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ABSTRACT

Declining Home Bias and the Increase in International Risk Sharing: Lessons from European Integration*

This paper provides further evidence on the recent increase in international consumption risk sharing. We show that this increase is more pronounced among EU and EMU countries than among non-E(M)U industrialised countries. We also show that the patterns of international but not intra-European risk sharing have started to diverge from what is found at the level of the OECD as a whole. During the 1990s, capital income flows have started to play a relatively more important role between European countries, whereas the increase in international risk sharing among the OECD as a whole is almost exclusively driven by better consumption smoothing through the accumulation or decumulation of foreign assets. This EMU effect on the pattern of risk sharing survives once we control for differences in international portfolio holdings: while we find that countries with higher equity cross-holdings also tend to share more risk through capital income flows there remains an independent EMU-effect on the way in which risk is shared. While it is too early to evaluate these findings conclusively, we discuss some possible interpretations and their implications for economic policy.

JEL Classification: C23, E21 and F36
Keywords: capital flows, consumption risk sharing, EMU, financial integration and home bias

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1 Introduction

The last decade has seen a virtual explosion of international cross-holdings of financial assets (see e.g. Lane and Milesi-Feretti (2003, 2005)). It seems more than plausible that the gradual removal of portfolio home bias should lead to more efficient international risk sharing. From a macroeconomic perspective, a natural way to assess the welfare implications of better international portfolio diversification is to look at consumption-based measures of risk sharing. However, to date very few papers have been able to document that consumption risk sharing has actually improved along with the removal of portfolio home bias.

In this chapter, we first review this recent evidence that also includes some of our own work. We discuss why conventional consumption-based measures of risk sharing have a hard time picking up the increase in international risk sharing and we build on a novel approach suggested in Artis and Hoffmann (2006) to corroborate that international consumption risk sharing has indeed increased. This approach uses the information implicit in the levels of relative consumption and output. The focus on relative levels – rather than on first differences of the data as in virtually all of the earlier literature – allows us to document longer-term trends in consumption risk sharing that earlier specifications have not been able to pick up. We find that the increase in international risk sharing is economically significant: If regional evidence from a well-integrated economy such as the United States is taken as the benchmark, we find that between a third to one half of the lack of international risk sharing has vanished within a single decade.

The chapter first summarizes some of our previous analyses of portfolio holdings and capital income flows and risk sharing (Artis and Hoffmann (2006, 2004)). It is also closely related to Sorensen, Wu, Yosha and Zu (2006).[1] To our knowledge, these are so far the only papers to provide conclusive evidence that consumption risk sharing has indeed increased during the 1990s. In particular, SWYZ is the first to show that this increase in risk sharing is related to increased international portfolio diversification. Artis and Hoffmann (2006), establishes a similar result, but in contrast to SWYZ, ours is based on international cross-holdings of assets; we find that countries with higher cumulated asset trade also share more risk.

Besides a synthesis of recent findings that we and others have obtained, we offer some important new results: first, we analyse the increase in international risk sharing with special reference to the experience of current EMU member countries. Secondly, we offer a detailed analysis of the chan-

[1] We refer to this paper via the acronym 'SWYZ '.

nels through which improvements in international consumption risk sharing have come about. We confirm that consumption risk sharing has improved equally in all industrialised countries. But the level of consumption risk sharing reached among E(M)U countries is higher and – possibly most interestingly – recent improvements have occurred through different channels: among EU countries international capital income flows have become more important as a way to shield consumption from fluctuations in relative outputs, whereas in our entire panel of 23 industrialised countries, the ex-post cumulation and decumulation of foreign assets remains the main channel of international risk sharing.

These findings are robust once we control for other determinants of the patterns of international risk sharing and in particular so for the characteristics of countries' asset portfolios. We corroborate the finding that countries with lower home bias achieve more risk sharing – low risk sharing and portfolio home bias are twin puzzles separated at birth. We add to this the finding that countries with higher equity shares in their international portfolios share a larger portion of risk through capital income flows.

Our results suggest that by the end of our sample period that ranges from 1980-2004, the possibly most important difference between E(M)U and other industrialised countries is that, in the late 1990s, capital income flows have taken over as the main driver of improvements in intra-European risk sharing. By the year 2004, one third of the risk sharing achieved through international financial markets was achieved through capital income flows. Outside Europe, this channel still virtually plays no role for risk sharing. While the sheer growth in intra-European risk sharing over the 90s is already impressive, the patterns that emerge increasingly resemble those observed within national boundaries. EMU-membership may matter for how *much* risk a country shares, but increasingly it also matters for *how* it shares it. While it is too early to evaluate these trends in a conclusive manner, we discuss the possibility that the creation of EMU itself and the associated elimination of exchange rate variability is responsible for the emergence of this pattern.

The remainder of this chapter is structured as follows: in the next section we review the theoretical rationale behind consumption-based measures of risk sharing. Section three then documents that simple risk sharing measures do not seem to have increased in the recent period of globalization and outlines our alternative approach that is based on relative levels of consumption, income and output. In section four we then document patterns of international risk sharing for different country groupings, using an adaptation of the variance decomposition suggested by Asdrubali, Sorensen and Yosha (1996). Finally, we also relate these patterns to the structure of international

portfolio holdings. Section five discusses and concludes.

2 Measuring consumption risk sharing

All consumption-based measures of risk sharing that we consider in this chapter are motivated by a benchmark model with complete markets. In the simplest complete markets model, marginal utility growth in country or region k equals the growth in the shadow price of consumption and is therefore equalized across countries:

$$\frac{u'_k(C^k_{t+1})}{u'_k(C^k_t)} = \frac{\mu_{t+1}}{\mu_t} \tag{1}$$

where $u'(.)$ is the period utility function and C^k_t measures consumption in country k and μ_t is the shadow price of consumption. There are two related readings of this fundamental equation that have both found their reflections in the empirical literature. The first is that marginal utility growth should be perfectly correlated across countries. One branch of the literature therefore looks at consumption correlations. This line of research has encountered the now famous consumption correlation puzzle (Backus, Kehoe, Kydland (1992)) that consists in the stylized fact that international consumption correlations are lower than the corresponding output correlations. Stockman and Tesar (1995) have argued that consumption is likely to be driven by preference shocks and subject to considerable measurement error so that low empirical consumption correlations could in principle arise even in complete markets. While this puzzle is an important stylized fact that calls for a theoretical explanation, the argument by Stockman and Tesar demonstrates that it is difficult to directly interpret consumption correlations as *measures* of risk sharing: the very fact that consumption correlations (as a measure of relative marginal utility) are less correlated than the underlying risks (i.e. output) would suggest that people use financial markets to destabilize their relative marginal utilities.

