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Is Increasing Financial Integration Related to Improved International Risk Sharing?

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In order to answer the question whether more integrated financial markets are characterized by less international risk sharing we focus on the long-term evolutions of the intensively discussed anomalies of the equity home bias, used as indicator for financial integration, and the international risk sharing in consumption. Using panel-data regressions for 21 OECD countries from 1980 to 2010, we show that a less than average amount of equity home bias, e.g. higher than average amount of international income flows, is associated with more international risk sharing. Much of the increase in international asset positions came during the recent globalization period. More generally, by measuring financial integration by the index of the equity home bias, our results indicate that more financial integration goes hand-in-hand with more internationally shared risk. Our results are robust across countries and time.

JEL- Code: E21, F36, G11, G15

1. Introduction

Although the concept of full risk hedging is different in macroeconomics and finance, it is one of the central topics in both streams of literature. While financial literature typically builds on the International Capital Asset Pricing Model (CAPM) as reference model, macroeconomists depart from the benchmark model of perfect markets. The CAPM from finance literature predicts under standard assumptions that countries hold an identical international portfolio of risky assets. In a setting of endowment economies under standard assumptions, perfect markets imply that consumption growth rates are equalized across countries, i.e. risk is perfectly shared.

In this paper we first measure the deviations from the International CAPM allocation, the so called home bias, and the deviations from perfect risk sharing allocation in the time period between 1980 and 2010, called unshared consumption risk. Analyzing a relatively long time period allows us to compare the evolution of both phenomena including the globalization period typically allocated in the 1990s. Here we show that long-term consumption risk sharing among the 21 analyzed OECD (Organization for Economic Cooperation and Development) countries has increased.

Second, we identify a notable increase in long-term international capital income flows and show that this is the driving force behind the notable improvements in international risk sharing. Third, we empirically link this increasing importance of international capital income flows for risk sharing to the large increase in cross-holdings of international assets (i.e. decreasing home bias) that has been documented in literature.

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It is important to examine the link between these two phenomena, i.e. international risk sharing, and financial integration on long-term data mainly due to the amount of potential welfare benefits from globalization on financial markets (Lucas, 1987). In case of permanent idiosyncratic macroeconomic shocks, benefits from consumption smoothing are expected to be huge. We will analyze empirically to what extent international risk sharing has actually increased during the considered time period. Furthermore it is important to study the linkage of those phenomena, as earlier studies found it hard to detect significant improvements in consumption risk sharing associated to the growth in international asset positions. For this purpose we explicitly condition on international asset holdings including data of a 30 years period. In line with Artis and Hofmann (2012) we argue that focusing on the long-term evolution allows us identify better the increase in international risk sharing. As long as macroeconomic shocks are not persistent, countries are indifferent whether they insure their consumption through international capital income flows or through consumption by savings and dis-savings. So we expect focusing on a longer term will enable us to detect more sharply the effect on the risk sharing channels.

For the theoretical background please consider these identities:

$$GNI = GDP + r_H S_H + r_F S_F,$$
$$CONS = GNI - GNS$$

where GNI stands for Gross National Income (later denoted as income, or INC), GDP is the Gross National Product (later denoted as output, or Y), S_H is the stock of foreign assets owned by domestic investors, r_H is the rate of return of these assets, and S_F and r_F is the stock of national assets owned by foreign investors and their return, respectively. $CONS$ stands for the total final consumption.[1] GNS caputes the Gross National Savings.

International risk sharing and home bias have been discussed quite separately in literature and need not be closed phenomena (Lewis, 1999): If agents do not smooth their income streams through the cross-ownership of assets they can smooth consumption through inter-temporal asset trading, i.e. through savings and dis-savings. By the logic of Permanent Income Theory (PIT), this behavior may be optimal if macroeconomic shocks are not permanent. Another case where full international equity portfolio diversification will not lead to smooth income flows is when the total equity portfolio is small relative to GDP.

Our paper is directly related to recent studies by Lane and Milesi-Ferretti (2007), Sørensen et al. (2007), and Artis and Hoffmann (2012). Lane and Milesi-Ferretti (2007) show a very strong increase in international asset holdings during the 1990s. Sørensen et al. (2007) investigate whether economies with comparatively high shares of foreign assets tend to realize better international factor income flows. Artis and Hoffmann (2012) follow Sørensen et al. (2007) and employ long-run level data as they expect them to give better insights on the linkage of increasing risk sharing and higher international asset positions. We go in a line with both approaches and use long-run growth rates to shed light on the effect of financial globalization. Matsumoto et al. (2009) analyze long-term volatility on consumption shares for measuring risk sharing. Both studies document an increase in international consumption risk sharing. But building on consumption volatility confronts them to limitations: consumption volatility does not permit them to study the roles of the risk sharing

channels and consequently they cannot detect how increasing international asset holdings affect long-term risk sharing. Studying level data as do Artis and Hoffmann (2012) poses the problem of non-stationarity, including the possibility that the data is co-integrated.

The main contribution of our paper is that, employing the risk sharing channel framework we show that the main driver of the increase in international risk sharing is the rising importance of international capital income flows across all analyzed OECD countries. As far as we know we are the first to study the effect of financial globalization on international risk sharing by explicitly condition on the equity home bias as measure for financial integration in the income channel regression of risk sharing.

