International Risk Sharing and the Irish Economy

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Abstract: This paper studies international risk sharing in Ireland during the 1970-2007 period. Following the correlation- and regression-based approaches, we confirm that Ireland belongs to the rare set of countries where risk sharing took place. We also study whether changes in consumption and income risk sharing were associated with the European integration process by looking at specific sub-periods. We find no evidence of consumption risk sharing being associated with this. However, our empirical results suggest that income risk sharing improved as Europe became more integrated.

I INTRODUCTION

Theory suggests that international financial integration is potentially beneficial along three main dimensions. First, it allows countries to engage in intertemporal borrowing, which can be welfare improving relatively to an autarky situation. Second, it can increase long-term output growth prospects.[1] Third, it opens the possibility for international diversification of idiosyncratic risk.

[1] The reasons are mainly two. First, financially integrated economies are better able to efficiently allocate investments worldwide. Second, these countries have better access to insurance that facilitates the undertaking of high-mean/high-risk investment projects (Obstfeld, 1994; Acemoglu and Zilibotti, 1997 and Devereux and Saito, 1997).
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This paper studies international risk sharing and focuses on Ireland as a benchmark case study given that it exhibits the preconditions needed for risk sharing to emerge.[2] First, it is very much integrated with the international financial system. Second, it faces low assets market frictions. Third, it is an open economy with low trade costs. Fourth, it does not present the features, such as enforcement problems, that deter international risk sharing from taking place (Lane, 2000).

In addition, we assess whether different risk sharing indicators changed with the developments in the European integration process. More specifically, we study whether the signature of the Maastricht Treaty and the creation of the European Monetary Union (EMU) have affected Ireland's risk sharing profile. This is important in view of the prospects that these institutions may have created for Irish and international investors. For instance, these affected expectations on the conduct of fiscal policy, public debt levels, capital market frictions and exchange rate risk. These are factors associated with the process of European integration that may have influenced international capital flows and, therefore, risk sharing.

We look at the 1970-2007 period to learn about the Irish risk sharing profile in tranquil times. As such, these findings can be used to assess how different the impact of the recent crisis would have been in the absence of risk sharing. More precisely, we provide an empirical benchmark that can be used for the study of the Irish economy going forward as well as for cross-country comparisons.

Although relevant for the current Irish situation, we do not study risk sharing during the crisis years. One reason is that investment and consumption decisions during these times are likely to be different from those in tranquil periods. For instance, investors may decide to repatriate foreign investments to limit current capital loses, instead of rebalancing their international portfolio to insure themselves against future idiosyncratic shocks. Saving decisions may also differ in crisis years. These could be associated with changes in household preferences, such as their inter-temporal discount factor or degree of risk aversion. In addition, the large global component of the crisis makes it difficult to disentangle the idiosyncratic from the systemic part of output and consumption. Since our goal is to provide an empirical benchmark for international risk sharing, these sources of variation limit the scope of this paper to the pre-crisis period.

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[2] It could be argued that international financial integration may not be relevant for the study of risk sharing in Ireland since these financial linkages are mainly related to financial centre services. However, these activities concentrate on portfolio investments only. Ireland is also integrated through other types of investments such as foreign direct investment, bank debt or pension funds that generate important income flows relevant for risk sharing.

The empirical findings presented here are a relevant contribution to the broad literature on international risk sharing. In particular, this paper confirms the findings by Lane (2000) of Ireland belonging to a rare set of countries where consumption risk sharing took place, but using a different time period. These results are robust to alternative empirical strategies and definitions of the idiosyncratic components of consumption and output. In addition, we provide evidence showing that income risk sharing also took place.

In terms of the evolution of these indicators and the European integration process, we find no evidence of consumption risk sharing being associated with this. However, our empirical results suggest that income risk sharing improved as Europe became more integrated.

The rest of the paper is organised as follows. Section II places our paper in the relevant literature. Section III studies risk sharing by following two empirical approaches. It first looks at international correlations and then at a regression-based approach. The latter is implemented to look for evidence of consumption and income risk sharing. Finally, the paper conclusions are presented in Section IV.

II RELATED LITERATURE

The broad empirical literature focusing on risk sharing can be divided into three main branches.

The first one studies risk sharing by focusing on international consumption and output correlations. Theory predicts that international consumption correlations will be perfect as a result of agents consuming out of the same fully diversified international portfolio. By contrast, international output correlations may be low as international financial integration becomes stronger, given that capital flows tend to follow returns differentials.

Several papers following this correlation-based approach find no support for the above predictions. More specifically, international consumption correlations are found to be low and sometimes lower than international output correlations (Backus *et al.,* 1992; Obstfeld, 1995 and Lewis, 1996). This is the so called "consumption correlation puzzle" or "quantity puzzle". Moreover, some papers find that consumption correlations fell in time (see Heathcote and Perri (2004) focusing on the US or Labhard and Sawicki (2006) for a UK study), giving evidence that consumption may have become more dependent on idiosyncratic factors.

The second branch takes a regression analysis strategy. The goal of these papers is to test the hypothesis that fluctuations in idiosyncratic consumption

should be independent of idiosyncratic output risk. More specifically, the coefficient associated with output should be equal to zero if full risk diversification is at place (Asdrubali *et al.,* 1996; Sørensen and Yosha, 1998 and Crucini, 1999). As in the correlation-based literature, the usual finding is that consumption risk sharing is small or non-existent.

The surge in international investment positions documented by Lane and Milesi-Ferretti (2001, 2007) has motivated several researchers to study the role of financial integration on risk sharing. One example is the work of Artis and Hoffmann (2008a). This paper finds that risk sharing has increased but not as a result of international financial markets becoming more integrated. Instead, the reason for this improvement is associated with international business cycles becoming less volatile.[3] Looking at a similar research question, Imbs (2006) finds that more financially integrated countries exhibit higher international consumption correlations. However, he also shows that international output correlations have increased by a larger magnitude.

In contrast to the above studies, some papers find evidence of financial globalisation having an impact on international risk sharing. One example is Kose *et al.* (2007) studying emerging market economies and advanced countries. That paper finds that international financial integration contributed to risk sharing in the latter group only. Focusing on a similar country group but taking international financial integration in equity and debt, Corcoran (2008) also finds evidence of financial globalisation improving consumption risk sharing.

