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Home bias and international risk sharing: Twin puzzles separated at birth

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Abstract

We document that international home bias in debt and equity holdings declined during the period 1993–2003 at the same time as international risk sharing increased. Using panel-data regressions for OECD countries, we demonstrate that less home bias is associated with more international risk sharing. More generally, we show that more financial integration is associated with more risk sharing when we measure financial integration as the ratio of foreign assets to Gross Domestic Product. Our results indicate that risk sharing and international financial integration are closely related empirical phenomena.
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1. Introduction

Hedging of risk is a central topic in economics and finance but macroeconomists and financial economists tend to have different notions of full hedging. The economic literature departs from the benchmark model of perfect markets, which in a setting of endowment economies under standard assumptions implies that consumption growth rates are equalized (''perfect risk

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sharing'') while the financial literature typically departs from the benchmark of the international Capital Asset Pricing Model (CAPM) which under standard assumptions predicts that countries hold identical international portfolios of risky assets. In this article, we measure the deviation from the perfect risk sharing allocation (or, equivalently, the amount of risk sharing obtained) and we measure the deviation from the international CAPM allocation (''home bias''). Then, we examine if large home bias is associated with low risk sharing for a sample of countries from the Organization for Economic Cooperation and Development (OECD) 1993–2003.

The macroeconomic literature on risk sharing and the financial literature on home bias have been quite separate which explains the subtitle of this article. Lewis (1999) considers both literatures in a very readable survey but she does not attempt to link the two phenomena empirically. Home bias and risk sharing may be manifestations of the same underlying behavior: if agents diversify their portfolios internationally they will likely obtain smoother income streams as domestic shocks partially will be offset by foreign asset income and, of course, smoother income is likely to imply smoother consumption. Consider the (simplified) identities:

$$\text{GNI} = \text{GDP} + r_{\text{D}}A_{\text{D}} - r_{\text{F}}A_{\text{F}}, \tag{1}$$

$$\text{CONS} = \text{GNI} - \text{Gross National Saving}, \tag{2}$$

where GNI is Gross National Income (formerly referred to as Gross National Product), GDP is Gross Domestic Product, A_{F} is the stock of domestic assets owned by foreign residents, r_{F} is the rate of return on these assets, and A_{D} and r_{D} are domestically owned foreign assets and the return on those, respectively. CONS is total consumption, including government as well as private consumption. The equations displayed highlight the major components of the national accounts and ignore less important parts.[1]

If the term $r_{\text{D}}A_{\text{D}} - r_{\text{F}}A_{\text{F}}$ is not perfectly correlated with GDP, the GNI of a country may be less variable than it would be in the absence of international assets. CONS may be stabilized relative to GDP because GNI is stabilized, or because pro-cyclical saving helps insulate consumption from shocks to GDP that are not stabilized in GNI.

Home bias and risk sharing *need* not be close twins. Home bias may not lead to lack of risk sharing: if agents do not smooth income through cross-ownership of assets they can smooth consumption through borrowing and lending which may be optimal, by the logic of permanent income theory, if income shocks are temporary; however, aggregate shocks seem to mainly be permanent. Also, full international diversification of equity portfolios may not lead to smooth income if overall equity investment is small relative to GDP or if equity provides little hedging of returns to human capital (wage income)—see Baxter and Jermann (1997). Most countries

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[1] In the national accounts, GNI equals GDP (the value of domestic production) plus net factor income from the rest of the world. Net factor income from the rest of the world is net asset income plus domestic residents' income from foreign countries minus income of foreign residents from the domestic country. Since the latter type of factor income is based on residency rather than citizenship, it is typically small. Subtracting depreciation and net indirect business taxes from GNI gives *national income*. Subtracting corporate profits and net personal interest payments and adding transfers gives *personal income*. Subtracting personal taxes gives *disposable personal income* and subtracting personal saving gives *personal consumption*. The major part of the difference between GNI and consumption is gross saving which consists of depreciation and net saving (by governments, corporations, and individuals). Sørensen and Yosha (1998) and Balli and Sørensen (2006) examine the contribution of the various components of GDP to international risk sharing in much more detail.

hold fairly small amounts of *net* foreign assets. In the context of Eq. (1), this implies approximately $A_F = A_D$ and if returns on foreign and domestic assets are highly correlated it is immediately obvious that GNI will differ little from GDP. Such could be the case if foreign investment is not primarily determined by hedging considerations.

This paper empirically provides the missing link between home bias and risk sharing by showing that disappearing home bias and increasing risk sharing move hand-in-hand. We use a panel of OECD countries and find that when home bias declines, risk sharing increases. In terms of Eq. (1), a larger domestic stock of foreign assets (A_D) (variously transformed) predicts higher risk sharing.

We use two alternative measures of risk sharing. Ultimately, economic agents care about consumption and the macroeconomic literature focuses on consumption risk sharing. However, consumption data are affected by taste shocks (broadly defined) and because net foreign capital income, such as dividends and interest from foreign assets, directly affects GNI, we also consider ''income''-based risk sharing based on GNI in the hope of getting a better ''signal-to-noise'' ratio. On the other hand, consumption data may be preferable if the returns to foreign assets are dominated by yet-to-be-realized capital gains which will affect consumption but not be recorded in net foreign asset income.

Previously, very little systematic empirical evidence has been brought to bear on this issue. Lane (2001) concludes that ''positive gross international investment positions in general are not associated with income-smoothing at business-cycle frequencies'' although Lane (2000) finds that international equity positions do contribute to Ireland's risk sharing with other European countries. However, international security holdings have been rapidly increasing throughout the 1990s and, therefore, any impact on risk sharing should now be easier to detect.

Section 2 shows that home bias in bonds and equities has declined rapidly from 1993 to 2003. Section 3 shows that international risk sharing increased significantly during the 1990s while Section 4 asks if countries with less home bias obtain better income and consumption risk sharing and, in more detail, if risk sharing is correlated with the amount of foreign assets or liabilities held as a fraction of GDP. Section 5 concludes the paper.

2. International portfolio holdings and home bias

2.1. A first look at the data

Table 1 displays the ratio of foreign equity, debt, and Foreign Direct Investment (FDI) holdings to GDP for 1993 and 2003 for the 24 OECD countries that comprise our sample.[2] Data sources and definitions are in the Appendix. Foreign asset holdings increased sharply from 1993 to 2003. For instance, foreign equity holdings in Italy increased from 3% of GDP to 23% of GDP. While this might partly be due to a run-up in the value of foreign equity holdings we observe the same pattern, although slightly less pronounced, for international holdings of debt and FDI—these categories relative to GDP more or less trebled for many countries. There are large differences across countries. In 2003 Ireland held amounts of foreign equity and debt

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[2] The countries included are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Mexico, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the UK, and the United States.