This paper empirically provides evidence on the increasing importance of international income streams for international risk sharing and provides the missing link between this increasing role of international capital flows and the decreasing equity home bias. To check for robustness we run separate regressions for geographic subsamples and sub-periods and introduce foreign equity holding to GDP next to the equity home bias as alternative measure for financial integration.

The reminder of this paper is structured as follows: In section 2 we give a first look at the data. Section 3 gives a brief overview of the existing literature on the equity home bias and the international risk sharing. We show that the equity home bias among the analyzed OECD countries decreases, while international risk sharing in consumption among those industrialized economies increases. In section 4 we analyze the channels of risk sharing and identify the income smoothing channel to be of growing importance of international risk sharing. In section 5 we introduce in our risk sharing channel regression a measure of international diversification and show that this is the main driver behind the increasing role of international income flows for risk sharing. Section 7 summarizes and concludes.

2. Theoretical Background and Placement in Literature

2.1 International Portfolio Holdings and the Equity Home Bias

Theory – One of the first empirical surveys on behalf of the overweighting share of national positions in investment portfolios was the analysis of French and Poterba (1991), who investigated on the portfolio allocation of American equity traders. They show that although U.S. equity market comprises less than 48% of the global equity market, nearly 94% of the traders' analysed funds were invested in domestic securities. In Japan 98.1% and in the U.K. 82.0% of the stock holding is domestic. This strong preference for domestic assets was also documented in other countries.

De Bondt (1998) focuses on different types of investors. They make evidence that the equity home bias is not a phenomena limited to individual or retail investors, which in general are characterized as less experienced than professional investors. Also 62% of the interviewed German fund managers prefer investments in geographically near markets. This result of the empirical study of Lütje and Menkhoff (2004) provides evidence of the anomaly on professional level and so indicate high deviations from theory in portfolio allocation. Buch et al. (2005) and García-Herrero and Vazequez (2007), using the mean-variance portfolio model as normative benchmark

studies, document that recent allocation of international bank portfolios show a substantial overweighting of the home market in portfolio allocation.

Explanations – The stream of explanations for the home bias can be divided into two groups: the direct (institutional) factors and indirect (behavioral) factors. Direct factors have their source in the violation of the main assumptions of perfect markets and have a direct effect on portfolio allocation. On the other side behavioral factors stem from the violation of the key assumption that characterizes investors as rational. These factors influence asset allocation indirectly.

Transaction costs associated with cross-border acquisitions or holdings of stocks such as fees, commissions and information acquisition costs, communication costs or taxes on dividends is one of the most discussed direct explanations for the anomaly. Black (1974) and Stulz (1981) both study the effect of direct barriers such as transaction costs on portfolio choice, which make it costly to hold non domestic securities. Cooper and Kaplanis (1994) test whether equity home bias is caused by investors trying to hedge inflation risk. Their empirical analysis only confirms this coherence if investors are characterized by a very high level of risk tolerance and if equity returns are negatively correlated with domestic inflation. They develop a model of equity market equilibrium and international portfolio choice that integrates the purchasing power parity (PPP) deviations and deadweight costs. They estimate the levels of cost required to generate the observed home bias in investors' portfolios. Only in case of low levels of investors risk aversion, these costs are consistent with empirically observable costs such as withholding taxes.

Direct barriers, such as regulative barriers, taxes, and transaction costs, have significantly decreased over time, and in some cases have been completely eliminated. As there is still a large bias towards domestic assets in portfolio investment, researchers focus on indirect barriers. In addition to explicit costs, investors face implicit costs, which arise from informational disadvantages to local investors.

Gehrig (1993) develops a model, where even in equilibrium, investors have incomplete information. The result of his analysis is that a bias toward domestic assets arises automatically when investors have on average better information about domestic stocks. Hence, informational segregation seems to be an important contributing factor for explaining the equity home bias. Coval and Moskowitz (1999) and Huberman (2001) suggest that asymmetric information may also justify intra-national investment patterns within the US. Differences in corporate governance across countries can give a contribution for solving to the home bias puzzle through the impact of the share ownership (Dahlquist et al., 2003).

Any meaningful way to explain the Home Bias phenomenon requires in a first step a correct description and characterization of the benchmark weights to which actual portfolio allocation is compared. Financial literature discusses different approaches to calculate theoretical benchmark portfolio weights, but as empirical results do not differ significantly we focus on the traditional benchmark model – the International CAPM. For a detailed discussion of the Bayesian Mean-Variance approach, see Pástor (2000) and for the Bayesian Multi-Prior Framework see Garlappi et al. (2004). Baele et al. (2006) empirically compare the respective degrees of Home Bias employing these three models. Also their results show partly different optimal domestic shares, they conclude that independently from the model only the level of Home Bias varies marginally but not the long-run decreasing evolution of this phenomenon. So

they are not able to document any additional benefit of these approaches compared to the traditional model.