The third branch of the literature looks at how cross-border assets ownership help smoothing consumption through their impact on national income. Within this group, we find papers focusing on international income flows and capital gains. While Kose *et al.* (2007) and Sørensen *et al.* (2007) find evidence of foreign asset positions affecting income and consumption smoothing, Lane (2001) shows that gross international investment positions are not associated with income-smoothing at business-cycle frequencies.

The impact of income flows seems to depend on the risk sharing horizon. Using a regression approach but taking the levels of output and consumption differentials, Artis and Hoffmann (2008b) find strong effects for international

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[3] These authors argue that consumption-based measures of risk sharing (like volatility of consumption conditional on output or international output correlations) have been unable to detect changes in risk sharing because consumption has also been affected by the fall in output volatility. The reason for this is that volatility in output at business cycle frequency fell more than the volatility of permanent output. Since consumption depends more on the latter it appears more volatile in relation to current changes in output. Artis and Hoffmann (2008b) argue that this effect may have offset the tendency of financial globalisation to lower volatility of consumption. Similarly, Moser *et al.* (2003) are unable to detect evidence of increase in international risk sharing when international financial globalisation is accounted for.

income flows on long-term risk sharing. For the case of Ireland, the available empirical evidence points in the same direction. Lane (2000) finds that its international equity position contributed to risk sharing with other European countries.

In relation to the role of capital gains, Schmitz (2010) finds that domestic market capital gains are pro-cyclical in emerging market economies, indicating the existence of room for risk sharing. More precisely, if foreign investors have claims on local stocks, the pro-cyclical behaviour of capital gains in debt and equity liabilities will act as a stabilising mechanism, i.e., risk sharing.

In the context of the Irish economy, the sole paper analysing international risk sharing is Lane (2000). Looking at the 1975-98 and 1950-90 periods, this study finds evidence supporting partial hedging of domestic production fluctuations. In particular, this paper suggests that Ireland is part of a rare set of countries exhibiting international consumption correlations being larger than output correlations. Moreover, it shows that the yield paid by Ireland on its net external liability position is significantly pro-cyclical, which is in line with the fact that Ireland has a heavy dependence on Foreign Direct Investment (FDI).

Our paper falls in the first and second branches of the literature and has some similarities with the above paper. However, we differentiate along several dimensions. First, we extend that analysis and concentrate on the 1970-2007 period. Second, we assess whether the evolution of different risk sharing indicators is associated with the European integration process. Third, we analyse the effect of different rest-of-world benchmarks to explicitly account for different types of international linkages. Fourth, we also look at Ireland's investment income risk sharing.

III RISK SHARING

Most of the papers studying consumption risk sharing base their analysis on a benchmark model that assumes complete markets and frictionless trade in goods. That model yields the optimal relation (1) which implies equality between the growth rates of the marginal utility of consumption ($u'(C^i)$) in one country and the marginal utility of income (λ) in all countries.

$$\frac{u'(C^i_{t+1})}{u'(C^i_t)} = \frac{\lambda_{t+1}}{\lambda_t} \tag{1}$$

This section builds on two implications of this optimal relation. First, growth in the marginal utility of consumption should be perfectly correlated across countries. Second, deviations in the marginal utility of consumption across countries should be driven by idiosyncratic shocks.

One strategy adopted here is to look for evidence of international consumption correlations being larger than international output correlations as one indicator of risk sharing. This follows the first implication of Equation (1) indicating that consumption plans across countries will be perfectly correlated if agents consume out of a fully diversified portfolio. In addition, it is expected that output correlations will fall as international capital flows driven by return differentials become stronger. Thus, consumption correlations will be larger than output correlations when agents diversify risk internationally.

As discussed in the previous section, the empirical literature studying risk sharing does not find support for this prediction. By contrast, the common finding is that most countries exhibit output correlations which are larger than consumption correlations. This could be the result of several factors that may prevent international risk sharing from taking place. Some of these are market incompleteness, enforcement problems, capital market restrictions, non-tradable or durable goods, exchange rate changes, non-tradable labour income risk or habit persistence.[4] However, since these restrictions are unlikely to hold for the Irish economy (Lane, 2000), the correlations approach can be implemented.

The next part of this section is based on the second implication of Equation (1). More precisely, deviations between the marginal utility of consumption should be independent of idiosyncratic output risk if the marginal utility of income grows at the same rate in all countries. Thus, the expected value of the deviation between consumption growth rates in one country and the rest of the world should be zero if country-specific factors are accounted for. More formally, we have that

$$E[c_t^i - c_t^* \,|\, X_t^i] = 0 \qquad\qquad (2)$$

where c_t^i and c_t^* are country's i and rest of the world's consumption growth rates, X_t^i is a vector of time-varying country i characteristics (for instance, country GDP growth relative to the rest of the world) and E is the expectation operator.

We follow a regression-based approach and study risk sharing by estimating several models where consumption growth differential is the dependent variable and output growth differential is the explanatory variable. The

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[4] For a review of this literature and examples of models accounting for some of these factors see Obstfeld (1989, 1995), Backus *et al.* (1995), Stockman and Tesar (1995), Lewis (1996), Hess and Shin (1997), Heathcote and Perri (2004), Obstfeld and Rogoff (2001), Ravn (2001) and Fuhrer and Klein (2006).

degree of international risk sharing will be inversely related to the size of the coefficient on output growth. The larger its size, the greater will be the effect of output shocks on consumption.

This strategy can be adapted to put in evidence the channels through which consumption growth and output growth are de-coupled, as opposed to the correlations approach. This is attained by including additional explanatory variables and interaction terms in the model, such as a measure of international financial integration, capital account openness, etc.

3.1 *Correlation Analysis*

Following the first strategy, Table 1 reports Ireland's international correlation coefficients for consumption and output growth in the 1970-2007 period. For private consumption we use household consumption expenditure while for output we take GDP. Both variables are measured in constant US dollars. Their source is the National Accounts Main Aggregates database of the United Nations.

We then assess whether these correlations changed in time by splitting the sample in two sets of sub-periods. To this end, we put the focus on two representative dates of the European integration process. First, we split the period in 1993 and then we do it in 1999. We call these "Split 1"and "Split 2," respectively.

Split 1 follows the signature of the Maastricht Treaty while Split 2 follows the start of the EMU. Split 2 is of particular importance for risk sharing in the context of the Irish economy since the introduction of the Euro acted as a stimulus for financial liberalisation with sharp reductions in interest rates. This relaxed credit constraints and stimulated private consumption. In countries like Ireland this effect was amplified by booms in the residential and commercial property sectors (Lane, 2009). In addition, the creation of the monetary union eliminated the exchange rate risk, which is relevant for international risk sharing.