Table 1

County-level foreign asset and liability holdings of equity, debt, and foreign direct investment relative to GDP

Country	Assets						Liabilities					
	Equity		Debt		FDI		Equity		Debt		FDI	
	Year											
	1993	2003	1993	2003	1993	2003	1993	2003	1993	2003	1993	2003
Australia	0.07	0.17	0.08	0.17	0.13	0.28	0.11	0.26	0.47	0.67	0.27	0.37
Austria	0.02	0.17	0.47	1.28	0.04	0.23	0.02	0.10	0.63	1.55	0.06	0.22
Belgium	0.27	0.47	1.46	2.48	0.28	1.01	0.04	0.09	1.51	2.36	0.43	1.15
Canada	0.18	0.36	0.18	0.25	0.17	0.37	0.08	0.22	0.66	0.62	0.19	0.32
Denmark	0.06	0.24	0.55	0.83	0.14	0.48	0.02	0.15	0.98	1.27	0.10	0.47
Finland	0.00	0.22	0.29	0.88	0.11	0.47	0.06	0.64	0.89	0.96	0.05	0.31
France	0.04	0.19	0.51	1.07	0.21	0.67	0.08	0.28	0.58	1.17	0.24	0.44
Germany	0.06	0.24	0.47	1.07	0.08	0.30	0.05	0.15	0.46	1.15	0.04	0.27
Greece	0.01	0.02	0.20	0.52	0.01	0.06	0.02	0.09	0.44	1.10	0.10	0.12
Iceland	0.00	0.32	0.04	0.38	0.02	0.16	0.00	0.06	0.67	1.51	0.02	0.11
Ireland	0.26	1.42	0.80	6.64	0.10	0.47	0.32	3.07	0.97	4.33	0.40	1.42
Italy	0.03	0.23	0.31	0.62	0.08	0.16	0.03	0.11	0.47	0.96	0.05	0.12
Japan	0.02	0.06	0.39	0.54	0.06	0.08	0.04	0.13	0.32	0.31	0.00	0.02
Mexico	0.00	0.01	0.09	0.07	0.00	0.02	0.12	0.09	0.33	0.25	0.11	0.26
Netherlands	0.18	0.61	0.81	1.86	0.36	0.99	0.27	0.54	0.80	2.20	0.22	0.85
New Zealand	0.04	0.18	0.07	0.25	0.13	0.14	0.11	0.07	0.63	0.80	0.56	0.57
Norway	0.03	0.34	0.22	0.98	0.11	0.41	0.08	0.10	0.38	1.00	0.06	0.21
Portugal	0.02	0.08	0.29	1.35	0.02	0.24	0.03	0.24	0.41	1.72	0.15	0.40
Spain	0.01	0.10	0.28	0.71	0.05	0.34	0.07	0.21	0.40	0.98	0.16	0.38
Sweden	0.08	0.47	0.28	0.60	0.30	0.76	0.11	0.30	0.90	1.17	0.12	0.52
Switzerland	0.37	0.91	1.76	3.28	0.38	1.05	0.57	1.25	0.89	2.32	0.20	0.57
Turkey	0.00	0.01	0.10	0.14	0.00	0.02	0.01	0.04	0.37	0.66	0.03	0.09
UK	0.30	0.37	1.48	2.43	0.27	0.66	0.21	0.48	1.62	2.71	0.21	0.35
United States	0.08	0.19	0.20	0.30	0.16	0.25	0.06	0.17	0.32	0.58	0.12	0.23
Average	0.09	0.31	0.47	1.20	0.13	0.40	0.10	0.37	0.67	1.35	0.16	0.41

Note. The rows display the value of foreign equity, debt, and foreign direct investment holdings divided by GDP in the same year. The term "debt" refers to debt securities of any maturity while the term "FDI" refers to foreign direct investment.

far exceeding the level of Irish GDP. For Switzerland the ratio of equity to GDP is 91% and 328% for debt assets. Turkey held foreign equity in amounts less than 1% of Turkey's GDP while Japan held an amount of foreign equity equal to only 6% of GDP in 2003. One cannot help but wonder if Japan might have softened the blow of her long recession in the 1990s through further international diversification.

Foreign debt holdings are on average four times larger than foreign equity holdings although that ratio is much larger for Japan and lower for the United States. FDI assets are on average slightly larger than portfolio equity holdings although Ireland holds significantly more portfolio equity and Belgium, France, and the UK hold relatively more FDI. Liabilities outstanding are quite similar to asset holdings although debtor nations, such as Australia, hold less assets than liabilities and vice versa for creditor nations, such as Switzerland.

The large variation across time and across countries delivers the variation that allows us to test econometrically if countries with large amounts of foreign assets (less home bias) obtain more risk sharing.

2.2. Theoretical background and previous literature

Recent empirical research typically builds on the simple CAPM-model which predicts that all investors hold a mix of the safe asset and the "market portfolio". In early applications, the "market" was understood to be the domestic market, but Grubel (1968) pointed out 40 odd years ago that international diversification can improve the mean-variance trade-off compared to holding a purely domestic portfolio and Lewis (1999) shows that this conclusion hasn't changed since then. However, countries typically hold the vast majority of their asset portfolio in domestic assets which is referred to as international home bias and documented by, e.g., French and Poterba (1991).[3]

A large literature attempts to explain home bias. Some suggested explanations are (1) hedging of currency risk—see Adler and Dumas (1983); (2) transaction costs associated with holding or transacting in international assets—see Cooper and Kaplanis (1994) who find that with reasonable levels of risk aversion, transaction costs cannot explain home bias in equity holdings; (3) lack of information about foreign assets—see Gehrig (1993); and (4) costs of trading goods internationally—see Obstfeld and Rogoff (2001). Moral hazard and enforcement issues can also affect international investment—see Lewis (1999) and Karolyi and Stulz (2003) for further potential explanations. The strong decline in equity and debt home bias during the late 1990s is consistent with a role for declining costs of trading goods and acquiring information. While currency risk has been eliminated for mutual investments among members of the European Monetary Union (EMU), countries that are not members of any currency union also display rapidly declining home bias. Likely, hedging of currency risk is not the main reason for home bias.

Home bias in the composition of portfolios may be of little importance for risk sharing if overall asset portfolios are small relative to GDP which is why we also consider simple ratios of foreign asset portfolios relative to GDP.

2.3. Measuring home bias

We define "Equity Home Bias" such that (Equity) Home Bias is 0 if the share of country i's equity holdings invested domestically equals the share of country i's equity market in the total world equity market—in other words, a country will have Home Bias equal to 0 if it shows no preference for equity issued domestically. We normalize Equity Home Bias to be 1 if a country invests 100% domestically. More precisely, we define Equity Home Bias of country $i = 1 -$ (share of country i's holdings of foreign equity in country i's total equity portfolio/the share of foreign equity in the world portfolio).[4]

International diversification need not be limited to corporate equity. Investments can be diversified through FDI, real estate, bank deposits, etc.[5] We calculate indices for home bias in debt markets along with home bias in equity markets and leave the study of home bias in

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[3] Parts of the literature on home bias focus on the amount of international asset *holdings* relative to benchmarks, such as the CAPM, and parts of the literature focus on *returns* to domestic versus more internationally diversified portfolios. In this article, we calculate indices of home bias for equity and bond holdings while we do not consider returns.

[4] This measure is used in numerous articles, such as Warnock (2002), and our goal here is to see if this, standard, measure relates to risk sharing. We do not take "bias" to indicate that individuals are not rational—we take no stand on this.

[5] Buch et al. (2005) show that banks over-invest domestically relative to simple benchmarks.