Measuring Equity Home Bias – International diversification needs not to be limited to corporate finance, as investments can be diversified through different asset classes, e.g. foreign direct investment, bank deposits, real estate, etc. As shown by Sorensen et al. (2007), home bias in bond markets is highly correlated with equity markets and a separate analysis in their study with regard to this asset class does not shed more light in the respective puzzle. Following their results we only focus on equity holdings and analyse the evolution of their allocation over time and leave other asset classes for future research. That is why in the following we talk about the equity home bias (EHB).

We measure this deviation from perfect portfolio allocation by this equation:

$$EHB_i = 1 - \left(\frac{Share\ of\ country\ i\ holdings\ of\ foreign\ equity\ in\ country\ i's\ total\ equity\ portfolio}{Share\ of\ foreign\ equity\ in\ the\ world\ portfolio} \right) \quad (1)$$

The EHB is one minus the ratio of the actual and the optimal share of foreign equity holdings to the total equity holdings. It becomes zero if the portion of domestic investment equals the portion predicted by theory – in other words, according to the International CAPM the weight of domestic investments should be equal to the share of that country's equity market in the total world equity market. In this case, where investors act according to theory, the diversification measure becomes zero. The other way around EHB will get to unity if all investments are allocated in the domestic market.

As the standard measure of EHB will have measurement errors we will also employ a simpler measure for further regressions: the ratio of foreign equity and domestic GDP. Although this value will not suffer from measurement error it has no theoretical benchmark.

Table 1 illustrates the EHB (row 2) in the analysed industrialized countries for the years 1990, 2000, and 2010. Except for Canada, Israel, and Norway, we see in each country a clear decrease of the EHB. Over all analysed countries we document an average decrease from 1990 to 2010 of 37%.[2] The value of Austria and Finland even gets reduced to 0.054 and 0.086 in 2010. On average the values decreased from 0.841 in 1990 to 0.7388 in 2000 to 0.5916 in 2010. This development is confirmed by the other variables as from the percentage of foreign equity in the portfolio. In nearly all cases this value increased sharply (again excluding Canada, Israel, and Norway).

Our alternative diversification measure in row 3 the foreign equity holding relative to GDP shows increasing values across all countries

Table 1: Equity Home Bias and Foreign Equity Holdings/GPD in 1990, 2000, and 2010

Country	(1) Equity Home Bias			(2) Foreign Equity Holdings / GDP		
	1990	2000	2010	1990	2000	2010
AUT	0.739	0.195	0.054	0.132	1.344	2.448
BEL	0.636	0.572	0.464	1.349	4.102	7.374
CAN	0.871	0.738	0.883	1.128	7.392	7.340
CHI	0.973	0.859	0.770	0.054	0.869	6.954
DEN	0.886	0.590	0.511	0.184	1.784	4.094
FIN	0.990	0.813	0.086	0.009	0.741	4.107
FRA	0.861	0.810	0.612	1.654	7.426	23.013
GER	0.854	0.613	0.519	1.737	18.914	22.138
GRE	0.977	0.976	0.697	0.020	0.122	0.995
ISR	0.586	0.809	0.808	0.088	0.326	1.336
ITA	0.977	0.976	0.697	0.951	10.302	16.742
JAP	0.968	0.899	0.807	2.410	9.165	22.192
KOR	0.996	0.966	0.898	0.035	0.244	3.175
NLD	0.654	0.524	0.247	1.266	7.527	16.543
NOR	0.586	0.809	0.808	0.082	0.998	8.624
PRT	0.915	0.845	0.350	0.045	0.360	1.656
SPA	0.963	0.800	0.877	0.175	3.583	4.735
SWE	0.897	0.669	0.560	0.421	3.379	8.637
SWI	0.655	0.596	0.548	1.245	7.699	11.737
UK	0.769	0.685	0.559	8.709	22.048	35.833
US	0.903	0.772	0.668	6.195	46.814	106.050

Note: Column (2) = (1-column (1))/(1-A), where 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. Data Source: Foreign Equity Holdings and Domestic Equity held by Foreigners are from the IMF; Stock market capitalizations are from the World Bank.

2.2 International Risk Sharing

Theory – The basic theory of international risk sharing was written by Obstfeld and Rogoff (1996). We just outline the basic ideas for endowment economies with one homogeneous tradable good:

In period t per capita output of country i is an exogenous random variable with a commonly known probability distribution.[3] In each country there is a representative consumer which is risk averse and maximizes his expected utility. Consumers within each country have identical Constant Relative Risk Aversion (CRRA) utility functions and access to a complete set of Arrow-Debreu markets for contingent claims. Optimal consumption then satisfies the full risk sharing relation $C_t^i = k^i C_t^W$, where k^i is a country specific constant, C_t^W is world per capita consumption, and C_t^i is country i per capita consumption in period t. A testable implication is that consumption growth rates are identical for all countries, i.e.

$$\Delta \log C_t^i = \alpha + \beta \Delta log C_t^W + \epsilon_t^i, \tag{2}$$

where α is a constant and ϵ_t^i is an error term due to taste shocks or noise. After controlling for world consumption growth ($\Delta log C_t^W$), the consumption growth rate of a country ($\Delta log C_t^i$) should not be a function of countries output growth. Obstfeld (1994) and Canova and Ravn (1996) conducted regression based tests for full risk sharing at country level.[4]

If consumption growth rates are identical in all countries, there is perfect consumption risk sharing (or full consumption smoothing). Market equilibrium is then defined as a state where each country consumes a constant country-specific fraction of the world output.[5] This is a market equilibrium, in which countries with a more stable country-specific output than world output will get compensated for accepting higher variance in consumption and therefore take on more risk by being allocated a larger average share of world output. Vice versa, countries with a less stable output than world output take on less risk and as consequence have a minor average share of world output (Sørensen et al., 2007). Asdrubali et al. (1996) identified channels through which countries can share their risk. We will analyze the impact of these channels later.