Our main focus in this chapter will therefore be on an alternative reading of equation (1) that has equally made a profound impact on the risk sharing literature: marginal utility growth in country k should be independent of country-specific risk-variables. Since growth in the shadow price is common to all countries, the difference between marginal utility growth in two countries should be statistically independent of the relative endowment variables.

In order to obtain an estimable equation, specific assumptions on the form of the utility function are typically made. Under log-utility, the optimality condition can therefore be written

$$\mathbf{E}\left[\Delta c_t^k - \Delta c_t^* | \mathbf{X}_t^k\right] = 0$$

where $\mathbf{X}$ is a vector of idiosyncratic risk factors for country k , such as relative output growth, and the asterisked variable refers to a world average. Therefore, under full insurance, the regression

$$\Delta c_t^k - \Delta c_t^* = \mathbf{b}'\mathbf{X}_t^k + \varepsilon_t$$

should yield a coefficient of zero.[2] Specifically, many researchers, including Asdrubali, Sørensen and Yosha, as well as Hess and Shin (1998) and Crucini (1999) have used regressions of the form

$$\Delta c_t^k - \Delta c_t^* = \beta_u \left[\Delta y_t^k - \Delta y^*\right] + \varepsilon_t \tag{2}$$

where y^k is the logarithm of output in country k and the asterisk denotes the world average. We call this equation the basic risk sharing regression (RSR). Clearly, in a model with complete markets (and against the backdrop of the qualifications given above) the coefficient estimate of β_u should be zero or close to zero. The acknowledgement that real world financial markets are likely to be incomplete in many ways has led researchers to adopt a more pragmatic approach in applied work. Rather than testing the null of complete markets, i.e. $\beta_u = 0$, Asdrubali, Sørensen and Yosha (1996) as well as Sørensen and Yosha (1998) have argued very convincingly that the coefficient β_u may be of interest in itself and that it should be interpreted as a *measure* of the deviation from the complete markets outcome. Applying this insight to US state level data, Asdrubali, Sørensen and Yosha find that roughly a quarter of idiosyncratic output fluctuations remain uninsured. Conversely, Sørensen and Yosha (1998) show that among OECD countries, more than 70 percent of idiosyncratic fluctuations remain uninsured. Hence, there is a lack of international consumption risk sharing when risk sharing within countries is taken as the benchmark.

In the next section, we examine this basic risk sharing regression in our international data set. In particular, we will focus on the way in which estimates of β_u have changed during the recent globalization period.

[2] Mace (1991) and Cochrane (1991) and Townsend (1994) were the first authors to investigate regressions of this type in household-level data.

3 The increase in international risk sharing

3.1 Data

Our data are from the Penn World Table, release 6.2 (PWT 6.2.) by Heston, Summers and Aten (2006) and range from 1960 to 2006. All data are in constant (1996) international prices. The countries included in our estimation are:

1. Canada, 2. the United States, 3. Japan, 4. Austria, 5. Belgium, 6. Denmark , 7. Finland, 8. France, 9. Germany (West), 10. Greece, 11. Iceland, 12. Ireland, 13. Italy, 14. Luxemburg, 15. Netherlands, 16. Norway, 17. Portugal, 18. Spain, 19. Sweden, 20. Switzerland, 21. United Kingdom, 22. Australia, 23. New Zealand.

Most of these countries are OECD countries and we will refer to them under this label. Since we are particularly interested in the role that European integration and monetary integration in particular may have played in allowing countries to share risk more efficiently, we also report results for EU and EMU member countries. Specifically, we consider the group of 15 EU countries as of 1996 (EU15): Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom and the group of the twelve current (as of June 2006) EMU members (EMU12).

We express all data in per capita terms. Rest of the World (RoW) aggregates are the OECD-wide average per capita values. Population data are also from the PWT.

We will report results for two subperiods. The first subperiod ranges from 1980-1990 and covers a decade in which the momentum of formal liberalization of international capital markets increased apace. The second period covers the period 1990-2004. Considering this period should provide insights into the effects of the dramatic increase in net international asset positions that took place in particular in the 1990s (compare e.g. the data in Lane (2000) and Lane and Milesi-Ferretti (2001,2006)). We refer to this latter part of our sample as the globalization period.

3.2 The impact of globalization on consumption-based risk sharing measures.

Clearly, getting right the link between financial globalization – that undoubtedly *is* happening – and consumption-based measures of risk sharing is of the utmost importance if such measures are to inform policy discussions. Equally clearly, there is also a challenge from a theoretical perspective: the very rai-

son d'être of financial markets is the allocation of consumption risk and in virtually all modern macroeconomic models the welfare gains from financial globalization will be a function of the variability of consumption.

But while basic risk sharing regressions have proven enormously useful in documenting a lack of risk sharing among countries, they have been much less successful in picking up the effects of financial globalization. Table 1 presents basic risk sharing regressions for the two subperiods 1980-1990 and 1990-2004. We report results from two different estimation procedures: the first is simply panel OLS, in the second we account for potential heteroskedasticity by first running the risk sharing regression country by country. We then use the country-specific residual variance to weight the data for the second-stage regression. Only for the OECD do the regressions suggest a significant increase in risk sharing. This is clearly not the case for the two groups of European countries, the EU15 and EMU12. Rather to the contrary; here the estimates generally would even seem to suggest a decrease in risk sharing, even though the difference between subperiods does not generally appear significant.

