Macroeconomic Issues

The Impact of the EMU on Channels of Risk Sharing between Member Countries

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We estimate the amount of income and consumption smoothing (risk sharing) between countries in the European Monetary Union (EMU) and between other developed countries during the period 1970–2003. In particular, we examine if EMU countries display different patterns of risk sharing than other developed countries in the period leading up to and following the formation of the EMU in 1999. We find that income smoothing from international factor income has increased in the EMU since the introduction of the EMU and that consumption smoothing from procyclical government saving has declined steeply in the EMU since the signing of the Maastricht treaty

Introduction

Income and consumption smoothing between states in a monetary union are potentially important for the functioning of the union because monetary policy is unable to address "asymmetric" shocks, where some countries experience negative shocks while others are booming. Sala-i-Martin and Sachs (1992) suggested that the risk sharing provided to states by the U.S. federal government may be essential in making the United States a successful "monetary union."[1]

We refer to the situation where consumption grows at identical rates in all countries as full risk sharing. We refer to the growth rate of a country-level variable minus the union-wide counterpart as the "idiosyncratic" growth-rate and we say that risk sharing is higher the less idiosyncratic consumption growth co-varies with idiosyncratic income growth. There are different ways that countries can obtain risk sharing which we refer to as channels of risk sharing. The main channels are cross-ownership of assets that "smooth" income (making income growth in a country less sensitive to output growth in that country), transfers that smooth disposable income for given income, and borrowing and lending that smooth consumption for given disposable income. Asdrubali, Sørensen, and Yosha (1996) (ASY) derived a simple way of quantifying the relative contributions of various channels of income and consumption smoothing within a common framework. ASY found, for U.S. states, that market institutions provide the bulk of risk sharing through income smoothing Sorensen and Yosha (1998) (SY) used similar methods to evaluate channels of risk sharing between EU and OECD countries and found that the bulk of risk sharing was provided by procyclical government saving with some risk sharing provided by corporate saving at shorter horizons.

In this paper, we explore risk sharing patterns among EMU countries and, for comparison, long-standing non-EMU European Union (EU)-countries as well as other developed countries in the Organization for Economic Cooperation and Development (OECD). Our paper updates and expands on the results of SY.

Mundell (1961) defined an optimum currency area as one where internal factor mobility is high although two other criteria may be as important as labor mobility in the face of adverse idiosyncratic country shocks. One obvious criteria is whether such asymmetry is prevalent. Frankel and Rose (1998), in a provocative article, argued that countries that this criteria may actually be endogenous to the formation of currency unions: A currency union is likely to generate more trade among its members and Frankel and Rose find that "more trade" leads to less asymmetry between the trading countries.

It is feasible, indeed likely, that risk sharing is also endogenous to the formation of a currency union.[2] A common currency is likely to reduce the costs of trading or information gathering in asset trade and therefore lead to higher cross-ownership of financial assets. The removal of currency risk may further stimulate foreign direct investment and the integration of bond markets—already documented for the EMU see, for example, Adam et al. (2002) and Baele et al. (2004)—will imply deeper and more liquid markets for borrowing and lending.[3]

Less obvious is how important these effects are quantitatively for, in particular, the EMU. Six years have passed since the adoption of the Euro and while integration of financial

[1] See also von Hagen (1992), Atkeson and Bayoumi (1993), Goodhart and Smith (1993), and Bayoumi and Masson (1995).

[2] De Grauwe and Mongelli (2005) consider more generally how the criteria for optimally of currency areas may be endogenous and provides evidence from the EMU.

[3] Sørensen, Wu, Yosha, and Zu (2005) show that larger holdings of foreign assets are associated with more international risk sharing. Demyanyk, Ostergaard, and Sørensen (2005) demonstrate that the integration of the banking markets of U.S. states was following by increasing income smoothing.

markets likely takes time to evolve making it to early to draw definitive conclusions, we can get a preliminary reading.[4]

We find that smoothing through factor income flows—resulting from international crossownership of assets—has increase steeply in the EMU. On the other hand, smoothing of consumption through government counter-cyclical saving has virtually disappeared for the group of EMU countries leading to less overall risk sharing. Whether this pattern is due to the constraints on fiscal deficits imposed by the Growth and Stability pact and whether it is a permanent pattern remains to be seen as the monetary union matures.

Full risk sharing and perfect consumption smoothing: Theory

The basic theory of international risk sharing is well known—see Obstfeld and Rogoff (1996)—and we only outline the basic ideas for endowment economies. We think of GDP as a homogeneous tradable good. The period t per capita output of country i is an exogenous random variable with a commonly known probability distribution. Let the representative consumer of each country be a risk averse expected utility maximizer who derives utility from consumption.[5] Assume that consumers within each country are identical with felicity ranked by Constant Relative Risk Aversion utility function and that perfect Arrow-Debreu markets for contingent claims exist. Optimal consumption then satisfies the full risk sharing relation $c_t^i = k^i \ C_t^W$, where ki is a country specific constant, c_t^i is country i per capita consumption, and C_t^W is world per capita consumption in period t. An implication is that when risk is fully shared among countries, the consumption of a country comoves with world consumption but not with country specific shocks.