Measuring International Risk Sharing – We will measure international risk sharing both based on growth rates and will run our regressions based on log-linear specifications. Using log-linear specifications offers two advantages: First, most of the risk sharing regressions in literature is based on log-linear specifications and keeping with this tradition will allow us to compare parallels and differences in results. Second, specifications employing logarithmic growth rates rather than macroeconomic variables generally have normal residuals and therefore appear more robust.[6]

Using growth rates rather than absolute values for calculating the aggregated values is due to the fact that aggregated fluctuations cannot be eliminated by risk sharing. We measure the amount of deviation from perfect consumption smoothing through this regression:

$$\Delta \log \frac{C_t^i}{C_t^*} = \alpha_{\boldsymbol{t}} + \beta_U \left(\Delta \log \frac{Y_t^i}{Y_t^*} \right) + \epsilon_t^i \qquad (10)$$

where C_t^i is the (log) final consumption per capita of country i in year t, C_t^* is the respective (log) value for the group, $\alpha_{\boldsymbol{t}}$ is the constant and ϵ_t^i stands for the residual. Equation 10 relates relative consumption to relative output and implies that in a model with complete international financial markets and under perfect risk sharing the left-hand side will be zero. Hence, the co-movement coefficient β_U which can be interpreted as the portion of non-diversified idiosyncratic risk faced will also become zero – the lower the coefficient the higher the international consumption risk sharing, as more consumption is buffered against output fluctuations. The smaller β_U becomes, the lower is the average co-movement of the idiosyncratic consumption growth with the idiosyncratic output growth in this country. This equation is similar to Mace (1991), Asdrubali et al. (1996), Cochrane (1991) and Crucini (1999) on differenced data and reminiscent to Artis and Hoffmann (2012) on level data.

Long-run international risk sharing – We now estimate pooled risk sharing regressions on differenced data. Table 2 presents our first results and suggests that there is a lack of long-run risk sharing in international data. As pooled estimate is potentially more susceptible to unobserved heterogeneity across countries, we always run fixed-effect panel regressions.

Table 2: Consumption Risk Sharing: Pooled Regression

	Panel I: OECD countries				
	1980-2010	1980-1995	1995-2010	1990-2000	2000-2010
β_U	0.972	0.971	0.670	0.782	0.630
t-Stat	(12.39)***	(10.28)***	(20.39)***	(22.96)***	(13.53)***
	Panel II: SOE countries				
	1980-2010	1980-1995	1995-2010	1990-2000	2000-2010
β_U	0.830	0.810	0.677	0.801	0.773
t-Stat	(20.41)***	(12.69)***	(11.67)***	(11.78)***	(11.11)***
	Panel III: OECD w/o SOE countries				
	1980-2010	1980-1995	1995-2010	1990-2000	2000-2010
β_U	0.975	0.971	0.728	0.830	0.681
t-Stat	(18.57)***	(9.91)***	(19.13)***	(21.58)***	(12.48)***

*Note: Fixed-effects are included. The parameters are estimated from pooled OLS regression of equation 10 described above: First row captures the results for the whole period. Row two and three are 15-year pools and rows four and five are the 10-year pools. Panel I includes all analyzed 21 OECD countries, Panel II comprises small but financially open economies (SOE) which are Austria, Belgium, Denmark, the Netherlands, Sweden, and Switzerland in our case, and in Panel III we see all analyzed OECD but the small but financially open countries (SOE). Numbers in parentheses are t-values, where *, **, and *** stand for 10%, 5%, and 1% significance.*