One reason why the basic risk sharing regression may often fail to pick up the effects of financial globalization is that the risk sharing coefficient β_u will be a function not only of the degree of international diversification but also of the cross-sectional variability of output growth rates, their degree of synchronization and their relative persistence, i.e. of the underlying risks. In a world with complete markets, none of these parameters should matter: if $\beta_u = 0$, i.e. of the correlation between relative output and consumption growth is zero, then no matter what the stochastic properties of relative output growth is, consumption will not react. But if there is *some* but not complete risk sharing, then the coefficient of the basic risk sharing regression can also be a function of the structure of business cycles, i.e. of the correlation structure of Δy^k and Δy^*.

For example, Crucini (1999) considers a model in which countries diversify their risk ex ante through trade in a set of Shiller Securities, i.e. assets that pay a country's per capita output as a dividend (see Shiller (1993)). Each country allocates its wealth between two assets: a world mutual fund of Shiller securities that pays world per capita output as its dividend and a claim to home output. In this model, income (GNP) growth in country k is a portfolio-weighted average of output growth rates at home and in the rest of the world,

$$\Delta inc_t^k = (1-\lambda)\Delta y_t^k + \lambda \Delta y_t^*$$

where Δinc^k denotes income growth and λ is the share of wealth invested in the world mutual fund. In this toy model, λ can be interpreted as the

degree of diversification or of risk sharing and $1-\lambda$ is a measure of the home bias. As we discuss in Artis and Hoffmann (2004), in this model, the basic risk sharing regression will only reveal the degree of diversification, i.e will uncover λ, if the representative consumer actually consumes her entire income, i.e. if $\Delta c^k = \Delta inc^k$. Then, it must also be that $\Delta c^* = \Delta inc^* = \Delta y^*$ so that the above reduces to:

$$\Delta c_t^k - \Delta c_t^* = (1-\lambda)\left[\Delta y_t^k - \Delta y_t^*\right]$$

But the basic risk sharing regression (as equation (2)) will not generally correctly recover the lack of diversification. If λ is not equal to unity, optimizing consumers will generally seek to smooth their consumption further, e.g. by seeking to consume what is the permanent component of their income. Then, $\Delta c^k = \Delta inc^{kP}$, where the superscript denotes the permanent component.

It is well-known that in a permanent income setting the response of consumption to current income critically depends on the degree of persistence of the underlying shocks. For example, if permanent output shocks trigger a positively serially correlated output response, then current consumption will be relatively more volatile than current income: since high current income forebodes higher income tomorrow and since the shock is permanent it is optimal to destabilize consumption; current consumption will be more volatile than current income, so that

$$\Delta c_t^k - \Delta c_t^* = (1+\phi)(1-\lambda)\left[\Delta y_t^k - \Delta y_t^*\right]$$

and $\beta_u = (1+\phi)(1-\lambda)$ with $\phi > 0$ – the coefficient of the basic risk sharing regression will be biased upwards. Conversely, if shocks to income are temporary, then current income will be more volatile than consumption, so that $\phi < 0$, which biases β_u downward. In this case, the basic risk sharing regression would signal too much risk sharing.

In some of our earlier work (Artis and Hoffmann (2004)) we argue that the basic risk sharing regression is still likely to be a very useful tool in the sense that the biases in β_u seem relatively limited in any given subperiod that a researcher may wish to consider. In particular, differences in ϕ between say countries and regions can certainly not explain away the lack of international risk sharing. Still, gradual but secular changes in the structure of international business cycles, e.g. their variability and degree of synchronization can over time affect ϕ and may therefore render long-range comparisons of estimates of β_u invalid.

In particular over the last decade, financial globalization has led to ever larger cross-holdings of assets across countries; the home bias is eventually vanishing. In the toy model above, this is likely to have increased λ. But

at the same time, the last two decades have also seen huge changes in the structure of international business cycles. Stock and Watson (2005) have argued very forcefully that international business cycles have become much less volatile. Kose, Otrok and Whiteman (2003, 2004) show that they have also become more synchronized once one conditions on the presence of large negative shocks (such as the first and second oil shocks) that tend to be common across countries. As we argue in Artis and Hoffmann (2004), the presence of large common shocks is likely to increase consumption correlations given the degree of international diversification. Since the beginning of the 1980s has seen large common negative shocks that we have not experienced in the 1990s, consumption correlations today may appear no higher than they were in the 1980s, even though globalization is likely to have affected them *ceteris paribus*. In a similar mould, Imbs (2006) provides cross-sectional evidence that countries with higher bilateral trade linkages have higher consumption correlations. Still, he finds the quantity puzzle (i.e. the fact that consumption correlations are lower than output correlations) persists because output correlations also increase with trade intensity. It is beyond the scope of this chapter to analyse these mechanisms in detail. What we wish to convey here is that the basic risk sharing regression may fail to pick up secular changes in risk sharing because it is highly susceptible to changes in the stochastic environment at the business cycle frequency. Here we illustrate this point by dissecting the basic risk sharing regression (2) into a sequence of cross-sectional regressions at each point during the sample period, i.e. we run

$$\Delta c_t^k - \Delta c_t^* = \beta_u(t) \left[\Delta y_t^k - \Delta y_t^* \right] + \varepsilon_t^k$$

for $t = 1980...2004$.[3]

The first column of figure (1) plots the sequence $\{\beta_u(t)\}_{t=1980...2000}$ for the three groups: OECD, EU and EMU countries. As is apparent, the estimates of $\beta_u(t)$ are extremely volatile for all three country groups.

In spite of the huge volatility in the estimates, there seems to be an upward trend in risk sharing which can be teased out from the data, once we smooth the sequence of coefficients through HP-filtering.[4] These HP-trends are given by the smooth lines in the graphs. Indeed, it seems that there is a gradual increase in risk sharing. It is noteworthy, however, that for the OECD23 this trend accelerates in the first half of the 1990s but flattens out thereafter. For the other two groups there is also a trend towards more

[3] Asdrubali, Sørensen and Yosha (1996) demonstrate that the panel OLS-coefficient β_u is a weighted time-average of the cross-sectional coefficients $\beta_u(t)$.

[4] Our results reported here are based on a smoothness parameter of 100, but the results are not sensitive to this choice.

risk sharing, but in particular for EMU countries most of the increase comes about in the first half of the 1980s, which seems odd if we take into account that financial integration even among EU and EMU countries is likely to have picked up speed only in the second half of the 1980s.