If the period t utility function of country i is $\theta_t^i u(\cdot)$ where θ_t^i is an idiosyncratic taste shock (normalized so that $\Sigma_i(1/\theta_t^i) = 1$ in all periods), then consumption, assuming perfect markets for contingent output, will satisfy the relation $c_t^i = \theta_t^i \ k^i \ C_t^W$, in any state of nature. Consumption in country i is no longer a fixed fraction of world consumption, as is the case when there are no idiosyncratic taste shocks, but the central property of equation (1) is preserved—the consumption of country i is affected by aggregate shocks and by idiosyncratic taste shocks, but not by other idiosyncratic shocks (including income shocks).

The testable implication that we will focus on is that consumption growth rates are identical for all countries; i.e.,

$$\Delta \log c_t^i = c \ + \ \Delta \log C_t^W \ + \ \epsilon_{it},$$

where c is a constant and ϵ_{it} is an error term—due to either taste shocks or noise—which is uncorrelated with output growth.

[4] Shocks to the EMU economies have become more shallow in the last decade as documented by, for example, Ginannone and Reichlin (2005)—potentially reducing the importance of risk sharing. This reduced volatility seems to be a world-wide phenomenon and the reasons for it are not well understood, leaving open the possibility that this is a temporary pattern.

[5] We do not consider non-separabilities in the utility function between consumption and leisure or nontradable output. See Canova and Ravn (1996) and Lewis (1996) for a treatment of these issues in the context of international risk sharing.

Regression based tests for full risk sharing at the country level were conducted by Obstfeld (1994), Canova and Ravn (1996) and Lewis (1996).[6] A comprehensive survey of research on international diversification is provided in Lewis (1995).[7]

Even if full risk sharing is rejected it is important to quantify the extent to which risk is shared within a group of economic agents, countries in our case. It is also interesting to identify the exact channels through which risk is shared, and to quantify the amount of risk sharing obtained via each channel. ASY developed a method for answering these questions. The method takes equation (1) as a benchmark, and quantifies the deviation from this benchmark, interpreting the deviation as the amount of risk that is not shared. We turn to a presentation of the conceptual framework and the method of measuring deviations from the full risk sharing allocation.

Channels of Income Insurance and Consumption Smoothing

There are several mechanisms for sharing risk among countries. The most natural way or sharing risk internationally is through international income diversification; i.e., through cross-border ownership of productive assets. Net income from foreign assets is reflected in the National Accounts data as the difference between Gross Domestic Product (GDP) and Gross National Income (GNI).[8]

If risk is fully shared through this channel GNI will satisfy equation (1):

$$\Delta \log \mathrm{GNI}_t^i = c + \Delta \log \mathrm{GNI}_t^{\mathrm{W}} + \epsilon_{it}. \quad (2)$$

If risk is not fully shared through factor income flows, GNI does not satisfy equation (1) and there may be scope for further income smoothing. One source of income smoothing is simply that the amount of depreciation doesn't vary one-to-one with GDP—this source of risk sharing is not very interesting but it is included because we want to consider all "wedges" between GDP and consumption. GNI minus depreciation is (net) National Income (NI). Income can further be smoothed through international transfers. We refer to NI plus net (incoming) international transfers as Disposable National Income (DNI).

If DNI is not perfectly diversified there is room for consumption smoothing through procyclical saving behavior. Individuals decide on their saving in order to smooth consumption intertemporally. If the shocks to GDP that are not smoothed through international factor income flows are highly persistent, individuals may—if there behavior is guided by permanent income considerations—-optimally choose to engage in very little consumption smoothing through saving although patterns of life-cycle saving may or may not help smooth consumption. If the shocks to GDP that are not smoothed through international factor income flows are transitory, individuals will optimally choose to engage in much consumption smoothing through saving.[9]

[6] The first tests for full risk sharing, using individual-level data were performed by Cochrane (1991), Mace (1991) and Townsend (1994).

[7] The International Real Business Cycle literature, most notably Backus, Kehoe, and Kydland (1992), Baxter and Crucini (1995) and Stockman and Tesar (1995) have examined the of full risk sharing in the absence of taste shocks, that the correlation of consumption across countries should be equal to unity. The data are, however, far from confirming that prediction.

[8] GNI was previously called Gross National Product (GNP).

[9] Baxter and Crucini's (1995) showed that even if is no income insurance through factor income flows but a riskless asset that can be traded then, if shocks to GDP are transitory, equation (1) will be closely approximated. That is, when shocks to GDP are transitory, a riskless bond (the credit market) is a close substitute for income insurance (i.e. for capital markets). In contrast, if shocks to GDP are highly persistent, consumption smoothing

The variance decomposition described below allows us to measure the fraction of shocks to GDP that are smoothed through international factor income flows, through saving, and the fraction of shocks that are not smoothed, namely, the residual deviation of the international consumption allocation from equation (1), the full risk sharing benchmark.

Decomposing the Cross-Sectional Variance of Shocks to GDP

We turn to the cross-sectional variance decomposition of shocks to GDP—for further details and interpretation see ASY or SY. Consider the identity, holding for any period t,

$$\mathrm{GDP}^i = \frac{\mathrm{GDP}^i}{\mathrm{GNI}^i}\frac{\mathrm{GNI}^i}{\mathrm{NI}^i}\frac{\mathrm{NI}^i}{\mathrm{DNI}^i}\frac{\mathrm{DNI}^i}{\mathrm{C}^i+\mathrm{G}^i}(\mathrm{C}^i+\mathrm{G}^i),$$

where all the magnitudes are in per capita terms, and i is an index of countries. To stress the cross-sectional nature of our derivation, we suppress the time index.