All correlation coefficients for the full period and the two splits are presented in Table 1. The first panel shows consumption correlations and the second reports output correlations. Rows (1) take the World total in the UN database (excluding Ireland) as the rest-of-world benchmark.

In line with the results of Lane (2000) for the 1973-1998 period, we find that consumption correlations were larger than output correlations in 1970-2007 and in the sub-periods, suggesting international risk sharing.

However, a complete correlation-based analysis should also account for the fact that not all the rest-of-world countries have the same importance. Shocks to trade or financial partners will spread more quickly and have greater effects than shocks to countries that are unrelated to the Irish economy. Thus,

Table 1: *Ireland's GDP and Consumption Correlations Vis-à-Vis Selected Country Groups*

| Ireland Vis-à-Vis | (1970-07) | Split 1 | | Split 2 | |
		(1970-92)	(1993-07)	(1970-98)	(1999-07)
corr (c, c*)					
(1) ROW	0.49	0.61	0.60	0.51	0.65
(2) PI	0.48	0.60	0.74	0.52	0.76
(3) BANK	0.50	0.58	0.72	0.53	0.72
(4) FDI	0.62	0.68	0.70	0.67	0.73
(5) TRADE	0.49	0.57	0.70	0.51	0.74
(6) ADV	0.43	0.60	0.72	0.49	0.79
(7) EU14	0.39	0.59	0.72	0.44	0.83
(8) EMU11	0.30	0.57	0.70	0.36	0.86
(9) US	0.46	0.45	0.64	0.46	0.72
(10) UK	0.44	0.43	0.50	0.44	0.44
corr (y, y*)					
(1) ROW	0.10	0.09	0.31	0.08	0.14
(2) PI	0.19	0.18	0.68	0.18	0.66
(3) BANK	0.21	0.13	0.63	0.18	0.67
(4) FDI	0.27	0.14	0.69	0.23	0.71
(5) TRADE	0.21	0.15	0.60	0.19	0.61
(6) ADV	0.15	0.24	0.63	0.17	0.54
(7) EU14	0.17	0.18	0.64	0.15	0.61
(8) EMU11	0.12	0.21	0.64	0.12	0.60
(9) U.S.	0.19	0.16	0.52	0.19	0.56
(10) U.K.	0.20	0.03	0.40	0.15	0.62

Note: Correlations are computed using the real growth rate of household consumption expenditure and GDP from the UN National Accounts Main Aggregates database.

ignoring the importance of these bilateral linkages could be problematic. For instance, a shock taking place in a large trade partner could be interpreted as an idiosyncratic shock taking place in Ireland if bilateral linkages are not explicitly accounted for. With this in mind, we compute correlations and estimate regression models using rest-of-world benchmarks that account for these links.

Rows (2) to (4) use bilateral international investment data.[5] Row (2) uses portfolio investment to compute a rest-of-world measure. This is done by

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[5] The source for bilateral portfolio investment is the IMF's Coordinated Portfolio Investment Survey (CPIS). Bilateral data on bank loans are obtained from the Bank of International Settlements (BIS) locational database while FDI data are from the United Nations Conference on Trade and Development (UNCTAD).

taking the weighted average of the top fifteen country partners. Applying this same methodology, rows (3) and (4) take bank and direct investment data, respectively. In all cases, we use the sum of foreign assets and foreign liabilities since this is the industry standard measure for international financial integration. We take portfolio investment weights following the portfolio balance theoretical literature. This focuses on portfolio investment as a means for risk diversification.[6] We take bilateral bank debt to account for the impact of bank international linkages and shocks to foreign banks. We use FDI weights to account for Ireland's particular dependence on direct investment.

As in the case where the broad rest-of-world benchmark is used, these correlations support the consumption risk sharing hypothesis: consumption correlations are large and greater than output correlations.

Row (5) presents the same set of correlations but taking Ireland's fifteen most important trade partners. This exercise yields results which are similar to those previously discussed. Consumption correlations are positive and stronger than output correlations. To complement this analysis, Figures 1 and 2 present bilateral consumption and output correlations vis-à-vis each of the 190 countries in the UN database. Instead of aggregating a rest-of-world measure, these show bilateral correlations taking into account Ireland's trade intensities.

Figure 1 shows that many consumption correlations were greater than output correlations in the full period. In particular, this is the case for Ireland's main trading partners. Figure 2 does the previous exercise but taking each sub-period individually. It shows that the spread of consumption and output correlations increased and that bilateral correlations with large trade partners increased substantially in the more recent sub-periods. However, it is not clear from this figure whether risk sharing changed in time.

Several papers report that European countries disproportionately invest in each other (e.g., Lane, 2006 and Lane and Milesi-Ferretti, 2007). To account for this, we compute correlations vis-à-vis other advanced, EU and EMU countries in Table 1. Rows (6) to (8) show that international consumption correlations were always larger than output correlations giving further evidence of consumption risk sharing.

As in Lane (2000), we report correlations vis-à-vis the US and vis-à-vis the UK in rows (9) and (10), respectively. In line with the previous results most consumption correlations are stronger than output correlations (the exception