Though the findings here provide first evidence that risk sharing may indeed have increased, they underpin our earlier point that estimates of the basic risk sharing regression have a hard time uncovering the effect of identifying this increase head on. One possible reason that we have discussed is that these estimates are likely to be sensitive to the exact nature of shocks and in particular to changes in the stochastic environment that affect the correlation between consumption and output at business cycle frequencies. As a result, repeated cross-sectional estimates of the risk sharing coefficient $\beta_u(t)$ appear extremely volatile and even though these estimates do display a downward trend, they easily vary more over the business cylce than does the trend in $\beta_u(t)$ over the entire sample period.

A plausibly more direct approach that builds on our analysis in Artis and Hoffmann (2006) and that we also advocate here is to emphasize the low-frequency comovement of consumption and output by formulating the risk sharing regression in terms of relative levels rather than in relative differences. Hence, the regressions we will use in the remainder of this paper are of the form

$$c_t^k - c_t^* = \beta_u^{LR}\left[y_t^k - y_t^*\right] + v_t^k + \text{constant} \tag{3}$$

Here, the superscript 'LR' is meant to emphasize that we think of this level risk sharing regression as picking up longer-term risk sharing.

The estimation of this level risk sharing regression poses some interesting econometric issues, since relative consumption and output levels could be integrated variables. We discuss these issues in some more detail in the next section. For now, we provide a first demonstration of the potential usefulness of our approach by, again, dissecting the above regression into a sequence of cross-sectional regressions along the lines of the equation above. The second column of figure (1) plots the sequences of $\{\beta_u^{LR}(t)\}$ thus obtained. For comparison, the smooth lines in the individual graphs reproduce the HP-trend of the sequence of basic risk sharing regressions. The first thing that is noteworthy is that for all three groups of countries, the long-run risk sharing coefficient displays a clear downward tendency that is clearly discernible without having to resort to filtering techniques. As we would expect, this trend towards more risk sharing is somewhat more pronounced in the EU and EMU countries but follows the same overall pattern for all three country groups in that it kicks in in the second half of the 1980s to pick up speed throughout the 1990s.

4 Patterns of international risk sharing

We now turn to estimating the level risk sharing regressions as a panel relation. At the same time, we attempt to identify the channels through which the apparent increase in international risk sharing has come about. In so doing, we adapt the variance decomposition proposed by Asdrubali, Sorensen and Yosha (1996) to our level regressions here. This will allow us to identify two fundamental channels through which risk sharing can occur and which are also embodied in the simple theoretical framework that we have discussed in the previous section. The first is the capital income flow channel; countries that have diversified by swapping assets *ex ante* will derive capital income flows from these assets. This will allow them to decouple their output from their income, their GDP from their GNP. We refer to this channel as the capital income flow or income smoothing channel. The second channel pertains to further smoothing of consumption vis-à-vis current income through asset accumulation or decumulation. We refer to this channel as the accumulation or consumption smoothing channel.

Following Asdrubali, Sørensen and Yosha, we gauge the role of the capital income flow channel by the comovement of international net factor income flows – given by the wedge between GDP and GNP – with home GDP fluctuations. This suggests a panel regression

$$gdp_t^k - gnp_t^k = \beta_K^{LR} gdp_t^k + u_t^k \tag{4}$$

where gdp and gnp denote the idiosyncratic relative component of the logarithm of GDP (output) and GNP (income) in country k, i.e. $gdp^k = \log(GDP^k/GDP^*) = y_t^k - y_t^*$ and $gnp^k = \log(GNP^k/GNP^*) = inc_t^k - inc_t^*$. Again, the superscript 'LR' is meant to distinguish the coefficient of this level regression from the one obtained from the analogous regressions in first differences.

We measure the contribution of the second channel by the comovement of saving or dissaving with GDP, i.e. we run regressions

$$gnp_t^k - cons_t^k = \beta_C^{LR} cons_t^k + \xi_t^k \tag{5}$$

where in analogy to the above, $cons^k = \log(C^k/C^*) = c_t^k - c_t^*$ denotes log relative consumption.

Note that by construction, the uninsured component of output risk is given by

$$\beta_u^{LR} = 1 - \beta_K^{LR} - \beta_C^{LR}$$

where β_u^L is the coefficient of the panel version of the level risk sharing regression defined by (3) above and which for convenience we reproduce here

using the more compact notation:

$$cons_t^k = \beta_u^{LR} gdp_t^k + v_t^k \tag{6}$$

We estimate the three equations (4), (5), and (6) by weighted panel OLS. To account for heteroskedasticity, we first run the above regressions country by country. We then weight all variables in the second-stage panel OLS regression by the standard deviation of the country-specific residual.

Estimation of the level regressions may, however, raise an additional issue because unlike relative growth rates of consumption, income and output, relative levels may contain unit roots. But we note that even in the presence of unit roots, the level risk sharing regressions (4)-(6) constitute long-run panel relations in the sense of Phillips and Moon (1999) and can, in principle, be estimated consistently by OLS. Since OLS may suffer from second-order bias due to potential simultaneity and serial correlation of the errors, we also experimented with a Panel Dynamic OLS estimator. Mark and Sul (2003) have forcefully argued for the use of this estimator not only on grounds of its simplicity but also because – unlike alternative methods such as Phillips and Moon's (1999) panel version of the fully modified OLS estimator – it is well-suited for relatively small samples. The use of the Panel Dynamic OLS-estimator yielded very similar results for all our specifications. In the remainder of the paper, we therefore only report results obtained from plain panel OLS estimations.

Another important issue in estimating the above risk sharing regressions concerns the treatment of country-specific fixed effects. As argued in SWYZ, panel regressions in which country-specific effects are not controlled for can be thought of as capturing some notion of long-run risk sharing. In our setting, the level specification already is meant to capture long-run risk sharing. Still, as we argue in Artis and Hoffmann (2006), where we discuss this issue in considerable detail, the very notion of home bias implies that country portfolios are heterogeneous. For example, relative changes in asset prices can only affect a country's wealth in an asymmetric way if the size or composition of the country's portfolio is different from that of other countries. We think that this kind of heterogeneity is clearly interesting from a risk sharing perspective and should therefore not be removed up-front. We therefore report results that are based on regressions in which no control for fixed effects has been included.