Now take logs and differences on both sides of (3), multiply both sides by _log GDPi (minus its mean) and take the cross-sectional average, obtaining the variance decomposition

$$\begin{aligned}\mathrm{var}\{\Delta\log \mathrm{GDP}^i\} \;=\;& \mathrm{cov}\{\Delta\log \mathrm{GDP}^i-\Delta\log \mathrm{GNI}^i,\Delta\log \mathrm{GDP}^i\}\\ &+\mathrm{cov}\{\Delta\log \mathrm{GNI}^i-\Delta\log \mathrm{NI}^i,\Delta\log \mathrm{GDP}^i\}\\ &+\mathrm{cov}\{\Delta\log \mathrm{NI}^i-\Delta\log \mathrm{DNI}^i,\Delta\log \mathrm{GDP}^i\}\\ &+\mathrm{cov}\{\Delta\log \mathrm{DNI}^i-\Delta\log(\mathrm{C}^i+\mathrm{G}^i),\Delta\log \mathrm{GDP}^i\}\\ &+\mathrm{cov}\{\Delta\log(\mathrm{C}^i+\mathrm{G}^i),\Delta\log \mathrm{GDP}^i\}\ .\end{aligned}$$

In this equation "var { X }" and "cov { X,Y }" denote the statistics $\frac{1}{N}\sum_{i=1}^{N}(\mathrm{X}^i-\bar{\mathrm{X}})^2$ and $\frac{1}{N}\sum_{i=1}^{N}(\mathrm{X}^i-\bar{\mathrm{X}})(\mathrm{Y}^i-\bar{\mathrm{Y}})$, respectively, where N is the number of countries in the sample. Dividing by $\mathrm{var}\{\Delta\log \mathrm{GDP}^i\}$ we get

$$1=\beta_f+\beta_d+\beta_\tau+\beta_s+\beta_u, \qquad (4)$$

where, for example,

$$\beta_f=\frac{\mathrm{cov}\{\Delta\log \mathrm{GDP}^i-\Delta\log \mathrm{GNI}^i,\Delta\log \mathrm{GDP}^i\}}{\mathrm{var}\{\Delta\log \mathrm{GDP}^i\}} \qquad (5)$$

is the ordinary least squares estimate of the slope in the cross-sectional regression of $\Delta\log \mathrm{GDP}^i-\Delta\log \mathrm{GNI}^i$ on $\Delta\log \mathrm{GDP}^i$ and similarly for $\beta_d,\ \beta_\tau,$ and β_s. The last coefficient in the decomposition is given by:

through trade in a riskless bond will not approximate the allocation in equation (1), namely, the credit market will not closely mimic the role of capital markets—shocks that were not insured ex-ante on capital markets will not be smoothed ex-post on credit markets.

$$\beta_u = \frac{\text{cov}\{\Delta \log(\text{C}^i + \text{G}^i), \Delta \log \text{GDP}^i\}}{\text{var}\{\Delta \log \text{GDP}^i\}}, \qquad (6)$$

which is the ordinary least squares estimate of the slope in the cross-sectional regression $\Delta \log(\text{C}^i + \text{G}^i)$ on $\Delta \log \text{GDP}^i$.

We turn to the predictions of the theory regarding the signs and magnitudes of these coefficients. If there is full risk sharing, that is, if equation (1) holds, then $\text{cov}\{\Delta \log(\text{C}^i + \text{G}^i), \Delta \log \text{GDP}^i\} = 0$, and hence $\beta_u = 0$. If full risk sharing is not achieved, then consumption in country i varies positively with idiosyncratic shocks to country i's output, and $\beta_u > 0$. A cross-sectional regression of consumption on output, controlling for fluctuations in world consumption is, therefore, a test of full risk sharing.[10]

If full risk sharing is achieved through income insurance via factor income flows, GNI will satisfy equation (1). Then $\text{cov}\{\Delta \log \text{GNI}^i, \Delta \log \text{GDP}^i\} = 0$ and hence, $\text{cov}\{\Delta \log \text{GDP}^i - \Delta \log \text{GNI}^i, \Delta \log \text{GDP}^i\} = \text{var}\{\Delta \log \text{GDP}^i\}$, implying $\beta_f = 1$. Moreover, in this case, since consumers in each country consume their GNI, namely, $\text{C}^i = \text{GNI}^i$, consumption satisfies equation (1) implying $\beta_u = 0$.[11]

Suppose that full risk sharing is not achieved through income insurance via factor income flows and capital depreciation, but is achieved through the combination of factor income flows, depreciation, and international transfers. Then DNI will satisfy equation (1) and, by analogous reasoning, $\beta_f + \beta_d + \beta_\tau = 1$, and since consumers in each country will consume their DNI, $\beta_u = 0$. Similarly, if the full risk sharing allocation is achieved through factor income flows, depreciation, international transfers, and saving, C+G will satisfy equation (1). Then, by analogous reasoning, $\beta_f + \beta_d + \beta_\tau + \beta_s = 1$ and $\beta_u = 0$.

β_u is the fraction of shocks to GDP that is not smoothed. The coefficients β_f, β_d, β_τ, and β_s are interpreted as the fraction of shocks absorbed through factor income flows, depreciation, international transfers, and saving, respectively. If consumption satisfies equation (1), they sum to unity and $\beta_u = 0$. If not, they sum to less than unity. In either case, they reflect the incremental amount of smoothing achieved through the various channels discussed above.

