and Nieuwerburgh (2008), Gali (1999), Rotemberg (2003) and Francis and Ramsey (2004) etc.)

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Data Decription

- annual data on labor and capital income from the OECD National Accounts for Germany, Japan, the United Kingdom, and the United States over the sample 1960-2012.
- Labor income = total employee compensation paid by resident producers
- Capital income = GDP minus Labor income: bad assumption $\rightarrow$ we will relax it.
- real, per-capita, values are constructed using population and GDP figures deflator from the IMF International Financial Statistics service.
- Stock market indexes: DAX for Germany, Nikko for Japan, FTSE All-Share for the United Kingdom, S&P 500 Total Return Index as well as Dow Jones Industrials Total Return Index (DJ) and Fama and French benchmark market return for the United States.

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Measuring Factor Returns

- Given the latent nature of r_L, returns are estimated using Campbell and Shiller (1988) log-linearization:

$$r_{j,t+1} - E_t\left[r_{j,t+1}\right] = \sum_{\tau=1}^{\infty} \rho^{\tau-1} \left(E_{t+1} - E_t\right)\left[\Delta d_{j,t+\tau}\right] \quad j = L, K \tag{1}$$

where Δd_j is the "dividend" growth of the j factor, $(E_{t+1} - E_t)[x] := E_{t+1}[x] - E_t[x]$ and E_τ is the expectation operator conditional on information up to time τ.

E_t: normally proxied with country specific VAR/VECM forecasts.

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Example: BJ use for each country $i =$ US, UK, J, G, the VECM:

$$\begin{bmatrix} \Delta d^i_{L,t+1} \\ \Delta d^i_{K,t+1} \end{bmatrix} = \begin{bmatrix} c^i_L \\ c^i_K \end{bmatrix} + \Psi^i(L) \begin{bmatrix} \Delta d^i_{L,t} \\ \Delta d^i_{K,t} \end{bmatrix} + \begin{bmatrix} \pi^i_L \\ \pi^i_K \end{bmatrix} \left(d^i_{L,t} - d^i_{K,t} \right) + \begin{bmatrix} \varepsilon^i_{L,t+1} \\ \varepsilon^i_{K,t+1} \end{bmatrix}$$

Or equivalently:

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

where ΔD_{t+1} has elements $\Delta D^i_{t+1} = \left[\Delta d^i_{L,t+1}, \Delta d^i_{K,t+1} \right]$, Π^i denotes the vector of coefficients on the domestic cointegration vector, and ε is the vector of shocks.

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Model Selection and Misspecification

The country specific VAR/VECM imposes very strong economic restrictions that are testable:

1. The zeros imply block exogeneity of each country w.r.t. each other: no cross-country Granger causality.

⇒ **Strongly rejected** (frequentist and Bayesian) Table 1

2. within country cointegration of labor and capital.

⇒ very **weak evidence** (typically cannot rejected no cointegrationin) Table A2

3. No cross-country/common cointegrations, i.e. no common long-run trends.

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- The combined effect of misspecification:

within countries returns correlations biased ↑ by ≈ 0.11 (all cases)

between countries returns correlations biased ↓ by ≈ 0.44 (11 out of 12 cases)

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Note: returns to publicly tradable equities is directly observable.
⇒ appropriate benchmark for households' hedging opportunities & relaxes a bad assumption.

Table 4: Correlations using stock market data

	r_L^G	r_L^J	r_L^{UK}	r_L^{USA}
r_K^G	0.118	0.138	0.110	0.145
	[−0.08,0.24]	[−0.8,0.24]	[−0.07,0.26]	[−0.04,0.27]
r_K^J	0.122	0.071	0.145	0.194
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But: correlations are very small (cf. Fama and Schwert (1977)) → minimal effect on portfolio choice with frictionless markets and complete spanning (Table A5)

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A Buffer-stock Saving Model of Portfolio Choice

- We calibrate a multi-asset generalization of Heaton and Lucas (1997) consistent with both PSID (Gourinchas and Parker (2002)) and aggregate labor income dynamics.

  I.e.