Table 2 presents the estimation results of the three level risk sharing regressions (4), (5), and (6) for the two subperiods 1980-90 and 1990-2004.

The first important observation is that risk sharing has indeed increased, in line with what we find from the time-slice regressions in the previous

section. EU countries and countries that later, in the 1990s, were to become EMU countries already in the 1980s shared more risk among themselves than the OECD average. Also the increase in risk sharing in Europe seems larger than for the OECD average, notably among EMU members. Note also that the group of future EMU countries started out from (slightly) less risk sharing than the EU 15 average in the 1980s but ended up sharing slightly (but significantly) more risk during the 1990-2004 period. This suggests that EMU membership in itself and the associated elimination of exchange rate risk along with the emergence of a common monetary policy may in itself have led to better risk sharing – an issue to which we return below.

It is important to put the increase in international risk sharing reflected by our estimates of β_u^{LR} into perspective. This increase in risk sharing is not only statistically significant, it is economically very important: the memorandum item in table (2) shows that even in the U.S. roughly 50 percent of long-run idiosyncratic risk remains uninsured. So, if we depart from a world of complete risk sharing and consider instead the empirically much more relevant benchmark of a financially highly integrated economy such as the U.S., then the full extent of the increase in international risk sharing – and in particular of intra-European risk sharing can be appreciated. Starting from an estimate of β_U^{LR} of more than 0.95 in the 80s and going to 0.75-0.78 as in the OECD case then implies that – vis-à-vis a realistic benchmark such as the federal states of the U.S. – at least a third, if not half of the previous 'lack of international risk sharing' has vanished within a single decade. This increase in risk sharing is even more impressive among the European countries in the sample: starting from around 0.85, these countries get stuck with just about 60 percent of their idiosyncratic risk in the 1990-2004 period, implying that almost two third of the risk sharing gap vis-à-vis the U.S. has closed.

But while there is a clear increase in risk sharing, there seem to remain major differences in the way in which risk is shared at the international and at the regional levels. At the bottom of the table, we reproduce estimates of long run risk sharing for the U.S. obtained by Becker and Hoffmann (2006). Comparing our international estimates to these numbers reveals that at the international level, all of the increase in risk sharing seems to come through asset accumulation and decumulation, whereas in the U.S. most of the (long-run) risk sharing seems to be happening through capital income flows.

As widely documented in the literature, the second half of the 1990s has seen tremendous growth in portfolio gross holdings, so, even though the sample period 1990-2000 is relatively short, the panel estimate could mask important changes in the relative role of the channels for risk-sharing that might have occurred in the more recent past. In particular, the advent of European monetary union and the elimination of exchange rate risk are likely

to have substantially affected the portfolio choice of European investors and may therefore also have changed the pattern of risk sharing.

In figure (2), we investigate this issue, by presenting the estimates of time slice decompositions of the two channels into sequences $\{\beta_K^{LR}\}$ and $\{\beta_C^{LR}\}$ along the lines of our earlier decompositions of β_u^{LR} in figure (1). Table (2) seems to suggest that the main difference between OECD countries and EMU or EU countries lies in how *much* risk they share, not so much in *how* they share it. However, the graphs in figure (2) suggest that the time-average emphasized by our panel regressions does indeed hide as of yet subtle but increasingly important differences in the pattern of risk sharing that have started to emerge in the 1990s: In both the EU and EMU countries, capital income flows, starting from a very low (actually rather large negative) contribution to risk sharing in the 1980s, have grown to help smooth roundabout ten percent of idiosyncratic output level risk in 2004. Given that 60 percent of this risk remained uninsured at the end of the 1990s, this implies that one quarter of the total risk sharing achieved between E(M)U countries is achieved through capital income flows. In fact, for the E(M)U, much of the growth in total consumption risk sharing in the most recent period seems to have been driven by the growth in capital income flows. For all three country groups, the accumulation/consumption smoothing channel has grown in importance but the curve described by $\beta_C^{LR}(t)$ seems to have flattened out somewhat in the second half of the 1990s whereas for the EU and EMU countries, the rise in income flows only really starts after 1995.

Certainly, income smoothing through capital income flows has also increased on average in the OECD as a whole. But, first,the growth in $\beta_K^{LR}(t)$ is much more subdued – by the end of the sample period $\beta_K^{C}(t)$ barely exceeds 6 pecent – so that improvements in risk sharing seem to be driven mainly by a larger contribution of the asset accumulation channel. And secondly, (results not reported) we do not find any growth in the role of income smoothing over the 1980-2004 period, if we drop the EU or EMU countries from the OECD panel, which suggests that any growth in income flows we see in the larger group of OECD countries is ultimately driven by larger capital income flows among European countries.

4.1 Determinants of the pattern of risk sharing

We assess to what extent the rise in the contribution of capital income flows to risk sharing between EU and EMU countries is driven by country portfolio characteristics. Recent research (SWYZ) has started to document that the increase in international risk sharing can be associated with the decline in international portfolio home bias. In our own earlier work (Artis and Hoff-

mann (2006)), we show that portfolio heterogeneity matters for the way in which risk is shared among countries. To the extent that EU countries hold different portfolios than other economies, this could possibly explain why the patterns of risk sharing differ between E(M)U and non-EU industrialised countries.

To assess this issue, we extend SWYZ's and our own work by parameterizing the risk sharing coefficients β_K^{LR} , β_C^{LR} , and β_U^{LR} as a function of both country portfolio characteristics and a time trend, so that

$$\beta_X^k(t) = \overline{\beta}_X + \boldsymbol{\kappa}_X'(\mathbf{z}_k - \overline{\mathbf{z}})(t - t_0)$$

where $X = K, C, U$, $\overline{\beta}_X$ denotes average risk sharing through channel X, $\mathbf{z}_k$ is a vector of country characteristics and $\overline{\mathbf{z}}$ the vector of cross-country means of $\mathbf{z}_k$.[5] While we use period averages of country characteristics, so that $\mathbf{z}_k$ is not time-varying, we allow for time dynamics in β_X^k by interacting the country-characteristics with a deterministic trend term. In this way, we essentially proxy for a country-specific time trend in β_X^k. Plugging the above relation into (4) – (6) we then obtain a panel regression in which the elements of $(t - t_0)(\mathbf{z}_k - \overline{\mathbf{z}})$ are interacted with gdp_t^k and from which the coefficient vector $\boldsymbol{\kappa}_X$ can be estimated.