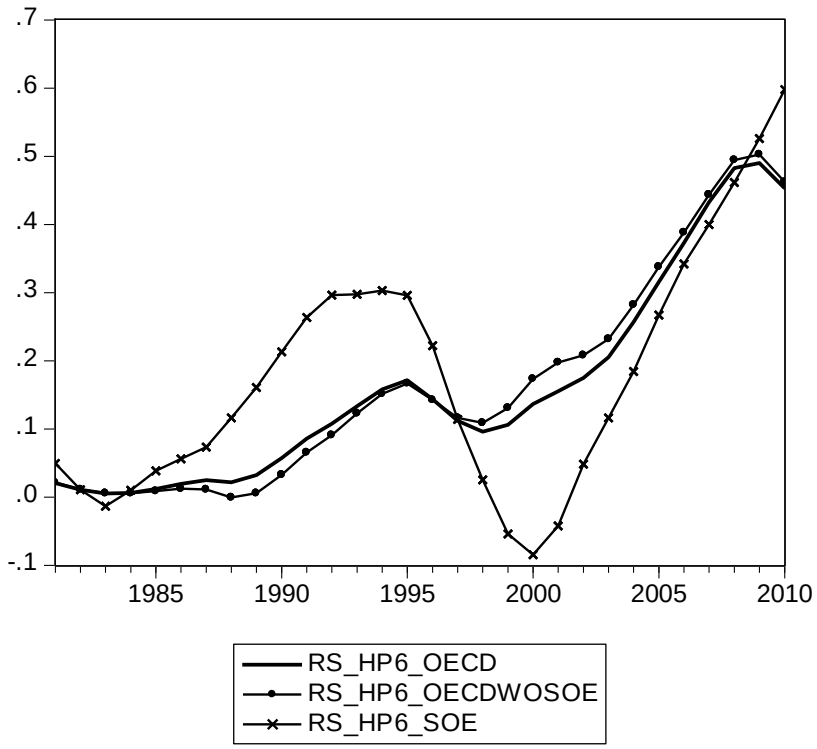
In Panel I we show results from pooled regression for our whole OECD sample. First, we run the regression for the whole period considered (1980-2010) and then construct sub-samples including both fifteen and ten year periods. Furthermore we build geographic sub-samples to emphasize the cross-sectional dimension of the data. In Panel II we see the results for small but financially very open economies (SOE) namely Austria, Belgium, Denmark, the Netherlands, Sweden, and Switzerland in our case.

For our analyzed 21 OECD countries (Panel I) unshared risk β_U exceeds 0.971 [t-Stat 10.28] in the 1980-95 period. For the later 15-years period estimates of the coefficient are 0.670 [t-Stat 20.39]. The same increase in risk sharing we observe in the estimates from 0.782 [t-Stat 22.96] in the 1990-2000 period to 0.630 [t-Stat 13.53] in the 2000-2010 period. As we document, this decrease of β_U is robust across our geographic sub-samples. Panel II captures for SOE countries a similar decrease. The estimates of the coefficients decline from 0.810 [t-Stat 12.69] to 0.677 [t-Stat 11.67] in the 15-years pools. Excluding those SOE changes the results only marginally (Panel III).

The cross-sectional analysis in Figure 1 underlines the evolution of the increasing risk sharing, so what we see is $(1 - \beta_U)$ for all three geographic sub-samples. As the year-by-year estimates for β_U highly fluctuate, we display the coefficients after we filtered to smooth the estimates (Hodrick-Prescott filter with smoothness parameter $\lambda = 6$). For OECD countries we have a minimum at 1983 with 0.005 and a maximum

in 2009 with 0.490. On average over the whole period we calculate for OECD countries a risk sharing of 0.160.

Figure 1: International Consumption Risk Sharing from 1980 to 2010



Note: Cross-sectional estimates for $\beta_{u,t}$. The black solid line are the cross-sectional estimates for the risk sharing regression based on growth rates for the whole analyzed sample of 21 OECD countries. The black (dots) displays estimation results for OECD countries without the small but financially very open economies (SOE).The dashed line is the sequence of cross-sectional estimates for small but financially very open economies (SOE), which are Austria, Belgium, Denmark, the Netherlands, Sweden, and Switzerland. All sequences are filtered using a HP filter with a smoothness parameter $\lambda = 6$.

We see that fluctuations for SOE are much higher than for the other analyzed countries. The average value for the small but financially very open economies is slightly higher. Here we get an average risk sharing of 0.177, while the minimum was reached in 1991 with -0.001.

By analyzing OECD countries without the small economies (SOE), we see that both maximum and minimum is more pronounced for SOE countries, which indicates more volatile macroeconomic variables.

2.3 Testable Hypotheses

We examine the patterns of international capital income flows and international risk sharing on the long run. The sections before showed a strong decrease in the amount of the equity home bias while there is an increase in the international consumption risk sharing. We will try to put those two phenomena together: Therefore we employ the theory of the so called risk sharing channels first introduced by Asdrubali et al. (1996). We hypothesize that the improvements in international consumption risk sharing are associated with increases in international capital income

flows. To the contrary, the weight of the ex-post channel of countries' risk sharing will decrease over time.

However, the second hypothesis we test is whether the increasing importance of capital income flows for risk sharing is linked to the increase in international cross-holdings of financial assets. To our knowledge we are the first to introduce the index of the equity home bias, as a measure for financial integration into the regression for the risk sharing channels. Doing so, we are able to separate the effect of better diversification of both the ex-ante and the ex-post channel.

3. Data

For testing these two main hypotheses we analyze the development of the portion of foreign portfolio investments, GNI, Final Consumption and GDP for a group of 21 OECD countries from 1980 to 2010 on annual frequency. We focus on these countries due to data availability and do not consider non-industrialized countries. Several empirical papers document that the extent of idiosyncratic risk shared is higher for industrialized countries than for emerging markets (among others see Kose et al., 2006). As our focus is not on the differences in the amount of risk sharing among different groups of countries but on the documentation of the evolution of risk sharing and Equity home bias over time we only consider a group of industrialized countries. The selected countries are: Austria, Belgium, Canada, Chile, Denmark, Finland, France, Germany, Greece, Israel, Italy, Japan, Korea, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK, and the US.