We not impose any restrictions on the sign of the β-coefficients. If a country that is hit by a positive shock has a smaller share of GDP allocated to, e.g., capital consumption, then depreciation provides cross-sectional dis-smoothing. Similarly, if taxes increase or decrease less than proportionately with output, they provide dis-smoothing.

[10] This is precisely the test suggested by Mace (1991) and Townsend (1994). They test for full risk sharing by running cross-sectional (or panel) regressions of consumption on income, controlling for aggregate movements in income and consumption. Cochrane's (1991) test is very similar.

[11] If full risk sharing is not achieved through income insurance via factor income flows, then $\text{cov}\{\Delta \log \text{GNI}^i, \Delta \log \text{GDP}^i\} > 0$ and hence, $\text{cov}\{\Delta \log \text{GDP}^i - \Delta \log \text{GNI}^i, \Delta \log \text{GDP}^i\} < \text{var}\{\Delta \log \text{GDP}^i\}$, implying $\beta_f < 1$.

The role of Government, Personal, and Corporate Saving in Consumption Smoothing

Net national saving consists of three components: personal, corporate, and government saving. This role of each of these components in consumption smooth can help shed light on institutional barriers to consumption smoothing—in particular whether the 1992 Maastricht requirements regarding government debt, and the subsequent Stability and Growth Pact, have been impediments to risk sharing.[12]

The corporate sector may contribute to income insurance if it adjusts patterns of earnings retention so that a larger share of profits is distributed to shareholders during recessions.[13]

Individuals can smooth consumption through personal saving by borrowing and lending. The ability of individuals to smooth their consumption through cross-country borrowing and lending depends on whether the banking system, and credit markets in general, are sufficiently integrated internationally—otherwise, say, an increase in the demand for loans may increase the domestic interest rate leading to less borrowing. Ostergaard, Sørensen, and Yosha (2001) and Sørensen and Yosha (2000) find that aggregate state-level consumption and, therefore, savings patterns are closer to the prediction of the Permanent Income Model than aggregate country-level consumption. Whether this implies more or less risk sharing at the country-level in our metric depends on the time-series properties of shocks to disposable income.

Allocation of Saving

The amount of consumption smoothing achieved through saving can also be decomposed according to the "destination" of savings, namely, domestic physical investment versus investment abroad. Net investment abroad equals the current account surplus CA and S = I + CA, where "I" denotes net domestic physical investment. If higher saving in a country in a particular year is mainly reflected in higher investment in that country in the same year, this would indicate that international investment patterns do not respond strongly to shocks and, therefore, do not contribute to cross-country consumption smoothing. The well-known paper by Feldstein and Horioka (1982) raises the question of why saving and investment at the country-level are so highly correlated. While there may be conditions where this is an optimal outcome, a high correlation between investment and saving is typically considered a symptom of lack of international financial integration.

In theoretical work risk sharing is typically modeled as the shipping of goods abroad in good times.[14] We denote net export by $\mathrm{X}^i - \mathrm{M}^i$ and examine if $\mathrm{GDP}^i - \mathrm{X}^i + \mathrm{M}^i$ is smoothed relative to output (after controlling for the aggregate).

Estimation
Estimating channels of risk sharing

At the practical level, the following (panel) equations are estimated:

[12] Gali and Perotti (2003) find that the Maastricht rules in practice have not limited the ability of fiscal policy in the EMU to be counter-cyclical. However, their metric is somewhat different from our risk sharing measure.
[13] This is consistent with the standard textbook view that corporations smooth dividend payout ratios, adjusting them only in response to shifts in long-run sustainable earnings; see, e.g., Brealey and Myers (1991, Chapter 16).
[14] See Heathcote and Perri (2004) for an example.

$$
\begin{aligned}
\Delta \log \mathrm{GDP}_t^i - \Delta \log \mathrm{GNI}_t^i &= \nu_{f,t} + \beta_f \ \Delta \log \mathrm{GDP}_t^i + \epsilon_{f,t}^i \ , \\
\Delta \log \mathrm{GNI}_t^i - \Delta \log \mathrm{NI}_t^i &= \nu_{d,t} + \beta_d \ \Delta \log \mathrm{GDP}_t^i + \epsilon_{d,t}^i \ , \\
\Delta \log \mathrm{NI}_t^i - \Delta \log \mathrm{DNI}_t^i &= \nu_{\tau,t} + \beta_\tau \ \Delta \log \mathrm{GDP}_t^i + \epsilon_{\tau,t}^i \ , \\
\Delta \log \mathrm{DNI}_t^i - \Delta \log(\mathrm{C}_t^i + \mathrm{G}_t^i) &= \nu_{s,t} + \beta_s \ \Delta \log \mathrm{GDP}_t^i + \epsilon_{s,t}^i \ , \\
\Delta \log(\mathrm{C}_t^i + \mathrm{G}_t^i) &= \nu_{u,t} + \beta_u \ \Delta \log \mathrm{GDP}_t^i + \epsilon_{u,t}^i \ ,
\end{aligned}
\tag{7}
$$

where _·,t are time fixed effects. The time fixed effects capture year specific impacts on growth rates, most notably the impact of the growth in aggregate EMU (or OECD) output Furthermore, with time fixed effects the _-coefficients are weighted averages of the year-by year cross-sectional regressions. To take into account autocorrelation in the residuals we assume that the error terms in each equation and in each country follow an AR(1) process. Since the samples are short, we assume that the autocorrelation parameter is identical across countries and equations. We further allow for state specific variances of the error terms. In practice, we estimate the system in (7) by a two step Generalized Least Squares (GLS) procedure. Unless we explicitly say otherwise, we use differenced data at the yearly frequency. Because our method is based on panel estimation with time fixed effects, it yields fully consistent estimates even if there are worldwide taste shocks.