Our vector of country characteristics $\mathbf{z}_k$ includes two separate measures of international asset cross-holdings: the first, that we abbreviate as *cat* is a measure of country k's *c*umulative *a*sset *t*rade relative to its total financial wealth. The second, called *eqshare* is the share of equity in cumulative asset trade.[6] To assess the role of EMU membership on the extent and the pattern of risk sharing, we use an EMU membership dummy. Finally, we also include a pure time trend to capture the common time trend in risk sharing that is we can think of as being driven by time variation in the cross-sectional mean $\overline{z}$ and by other un-modelled common characteristics. This implies that we have

$$\mathbf{z}_k = \left[\begin{array}{cccc} 1 & cat_k - \overline{cat} & eqshare_k - \overline{eqshare} & EMU^k - \overline{EMU} \end{array}\right]'$$

To focus on recent developments, we present our results for the period since the start of EMU, i.e. for 1999-2004. Table (3) summarizes our findings.

[5] Since in this part of the paper we are only dealing with level regressions, we simplify notation by dropping the superscript 'LR'.

[6] Specifically, we construct *cat* as gross foreign assets relative to GDP, i.e. $cat_k = \frac{A_k + L_k}{Y_k}$ and cumulative equity trade as $ceqt_k = \frac{A_k^{eq} + L_k^{eq}}{Y_k}$, where A_k and L_k are total gross foreign assets and gross liabilities respectively and A_k^{eq} and L_k^{eq} are gross foreign equity assets and liabilities. The equity share is then $eqshare_k = ceqt_k / cat_k$. Our data are based on Philip Lane's and Gianmaria Milesi-Ferretti's (2006) recently updated External Wealth of Nations data set.

For aggregate risk sharing, the results are very intuitive and confirm some of the earlier findings by SWYZ and ourselves: most importantly, countries with more asset trade (higher *cat*) share significantly more risk overall. The uninteracted part of the aggregate time trend tends to decrease risk sharing over the period, though. This could reflect the decline in world stock markets over that period that lowered the value of financial relative to real assets such as human capital and housing. It is possible that this relative increase in the value of virtually non-diversifiable assets could have resulted in a temporary decrease in aggregate risk sharing. Such an interpretation would also tie in with our finding that countries with relatively more equity trade share significantly less risk, an otherwise somewhat surprising result. Possibly, however, this effect could also be explained by the correlation between equity shares in country portfolios and the cumulated asset trade, which may make it somewhat difficult to isolate the effects of *eqshare* and *cat*.[7] EMU-membership *per se* as a point estimate is positive which would suggest that EMU membership lowers risk sharing relative to the rest of the country group. However, this result is barely significant.

To our knowledge, results for the way in which portfolio characteristics affect the role of the individual channels of risk-sharing have not been reported in the literature. We find that the common time trend is negative for both capital income flows and asset accumulation/decumulation, in line with our previous result that there was a downward 'trend' on risk sharing during this short sample period. The EMU dummy has a strongly positive effect on the contribution of capital income flows and a negative one on asset accumulation/decumulation. These two effects seem to cancel out, the net effect, as discussed previously, would barely seem significant. This reconfirms our point - already apparent from the earlier graphical results, that by the end of the 1990s EMU membership matters maybe less for how *much* risk an industrialised country shares but increasingly for *how* this risk sharing is accomplished.

Finally, by way of comparison, the lower panel of table (3) also gives the estimates of β_X^{LR} for the period 1999-2004 obtained from a level risk sharing regression without interaction effects. These coefficients are very much in line with the estimates of $\overline{\beta}_X$ reported in the first line of the table. This fact, together with the substantial improvement in R^2 that we obtain through the interaction terms on the two channel regressions, i.e. for β_K^{LR} and β_C^{LR}, suggests that the three country characteristics we consider here – cumulative

[7] Note that the size of the coefficient on *eqshare* is owed to the fact that *eqshare* is the percentage point deviation from the mean, whereas the other variables are measured in absolute deviations from their respective cross-sectional means.

asset trade, the role of equity trade in international asset cross-holdings and EMU membership – do a reasonably good job in explaining country-specific trends in the patterns of international risk sharing since the inception of EMU.

5 Discussion and Conclusion

International risk sharing has increased in the 1990s. This paper has shown that this increase is economically important and even more so in Europe than elsewhere. We have reported empirical findings to support the notion that intra-European risk sharing increasingly approximates the pattern observed in the U.S. or more generally within countries; this is true maybe not so much for the actual extent of risk sharing – here there is still some way to go, even though one third to one half of the lack of international risk sharing seems to have vanished within a decade if the U.S. is taken as a benchmark – but rather in the way in which risk gets shared, namely through more capital income flows due to *ex ante* swaps of equity.

It is interesting to link these findings to the more traditional approach of testing for long-run capital mobility between countries. A lot of this literature has built on Feldstein and Horioka (1980) by examining savings-investment correlations. In a recent study of European countries, Blanchard and Giavazzi (2002) document that savings-investment correlations have decreased in Europe and especially in the Euro area. Our findings here complement this result from the perspective of the macroeconomic risk sharing literature: in particular, the rise of risk sharing through capital income flows is not only consistent with, but is ultimately a necessity, for the patterns in savings-investment correlations documented by Blanchard and Giavazzi to prevail. In the long-run for a country to decouple its savings from its investment will only be possible if the persistent current account imbalance is financed through non-zero net capital income flows.