In our analysis we employ asset holdings from the International Monetary Fund (IMF), precisely from the Coordinated Portfolio Investment Surveys (CPIS). These surveys were conducted for investor countries using consistent guidelines for quantifying equity and bond holdings across countries. High quality data on international asset positions are hard to come by. As IMF surveys seem to contain the best available, we use this high quality data source which is also standard in this branch of research. As CPIS data are only available in 1997 and from 2001 on, we further use the Lane and Milesi-Ferretti (2007) database to obtain a complete time series, which allows us to capture three economic crises and the development of the Equity Home Bias on the long-run. The sum of stock market capitalization and foreign equity held by a country minus the amount of this country's equity held by foreigners is the size of the total equity portfolio of that country. Also all other data we need for the calculation of the Equity home bias would be available for the analyzed countries up to 1980, we have to reduce the series due to missing data on countries' market capitalization that are from Datastream and only available up to 1988. The stock market capitalization of a country is defined as the value of publicly traded equity listed on the stock market.

For estimating international risk sharing we need these macroeconomic variables: GDP, GNI, Final Consumption, Consumer Prices (CPI), and Population which are all provided by the World Bank (World Development Indicators).

4. Patterns of Risk Sharing and International Asset Positions

4.1 Channels of Risk Sharing

In this section we analyze the channels through which the increase in international risk sharing has occurred. We show that international capital income flows are the main driver of improved risk sharing and demonstrate that increasing risk sharing can mainly be traced back to the growth in international investment positions.

The first channel leads to risk sharing as it de-couples consumption from income, through saving and dis-saving. We refer to this channel as the ex-post channel. The second channel is consumption risk sharing through income smoothing (by de-coupling income (GNI) from output (GDP)), which we refer to as the ex-ante channel. Following theory it should not be possible to insure against permanent idiosyncratic shock through the consumption channel, but only through the ex-ante income channel.

We expect changes in the long-run risk sharing parameter β_U to be associated mainly to the ex-ante channel. To test this prediction, we follow Asdrubali et al. (1996) and Artis and Hoffmann (2012) and decompose our estimate of the risk sharing parameter above and measure the importance of the income channel (ex-ante channel), by running the following regression:

$$\left(\Delta \log \frac{Y_t^i}{Y_t^*}\right) - \left(\Delta \log \frac{INC_t^i}{INC_t^*}\right) = \alpha_t + \beta_I \left(\Delta \log \frac{Y_t^i}{Y_t^*}\right) + \epsilon_t^i, \tag{11}$$

where INC denotes the logarithm of income growth, Y the respective value for the output and α_t is a country or state-level fixed effect. Remember, outputs minus income are the net foreign investments.[7] The more than average increase of the net foreign investments is best explained by the more of output growth.

The risk shared through the consumption channel (ex-post channel) is measured by the regression:

$$\left(\Delta \log \frac{INC_t^i}{INC_t^*}\right) - \left(\Delta \log \frac{C_t^i}{C_t^*}\right) = \alpha_t + \beta_C \left(\Delta \log \frac{Y_t^i}{Y_t^*}\right) + \epsilon_t^i \tag{12}$$

where C denotes the logarithm of consumption growth, Y the respective value for the output and α_t is a country or state-level fixed effect. Keep in mind, that the left-hand side is the value for gross national savings. We see, that the idiosyncratic growth of these savings is best explained by systematic output growth.

By construction, the sum of the two channels must always be equal to one minus the coefficient from our risk sharing regression calculated above (unshared risk):

$$\beta_I + \beta_C = (1 - \beta_U). \tag{13}$$

Table 3: Channels of Risk Sharing

	Panel I: OECD countries				
	all	1980-1995	1995-2010	1990-2000	2000-2010
β_I	0.201	0.005	0.291	0.042	0.368
t-Stat	(3.53)***	(2.19)**	(3.19)***	(2.13)**	(3.69)***
β_C	0.026	0.024	0.027	0.018	0.031
t-Stat	(3.33)***	(2.54)***	(7.44)***	(4.89)***	(7.77)***
	Panel II: SOE countries				
	all	1980-1995	1995-2010	1990-2000	2000-2010
β_I	0.0104	0.067	0.246	0.089	0.294
t-Stat	(3.87)***	(2.19)***	(3.70)***	(2.77)**	(3.50)***
β_C	0.170	0.109	0.091	0.109	0.113
t-Stat	(4.18)***	(2.97)***	(3.18)***	(2.78)***	(3.18)***
	Panel III: OECD w/o SOE countries				
	all	1980-1995	1995-2010	1990-2000	2000-2010
β_I	0.101	0.005	0.154	0.045	0.171
t-Stat	(4,02)***	(1.89)*	(2.14)***	(2.15)**	(3.66)***
β_C	0.027	0.025	0.125	0.107	0.138
t-Stat	(3.27)***	(2.53)***	(7.15)***	(4.64)***	(7.56)***

*Note: Fixed effects are included. The parameters are estimated from pooled OLS regression of equation 11 and 12 described above: equation 11 (ex ante) and equation 12 (ex post). See β_I to be the income channel and β_C to be the consumption channel. Panel I reports results for analyzed OECD countries, Panel II includes small open economies (SOE), whereas Panel III documents channels of risk sharing for analyzed OECD countries without SOE. Numbers in parentheses are t-values, where *, **, and *** stand for 10%, 5%, and 1% significance.*