Table 2
Equity and Debt Home Bias 1993 and 2003

Country	(1) Foreign equity in portfolio (%)		(2) Equity Home Bias		(3) Foreign debt security in portfolio (%)		(4) Debt Home Bias	
	1993	2003	1993	2003	1993	2003	1993	2003
Australia	11.26	17.20	0.89	0.82	14.68	23.73	0.85	0.76
Austria	13.03	61.14	0.87	0.39	47.25	61.79	0.52	0.38
Belgium	45.94	50.16	0.54	0.50	50.33	63.11	0.49	0.36
Canada	26.00	30.27	0.73	0.69	17.63	23.02	0.82	0.77
Denmark	17.14	36.58	0.83	0.63	24.86	31.33	0.75	0.68
Finland	1.66	35.02	0.98	0.65	31.28	57.29	0.69	0.43
France	12.86	28.15	0.87	0.71	38.72	51.12	0.59	0.46
Germany	23.75	44.70	0.75	0.54	40.57	55.52	0.57	0.40
Greece	4.27	4.30	0.96	0.96	23.83	33.95	0.76	0.66
Iceland	–	–	–	–	7.52	17.09	0.92	0.83
Ireland	–	–	–	–	63.50	93.81	0.36	0.06
Italy	21.25	41.84	0.79	0.57	20.50	30.48	0.78	0.68
Japan	3.59	9.97	0.95	0.89	31.30	22.82	0.62	0.73
Mexico	1.16	11.45	0.99	0.89	38.10	23.01	0.62	0.77
Netherlands	40.00	62.01	0.59	0.37	54.79	63.04	0.44	0.35
New Zealand	7.10	35.10	0.93	0.65	16.63	46.30	0.83	0.54
Norway	16.70	51.45	0.83	0.48	33.93	69.55	0.66	0.30
Portugal	14.20	31.98	0.86	0.68	38.55	61.17	0.61	0.39
Spain	6.31	13.97	0.94	0.86	34.61	47.96	0.65	0.51
Sweden	14.94	41.60	0.85	0.58	22.05	39.39	0.78	0.60
Switzerland	40.13	47.52	0.59	0.51	71.43	82.59	0.28	0.17
Turkey	1.74	2.37	0.98	0.98	44.52	19.08	0.55	0.81
UK	23.16	29.51	0.75	0.68	77.19	84.13	0.21	0.12
US	10.25	14.32	0.84	0.74	12.55	16.07	0.78	0.73
Average	16.20	31.85	0.83	0.67	35.68	46.56	0.63	0.52

Note. Equity Home Bias in column (2) = 1 − column (1)/[1 − A]. Column (1) = total foreign equity held by country/country's total equity portfolio, where the total equity portfolio of a country = stock market capitalization + foreign equity held − amount of country's equity held by foreigners. A = stock market capitalization of a country/stock market capitalization of the world. Debt Home Bias in column (4) = 1 − column (3)/[1 − B]. Column (3) = total foreign debt security held by country/country's total debt security portfolio, where the total debt security portfolio of a country = domestic debt security outstanding + total foreign debt security assets held. B = debt market capitalization of a country/debt market capitalization of the world. Data sources: foreign equity holdings, domestic equity held by foreigners and foreign debt security holdings of a country are from Lane and Milesi-Ferretti (2006); stock market capitalizations are from the Standard & Poor's *Global Stock Markets Factbook* 2003, 2004 and 2005; domestic and international debt security outstanding of a country and world debt market capitalization are from the BIS.

other markets for future research. We define "Debt Home Bias" in the same way as Equity Home Bias—substituting "debt" for "equity" in the definition.[6]

In Table 2, the left-most columns labelled (1) show the percentage share of foreign equity in the aggregate portfolio of each country. It is clear that foreign equity holdings have increased faster than overall domestically held portfolios. The columns labelled (2) display numbers for

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[6] Burger and Warnock (2004) find that international bond holdings are much lower than a CAPM benchmark might suggest and that US investors could have obtained better risk-return trade-offs by investing more in foreign bonds during the 1994−2003 period as long as currency risks were hedged. It appears that the home bias puzzle only gets deeper if bond holdings are considered simultaneously with equity.

Equity Home Bias in 1993 and 2003.[7] Equity Home Bias declined for all countries, except Greece and Turkey, and by 2003 two countries, the Netherlands and Austria, had Equity Home Bias less than 0.4. Columns (3) of Table 2 display the shares of foreign debt securities in domestic debt security portfolio while columns (4) display Debt Home Bias. The numbers for debt securities are, overall, fairly similar to those for Equity Home Bias. For example, average Debt (Equity) Home Bias is 0.63 (0.83) in 1993 and 0.52 (0.67) in 2003. Debt Home Bias declined for most countries, with the exceptions being Japan, Mexico, and Turkey. All countries have positive Debt Home Bias but Ireland has the lowest at only 0.06 in 2003 while the value for Iceland is a high 0.83 in 2003.

3. International risk sharing

3.1. Theoretical background and previous literature

The situation where consumption growth rates in all countries are identical is denoted "full (or perfect) consumption risk sharing." This will be an equilibrium allocation if consumers have identical Constant Relative Risk Aversion utility functions and access to a complete set of Arrow-Debreu markets—see Obstfeld and Rogoff (1996) for a textbook treatment of risk sharing. The simple characterization of the equilibrium allocation makes it obvious that the existence of a full set of Arrow-securities is not necessary and countries may be able to smooth consumption through trade in international assets such as equity and debt. Similarly, we say that there is "full (or perfect) income risk sharing" when the growth rate of GNI is identical in all countries. In this case, we would expect consumption growth rates to also be similar, at least if taste shocks are not too large.

Mace (1991) suggests testing for full risk sharing, using individual-level data, by regressing consumption growth on income growth. At the country level, Obstfeld (1994) regresses country-level consumption growth on world consumption growth and own-country income growth and finds little evidence of risk sharing. Sørensen and Yosha (1998) perform regressions similar to those of Mace but nested within a decomposition of the cross-sectional variance of country-level GDP. Their analysis shows that GNI is typically not smoothed at all before 1990 while consumption is far from perfectly smoothed.

3.2. Year-by-year measures of risk sharing: specification

Our empirical estimations quantify deviations from perfect income and consumption risk sharing, respectively. Consider a group of countries and the following set of cross-sectional regressions—one for each year t:

$$\triangle \log \text{GNI}_{it} - \triangle \log \text{GNI}_t = \text{constant} + \beta_{K,t}(\triangle \log \text{GDP}_{it} - \triangle \log \text{GDP}_t) + \epsilon_{it}. \tag{3}$$

GNI_{it} and GDP_{it} are country i's year t per capita GNI and GDP, respectively, and GNI_t and GDP_t are the year t per capita aggregate GNI and GDP, respectively. The coefficient $\beta_{K,t}$ measures the average co-movement of idiosyncratic GNI growth (i.e., the deviation from aggregate GNI

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[7] The stock and debt market capitalizations used in the calculation of home bias are left out for brevity but are tabulated in the working paper version of this article.

growth) with idiosyncratic GDP growth in year t. Aggregate fluctuations cannot be eliminated by the sharing of risk, which is why the aggregate component is deducted from the growth rates. Under perfect risk sharing, the left-hand side of Eq. (3) will be zero implying that $\beta_{K,t}$ will be zero. The smaller the co-movement of idiosyncratic GNI with GDP, the more GNI is buffered against GDP fluctuations and the smaller the estimated value of $\beta_{K,t}$. Since GNI equals GDP plus net factor income from abroad, this regression measures the amount of income risk sharing provided by net factor income flows—the lower the $\beta_{K,t}$, the higher the income risk sharing within the group in year t. The $\beta_{K,t}$ coefficients measure the evolution of risk sharing over time. Often it is more instructive to look at the equivalent series $1 - \beta_{K,t}$. This series will take the value 1 if risk sharing is perfect and the value 0 if GNI moves one-to-one with output.

In a similar manner, we estimate year-by-year the relation

$$\triangle \log C_{it} - \triangle \log C_t = \text{constant} + \beta_{C,t}(\triangle \log \text{GDP}_{it} - \triangle \log \text{GDP}_t) + \epsilon_{it}, \tag{4}$$

where C_{it} is country i's year t per capita final consumption, and C_t is the year t per capita aggregate final consumption for the group. The coefficient $\beta_{C,t}$ measures the average co-movement of the countries' idiosyncratic consumption growth with their idiosyncratic GDP growth in year t. The smaller the co-movement, the more consumption is buffered against GDP fluctuations. Therefore, this regression provides a measure of the extent of consumption risk sharing.