  1. Each household solves the problem

$$\max_{\{C_t, B_t, S_t^d, \{S_t^j\}_{t=1}^N\}} E_0 \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\gamma}}{1-\gamma}$$

subject to the short selling constraints B_t, S_t^d, $S_t^j \geq 0$ for all t and j, the period budget constraint

$$C_t + B_t + S_t^d + \sum_{j=1}^{J} S_t^j \leq R_t^f B_{t-1} + R_t^d S_{t-1}^d + \sum_{j=1}^{J} R_t^j S_{t-1}^j + Y_t, \quad (2)$$

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A Buffer-stock Saving Model of Portfolio Choice cont'd

2. Labor income of agent i has both idiosyncratic and aggregate risks:

$$Y_t^i = Y_t^g P_t^i U_t^i \tag{3}$$

$$P_t^i = G P_{t-1}^i N_t^i \tag{4}$$

where U_t^i and N^i are iid log-normals independent of Y_t^g and asset returns, and

$$\int \Delta log Y_t^i di = \Delta log Y_t^g$$

where $\Delta log Y_t^g$ follows an (estimated) MA(2)

Calibrated Values

Table 5: Preference and Labor Income Parameters

γ	3
β	0.95
σ_U	0.210
σ_N	0.146
σ_g	0.021
μ_y	0.019
ϑ_1	0.448
ϑ_2	0.094
Mean Market Return	0.060
Market Return sd	0.175
Risk Free Rate	0.011

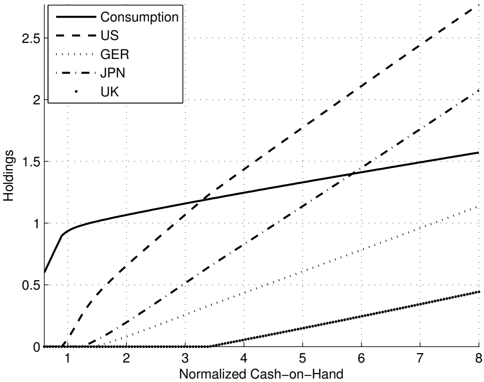
Note: vol of aggregate component is one order of magnitude smaller than the idiosyncratic one.

Calibrated Values cont'd

Table 6: Market Returns and Aggregate Labor Income Shock Correlations

	Correlations				Implied market portfolio w.o. labor income risk
	Germany	Japan	U.K.	Aggregate labor income shocks	
U.S.	0.57	0.32	0.72	0.04	25%
Germany		0.46	0.51	0.14	22%
Japan			0.41	0.19	36%
U.K.				0.15	18%

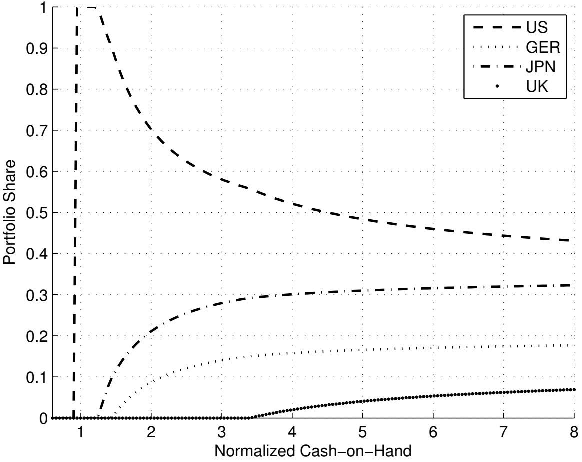
Optimal Consumption and Investment Policy Functions



Consumption and investment as a function of normalized cash-on-hand:

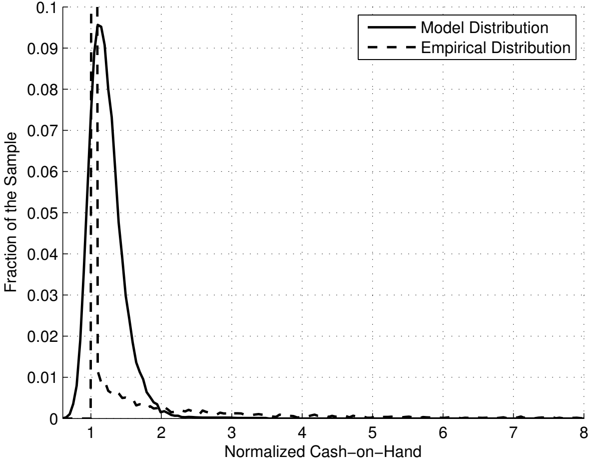
$$\frac{R^f B_{t-1} + R_t^d S_{t-1}^d + \sum_{j=1}^{J} R_t^j S_{t-1}^j + Y_t^i}{E_t\left[Y_{t+2}^i\right]}$$

Optimal Portfolio Shares



Optimal portfolio shares as a function of normalized cash-on-hand.

Cash-on-Hand distributions



Model implied and empirical invariant distributions.