However, if taste shocks are sufficiently persistent or even permanent, ex-post consumption smoothing though borrowing and lending will not be appropriate for sharing risk. So we expect an increasing importance of the ex-ante income channel for risk sharing over time confirmed by the data. We estimate the regressions by pooled OLS, controlling for both country and time fixed effects. Table 3 reports our results:

Panel I shows that over the whole period, β_I reaches a value of 0.201 [t-Stat 3.53] compared to β_C of 0.026 [t-Stat 3.33]. As shown above we also provide a number of checks to illustrate that the increase in the ex-ante channel is indeed a robust feature of the data. Looking at the sub-samples we see that the importance of the income smoothing channel increases and reaches a value of 0.368 [t-Stat 3.69] in the 10-year period. Analyzing also geographic sub-samples offers us the possibility to investigate where evolutions are more pronounced. We see that in the OECD countries the ex-post channel only grows marginally, whereas the income smoothing ex-ante channel increases from 0.005 [t-Stat 2.19] to 0.291 [t-Stat 2.19] in the 15-years groups.

Our results line up with theoretical predictions that risk sharing in the long-run should be associated with the ex-ante channel and not with consumption smoothing. Data of OECD countries as well as that of SOE clearly evidence this impact: in the 1980-

1995 period risk sharing is quite low, as both ex-ante and ex-post channels are very small. This changes, once we turn to the post-1995 period. We see a relatively high amount of risk sharing in international data, which is mainly driven by increasing capital income flows. The ex-post consumption smoothing channel also increases moderately, but reaches small values compared to the ex-ante channel.

4.2 The increase in International Risk Sharing and the growth in International Asset Positions

Now we analyze whether the driving force behind the growing importance of the ex-ante channel is the increasing internationalization of the asset ownership. We measure international portfolio diversification by the above introduced index of the equity home bias. As the theoretical benchmark weights for portfolio allocation may be non-optimal, we use foreign equity holdings to GDP as alternative measure to capture financial integration without including theoretical benchmarks. We employ this ratio rather than total equity holdings to GDP as if total equity holding may be small relative to GDP the ratio of foreign holdings to GDP may be more relevant for macroeconomics consumption risk sharing (Sørensen et al., 2007).

In our measure of the risk sharing channels we include the equity home bias. Doing so, both ex-ante and ex-post risk sharing becomes a function of the diversification measure. Therefore we estimate a pooled OLS including fixed effects:

$$\left(\Delta \log \frac{Y_t^i}{Y_t^*}\right) - \left(\Delta \log \frac{INC_t^i}{INC_t^*}\right) = \alpha_t + \kappa_I \left(\Delta \log \frac{Y_t^i}{Y_t^*}\right) + \epsilon_t^i \tag{14}$$

while coefficient κ_I stands for the average co-movement of the countries' idiosyncratic growth of net foreign investments with the idiosyncratic GDP growth during the time-period considered and is defined as follows

$$\kappa_I = \kappa_0 + \kappa_1(t - \bar{t}) + \kappa_2(EHB_{it} - \overline{EHB_t}) \tag{15}$$

where $\bar{t}$ indicates the middle year of the sample period, EHB_{it} the amount of the EHB in country i at time t, and $\overline{EHB_t}$ is the (un-weighted) average across countries at time t.

Substituting $\Delta \log \frac{GDP_t^i}{GDP_t^*} = \chi_t$ we can rewrite equation 14 in this way:

$$\left(\Delta \log \frac{Y_t^i}{Y_t^*}\right) - \left(\Delta \log \frac{INC_t^i}{INC_t^*}\right) = \alpha_t + \kappa_0 * \chi_t + \kappa_1 * (t - \bar{t}) * \chi_t + \kappa_2 * (EHB_{it} - \overline{EHB_t}) * \chi_t + \epsilon_t^i \tag{16}$$

where κ_0 captures the idiosyncratic output growth and $\kappa_1$measures the average year-by-year amount of increasing income risk sharing. The parameter κ_2 quantifies how much higher than average the EHB lowers the amount of income smoothing and consequently the obtained international risk sharing. Including the time trend allows us to guard against the decreasing trend of the equity home bias measure spuriously capturing trend changes in risk sharing maybe caused by other developments in international markets. Subtracting the respective aggregate value is crucial as the aggregate growth cannot be insured.

As we expect the EHB to have a negative effect on the international risk sharing and the ex-ante smoothing, κ_2 should have negative loadings.