3.3. Year-by-year measures of risk sharing: plots

Fig. 1 displays the series of risk sharing measures for the OECD together with the logarithm of foreign asset holdings normalized by GDP. More precisely, we display the estimated values

Fig. 1. Income risk sharing and foreign asset holdings in the OECD. Note: Mean of log(assets/GDP) is the cross-sectional mean of foreign (equity + debt + FDI) holdings normalized by GDP for 24 OECD countries. The countries comprise the subset of OECD for which data are available (see text). Risk sharing is estimated cross-sectionally year-by-year and is smoothed by using a Normal kernel with bandwidth (standard deviation) equal to 2.

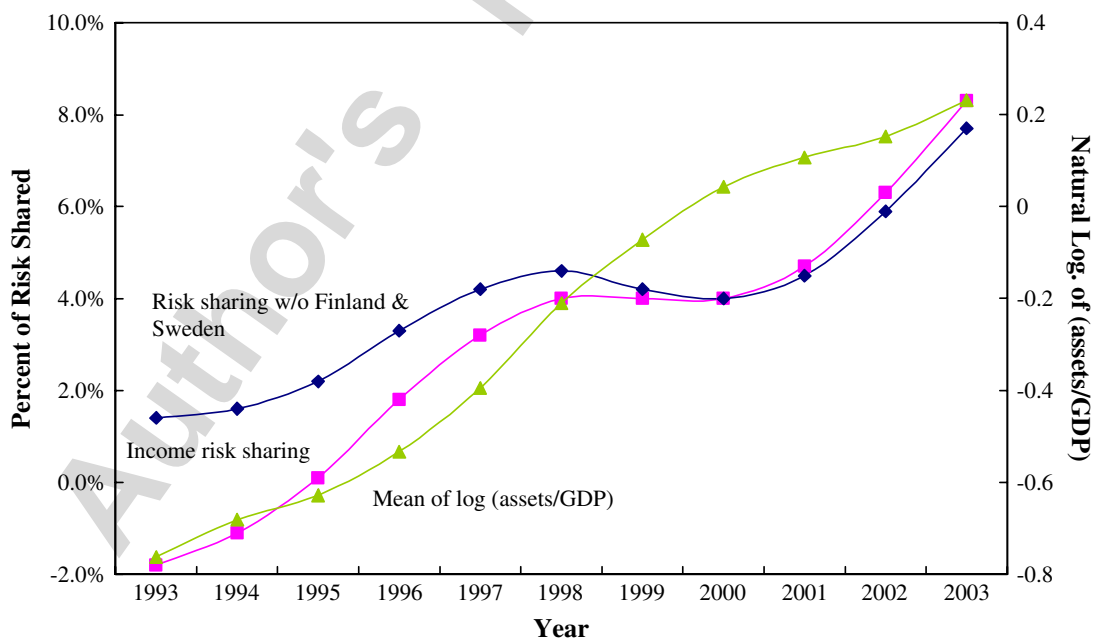Fig. 2. Consumption risk sharing and foreign asset holdings in the OECD. Note: Mean of log(assets/GDP) is the cross-sectional mean of foreign (equity + debt + FDI) holdings normalized by GDP for 24 OECD countries. The countries comprise the subset of OECD for which data are available (see text). Risk sharing is estimated cross-sectionally year-by-year and is smoothed by using a Normal kernel with bandwidth (standard deviation) equal to 2.
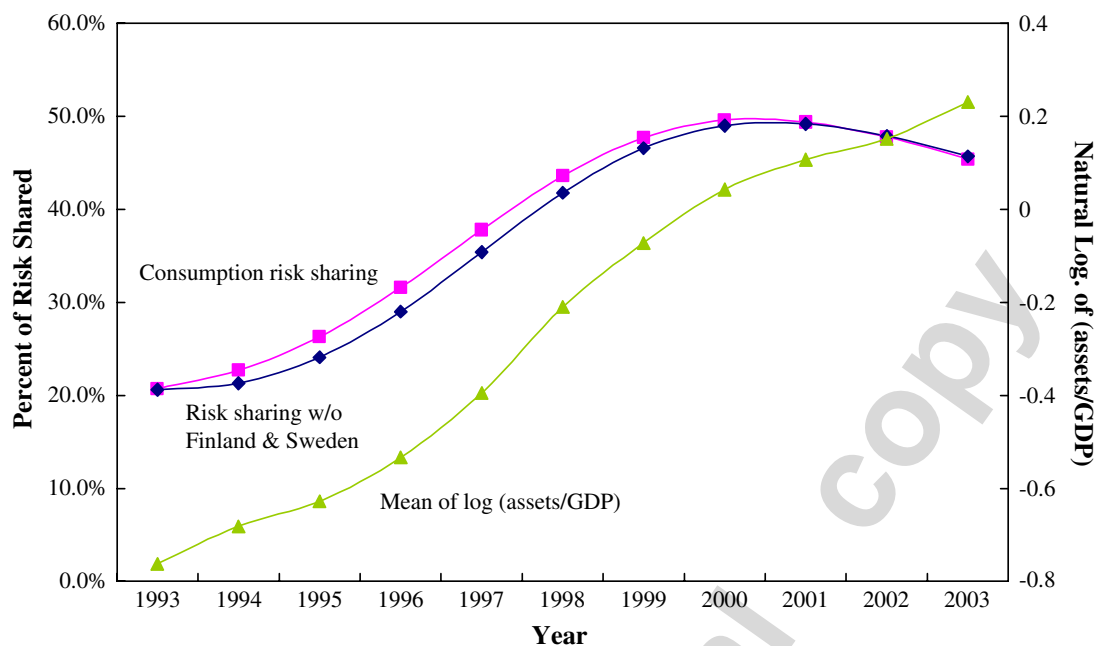
of $100 \times (1 - \beta_{K,t})$ which we interpret as the percent risk sharing obtained. The year-by-year estimates fluctuate a fair amount so the graph displays the coefficients after smoothing the time-variation using a Normal kernel with bandwidth (standard deviation) 2. Risk sharing is negative in the early 1990s. This result is due to Finland and Sweden, two countries which were severely affected by economic crises in the early 1990s—banking crises in Sweden and Finland in addition to the impact of the Soviet break-up in Finland.[8] We, therefore, also show risk sharing calculated without Finland and Sweden.[9] The graphs indicate that international income risk sharing increased quite steeply through the 1990s. Comparing with the graph for international asset holdings it is highly suggestive that this is related to the concurrent increase in international asset holdings.

Fig. 2 displays kernel smoothed estimates for year-by-year consumption risk sharing; i.e., $100 \times (1 - \beta_{C,t})$, where the $\beta_{C,t}$'s are the estimated coefficients from Eq. (4) for the OECD. The graph for asset holdings is the same as in Fig. 1. On average, consumption risk sharing is much larger than income risk sharing due to pro-cyclical savings behavior.[10] The graphs for consumption are similar with or without Finland and Sweden: the large drops in GNI experienced by these countries in the early 1990s seem not to have affected consumption significantly.[11] Overall, this

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[8] The negative coefficient mechanically reflects that the sharp declines in GDP in these countries in that period were associated with even sharper drops in GNI.

[9] The graph leaves the impression that income risk sharing might have been negative before the sample we consider but if we extend the graph further back in time we find zero income risk sharing.

[10] Sørensen and Yosha (1998) find that during the 1980s this was primarily due to pro-cyclical savings of corporations and governments.