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[6] These weights may not be entirely appropriate here since Ireland provides financial centre services and this implies that a large proportion of these flows do not stay in the Irish economy. However, this exercise is meaningful since these flows include pension funds, which are not part on Ireland's financial centre activities.
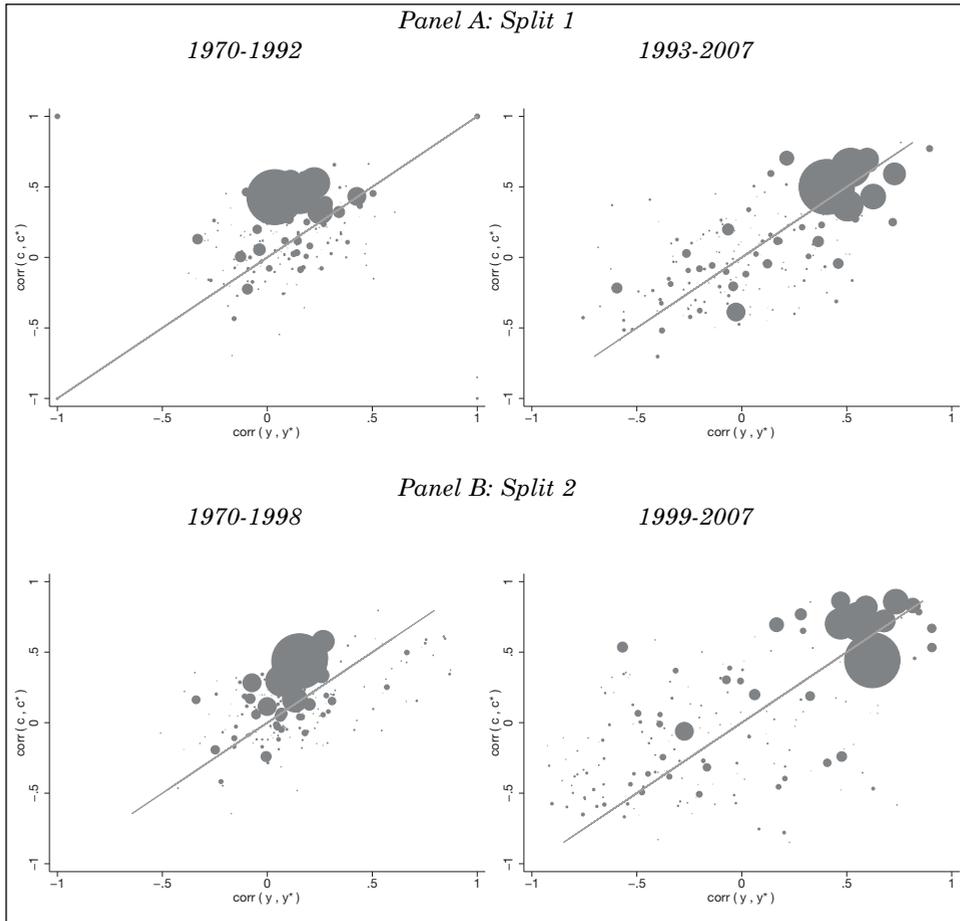
Figure 1: *GDP and Consumption Correlations. Full Period: 1970-2007*
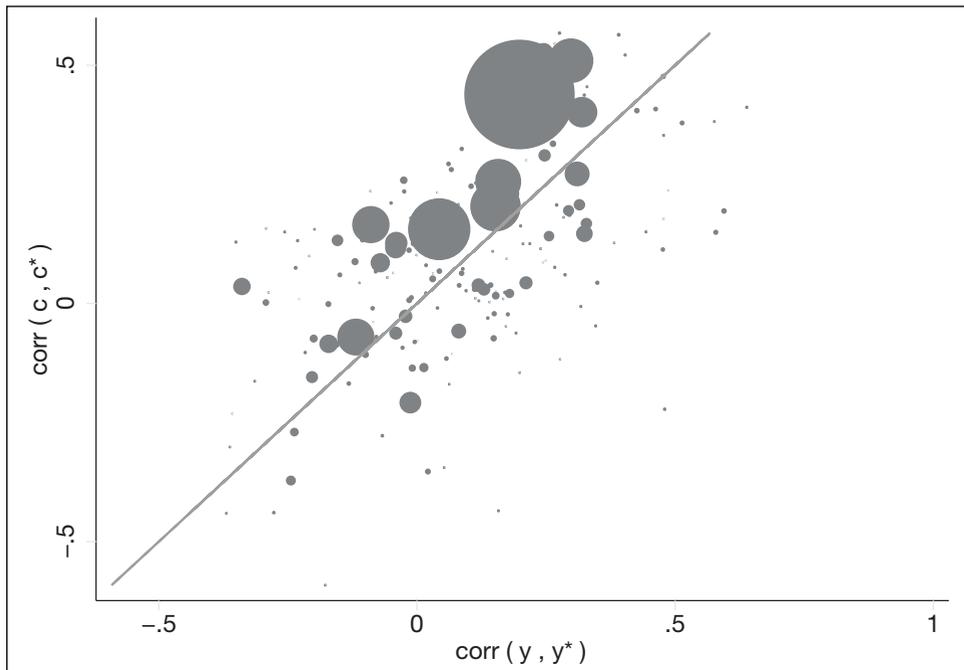
Note: Ireland's bilateral correlation with respect to 190 countries in the United Nations database. Bubble size indicates trade intensity.

is the correlation with the UK in 1999-2007), with a greater difference appearing in the first part of the sample.

An alternative strategy is to focus on GDP net of government consumption and investment. (This is also known as "net output".) This approach is followed by Obstfeld (1995) and Yakhin (2005) who argue that net output could be a more relevant measure for consumption risk sharing. The latter paper focuses on the differences that emerge when these alternative measures are used and concludes that the degree of international risk sharing changes for some countries. Taking this into account, we also computed the above correlations using net output. Our previous results are not affected by this change. In fact, these provide stronger evidence for consumption risk sharing since international net output correlations are lower than GDP correlations.

Finally, we take into account the related theoretical literature focusing on the welfare implications of risk sharing by looking at the outcomes for a representative agent. More precisely, we computed all correlations for the different types of benchmarks using consumption and output in per capita

Figure 2: *GDP and Consumption Correlations: Different Sub-periods*

Note: Ireland's bilateral correlation with respect to 190 countries in the United Nations database. Bubble size indicates trade intensity.

terms. In line with the previous findings, international consumption correlations are larger than output correlations.

   Overall, the correlation assessment suggests that consumption risk sharing took place in the years preceding the crisis and that these results are independent of the consumption and output measures or the rest-of-world benchmark.[7] In addition, the size of consumption and output correlations in

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[7] These results are robust to the presence of outlier growth rates. More specifically, the picture discussed above also emerges when large growth rates (greater than 8 per cent in absolute value) are excluded from the correlation analysis.

different periods suggests that risk sharing may have fallen over time. However, as shown in the next section, these results vanish when the regression-based approach is implemented.

3.2 *Regression Analysis*
3.2.1 Consumption Risk Sharing

This section follows a second interpretation of Equation (1). More precisely, when growth in the marginal utility of income is the same for all countries, the cross-country differences in the marginal utility of consumption should be independent of idiosyncratic output risk. With this in mind, we estimate several regression models to look for further evidence of risk sharing.

As in the previous section, we focus on the 1970-2007 period and the two splits. The regression model estimated here is given by Equation (3)

$$c_t - c_t^* = \beta_0 + \beta_1 (y_t - y_t^*) + \varepsilon_t, \tag{3}$$

where c_t and c_t^* are real consumption growth rates in Ireland and the rest of the world, respectively. y_t and y_t are Irish and foreign output growth rates while ε_t is a vector of orthogonal residuals. β_0 is the intercept coefficient that captures permanent deviations of consumption growth rates that are not explained by output growth differentials. Coefficient β_1 is an indicator of risk diversification. A large β_1 means low risk sharing, since it implies that a large proportion of shocks to idiosyncratic output is transferred to consumption.