Estimating economic determinants of risk sharing

Consider, for example, the estimated income smoothing from factor income flows, β_f·M´elitz and Zumer (1999) impose structure on β_f so that $\beta_f = \beta_{f0} + \beta_{f1}\gamma_i$, where γ_i is an "interaction" variable that affects the amount of smoothing that country i obtains. Sørensen, Wu, Yosha, and Zhu extended this method by allowing β_f to change over time, as follows:

$$\beta_f = \beta_{f0} + \beta_{f1}(t - \bar{t}) + \beta_{f2}(X_{it} - \overline{X}), \tag{8}$$

where Xit is a variable that potentially may impact on risk sharing. We subtract the mean of the "interaction variables" in order to leave the interpretation of β_{f0} as the average amount of income smoothing. We experiment with variables such as average size of country i which varies across countries but not over time, and with variables such as the U.S. interest rate which varies over time but not across countries.

In practice, we estimate the time varying amount of income smoothing by running the regression

$$
\begin{aligned}
\Delta \log \mathrm{GDP}_t^i - \Delta \log \mathrm{GNI}_t^i &= \nu_{f,t} + \beta_{f0} \ \Delta \log \mathrm{GDP}_t^i + \beta_{f1} \ \Delta \log \mathrm{GDP}_t^i * (t - \bar{t}) \\
&\quad + \beta_{f2} \ \Delta \log \mathrm{GDP}_t^i * (X_{it} - \overline{X}) \ + \ \epsilon_{f,t}^i \ ,
\end{aligned}
$$

possibly including further interaction variables.

We, similarly, examine if the amount of consumption smoothing from saving, β_s, varies with interaction variables.

Results

Data

The data are from the OECD National Accounts, Main Aggregates (Volume I) and Detailed Tables (Volume II), various issues, covering the period 1970–2003. The OECD countries in our sample consist of all 2005 members except Luxembourg (very small and atypical), Iceland (incomplete data), and the less developed countries: Czech Republic, Hungary, Korea, Mexico, Poland, Slovakia, and Turkey. In order to compare the results, we use three subsets of the OECD members in the various regressions. The EMU countries with the exception of Luxembourg.[15] The EU denotes all the 2003 EU member countries, excluding Luxembourg.[16] OECD–EU denotes the OECD members in our sample excluding the 14 member countries of the EU.[17]

Income insurance and consumption smoothing among EMU and OECD countries

We begin by presenting our estimates of the fraction of shocks to GDP absorbed at the various levels of smoothing for EMU, EU, and OECD countries.

In Table 1 we display the estimated percentages of shocks to GDP smoothed through each channel, among EMU, EU, Non-EU developed OECD ("OECD") countries, for the period 1970–2003. Conceptually, the coefficients add up to 100 percent but we choose not to impose this constraint.

From the first line in Table 1 it is immediately apparent that the contribution of crosscountry factor income flows to cross-country risk sharing, among EMU as well as OECD countries, has not been significantly different from zero for our sample period. This is the result that SY found for the period previous to 1990. Of course, it is well known that cross-country assets holdings were very small during that period as documented by French and Poterba (1991) and Tesar and Werner (1995), so this result is no big surprise. Note that factor income flows are almost solely dividend, interest, and other earnings accruing to capital. Income of, say, a U.S. resident working in the U.K. is also part of factor income, but earnings of, say, a Turkish citizen who is a resident of Germany is part of German GNI and doesn't enter factor income flows.

Depreciation contributed negatively to income smoothing. This variable isn't very interesting because depreciation is a function of past investment and, besides, is mainly imputed. However, the negative sign is intuitive because when output goes up depreciation typically doesn't move with output and therefore a larger share of output is available for income and consumption. We will not comment on this channel much.

During the 1971–2003 sample period transfers did not contribute to risk sharing. Transfers include official transfers, such as contributions to the EU budget and foreign aid, and workers remittances which, on average during this period, were fairly small.

The fourth line in Table 1 indicates that the bulk of the consumption smoothing of EU and OECD countries is achieved via saving. Such smoothing need not involve actual cross-

[15] The EMU consists of Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain.
[16] The EU consists of the EMU countries plus Denmark, Sweden and the U.K.
[17] OECD–EU consists of Australia, Canada, Japan, New Zealand, Norway, Switzerland, and the United States.

border flows of funds but can be reflected in domestic fixed or inventory investment. The point estimate for consumption smoothing through national saving is higher for the OECD countries but the difference is not statistically significant. Overall, two-thirds of output shocks were not smoothed during this period. SY found virtually identical results for the period 1966–1980 and for the OECD (including EU) in the 1980s. For the core EU countries they found lower consumption smoothing from saving in the 1980s. We will examine how our results vary by subperiods and in particular if risk sharing has increased in the EMU in recent periods.