[11] If the banking crises at the time were expected to be temporary (as they turned out to be) this is what would be expected from permanent income theories of consumption, see Deaton (1992).

graph confirms the pattern observed in Fig. 1 with consumption risk sharing increasing after 1995 roughly at the same time as foreign asset holdings start increasing.

4. Does higher foreign asset holdings predict better income and consumption risk sharing?

4.1. Panel-data regressions: specification

We estimate panel-data regressions of the form:

$$\triangle \log \text{GNI}_{it} - \triangle \log \text{GNI}_t = \text{constant} + \kappa(\triangle \log \text{GDP}_{it} - \triangle \log \text{GDP}_t) + \epsilon_{it}. \tag{5}$$

This regression is similar to (3) except that it is now estimated as a panel pooling the years in the sample. In this specification, suggested by Asdrubali et al. (1996), $1 - \kappa$ is a scalar that measures the average amount of income risk sharing during the time-period considered. The coefficient κ measures the average co-movement of the countries' idiosyncratic GNI growth with their idiosyncratic GDP growth over the sample period. In this regression, subtracting from each variable the aggregate value is crucial because aggregate GDP growth of the group is not insurable.

Mélitz and Zumer (1999) impose structure on κ so that $\kappa = \kappa_0 + \kappa_1 \gamma_i$, where γ_i is an "interaction" variable that affects the amount of risk sharing that country i obtains. $1 - \kappa_0 - \kappa_1 \gamma_i$ then measures the average amount of income risk sharing obtained by country i during the time-period in question. We enhance this method by allowing κ to change over time as follows:

$$\kappa = \kappa_0 + \kappa_1(t - \bar{t}) + \kappa_2(\text{EHB}_{it} - \overline{\text{EHB}_t}), \tag{6}$$

where $\text{EHB}_{it} \equiv \text{Equity Home Bias}_{it}$ is our Equity Home Bias measure for country i at time t. $\bar{t}$ is the middle year of the sample period, and $\overline{\text{EHB}_t}$ is the (un-weighted) average across countries of EHB_{it} at time t. The estimated value of $1 - \kappa_0$ corresponds to the average amount of income risk sharing within the group. $1 - \kappa_0 - \kappa_1(t - \bar{t}) - \kappa_2(\text{EHB}_{it} - \overline{\text{EHB}_t})$ then measures the amount of income risk sharing obtained in period t by country i with Equity Home Bias EHB_{it}. We include a time trend in order to guard against the downward trending home bias measure spuriously capturing trend changes in risk sharing that may be caused by other developments in international markets.[12]

The parameter $-\kappa_1$ captures the average year-by-year increase in income risk sharing. In this respect, the specification implied by (5) and (6) is a "middle-of-the-road" specification between the specification in (3)—where the amount of income risk sharing can change freely from period to period—and the specification in (5) where the amount of income risk sharing does not change over time. In the specification implied by (5) and (6), the amount of income risk sharing is allowed to change over time with the trend and with Equity Home Bias.

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[12] Including time-fixed effects changes the results very little—this is because the aggregate values of the variables have been subtracted leaving little variation to be captured by time dummies. We allowed for a quadratic term in time as an interaction term but the quadratic term was rarely significant and the estimated coefficient to home bias was robust to this alternative. We also tried to allow the coefficient to GDP to change each year in which case we use all information in the panel *except* the time-series patterns displayed in Figs. 1 and 2. The results for the effects of asset holdings and home bias on risk sharing are similar to those reported and are not displayed.

The parameter $-\kappa_2$ (which will typically be negative) measures how much higher than average Equity Home Bias lowers the amount of income risk sharing obtained. In fact, $-\kappa_2$ can be interpreted as an "exchange ratio" that translates fractions of Equity Home Bias to percentage points of idiosyncratic shocks absorbed via income risk sharing. We perform an analogous analysis using Debt Home Bias. In this case $\kappa = \kappa_0 + \kappa_1(t - \bar{t}) + \kappa_2[\text{BHB}_{it} - \overline{\text{BHB}_t}]$, where BHB_{it} measures Debt Home Bias in country i at time t.

We perform a similar analysis using foreign asset holdings relative to GDP. If total asset portfolios are small relative to GDP the ratio of foreign holdings to GDP may be more relevant for macroeconomic income and consumption risk sharing. Also, we can consider the ratio of FDI to GDP—for FDI it is not obvious how to calculate a measure similar to the Equity Home Bias measure.

Further, we can consider liabilities in the same way as assets. If pay-outs from domestic liabilities are (roughly) proportional to output, as often assumed in theoretical models of international risk sharing, liabilities would be effective in smoothing output shocks. Possibly, returns on equity and FDI liabilities may be more correlated with output and, therefore, provide more risk sharing than returns on debt liabilities.

For equity assets we let

$$\kappa = \kappa_0 + \kappa_1(t - \bar{t}) + \kappa_2(E_{it} - \overline{E}_t), \tag{7}$$

where $E_{it} \equiv \log[(\text{foreign equity holdings})_{it}/\text{GDP}_{it}]$ is the ratio of (gross) foreign equity holdings to GDP for country i in year t. We use a similar formulation for debt and FDI asset holdings and we explore similar specifications using liabilities. We also allow risk sharing to increase proportionally with the total amount of foreign portfolio asset holdings (of equity plus debt holdings) relative to GDP. In this case, we let $\kappa = \kappa_0 + \kappa_1(t - \bar{t}) + \kappa_2[\text{EB}_{it} - \overline{\text{EB}_t}]$ where $\text{EB}_{it} \equiv \log[(\text{foreign equity} + \text{debt holdings})_{it}/\text{GDP}_{it}]$ is the log-ratio of foreign debt + equity holdings to GDP for country i in year t. We can include several interaction terms or explore, say, the sum of equity, debt, and FDI—these extensions are simple permutations of the formulas already described.

We also estimate the contribution of Equity Home Bias to consumption risk sharing using regressions of the form:

$$\triangle \log \text{C}_{it} - \triangle \log \text{C}_t = \text{constant} + \eta(\triangle \log \text{GDP}_{it} - \triangle \log \text{GDP}_t) + \epsilon_{it}, \tag{8}$$

where $\eta = \eta_0 + \eta_1(t - \bar{t}) + \eta_2(\text{EHB}_{it} - \overline{\text{EHB}_t})$. In the same manner as the analysis performed for income risk sharing, we allow for interaction terms based on the ratio of foreign equity holdings to GDP, Debt Home Bias, the ratio of foreign debt holdings to GDP, etc.[13]

4.2. Panel-data regressions: results

Table 3 displays results for income and consumption risk sharing as a function of Equity Home Bias for the OECD and EU. For the OECD, we find a near-zero statistically insignificant (at the conventional 5% level) coefficient to the time trend. For income risk sharing, we find

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[13] All estimations are performed as two-stage estimations: in the first stage, we estimate the model by Ordinary Least Squares. We calculate the standard deviation of the residuals for each country and we then weigh each country with the inverse of its standard deviation in the second stage.