Table 2 reports the estimates for model (3) in its first column. In line with the findings of the correlations approach, it shows that β_1 is less than one indicating consumption risk sharing. More precisely, the period 1970-2007 was characterised by household consumption being partially insulated from idiosyncratic shocks to output. On average, 50 per cent of an idiosyncratic shock to output translated into a shift in consumption.

As in the previous section, we also estimated Equation (3) for consumption and output vis-à-vis different rest-of-world benchmarks. In line with the above results, the size of β_1 is always smaller than one with its magnitude varying across benchmarks. For instance, models taking the UK or EMU members as benchmarks suggest a low degree of risk sharing. By contrasts, models using the US or FDI weighted rest-of-world benchmarks show a larger degree of risk sharing.[8]

To account for potential changes in the degree of risk sharing associated with the European integration process, we augment the above model using period dummies and interaction terms as shown in Equation (4).

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[8] t-tests based on Monte Carlo simulations indicate that the β_1 coefficients obtained for each of the rest-of-world benchmark are statistically different from each other.

Table 2: *Idiosyncratic Consumption as Dependent Variable*

(c-c*)	(1)	(2)	(3)	(4)
(y-y*)	0.50***	0.22	0.41***	0.22
	(0.12)	(0.13)	(0.14)	(0.14)
D1993		0.98		0.19
		(0.86)		(0.98)
D1993x(y-y*)		0.34		0.39
		(0.23)		(0.32)
D1999			0.90	0.82
			(0.91)	(1.15)
D1999x(y-y*)			0.26	0.06
			(0.23)	(0.35)
R^2	0.28	0.39	0.35	0.40

Note: Robust standard errors in parentheses. ***, ** and * indicate significant at 1 per cent, 5 per cent and 10 per cent respectively. All models include a constant. Idiosyncratic output growth is constructed using World total in the UN database excluding Ireland. Standard tests indicate that the residuals of these regressions are well behaved. They are uncorrelated and homoscedastic.

$$c_t - c_t^* = \beta_0 + \beta_1 \, (y_t - y_t^*) + (\beta_2 + \beta_3^i \, (y_t - y_t^*)) \, D_t^i + \varepsilon_t, \, i = 1993, \, 1999 \quad (4)$$

D_t^{1993} is a period dummy variable that takes value one for the 1993-2007 years and zero otherwise, while D_t^{1999} takes value one for the EMU years (1999-2007) and zero otherwise. Thus, coefficients β_3^i will capture the change in international risk sharing vis-à-vis the preceding periods. When D_t^{1993} is included the baseline period will be 1970-1992. When D_t^{1999} is included, the baseline period will be 1970-1998. By contrast, when both period dummies are included simultaneously, β_3^{1993} will capture the change in risk sharing vis-à-vis 1970-1992 while β_3^{1999} will measure the change in risk sharing vis-à-vis risk sharing in 1970-1992 plus the change in 1993-1998. Thus, the inclusion of two period dummies will allow for two breaks in the risk sharing coefficient.[9]

Columns (2) to (4) of Table 2 present the regression outputs of these models including the above dummy variables individually and simultaneously.

Column (2) shows that the coefficient on idiosyncratic output (β_1) is statistically zero for the 1970-1992 period with a point estimate of 0.22. The interaction term between output growth differentials and the period dummy is also statistically zero, suggesting that the Maastricht Treaty was not

[9] Alternatively, one could allow for more time variation in the risk sharing coefficient and estimate a model by the Kalman filter approach, a rolling regression or a regime switching model. However, the interest here is not on the time variation of risk sharing per se. By contrast, we are interested in how risk sharing may have been associated with the European integration process.

associated with a change in risk sharing. Column (3) presents the estimates of a model using the EMU period dummy. In contrast to the previous case, the early period (1970-1998) shows a point estimate for β_1 which is statistically different from zero. Its value of 0.41 indicates that less than a half of a shock to idiosyncratic output transfers to consumption. Since the coefficient associated with the interaction term is statistically zero, this model suggests that there was no change in the degree of risk sharing in the EMU years. These results are in line with the findings of Demyanyk *et al.* (2008) that the EMU did not alter consumption risk sharing in member countries.[10]

Column (4) includes both dummy variables simultaneously. As shown in Table 2, the coefficients associated with idiosyncratic output growth and interaction terms are statistically zero suggesting that risk sharing did not change.[11]

As in the previous section, we also take a closer look at the role of alternative benchmark groups for the construction of the idiosyncratic components of consumption and output. To this end, Table 3 reports the model estimated in column (4) of Table 2 for each benchmark. As in the baseline model, the first period exhibits evidence of risk sharing with its degree varying across different benchmark groups. In most cases, β_1 is statistically zero. The lowest degree of risk sharing for the 1970-1992 period emerges in the model using the UK as benchmark. Here, more than half of a shock to output transfers to consumption. For the case of the interactions with the period dummies, none of the coefficients is statistically significant.

Taken together, these models give further evidence of consumption risk sharing. However, we are unable to identify shifts associated with the relevant dates for the European integration process.

In the context of the Irish economy, it could be argued that the change in household wealth, and more specifically, house prices may have affected international risk sharing. In particular, the recent boom in Irish house prices may have drifted international investments towards the domestic economy. This affects international risk sharing by making investors more exposed to

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[10] In order to study the EMU effect on risk sharing, this paper focuses on bilateral co-movements in consumption among pairs of advanced countries and looks at the EMU effect by interacting idiosyncratic output growth with an EMU dummy variable. The evidence produced by papers following this same strategy but using different data types and sources is mixed. Using Penn World Tables data for consumption and GDP, Gerlach and Hoffmann (2008) find that the EMU has improved risk sharing while Lane (2009) in a later paper confirms these results only when the same data are used. When the source is the UN, Lane (2009) finds no evidence of an EMU effect on risk sharing, as we do in this paper.

[11] Alternatively, we also estimated a panel version of all these models but taking bilateral consumptionand output growth differentials for three groups of countries: advanced, EU and EMU. The results produced by this alternative strategy are in line with our previous findings.