Table 1

Income and Consumption Smoothing (percent) by National Accounts Categories

	EMU 1971-2003	EU 1971-2003	(OECD–EU) 1971-2003
Factor Income (β_f)	2	0	−1
	(1)	(1)	(1)
Depreciation (β_d)	−5	−5	−7
	(1)	(1)	(2)
Transfers (β_τ)	1	1	0
	(1)	(1)	(0)
Saving (β_s)	41	36	53
	(4)	(3)	(4)
Not Smoothed (β_u)	61	68	56
	(3)	(3)	(4)

Notes. EMU: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, and Portugal. EU: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Portugal, Sweden, and UK. OECD–EU: Australia, Canada, Japan, New Zealand, US, Norway, and Switzerland. Percentages of shocks absorbed at each level of smoothing. Standard errors in brackets. β_f is the GLS estimate of the slope in the regression of $\Delta \log \text{GDP}^i - \Delta \log \text{GNI}^i$ on $\Delta \log \text{GDP}^i$, β_d is the slope in the regression of $\Delta \log \text{GNI}^i - \Delta \log \text{NI}^i$ on $\Delta \log \text{GDP}^i$, and similarly for β_τ and β_s. β_u is the coefficient in the regression of $\Delta \log(\text{C}^i + \text{G}^i)$ on $\Delta \log \text{GDP}^i$. We interpret the β-coefficients as the incremental percentage amounts of smoothing achieved at each level, and β_u is the percentage of shocks not smoothed.

SY stated: "..the large amount of consumption smoothing achieved in the European Community via government borrowing may not be sustainable in an EMU where fiscal coordination must be maintained. Until private capital and credit markets develop, there may be a need for a greater insurance role of European Community institutions." To throw light over this issue Table 2 repeats the exercise of Table 1 for the period 1999—2003 after the introduction of the Euro. Two things have changed noticeably: First, factor income now smooth 11 percent of GDP shocks in the EMU and still nothing in the OECD and, second, consumption smoothing through national savings has decreased steeply in the EMU and increased in the OECD with the net result being that 72 percent of shocks to GDP in the OECD are smoothed while only 34 percent are smoothed in the EMU. Also, transfers contribute modestly, but significantly, to income smoothing in the EMU. We do not have enough observations to make clear statements of the difference between the EMU and the

three EU members that are not member of the EMU.[18] However, including the non-EMU EU countries weakens the effect of factor income smoothing lending at least weak support to the notion that the common currency is helping this channel of risk sharing.

Table 2

Income and Consumption Smoothing (percent) by National Accounts Categories

	EMU 1999-2003	EU 1999-2003	OECD–EU 1999-2003
Factor Income (β_f)	11	6	−1
	(4)	(3)	(3)
Depreciation (β_d)	8	7	−7
	(3)	(3)	(3)
Transfers (β_τ)	3	3	−1
	(1)	(2)	(1)
Saving (β_s)	12	12	81
	(8)	(7)	(9)
Not Smoothed (β_u)	66	73	28
	(6)	(6)	(4)

Notes. EMU: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, and Portugal. EU: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Portugal, Sweden, and UK. OECD–EU: Australia, Canada, Japan, New Zealand, US, Norway, and Switzerland. Percentages of shocks absorbed at each level of smoothing. Standard errors are in brackets. β_f is the GLS estimate of the slope in the regression of $\Delta \log \text{GDP}^i - \Delta \log \text{GNI}^i$ on $\Delta \log \text{GDP}^i$, β_d is the slope in the regression of $\Delta \log \text{GNI}^i - \Delta \log \text{NI}^i$ on $\Delta \log \text{GDP}^i$, and similarly for β_τ and β_s. β_u is the coefficient in the regression of $\Delta \log(\text{C}^i + \text{G}^i)$ on $\Delta \log \text{GDP}^i$. We interpret the β-coefficients as the incremental percentage amounts of smoothing achieved at each level, and β_u is the percentage of shocks not smoothed.

Did factor income smoothing increase slowly over the full sample or steeply after the introduction of the Euro? Table 3 addresses this question. The answer is: factor income smoothing rose steeply after the introduction of the Euro. The table also shows that factor income smoothing robustly has been zero before 1999—the one significant number for the 1970s for the EMU is the lone significant number before that period. This is consistent with the large decline in home bias in asset holdings documented by, for example, Sørensen, Wu, Yosha, and Zu (2005). However, foreign asset holdings need to be very large in order to provide significant smoothing. To fix thoughts, think of the case where all capital in a country

[18] Particularly since a country like Denmark ties its currency very tightly to the Euro so that it isn't really obvious how it would be better classified

is owned by foreigners and residents of the country own foreign assets in the same amount. The capital output ratio is often assumed to be around three so, roughly, this would be a case where the level foreign asset holdings is three times GDP. Assume, as is also often done, that one third of GDP accrues to capital. Then one would expect 33 percent of output shocks to be smoothed by factor income. Consider how our measure works in a 1-period case where GDP in a country starts at GDP0 and GDP1 = 1.1 _ GDP0. If world per capita GDP in both periods is fixed at GDP0 then GNI1 = .33*GDP0+0.66*GDP1 = GDP0 + 0.66 * (GDP1 − GDP0). We have Δlog GDP1 ≈0.66 * Δlog GDP1 which show that 33 percent of the output shock is smoothed by factor income.

Table 3

Factor Income Smoothing (percent) among OECD Countries

	EMU	EU	OECD–EU
1971-1980	3	1	−2
	(1)	(1)	(1)
1981-1990	1	−2	−2
	(2)	(2)	(2)
1991-1999	3	0	−1
	(3)	(2)	(3)
1999-2003	11	6	−1
	(4)	(3)	(2)

Notes. EMU: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, and Portugal. EU: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Portugal, Sweden, and UK. OECD–EU: Australia, Canada, Japan, New Zealand, US, Norway, and Switzerland. Percentages of shocks absorbed at each level of smoothing. Standard errors in brackets. β_f is the GLS estimate of the slope in the regression of $\Delta \log \text{GDP}^i - \Delta \log \text{GNI}^i$ on $\Delta \log \text{GDP}^i$.