Table 3
Risk sharing and Equity and Debt Home Bias: OECD and EU 1993–2003

With country-fixed effects	Average risk sharing	Interaction terms with GDP		
		Trend	Equity Home Bias	Debt Home Bias
OECD				
Income	2 (1.02)	0 (0.02)	−39 (4.19)	
Risk	−1 (0.81)	0 (0.30)		−24 (2.27)
Sharing	2 (1.09)	0 (0.06)	−44 (3.70)	7 (0.57)
OECD				
Consumption	57 (15.06)	2 (2.09)	−136 (5.48)	
Risk	43 (10.46)	1 (0.94)		−6 (0.22)
Sharing	58 (14.81)	2 (1.43)	−168 (5.35)	54 (1.89)
EU				
Income	1 (0.33)	4 (3.46)	−21 (0.75)	
Risk	1 (0.14)	3 (3.23)		−13 (0.41)
Sharing	2 (0.35)	4 (3.28)	−20 (0.61)	−4 (0.12)
EU				
Consumption	27 (4.13)	0 (0.24)	37 (0.83)	
Risk	29 (4.54)	0 (0.05)		11 (0.30)
Sharing	27 (3.96)	0 (0.21)	40 (0.78)	−4 (0.09)

Note: Country-fixed effects included. The rows in income risk sharing of the table present $100 \times (1 - \kappa_0)$, $-\kappa_1$, $-\kappa_2$ and $-\kappa_3$, where the parameters κ_0, κ_1, κ_2 and κ_3 are estimated from panel-data regressions of the form $\Delta \log \mathrm{GNI}_{it} - \Delta \log \mathrm{GNI}_t = \mathrm{constant} + \kappa(\Delta \log \mathrm{GDP}_{it} - \Delta \log \mathrm{GDP}_t) + \epsilon_{it}$ where $\kappa = \kappa_0 + \kappa_1(t - \bar{t})$ + either $\kappa_2 [(\mathrm{EHB}_{it}) - (\overline{\mathrm{EHB}}_t)]$, EHB_{it} is the period t Equity Home Bias index of country i, and $\overline{\mathrm{EHB}}_t$ is the (un-weighted) average across countries of EHB_{it}; or $\kappa_3[(\mathrm{BHB}_{it}) - (\overline{\mathrm{BHB}}_t)]$, BHB_{it} is the period t Debt Home Bias index of country i, and $\overline{\mathrm{BHB}}_t$ is the (un-weighted) average across countries of BHB_{it}; or $\kappa_2[(\mathrm{EHB}_{it}) - (\overline{\mathrm{EHB}}_t)] + \kappa_3[(\mathrm{BHB}_{it}) - (\overline{\mathrm{BHB}}_t)]$.

The rows in consumption risk sharing of the table present the parameters from panel-data regressions of the form similar as above and replacing the dependent variable with $(\Delta \log C_{it} - \Delta \log C_t)$. See the text for further details. Numbers in parentheses are t-values. The countries included in OECD sample are those listed in Table 2 without Iceland and Ireland. EU sample is a subset of OECD sample above and includes 13 EU member states.

a highly significant coefficient to Equity Home Bias. The point estimate is also significant in economic terms: the coefficient for Equity Home Bias is −39 which implies that a country lowering Equity Home Bias by 0.1 will increase income risk sharing by about 4%. Considering Debt Home Bias, we find a coefficient of −24 with a significant t-statistic. Including both Equity and Debt Home Bias as interactions terms, see the third row, we find that Equity Home Bias is significant with a coefficient similar to that found in the first row, while Debt Home Bias is insignificant. We are reluctant to conclude that Debt Home Bias is immaterial for income risk sharing based on our relatively short sample, but the results point to equity assets as having a stronger impact on risk sharing than debt assets. For consumption, the average amount of risk sharing is much higher at about 50% (depending somewhat on the specification) and the impact of Equity Home Bias is estimated at −136 with very high significance. The point estimate is somewhat high—a large decline in home bias is not likely to lead to more than 100% risk sharing (the case where a negative GDP shock leads to a positive change in consumption) and we interpret the coefficient to imply that declining home bias has been associated with strongly increasing consumption risk sharing even if the actual value is likely to not be valid for very large changes in home bias. However, we find no association between declining Debt Home Bias and consumption risk sharing. Including both terms together results in an even stronger effect of Equity Home Bias and a positive coefficient to

Table 4
Correlation matrix of GDP, consumption, GNI growth rates and foreign asset, liability ratios interacted with GDP growth: OECD 1993−2003

	GDP growth	GNI growth	CONS growth	Assets			Liabilities		
				Equity	Debt	FDI	Equity	Debt	FDI
GDP growth	1.00	0.95	0.71	−0.64	−0.56	−0.64	−0.55	−0.32	−0.51
GNI growth		1.00	0.71	−0.69	−0.61	−0.66	−0.58	−0.38	−0.55
CONS growth			1.00	−0.60	−0.50	−0.62	−0.45	−0.24	−0.48
Equity asset				1.00	0.81	0.89	0.77	0.65	0.80
Debt asset					1.00	0.76	0.82	0.76	0.69
FDI asset						1.00	0.79	0.57	0.78
Equity liability							1.00	0.65	0.84
Debt liability								1.00	0.61
FDI liability									1.00

Note. The term "GDP growth" represents the data series ($\Delta \log \text{GDP}_{it} - \Delta \log \text{GDP}_t$), where GDP_{it} is country i's year t per capita GDP, and GDP_t is the year t per capita aggregate GDP for the group. The series "GNI growth" and "CONS growth" are defined similarly.

The term "equity asset" refers to the data series $(E_{it} - \overline{E}_t) \times [(\triangle \log \text{GDP}_{it} - \triangle \log \text{GDP}_t)]$, where E_{it} is the period t natural logarithm of the ratio of foreign equity owned to GDP for country i, and $\overline{E}_t$ is the (un-weighted) average across countries of E_{it}. "Debt asset", "FDI asset", and liabilities are defined similarly.

The countries included in the sample are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Mexico, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the UK, and the United States.

Debt Home Bias. Our interpretation is that there is not enough data to estimate the impact of both simultaneously.

Income risk sharing in the EU is not significantly different from zero but there is a positive significant trend. In the EU, income risk sharing is not significantly related to either stock or debt home bias. Consumption risk sharing among EU countries is lower than among the OECD countries and neither trend nor home bias indices are significant.[14]

Next, we turn to a more comprehensive set of regressions using assets and/or liabilities as our interaction variables. In Table 4, we display the correlations of the regressors in the following tables after country-specific means have been subtracted.[15] We can observe that GNI growth and GDP growth are highly correlated and consumption growth has a high correlation of 0.71 with GDP growth. These correlations indicate that income risk sharing is low and consumption risk sharing far from perfect. The ratios of equity, debt, and FDI to GDP (all interacted with GDP growth) are highly correlated indicating that it will be a challenge to tease out the effect of the individual components, while liabilities are somewhat less correlated with assets. Equity liabilities and FDI liabilities are highly correlated (0.84) while debt liabilities are slightly less correlated with equity (0.65) and FDI liabilities (0.61).

Table 5 examines whether the ratio of foreign asset holdings to GDP predicts income and consumption risk sharing in the OECD. We find a positive effect of higher foreign equity

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[14] Balli and Sørensen (2006) find a steep drop-off in the part of consumption risk sharing that is due to less pro-cyclical government saving among EU countries in the 1990s. They conjecture this pattern is a result of countries striving to satisfy the criteria for joining the European Monetary Union. We expect that the trend in income risk sharing in the longer run will result in a similar trend in consumption risk sharing.

[15] By the Frisch−Waugh theorem, the estimated coefficients in a regression where the country-specific means have been subtracted are identical to the coefficients in a regression with country-fixed effects.