Table 4: Channels of Risk Sharing as a function of the Equity Home Bias

$\boldsymbol{Ex-ante\ channel}\ \kappa_I$

	κ_0	t-Stat	κ_1	t-Stat	κ_2	t-Stat
Panel I: OECD countries						
1988-2010	0.056	(2.81)***	0.003	(1.01)*	-0.184	(-3.48)***
Subsample: pool 10 years						
1990-2000	0.023	(3.73)***	-0.007	(-1.60)*	-0.282	(-2.75)***
2000-2010	0.045	(5.32)***	0.007	(0.63)	-0.342	(-4.63)***
Panel II: SOE countries						
1988-2010	0.007	(2.06)**	0.007	(0.07)	-0.657	(-3.11)***
Subsample: pool 10 years						
1990-2000	-0.207	(-1.65)*	-0.012	(-0.68)	-0.575	(-2.87)***
2000-2010	-0.155	(-2.04)**	0.037	(0.54)	-0.987	(-7.62)***
Panel III: OECD w/o SOE countries						
1988-2010	0.065	(2.91)**	0.003	(0.98)	-0.240	(-2.69)***
Subsample: pool 10 years						
1990-2000	0.039	(1.11)	-0.008	(-1.53)*	-0.407	(-2.71)***
2000-2010	0.082	(0.90)	0.004	(0.34)	-0.439	(-1.96)**

*Note: Fixed effects are included. The parameters are estimated from pooled OLS regression of equation 14 described above: κ_0 captures the importance of idiosyncratic output growth, $\kappa_1$stands for the time-trend of the risk sharing, κ_2 stands for the impact of the more than average amount of Equity Home Bias. Numbers in parentheses are t-values, where *, **, and *** stand for 10%, 5%, and 1%*

Table 4 displays results from income smoothing (ex-ante channel) as a function of EHB for the OECD countries, as well as for the small but financially open economies. For the time trend we find a slightly significant coefficient of 0.003 [t-Stat 1.01]. For the EHB coefficients κ_2 in the time period from 1980-2010 our results indicate high significance robust across countries and time. For the whole sample and period we estimate κ_2 of -0.184 [t-Stat -3.48], which implies that in the analyzed countries lowering EHB by 0.1 will increase risk sharing through the income channel by about 0.184. Panel II documents the same significant relation for SOE with even higher coefficients. The coefficient κ_2 is -0.657 [t-Stat -3.11].

The picture we conduct from table 4 clearly indicates that the growth in international cross-holding in equity leads to an increasing importance of the income channel and thus to better risk sharing. Hence, we see that our results cannot reject the hypothesis that the main driver behind the income smoothing is the growing amount of foreign equity in countries portfolio allocation.

As results can be biased using the EHB measure that includes a theoretical benchmark, we perform a similar regression employing the ratio of foreign equity holdings to GDP as an alternative measure of financial integration. The outcomes from this regression confirm our previous results.

5. Concluding Remarks

Financial integration should make it easier for countries to trade in assets. But this access to international markets may also lead to shifts in the patterns of the underlying risks. For example, changing structures in industries and altering patterns of specialization, may lead to less symmetric business cycles. As a consequence of that pattern financial integration may induce a requirement for countries to share more risk (Kalemi-Ozcan et al., 2003).

We argue that one way to shed light on this issue is to focus on the long-run evolution of the data. Lucas (1987) discussed in his seminal work that welfare effects provided by the elimination of consumption risk may be small if idiosyncratic shocks are permanent. At the same time, long-run shifts (trends) in output or consumption are less likely to be affected by changes in the correlation of countries' business cycles. This implies in a next step that improvements in international consumption risk sharing may show up first and empirically most robustly in a long-run perspective. Doing so allows us to document an increase in international risk sharing among industrialized countries.

More than 37% of the consumption risk sharing among OECD countries gets shared across countries by the end of our sample period. We show that the main channel through which this improvement seems to be realized is due to a growing importance of international capital income flows (ex-ante channel) rather than ex-post through borrowing and lending.

We assume higher cross-holdings of assets (decreasing EHB) to lead to more consumption risk sharing. We can argue that both phenomena are endogenous reactions to common driving forces such as the liberalization of financial markets or technological innovations. As we cannot solve this endogenous problem our results cannot reject the hypothesis that the growth in international equity holdings is the driving force behind the documented improvements in long-run consumption risk insurance.

We first show that a less than average amount of EHB (higher than average amount of foreign equity holdings to GDP) induces higher long-run risk sharing. Second, we find that for countries with a higher than average amount of EHB the ex-ante income smoothing channel is of high importance for consumption risk sharing. We interpret the observed noticeable increase in income smoothing since late 1990s in a way that the amount of international equity positions need to become large (relative to GDP) before they have an impact on international risk sharing.

Endnotes

(1) Including private and government consumption. For a more detailed examination see the national accounts manual.

(2) This value results by excluding Canada, Israel and Norway. When they are included the equity home bias compared to 1990 decreases by 28%.

(3) According to Balli et al. (2011) non-separabilities in the utility function between consumption and leisure or non-tradable output are not considered. For these issues see Canova and Ravn (1996).

(4) First tests of full risk sharing were run by Cochrance (1991), Mace (1991), and Townsend (1994) using individual-level data. Backus et al. (1992), Baxter and Crucini (1995), and Stockman and Tesar (1995) in International Real Business Cycle literature examined notably the prediction that the correlation of consumption across countries should be equal to unity.

(5) In this setting world output is also world consumption. For further details see Obstfeld and Rogoff (1996) who show that under the described assumptions (complete Arrow-Debreau markets and identical Constant Relative Risk Aversion utility functions), across all consumers the rate of consumption growth and therefore also across countries should be identical.

(6) For detailed description of further transformations see the working paper version of Artis and Hoffmann (2006).

(7) Leaving small positions of the national accounts out of consideration.

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