In the example, there are really two reasons why factor income smooth output: First, when output goes up factor income paid to other countries increases—proportionally to output in our simple example and, secondly, factor income received does not move oneto- one with output. In reality, many other patterns can occur and it is possible for factor income to even dis-smooth. An example would be a country that pays interest on debt and pays a very large risk premium on bonds issued. In the face of high domestic growth the risk premium on debt may decline and interest payment to foreigners may decline. The high growth is overall a good situation for the country, but it does result in negative insurance. Of course, the reverse situation when output falls and interest paid goes up is particularly onerous. A more likely

situation for OECD countries may be one where a country has a large net debt position and the world interest rate falls, to take a concrete example, leading to lower debt payments. If creditor countries happen to grow fast during such a period while debtor countries grow slowly debt holdings could contribute negatively to risk sharing.

Table 4 examines the contributions to risk sharing from factor income paid and factor income received. We see some negative income smoothing from outgoing factor income in the 1980s for EMU and EU countries and, not statistically significant, for the OECD. We suspect this is related to the high interest rates during this period. During the 1990s factor income received provided strong negative risk sharing in the EMU and the EU while factor income paid contributed roughly the same amount but positively. Finally, since the adoption of the Euro we see strong risk sharing benefits from incoming and outgoing factor income in the Euro countries with no significant coefficients for the other country groups. (The point estimates are not statistically significant but we know from Table 2 that the combined impact is strongly significant.) This is suggestive of deeper capital market integration taking place among EMU countries, but the sample is still too short for firm conclusions.

Table 4

Income Smoothing (percent) from Incoming and Outgoing Payments of International Factor Income

	EMU incoming	EMU outgoing	EU incoming	EU outgoing	OECD–EU incoming	OECD–EU outgoing
1971-1980	3	0	3	−1	0	−2
	(1)	(1)	(1)	(1)	(1)	(1)
1981-1990	2	−5	2	−6	−1	−3
	(2)	(3)	(2)	(3)	(2)	(2)
1991-1999	−9	9	−8	5	2	−2
	(2)	(5)	(2)	(3)	(2)	(2)
1999-2003	7	8	−2	3	0	−1
	(5)	(8)	(3)	(6)	(3)	(2)

Notes. EMU: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, and Portugal. EU: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Portugal, Sweden, and UK. OECD–EU: Australia, Canada, Japan, New Zealand, US, Norway, and Switzerland. Percentages of shocks absorbed at each level of smoothing. Standard errors in brackets. The table shows, for incoming factor income, the coefficient β_{f+}, the GLS estimate of the slope in the regression of $\Delta \log \text{GDP}^i - \Delta \log(\text{GDP}^i + \text{international factor income received})$ on $\Delta \log \text{GDP}^i$. For outgoing factor income, the coefficient β_{f-}, the GLS estimate of the slope in the regression of $\Delta \log \text{GDP}^i - \Delta \log(\text{GDP}^i - \text{international factor income paid})$ on $\Delta \log \text{GDP}^i$.

Table 5 displays a similar breakdown by subperiods for transfers. Transfers contribute positively to income smoothing in the EU area since 1980. Likely from the combined impact of EU official transfers and remittances. The magnitude is not large, about 5 percent in the 1980s and 1990s and a bit smaller since 1999 but the impact is statistically significant and appears robust. For no subperiod do transfers smooth income in the OECD outside of the EU.

Table 5

International Transfers Smoothing among OECD Countries

	EMU	EU	OECD–EU
1971-1980	−3	−2	−1
	(1)	(1)	(1)
1981-1990	5	4	0
	(2)	(1)	(0)
1991-1999	6	4	0
	(2)	(2)	(1)
1999-2003	3	2	−1
	(1)	(1)	(1)

Notes. EMU: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, and Portugal. EU: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Portugal, Sweden, and UK. OECD–EU: Australia, Canada, Japan, New Zealand, US, Norway,and Switzerland. Percentages of shocks absorbed at each level of smoothing. Standard errors in brackets. β_f is the GLS estimate of the slope in the regression of $\Delta \log \text{NI}^i - \Delta \log \text{DNI}^i$ on $\Delta \log \text{GDP}^i$.

Savings contribute little to consumption smoothing in the EMU since 1999. Is that a recent phenomenon? Table 6 addresses that issue. For all subperiods are the amount of consumption smoothing through saving smaller in the EMU and the EU. The numbers are never larger in the EU than in the EMU so the indication is that this may have more to do with EU institutions than with the common currency. The divergence since 1999 is striking. We examined if the high numbers for the OECD were due to an outlier like Norway, where the government saves large amounts of oil-revenues, but this is not the case.

Table 6

Total Savings Smoothing among OECD Countries

	EMU	EU	OECD–EU
1971-1980	53	53	62
	(6)	(5)	(7)
1981-1990	26	24	43
	(6)	(4)	(6)
1991-1999	41	34	47
	(7)	(6)	(9)
1999-2003	12	12	81
	(8)	(7)	(9)

Notes. EMU: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, and Portugal. EU: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Portugal, Sweden, and UK. OECD–EU: Australia, Canada, Japan, New Zealand, US, Norway, and Switzerland. Standard errors in brackets. The table shows β_s, the GLS estimate of the slope in the regression of $\Delta \log \text{DNI}^i - \Delta \log \text{CON}^i$ on $\Delta \log \text{GDP}^i$.