Table 3: *Two Sample Breaks: Idiosyncratic Consumption as Dependent Variable. Alternative Rest-of-World Benchmarks*

(c-c*)	(1) PI	(2) BANK	(3) FDI	(4) TRADE	(5) ADV	(6) EU14	(7) EMU11	(8) US	(9) UK
(y-y*)	0.23	0.31*	0.20	0.31*	0.18	0.27	0.23	0.23	0.53***
	(0.18)	(0.18)	(0.19)	(0.18)	(0.20)	(0.21)	(0.22)	(0.23)	(0.18)
D1993	0.61	0.64	0.49	0.48	0.33	1.05	1.22	0.24	0.48
	(1.09)	(1.00)	(0.94)	(0.93)	(1.13)	(1.55)	(1.84)	(0.81)	(0.93)
D1993x(y-y*)	0.28	0.19	0.23	0.23	0.38	0.23	0.26	0.27	0.03
	(0.35)	(0.33)	(0.35)	(0.33)	(0.37)	(0.41)	(0.45)	(0.38)	(0.26)
D1999	0.75	0.85	1.60	1.15	0.75	0.80	1.00	0.37	0.67
	(1.64)	(1.59)	(1.78)	(1.48)	(1.55)	(1.95)	(2.18)	(1.22)	(1.39)
D1999x(y-y*)	0.05	0.03	−0.09	−0.03	0.07	0.01	−0.02	0.15	0.05
	(0.41)	(0.39)	(0.45)	(0.38)	(0.39)	(0.43)	(0.46)	(0.38)	(0.34)
R^2	0.41	0.41	0.36	0.40	0.42	0.44	0.47	0.31	0.40

Note: Robust standard errors in parentheses. ***, ** and * indicate significant at 1 per cent, 5 per cent and 10 per cent respectively. All models include a constant. Coefficients associated with (y-y*), D1993x(y-y*) and D1999x(y-y*) are jointly significant at standard confidence levels in most models. The exceptions are those in FDI and EMU11, with associated p-values of 0.26 and 0.11, respectively. Standard tests indicate that the residuals of these regressions are well behaved. They are uncorrelated and homoscedastic.

idiosyncratic shocks to the Irish economy. This could be one reason why Ireland was hit disproportionately by the recent financial crisis.

To take this into account, we have estimated models that control for the developments in the housing sector. We do this by including the change in house prices as an additional explanatory variable in the baseline model. The findings are in line with the above line of reasoning. Once changes in house prices are accounted for, the magnitude of the risk sharing coefficients fall suggesting that Ireland's risk sharing profile in the years before the crisis was worsened by the boom in house prices.[12] This sheds light on one of the determinants of risk sharing and reinforces the evidence reported above indicating that Ireland was able to diversify risk internationally in the period before the crisis. However, risk sharing was negatively affected by the boom in house prices.

[12] These results also show that the change in housing wealth was correlated with the change in idiosyncratic consumption. All estimated models, following the specifications in Table 2, exhibit house price coefficients which are statistically different from zero. These results are available upon request.

In summary, the regression analysis provides further evidence of consumption risk sharing in the 1970-2007 period. When we include both period dummies and the associated interactions terms, the coefficients linking idiosyncratic output growth with consumption become statistically zero in most cases.[13]

These findings seem at odds with the increase in financial globalisation experienced by Ireland. However, they are consistent with the findings of Artis and Hoffmann (2008a) showing that consumption-based indicators are unable to pick up the increase in risk sharing. The reason for this is that consumption has been affected by the decline in output volatility of advanced countries after the 1980s and that this period was associated with a more gradual response of output to idiosyncratic shocks.

Since consumption responds to permanent innovations, it appears to be more volatile in relation to the shifts in output. Moreover, the fact that global shocks became less volatile in the years preceding the crisis prevented international consumption correlations to increase as international financial linkages became stronger.

3.2.2 Investment Income Risk Sharing

A complementary approach for the assessment of risk sharing is to focus on income sharing. While consumption risk sharing deals with ex post risk sharing, through savings and dis-savings, income risk sharing deals with ex ante risk sharing and as a result, is more related to contingent assets. Although complementary, this approach has two main advantages with respect to the consumption based approach. First, national income data is easier to measure and, therefore, it is less subject to measurement errors. Second, this strategy is immune to the problems associated with changes in consumption preferences.

Taking this into account, this section studies whether international income flows help stabilise Ireland's GDP fluctuations. More specifically, we look for evidence of net income inflows increasing when Ireland's GDP growth falls relative to the rest of the world.

This is of particular interest in the context of the Irish economy because a large share of its GDP is generated by multinational firms. Accordingly, Figure 3 shows that GDP was larger than GNI during most of the years considered here. Its ratio exhibited a negative trend that lasted until 2002, where GDP was greater than GNI by a factor of 1.2. Although this negative trend was reversed in subsequent years, the GNI/GDP ratio started falling again in 2007 with a minimum in 2009. In that year GDP was more than 23 per cent larger than GNI.

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[13] These results also emerge when the data are in per capita terms.

Figure 3: $\dfrac{GNI}{GDP}$ Ratio
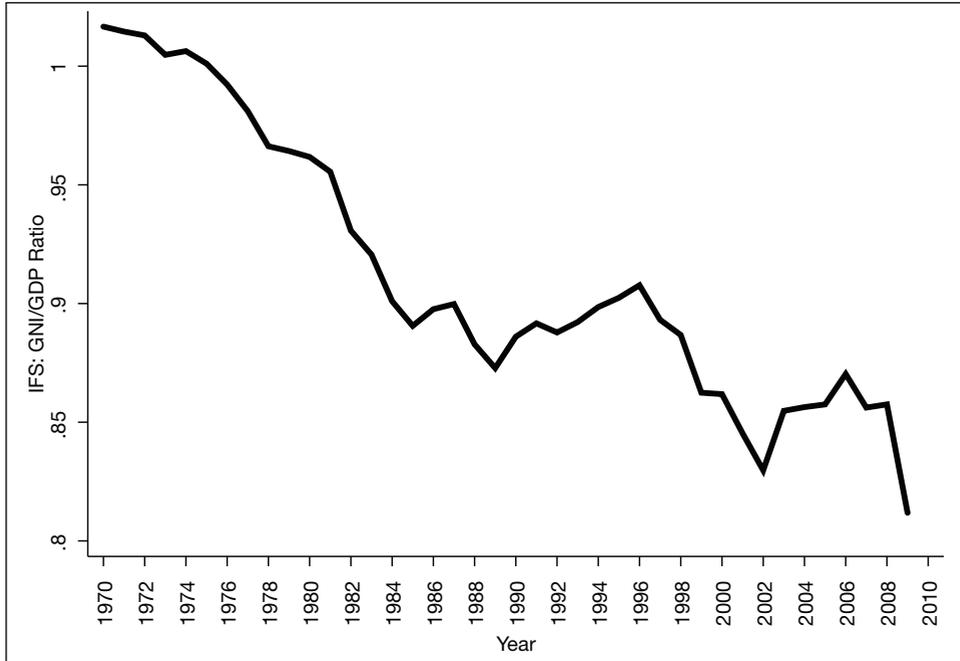
Source: Author's calculations based on IMF and OECD data.