Table 5

Risk sharing and foreign asset holdings relative to GDP: OECD 1993−2003

With country-fixed effects	Average risk sharing	Interaction terms with GDP					
		Trend	Equity	Debt	FDI	Equity + debt	All assets
Income risk sharing	6 (2.74)	0 (0.77)	5 (4.50)				
	5 (2.53)	0 (0.34)		9 (4.46)			
	3 (1.70)	0 (0.47)			3 (2.70)		
	6 (2.85)	0 (0.37)				9 (4.65)	
	6 (2.75)	0 (0.47)					8 (4.35)
Consumption risk sharing	51 (13.34)	1 (0.83)	11 (4.02)				
	45 (11.56)	0 (0.25)		7 (1.64)			
	51 (13.39)	0 (0.09)			9 (3.79)		
	47 (11.95)	0 (0.33)				9 (2.26)	
	48 (12.34)	0 (0.45)					11 (2.74)

Note. Country-fixed effects included. Rows in the top half of the table present $100 \times (1 - \kappa_0)$, $-\kappa_1$ and $-\kappa_2$, where the κ_0, κ_1, and κ_2 are estimated from panel-data regressions of the form $\Delta \log \mathrm{GNI}_{it} - \Delta \log \mathrm{GNI}_t = $ constant $+ \kappa(\Delta \log \mathrm{GDP}_{it} - \Delta \log \mathrm{GDP}_t) + \epsilon_{it}$ where $\kappa = \kappa_0 + \kappa_1(t - \bar{t}) + \kappa_2$ times "equity", "debt", "FDI", "equity + debt", or "all assets". For example, "equity" refers $[(E_{it} - \overline{E}_t)]$, where E_{it} is the period t natural logarithm of the ratio of foreign equity assets to GDP for country i, and $\overline{E}_t$ is the average of E_{it}. The other asset categories take the same format as equity. The term "debt" denotes foreign debt security assets and the term "FDI" denotes foreign direct investment holdings. "All assets" is the sum of equity, debt, and FDI. Numbers in parentheses are t-values. The lower half of the table presents the parameters from panel-data regressions for consumption risk sharing of the form similar to those of the upper panel with the dependent variable $(\Delta \log C_{it} - \Delta \log C_t)$. See the text for further details.

holdings on income risk sharing with a t-statistic similar to what was found using the Equity Home Bias index. For debt the significance is higher than for the Home Bias index and the coefficient is higher than for equity. FDI is less related to income risk sharing although the coefficient is still significant. Using the sum of equity and debt or the sum of all assets results in coefficients and t-values at the same order of magnitude as found for debt. For consumption risk sharing, in the lower panel of Table 5, the largest impact on risk sharing is from equity holdings. Debt holdings have a t-value of 1.64 and all other interaction terms are clearly significant at the 5% level or better.

Table 6 performs similar regressions using liability data. For income risk sharing, we get larger and more significant coefficients for debt and FDI and, in particular, for the sum of equity and debt, and for the sum of all three components, compared to Table 5. All liability components are insignificant for consumption risk sharing except for FDI.[16]

Table 7 reports the results of multiple regressions for income risk sharing. The first row includes interactions for all three asset categories: the point estimates for equity and debt are of similar magnitude; equity is clearly significant and debt is nearly significant at the 5% level while FDI has a negative significant coefficient. Given that the regressors are highly correlated and that FDI has a positive sign in a univariate regression we tend to believe that FDI is not detrimental to risk sharing but only a larger data set can determine this with certainty. For liabilities, see the second row, only debt holdings are nearly significant at the 10% level; however, all variables have a positive sign consistent with Table 6.

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[16] We speculate that FDI liabilities may smooth consumption—without affecting international net factor income flows—if owners of international corporations smooth wages across country-borders. Evidence of such behavior is presented in Budd and Slaughter (2000).

Table 6
Risk sharing and foreign liability holdings relative to GDP: OECD 1993−2003

With country-fixed effects	Average risk sharing	Interaction terms with GDP					
		Trend	Equity	Debt	FDI	Equity + debt	All liabilities
Income risk sharing	4 (2.00)	1 (1.08)	5 (2.43)				
	4 (1.73)	0 (0.69)		14 (3.01)			
	4 (1.99)	0 (0.52)			6 (2.97)		
	5 (2.45)	0 (0.83)				17 (3.67)	
	6 (2.75)	0 (0.86)					16 (3.88)
Consumption risk sharing	44 (11.22)	0 (0.25)	3 (0.71)				
	43 (10.87)	0 (0.14)		6 (0.76)			
	47 (12.10)	0 (0.35)			14 (3.44)		
	43 (10.90)	0 (0.18)				3 (0.48)	
	44 (11.15)	0 (0.25)					10 (1.41)

Note. Country-fixed effects included. Rows in the top half of the table present $100 \times (1 - \kappa_0)$, $-\kappa_1$ and $-\kappa_2$, where the κ_0, κ_1, and κ_2 are estimated from panel-data regressions of the form $\Delta \log \mathrm{GNI}_{it} - \Delta \log \mathrm{GNI}_t = \mathrm{constant} + \kappa(\Delta \log \mathrm{GDP}_{it} - \Delta \log \mathrm{GDP}_t) + \epsilon_{it}$ where $\kappa = \kappa_0 + \kappa_1(t - \bar{t}) + \kappa_2$ times "equity", "debt", "FDI", "equity + debt", or "all liabilities". For example, "equity" refers $[(E_{it} - \bar{E}_t)]$, where E_{it} is the period t natural logarithm of the ratio of foreign equity liabilities to GDP for country i, and $\bar{E}_t$ is the average of E_{it}. The other liability categories take the same format as equity. The term "debt" denotes foreign debt security liabilities and the term "FDI" denotes foreign direct investment liabilities. "All liabilities" is the sum of equity, debt, and FDI. Numbers in parentheses are t-values. The lower half of the table presents the parameters from panel-data regressions for consumption risk sharing of the form similar to those of the upper panel with the dependent variable ($\Delta \log C_{it} - \Delta \log C_t$). See the text for further details.

The third row includes both assets and liabilities: equity assets are significant at the 5% level and debt assets are nearly significant at the 10% level while FDI assets have a negative significant coefficient as in the first row. Equity and debt liabilities have much smaller coefficients when they are estimated together with assets, which probably reflects that assets are more effective in providing risk sharing. Likely, liabilities provide risk sharing but we do not have enough data to verify this. FDI liabilities are nearly significant at the 10% level with a coefficient near that found in the second row. The fourth and fifth rows further examine if assets dominate liabilities by including only equity assets and liabilities and debt assets and liabilities, respectively. Clearly assets "win out" in both cases. The sixth row shows the results from a regression including interaction terms for FDI assets and liabilities and in this regression the liability variable has the stronger influence even though the coefficient is only significant at the 10% level.

The bottom part of Table 7 shows multiple regressions for consumption risk sharing. In the seventh row, the coefficient to equity holdings is positive and significant while the coefficient to debt holdings is negative and significant and FDI has a positive insignificant coefficient.[17] Considering all liability components jointly, we find negative coefficients to equity (almost significant) and debt while the coefficient to FDI liabilities is positive and clearly significant. Likely, the negative coefficient to equity partly reflects a high correlation with FDI. In row nine, where

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[17] Because the difference between income and consumption is savings it appears that countries with high outstanding debt had relatively less pro-cyclical savings during our sample period.