The Aggregate Portfolio

Table 10: Implied Aggregate Portfolio Shares of U.S. Investors

	No Human Capital	Ergodic Dist.	Weighted Ergodic Dist.	Empirical Dist.	Weighted Empirical Dist.
U.S.	25%	95%	75%	75%	61%
Germany	22%	1%	7%	8%	13%
Japan	36%	4%	17%	17%	26%
U.K.	18%	0%	1%	0%	0%
Total	100%	100%	100%	100%	100%

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Conclusion

We reevaluate the role of HC for international portfolio diversification by showing that:

1. empirically plausible redistributive shocks can skew equity holdings toward domestic assets;
2. the customary VAR/VECM approach to assess human capital hedging needs is misspecified, and in a way that mechanically biases estimates toward worsening the IDP.
3. Removing the misspecification, and focusing on publicly traded equity, human capital hedging can generate large home country bias in a buffer-stock saving setting.

Note: unlike complementary explanations of the IDP (e.g., Engel and Matsumoto (2009), Nieuwerburgh and Veldkamp (2009), Heathcote and Perri (2013)), our human capital mechanism can explain the micro evidence on households' holdings. (Figure 1)

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Appendix

Table 1: Testing Block Exogeneity

	Test Statistic
Likelihood Ratio	83.7 (0.001)
Wald	91.8 (0.000)
Lagrange Multiplier	71.2 (0.016)

Table A2: Johansen cointegration test

Country:	Number of Lags	Trace	Max Eigenvalue	Likelihood Ratio
Germany	0	20.22	19.80	15.32
		(0.009)	(0.006)	(0.002)
	1	11.377	9.504	7.196
		(0.190)	(0.272)	(0.007)
	2	10.159	8.59	6.39
		(0.302)	(0.370)	(0.012)
	3	10.48	8.34	5.49
		(0.270)	(0.396)	(0.019)
Japan	0	54.96	51.84	4.36
		(0.001)	(0.001)	(0.037)
	1	27.42	22.86	3.70
		(0.001)	(0.002)	(0.055)
	2	17.40	12.06	4.37
		(0.026)	(0.109)	(0.037)
	3	30.04	26.04	19.83
		(0.001)	(0.01)	(0.000)
United Kingdom	0	18.63	17.46	13.58
		(0.016)	(0.015)	(0.000)
	1	12.41	9.91	4.98
		(0.0139)	(0.229)	(0.026)
	2	11.30	8.39	5.23
		(0.194)	(0.391)	(0.022)
	3	12.30	10.48	7.62
		(0.143)	(0.183)	(0.006)
United States	0	16.53	15.85	12.96
		(0.035)	(0.028)	(0.000)
	1	12.28	10.61	8.76
		(0.144)	(0.175)	(0.003)
	2	13.43	8.88	3.87
		(0.100)	(0.339)	(0.049)
	3	15.53	10.53	5.51
		(0.049)	(0.180)	(0.019)

Table 2: Log Bayes Factors and posterior probabilities

Row:	Specification:	log BF_j	PO_j
(1)	VECM with block exogeneity, domestic cointegration, one lag	724.35	$1.26e-51$
(2)	VECM without block exogeneity, domestic cointegration, one lag	790.15	$4.76e-23$
(3)	VAR in levels with block exogeneity, one lag	701.22	$1.14e-61$
(4)	VAR in levels with block exogeneity, two lags	725.06	$2.63e-51$
(5)	VAR in first-differences with block exogeneity, one lag	717.51	$1.38e-54$
(6)	VAR in first-differences without block exogeneity, one lag	781.58	$9.02e-27$
(7)	VAR in levels without block exogeneity, one lag	769.23	$3.91e-32$
(8)	VAR in levels without block exogeneity, two lags	841.55	1

Table 3: Correlation of factor returns

	r_K^G	r_L^J	r_K^J	r_L^{UK}	r_K^{UK}	r_L^{USA}	r_K^{USA}
r_L^G	0.761 [0.3,0.94]	0.701 [0.2,0.94]	0.828 [0.59,0.97]	0.727 [0.26,0.95]	0.747 [0.28,0.94]	0.847 [0.55,0.97]	0.808 [0.42,0.96]
r_K^G		0.144 [−0.55,0.73]	0.725 [0.14,0.95]	0.869 [0.55,0.99]	0.986 [0.95,1]	0.933 [0.76,0.99]	0.977 [0.92,1]
r_L^J			0.666 [0.15,0.93]	0.155 [−0.53,0.77]	0.170 [−0.52,0.74]	0.311 [−0.4,0.83]	0.239 [−0.48,0.78]
r_K^J				0.524 [−0.11,0.93]	0.751 [0.2,0.96]	0.738 [0.27,0.97]	0.739 [0.22,0.96]
r_L^{UK}					0.861 [0.55,0.99]	0.945 [0.8,0.99]	0.918 [0.73,0.99]
r_K^{UK}						0.933 [0.77,0.99]	0.982 [0.94,1]
r_L^{USA}							0.964 [0.87,0.99]