Following the previous section we present a set of regression estimates to analyse the conditional correlations between the change in the GNI/GDP ratio and GDP growth deviations from different rest-of-world measures. Column (1) of Table 4 presents the baseline estimates taking the full period and the world total excluding Ireland as the rest-of-world benchmark. It shows that a very low proportion of the GNI/GDP variance can be explained by the variance in output growth deviations.

By contrast, the inclusion of interaction terms between the period dummies and output growth, in columns (2) and (3), importantly improves the performance of these models. Here, the interaction terms between output growth and the period dummies suggest that income risk sharing changed. The coefficients are negative indicating that increases in net income flows were associated with decelerations in relative output indicating more risk sharing associated with the European integration process.

As in the consumption-based case, column (4) of Table 4 and Table 5 present the estimates of models including both period dummies simultaneously. These give evidence of the income risk sharing improvement being

Table 4: *ln(GNI/GDP) as Dependent Variable*

$\Delta \ln \left(\frac{GNI}{GDP} \right)$	(1)	(2)	(3)	(4)
(y-y*)	–0.02	0.07	0.05	0.07
	(0.08)	(0.11)	(0.08)	(0.11)
D1993		2.05**		2.11***
		(0.79)		(0.57)
D1993x(y-y*)		–0.46**		–0.35*
		(0.19)		(0.18)
D1999			2.36**	0.37
			(1.05)	(1.17)
D1999x(y-y*)			–0.69***	–0.35
			(0.21)	(0.24)
R^2	0.002	0.22	0.24	0.31

Note: Robust standard errors in parentheses. ***, ** and * indicate significant at 1 per cent, 5 per cent and 10 per cent respectively. All models include a constant. Standard tests indicate that the residuals of these regressions are well behaved. They are uncorrelated and homoscedastic.

Table 5: *Two Sample Breaks: ln(GNI/GDP) as Dependent Variable.*
Alternative Rest-of-World Benchmarks

$\Delta \ln \left(\frac{GNI}{GDP} \right)$	(1) PI	(2) BANK	(3) FDI	(4) TRADE	(5) ADV	(6) EU14	(7) EMU11	(8) US	(9) UK
(y-y*)	0.03	0.03	0.01	0.04	0.03	–0.01	–0.03	0.06	0.07
	(0.11)	(0.10)	(0.11)	(0.11)	(0.11)	(0.10)	(0.10)	(0.10)	(0.09)
D1993	2.05***	2.01***	1.84***	1.94***	2.12***	2.34***	2.45***	1.50***	1.80***
	(0.55)	(0.52)	(0.52)	(0.49)	(0.57)	(0.61)	(0.67)	(0.43)	(0.46)
D1993x(y-y*)	–0.29*	–0.29*	–0.26	–0.29*	–0.31*	–0.29*	–0.28	–0.25	–0.29**
	(0.17)	(0.16)	(0.18)	(0.16)	(0.18)	(0.17)	(0.17)	(0.17)	(0.14)
D1999	1.75	1.65	1.84	1.59	1.59	1.11	0.96	2.25	1.47
	(1.53)	(1.49)	(1.59)	(1.44)	(1.50)	(1.51)	(1.53)	(1.66)	(1.34)
D1999x(y-y*)	–0.56*	–0.55*	–0.59*	–0.55*	–0.53*	–0.43	–0.40	–0.69*	–0.53*
	(0.29)	(0.28)	(0.32)	(0.28)	(0.29)	(0.26)	(0.25)	(0.38)	(0.28)
R^2	0.29	0.28	0.26	0.29	0.31	0.25	0.24	0.34	0.29

Note: Robust standard errors in parentheses. ***, ** and * indicate significant at 1 per cent, 5 per cent and 10 per cent respectively. All models include a constant. Standard tests indicate that the residuals of these regressions are well behaved. They are uncorrelated and homoscedastic.

associated with the Maastricht Treaty and EMU periods for many rest-of-world benchmarks.

These finding are in line with Sørensen *et al.* (2007) reporting evidence of income smoothing after 1990 in advanced countries and Demyanyk *et al.* (2008) finding that the pass-through from gross domestic product shocks to gross national income declined in the EMU years for Euro Area members. Moreover, these results are in line with the findings of Artis and Hoffmann (2008b) showing that consumption risk sharing has importantly increased in OECD countries through international investment income flows.

IV CONCLUSIONS

This paper provides new correlation- and regression-based evidence on international consumption and income risk sharing in Ireland, which is robust to alternative strategies for the construction of idiosyncratic consumption and output.

We look at the 1970-2007 period to learn about the Irish risk sharing profile in tranquil times. As such, these findings can be used to assess how different the impact of the recent crisis would have been in the absence of risk sharing. More precisely, we provide an empirical benchmark that can be used for the study of the Irish economy going forward as well as for cross-country comparisons. In addition, we assess whether the evolution of different risk sharing indicators was associated with the European integration process.

Our findings show that idiosyncratic output shocks did not fully transfer to consumption and national income. In addition, we find that consumption risk sharing was not associated with the institutional developments of the European integration process, namely the Maastricht Treaty and EMU periods. By contrast, we find evidence of a link between these and improvement in income risk sharing.

REFERENCES

ACEMOGLU, D. and F. ZILIBOTTI, 1997. "Was Prometheus Unbound by Chance? Risk, Diversification and Growth", *Journal of Political Economy*, Vol. 105, pp. 709-751.

ARTIS, M. J. and M. HOFFMANN, 2008a. "Financial Globalization, International Business Cycles and Consumption Risk Sharing", *The Scandinavian Journal of Economics*, Vol. 110, No. 3, pp. 447-471.

ARTIS, M. J. and M. HOFFMANN, 2008b. "The Home Bias and Capital Income Flows between Countries and Regions", IEW Working Paper No. 316.