While it is too early to tell what is at the source of this development, one plausible candidate is the elimination of exchange rate risk within the EU and among EMU countries in particular. The recent literature has emphasized the role of valuation effects for the size of international asset positions. As we have argued in our own recent work, portfolio heterogeneity is a precondition for such valuation effects to have an effect (either a stabilizing or destabilizing one) and we have shown that substantial international portfolio heterogeneity is required to explain why – at least at business cycle horizons – international income flows have remained relatively muted as international risk sharing has increased (Artis and Hoffmann (2006)). As we

know from recent research on global imbalances (most prominently Gourinchas and Rey (2006)), valuation effects also work mainly through exchange rate adjustments. As argued in Hau and Rey (2006), such valuation effects can in themselves lead to frequent portfolio rebalancing if exchange rate risk cannot be fully diversified. The result is high turnover in equity markets: instead of holding foreign equity positions in order to reap dividend flows, investors rebalance their portfolio, by realizing foreign capital gains. For macroeconomic risk sharing that should imply, that risk sharing takes place rather through cumulation and decumulation of assets rather than through capital income flows. However, to the extent that exchange rate variability gets eliminated, countries may then hold more homogeneous portfolios with less turnover so that risk sharing may take place rather through income flows than through continual sale and purchase of assets. The result should be a pattern of risk sharing as we see it within countries: lots of capital income flows. Possibly, what we start to see in European data is the reflection of these fundamental changes.

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Table 1: Basic risk sharing regressions

$$(\Delta c_t^k - \Delta c_t^*) = const + \beta_u(\Delta y_t^k - \Delta y_t^*) + u_t^k$$

	OLS			
	1980-90		1990-2004	
OECD 23	0.83	(15.72)	0.64	(17.19)
EU 15	0.66	(9.56)	0.62	(14.63)
EMU 12	0.55	(7.14)	0.58	(13.33)
	Weighted Least Squares			
	1980-90		1990-2000	
OECD 23	0.80	(16.82)	0.68	(19.70)
EU15	0.66	(12.11)	0.65	(17.05)
EMU 12	0.61	(9.62)	0.63	(14.25)

NOTES:Upper panel: OLS estimates, lower panel Weighted least squares: In a first stage, the risk sharing regression was run country-by-country. The country-specific residual variance is then used to weight the data in the second-stage panel regression. t-values in parentheses.

Table 2: Channels of long-run risk sharing

$$x_t = const + \beta_X gdp_t^k + u_t^k$$

		1980-90		1990-2004	
OECD 23	β_K^{LR}	-0.05	(-9.55)	0.0168	(4.16)
	β_C^{LR}	0.05	(2.78)	0.1980	(13.54)
	β_U^{LR}	0.99	(58.64)	0.7852	(49.32)
EU 15	β_K^{LR}	-0.06	(-7.10)	0.0396	(9.71)
	β_C^{LR}	0.22	(18.61)	0.3540	(46.47)
	β_U^{LR}	0.84	(59.33)	0.6064	(64.77)
EMU 12	β_K^{LR}	-0.07	(-7.99)	0.05	(11.77)
	β_C^{LR}	0.18	(14.09)	0.37	(52.01)
	β_U^{LR}	0.89	(60.42)	0.58	(63.55)

Memorandum item (source: Becker and Hoffmann (2006))

		Regression-based	VAR-based
	β_K^{LR}	0.67	0.48
USA	β_C^{LR}	-0.16	0.08
	β_U^{LR}	0.51	0.44

NOTES: The table reports estimates of the long-run (level) risk sharing regressions for the capital income flow ($x = gdp - gnp, X = K$) and the asset cumulation and decumulation ($x = gnp - cons$, $X = C$) channels as well as for the unsmoothed component ($x = cons, X = U$). The regressions were performed as a two-stage weighted least squares procedure along the lines described in table 1. t-values in parentheses.The memorandum item contains a regression-based and a VAR-based estimate (at a 30-year forecasting horizon) of the long-run risk sharing channels for the U.S., 1963-90, taken from table 1, p. 791 and table 2, p. 793 in Becker and Hoffmann (2006).

Table 3

Determinants of the pattern of risk sharing 1999-2004

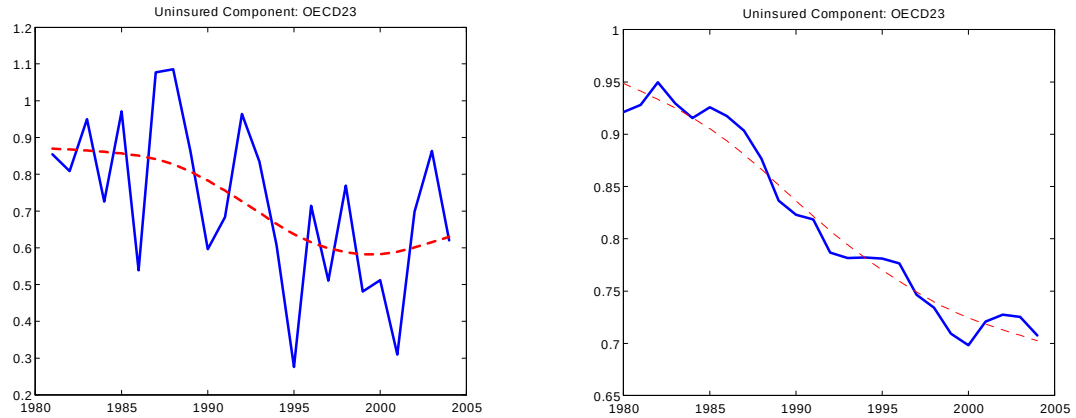
OECD-23 countries

	I Income Smoothing	II Cons. Smoothing	III Uninsured
$\overline{\beta_X}$	-0.007 (-0.20)	**0.30** (3.55)	**0.71** (8.03)
$t - t_0$	**-0.04** (-2.97)	-0.03 (-0.99)	**0.07** (2.0824)
$cat_k(t - t_0)$	*0.005* (1.88)	**0.02** (2.67)	**-0.02** (-3.29)
$eqshare_k(t - t_0)$	0.03 (0.50)	**-0.77** (-5.27)	**0.74** (4.90)
$EMU_k(t - t_0)$	**0.04** (2.57)	**-0.12** (-2.93)	*0.08* (1.86)
R^2	0.20	0.34	0.73
	Memorandum item: level regression without IA-term, 1999-2004		
β_X^{LR}	**0.0338** (2.0790)	**0.2518** (6.1169)	**0.7144** (16.6422)
R^2	0.03	0.22	0.67