Table 7

Income and consumption risk sharing and foreign asset and liability holdings relative to GDP: OECD 1993—2003

With country-fixed effects	Average risk sharing	Interaction terms with GDP						
		Trend	Assets			Liabilities		
			Equity	Debt	FDI	Equity	Debt	FDI
Income risk sharing	6 (2.64)	1 (1.49)	7 (3.34)	6 (1.86)	−4 (2.71)			
	6 (2.62)	0 (0.76)				3 (1.03)	9 (1.62)	3 (1.01)
	7 (3.12)	1 (1.43)	6 (2.71)	7 (1.69)	−5 (2.75)	0 (0.01)	−1 (0.22)	4 (1.61)
	6 (2.63)	0 (0.81)	5 (3.59)			0 (0.06)		
	5 (2.66)	0 (0.44)		8 (3.26)			5 (0.93)	
	5 (2.25)	0 (0.33)			1 (1.27)			4 (1.70)
Consumption risk sharing	53 (13.79)	1 (0.75)	11 (2.27)	−10 (1.98)	4 (1.05)			
	46 (12.02)	0 (0.05)				−7 (1.59)	−9 (0.90)	21 (3.93)
	55 (14.80)	1 (0.56)	13 (2.60)	7 (0.96)	5 (1.08)	−20 (4.30)	−27 (2.11)	12 (1.84)
	52 (13.87)	1 (0.67)	18 (5.41)			−16 (3.47)		
	47 (12.11)	0 (0.03)		14 (2.17)			−19 (1.50)	
	50 (13.12)	0 (0.15)			7 (2.14)			6 (1.16)

Note. Country-fixed effects included. The specifications of the regressions are similar to those of Tables 5 and 6 except more interaction terms are included simultaneously. The values of coefficients are reported in percent. Numbers in parentheses are *t*-values.

all asset and liability components are included simultaneously, equity and debt liabilities have large negatively significant coefficients. At face value, these estimates imply that a country with large but identical amounts of foreign equity, debt, and FDI assets and liabilities is going to achieve negative consumption risk sharing which seems to contradict our other results. We suspect that the large coefficients to assets together with large negative coefficients to liabilities reflect multi-collinearity in conjunction with noisy consumption data.[18] Considering income and consumption risk sharing together it seems that equity assets and FDI liabilities are conducive for risk sharing, but the empirical evidence for such a breakdown is not strong, in particular for consumption risk sharing. The last three rows of Table 7 show simpler specifications where the pairs of equity, debt, and FDI assets and liabilities are included separately as interactions. Equity assets have a positive significant coefficient while equity liabilities have a negative significant coefficient. Again, we hesitate to believe the negative coefficient at face value. The results for debt assets and liabilities are similar. Including FDI assets and liabilities we find positive coefficients to both with similar orders of magnitude although only FDI assets are significant. Nonetheless, it is likely that FDI can further risk sharing for both the investor and the receiving countries. Overall, Table 7 reveals that it is difficult to identify which components of international capital flows are more beneficial for risk sharing—in particular, for consumption risk sharing.

Table 8 shows that risk sharing increases with equity holdings within the EU. The results are similar for debt or debt plus equity holdings—likely both are important. However, there is no relation between higher FDI and income risk sharing. For consumption risk sharing we do not find significant coefficients although the coefficients are robustly positive and of a similar order of magnitude as those found for the OECD sample. Our interpretation is that the effect of

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[18] Strictly speaking, multi-collinearity means that the inner product matrix of the regressors is badly conditioned and, of course, this matrix is identical between the top and the bottom part of Table 7.

Table 8
Risk sharing and foreign asset holdings relative to GDP: EU 1993–2003

With country-fixed effects	Average risk sharing	Interaction terms with GDP					
		Trend	Equity	Debt	FDI	Equity + debt	All assets
Income risk sharing	9 (2.33)	4 (4.26)	9 (2.80)				
	7 (1.73)	3 (3.31)		13 (2.23)			
	4 (0.91)	3 (3.16)			−1 (0.14)		
	8 (1.86)	3 (3.52)				13 (2.28)	
	7 (1.73)	3 (3.68)					11 (1.85)
Consumption risk sharing	33 (5.76)	−1 (0.73)	8 (1.87)				
	32 (5.40)	−2 (1.54)		9 (1.34)			
	33 (5.72)	−1 (1.08)			5 (0.66)		
	32 (5.43)	−2 (1.45)				9 (1.43)	
	32 (5.39)	−2 (1.34)					10 (1.48)

Note. Country-fixed effects included. The specifications of the regressions are identical to those of Table 5. Countries included are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, and the UK. The values of coefficients are reported in percent. Numbers in parentheses are *t*-values.

foreign asset holdings is the same as for the rest of the OECD but for the EU other things are happening that increase risk sharing and this is captured by the trend.[19] The effect of FDI may be different in the EU but we do not explore this issue further.

4.3. Panel-data regressions: robustness

We verify that the results are not very sensitive to the inclusion of country-fixed effects—details are available in the working paper version of this article. We find slightly smaller coefficients when dropping country-fixed effects which may indicate that risk sharing is lower at longer frequencies, see Becker and Hoffmann (2006).

We also examine (table in the working paper version) if any country is an influential observation (statistical outlier): we estimate the impact of (equity plus debt) and FDI on income and consumption risk sharing, respectively, dropping one country at a time. These results show that the impact of equity plus debt assets on income risk sharing is highly robust with *t*-statistics of 3 and above. The impact of FDI assets on income risk sharing is robust although the *t*-statistic drops to 1.83 when we leave out the United States. For consumption risk sharing, the impact of equity plus debt assets is not totally robust (*t*-statistic of 1.32 when Japan is left out) but the impact of FDI assets on consumption smoothing is very robust with all *t*-statistics above 3.

5. Concluding remarks

We find that a high level of foreign portfolio assets is positively and robustly related to income risk sharing. For consumption risk sharing international asset holdings are positively related to risk sharing and it appears that equity and FDI assets are more important than debt although the data can't clearly separate out the effect of each group of assets. We find no

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[19] Possibly the correlation of foreign asset holdings with the trend adds to the standard errors of the estimates for the EU sample and results in less significance of coefficients for foreign asset holdings.

detectable role for liabilities in regressions where assets are included except that FDI appears to benefit consumption risk sharing. Our interpretation of the results is that various forms of "taste" shocks to consumption (such as fiscal or monetary policy, consumer sentiment, etc.) make it harder to robustly detect patterns of consumption risk sharing compared to those of income risk sharing—but we have little doubt further international asset diversification will lead to increased consumption risk sharing.

Acknowledgements

Appendix. Data

Foreign equity, debt, and foreign direct investment (FDI) asset and liability data are from Lane and Milesi-Ferretti (2006) (LMF).[20] Stock market capitalization for a country is measured as the value of publicly traded equity listed on the stock market exchange(s) and the data are from Standard & Poor's *Global Stock Markets Factbook* 2003, 2004, and 2005. "World market capitalization" is the sum of the stock market capitalizations of the developed and emerging stock markets. The total equity portfolio of country i is market capitalization plus foreign equity held minus the amount of country i's equity held by foreigners calculated as the sum of country i equity owned by other countries.

Capitalization of debt markets is from the Bank for International Settlements (BIS) *Quarterly Review*. The size of a country's market capitalization is outstanding domestic debt securities plus outstanding international debt. Foreign debt holdings and debt held by foreigners are from LMF while domestic and international debt securities outstanding are from the BIS. The total debt portfolio of a country is outstanding domestic debt securities plus foreign debt held by the country. "World market capitalization" is the sum of market capitalizations in the BIS.

GDP, GNI, population, consumption (including personal and government consumption), and consumer prices are from the OECD National Accounts 1970–2004. We compute Purchasing Power Parity (PPP) adjusted GDP, GNI, and consumption by deflating all series with the implicit private consumption deflator normalized to 1 in 1995. We do not use quantity indices for real GDP because we want to measure how the purchasing value of GDP gets insured internationally. We translate to PPP-adjusted US dollar values using 1995 exchange rates from the OECD National Accounts. Growth rates of GDP, GNI, and consumption are the growth rates of per capita PPP-adjusted variables. The PPP-adjusted series are aggregated to the OECD-wide series.

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[20] A previous version of this paper used asset data from the IMF's Coordinated Portfolio Investment Surveys for 1997 and 2001. The results were similar, although somewhat less robust, reflecting that the present data are superior.

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