ASDRUBALI, P., B. SØRENSEN and O. YOSHA, 1996. "Channels of Interstate Risk
    Sharing: United States 1963-90", *Quarterly Journal of Economics*, Vol. 111,
    pp. 1081-1110.
BACKUS, D., P. KEHOE and F. KYDLAND, 1992. "International Real Business
    Cycles", *Journal of Political Economy*, Vol. 100, No. 4, pp. 745-775.
BACKUS, D., P. KEHOE and F. KYDLAND, 1995. "International Real Business
    Cycles: Theory and Evidence" in T. F. Cooley (ed.), *Frontiers of Business Cycle
    Research*, Princeton, NJ: Princeton University Press.
CORCORAN, A., 2008. "International Financial Integration and Consumption Risk
    Sharing", IIIS Discussion Paper 241.
CRUCINI, M., 1999. "On International and National Dimensions of Risk Sharing",
    Review of Economics and Statistics, Vol. 81, pp. 73-84.
DEMYANYK, Y., C. OSTERGAARD and B. E. SØRENSEN, 2008. "Risk Sharing and
    Portfolio Allocation in EMU", European Economic Policy Papers No. 334.
DEVEREUX, M. and M. SAITO, 1997. "Growth and Risk-Sharing with Incomplete
    International Asset Markets", *Journal of International Economics*, Vol. 42,
    pp. 453-481.
FUHRER, J. and M. KLEIN, 2006. "Risky Habits: On Risk Sharing, Habit Formation,
    and the Interpretation of International Consumption Correlations", *Review of
    International Economics*, Vol. 14, No. 4, pp. 722-740.
GERLACH, S. and M. HOFFMANN, 2008. "The Impact of the Euro on International
    Stability and Volatility", Directorate General Economic and Monetary Affairs.
    European Commission Economic Paper No. 309.
HEATHCOTE, J. and F. PERRI, 2004. "Financial Globalization and Real Regionaliza-
    tion", *Journal of Economic Theory*, Vol. 119, pp. 207-243.
HESS, G. and K. SHIN, 1997. "International and Intranational Business Cycles",
    Oxford Review of Economic Policy, Vol. 13, pp. 93-109.
IMBS, J., 2006. "The Real Effects of Financial Integration", *Journal of International
    Economics*, Vol. 68, pp. 296-324.
KOSE, M. A., E. S. PRASAD and M. E. TERRONES, 2007. "How Does Financial
    Globalization Affect Risk Sharing? Patterns and Channels", IZA Discussion Paper
    2903.
LABHARD, V. and M. SAWICKI, 2006. "International and Intranational Consumption
    Risk Sharing: The Evidence for the UK and OECD", Bank of England Working
    Paper 302.
LANE, P. R., 2000. "International Diversification and the Irish Economy", *The
    Economic and Social Review*, Vol. 31, No. 1, pp. 37-53.
LANE, P. R., 2001. "Do International Investment Income Flows Smooth Income?",
    Review of World Economics, Vol. 137, No. 4, pp. 714-736.
LANE, P. R., 2006. "Global Bond Portfolios and EMU", *International Journal of
    Central Banking*, Vol. 2, No. 2, pp. 1-24.
LANE, P. R., 2009. "EMU and Financial Integration" in *The Euro at Ten – Lessons and
    Challenges*, 5th ECB Central Banking Conference Volume.
LANE, P. R. and G. M. MILESI-FERRETTI, 2001. "The External Wealth of Nations:
    Measures of Foreign Assets and Liabilities for Industrial and Developing
    Nations", *Journal of International Economics*, Vol. 55, pp. 263-294.
LANE, P. R. and G. M. MILESI-FERRETTI, 2007. "The External Wealth of Nations
    Mark II", *Journal of International Economics*, Vol. 73, pp. 223-250.

LANE, P. R. and G. M. MILESI-FERRETTI, 2007. "The International Equity Holdings of Euro Area Investors" in R. Anderton and F. di Mauro (eds.), *The Importance of the External Dimension for the Euro Area: Trade, Capital Flows, and International Macroeconomic Linkages*, Cambridge: Cambridge University Press.

LEWIS, K., 1996. "What Can Explain the Apparent Lack of International Consumption Risk Sharing?", *The Journal of Political Economy*, Vol. 104, No. 2, pp. 267-297.

MOSER, G., W. POINTNER and J. SCHARLER, 2003. "International Risk Sharing in Europe: Has Anything Changed?" in J. Christl and P. Mooslechner (eds.), *The Economic Potential of a Larger Europe*, Cheltenham and Northampton, MA: Edward Elgar.

OBSTFELD, M., 1989. "How Integrated are World Capital Markets? Some New Tests" in G. Calvo, R. Findlay, P. Kouri and J. Braga de Macedo (eds.), *Debt, Stabilization and Development: Essays in Memory of Carlos Diaz-Alejandro*, Oxford: Basil Blackwell.

OBSTFELD, M., 1994. "Risk-Taking, Global Diversification and Growth", *American Economic Review*, Vol. 84, pp. 310-329.

OBSTFELD, M., 1995. "International Capital Mobility in the 1990s" in P. Kenen (ed.), *Understanding Interdependence: The Macroeconomics of the Open Economy*, Princeton, NJ: Princeton University Press.

OBSTFELD, M. and K. ROGOFF, 2001. "The Six Major Puzzles in International Macroeconomics: Is There a Common Cause?" in *NBER Macroeconomics Annual 2000*, Vol. 15, pp. 339-412.

RAVN, M., 2001. "Consumption Dynamics and Real Exchange Rates", CEPR Discussion Paper 2940.

SCHMITZ, M., 2010. "Financial Markets and International Risk Sharing", *Open Economies Review*, Vol. 21, No. 3, pp. 413-431.

SØRENSEN, B. and O. YOSHA, 1998. "International Risk Sharing and European Monetary Unification", *Journal of International Economics*, Vol. 45, pp. 211-238.

SØRENSEN, B., O. YOSHA and Y. ZHU, 2007. "Home Bias and International Risk Sharing: Twin Puzzles Separated at Birth", *Journal of International Money and Finance*, Vol. 26, No. 4, pp. 587-605.

STOCKMAN, A. and L. TESAR, 1995. "Tastes and Technology in a Two-country Model of the Business Cycle: Explaining International Co-movements", *American Economic Review*, Vol. 85, pp. 168-185.

YAKHIN, Y., 2005. "Risk Sharing and the International Consumption Correlation Puzzle", University of California, Los Angeles, mimeo.