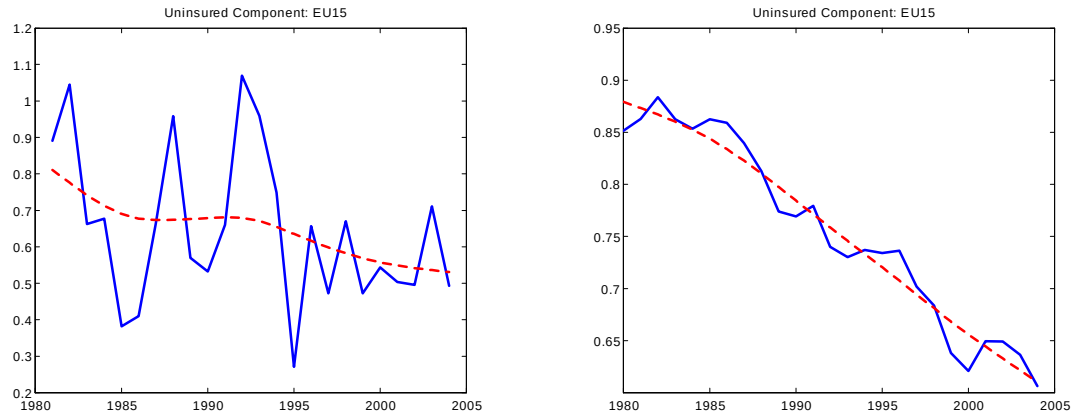
Figure 1: Cross-sectional risk sharing regressions 1980-2000

a) Differences b) Levels

OECD-23



EU-15



EMU12

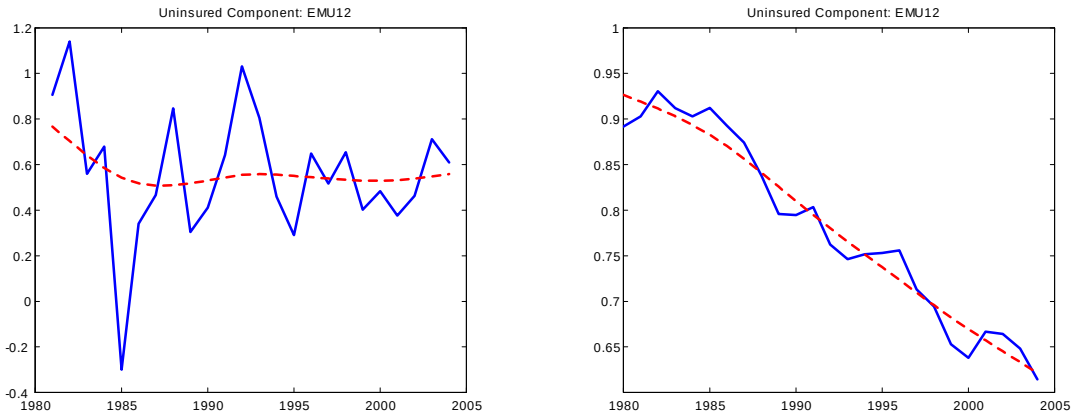
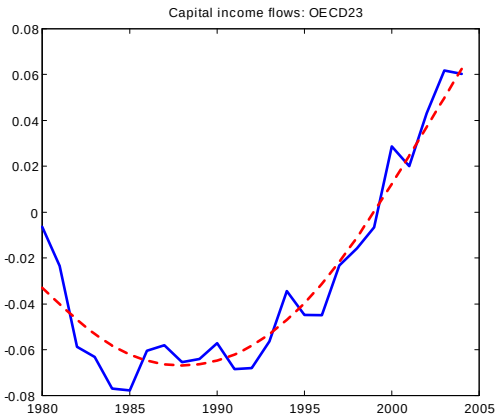
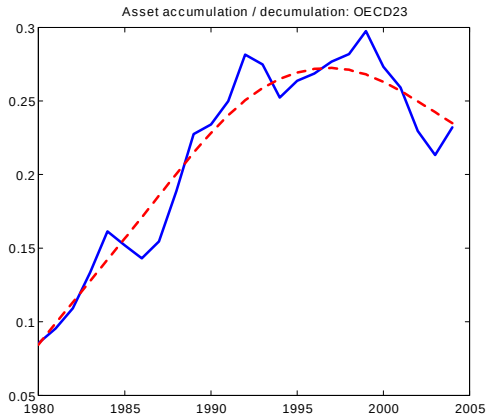


Figure 2: Cross-sectional level risk sharing regressions 1980-2000

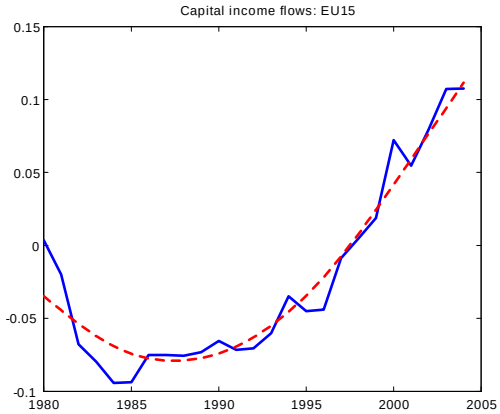
Capital income flows | Asset cumulation /decumulation

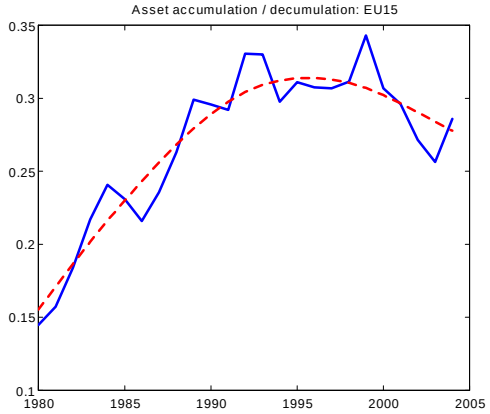
OECD 23





EU15





EMU12