Table 6: Market Returns and Aggregate Labor Income Shock Correlations

	Correlations				Implied market
	Germany	Japan	U.K.	Aggregate labor income shocks	portfolio w.o. labor income risk
U.S.	0.57	0.32	0.72	0.04	25%
Germany		0.46	0.51	0.14	22%
Japan			0.41	0.19	36%
U.K.				0.15	18%

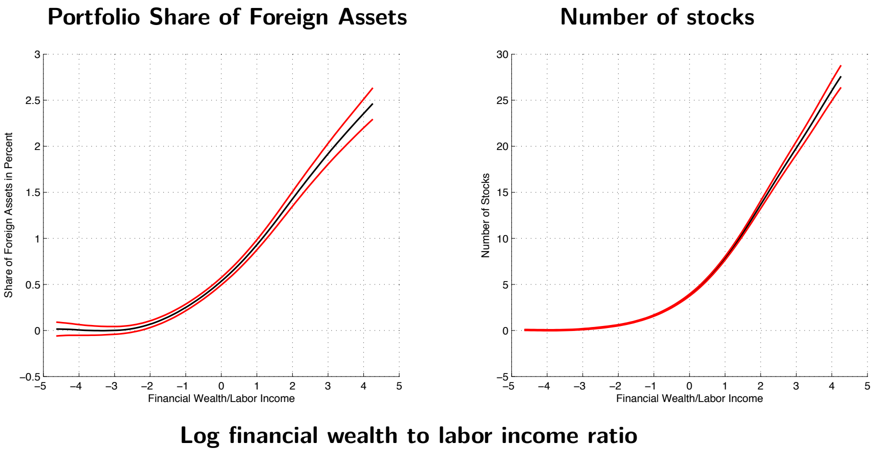
Table A5: Value-weighted diversified portfolio with complete markets

	Shares in each country traded asset:			
Investor Nationality:	Germany	Japan	UK	USA
Panel B: r_k measured using stock market returns				
Germany	0.040 [0.04,0.05]	0.289 [0.28,0.29]	0.145 [0.14,0.16]	0.526 [0.51,0.53]
Japan	0.034 [0.03,0.04]	0.290 [0.28,0.29]	0.139 [0.13,0.15]	0.537 [0.52,0.54]
UK	0.039 [0.03,0.05]	0.287 [0.28,0.29]	0.147 [0.14,0.17]	0.527 [0.5,0.53]
USA	0.039 [0.03,0.05]	0.287 [0.28,0.29]	0.145 [0.14,0.17]	0.530 [0.51,0.54]
World share	0.043	0.293	0.150	0.516

Shares computed for each country j as

$$\pi_k \left[1 + \frac{1-\alpha_j}{\alpha_j} \left(\sum_{k=1}^{4} h_{jk} \right) \right] - \frac{1-\alpha_j}{\alpha_j} h_{jk}, \tag{5}$$

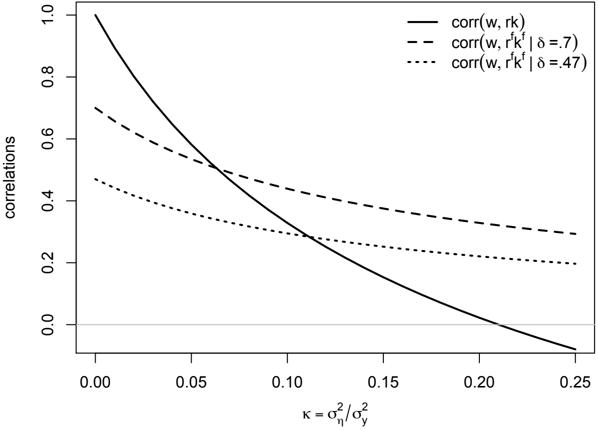
where: π_k = world share of country k; $1-\alpha_j$ = labor share of income in country j; $h_j = \Sigma^{-1}\Omega_j$ with Σ being the variance of returns, and Ω_j the r_L^j covariance with stock returns.



Based on all US Survey of Consumer Finances (SCF) data.

Cf. Calvet, Campbell and Sodini (2007, Table 5)

Note: hard to rationalise with current explanations of the IDP.



Correlations of domestic wage and: domestic (solid line) and foreign (dashed and dotted lines) capital compensation for different levels of international GDP correlation (δ).