Table 7 considers smoothing through government saving. The decline in smoothing from government saving since 1999 is very steep in the EMU and similarly when the whole EU is considered. In the OECD smoothing from government saving, on the contrary, increased steeply after 1999. Tables 8 and 9 consider smoothing from corporate and personal saving, respectively. There seem to be no time pattern in the smoothing from corporate saving. In the EMU and EU corporate saving smoothes consumption in most periods while it is insignificant in the OECD for all sub-periods. Private saving, examined in Table 8, has been dis-smoothing (counter-cyclical) in the EMU and EU until 1999 after which the effect is small and positive—statistically significant for the EMU. In the OECD the pattern is the opposite. It is intriguing that private saving seems to counteract the pattern in government saving.

Table 7

Smoothing via Government Saving among OECD Countries

	EMU	EU	OECD–EU
1987-1990	0	9	25
	(11)	(7)	(8)
1991-1995	46	36	50
	(9)	(8)	(3)
1996-2001	19	10	83
	(6)	(5)	(7)

Notes. EMU: Austria, Belgium, Finland ,France, Germany, Greece, Ireland,Italy, Nethe lands Spain, and Portugal. EU: Austria,Belgium, Denmark, Finland, France, Germany Greece,Ireland, Italy, Netherlands, Spain, Portugal, Sweden, and UK. OECD–EU: Aus tralia, Canada, US, Norway and after 1990 Japan. Standard errors in brackets. The tabl shows the GLS estimate of the slope in the regression of $\Delta \log \text{DNI}^i - \Delta \log(\text{DNI}^i -$ net gov ernment saving) on $\Delta \log \text{GDP}^i$.

Table 8

Smoothing via Corporate Saving among OECD Countries

	EMU	EU	OECD–EU
1987-1990	8	10	6
	(7)	(5)	(10)
1991-1995	4	7	−11
	(9)	(8)	(11)
1996-2001	9	12	−4
	(1)	(3)	(4)

Notes. EMU: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, and Portugal. EU: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands Spain, Portugal, Sweden, and UK. OECD–EU: Australia, Canada, US, Norway and after 1990 Japan. Standard errors in brackets. The table shows the GLS estimate of the slope in the regression of $\Delta \log \text{DNI}^i - \Delta \log(\text{DNI}^i -$ corporate saving) on $\Delta \log \text{GDP}^i$.

Table 9

Smoothing via Private Saving among OECD Countries

	EMU	EU	OECD–EU
1987-1990	−15	−17	12
	(4)	(5)	(11)
1991-1995	−17	−18	21
	(6)	(6)	(8)
1996-2001	6	1	-5
	(2)	(6)	(7)

Notes. EMU: Austria, Belgium, Finland ,France, Germany, Greece, Ireland, Italy, Netherlands, Spain, and Portugal. EU: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands Spain, Portugal, Sweden, and UK. OECD–EU: Australia, Canada, US, Norway and after 1990 Japan. Standard errors in brackets. The table shows the GLS estimate of the slope in the regression of $\Delta \log \text{DNI}^i - \Delta \log(\text{DNI}^i - \text{private saving})$ on $\Delta \log \text{GDP}^i$.

In Figures 1–4 we illustrate the results discussed so far in graphical form. Figure 1 shows the total amount smoothed and the contribution from saving. While there is some noise the pattern of increasing contributions from saving in the OECD is fairly clear and the decreasing contribution from saving in the EMU is particularly clear. In the OECD the combined contribution from other channels of smoothing is negative in all years while in the EMU this is, fortunately, not the case: as the contribution from saving has declined to near zero by the new century other channels of smoothing kept the overall amount of risk sharing at about 40 percent. Figure 2 displays the contributions from transfers and factor income. Factor income smoothing seems to have a tendency to dis-smooth for most of the period until the recent period. Smoothing from transfers were initially negative but turned positive in the EMU around 1980 with a slow decline since the mid 1980s. In the OECD transfers do not contribute either way. Figure 3 shows the contributions from components of saving. In the OECD government saving provided the bulk of the smoothing—in particular since 1992—although corporate saving started to contribute noticeably in the late 1992. In the EMU corporate saving is now more important for smoothing the government saving. Personal saving used to be counter-cyclical leading to strong dis-smoothing of consumption in the 1980s, although the role of private saving now is minor as it is in the OECD. In Figure 4 we display the simple ratio of the savings components to GDP. The ratio of government saving to GDP takes big dips in the OECD during the recessions in the early 1980s, the early 1990s, and early in the present century which is what our regressions correctly pick up. In the EMU this pattern is much less strong—it seems that for some reason EMU governments ran up large deficits until the mid-1990s after which they increased saving, presumably to meet the Maastricht criteria. Overall, we are left wondering if this is particularly optimal pattern of

saving although we of course do not evaluate the myriad of non-risk sharing consideration that may have motivated this. Counter-cyclical behavior of corporate saving is visible since 1990 in the EMU.

We turn to the decomposition of smoothing via saving into smoothing via domestic net physical investment and the current account. We also consider net exports. We measure the fraction of shocks smoothed via domestic net investment by estimating the coefficient in the regression of $\Delta \log \text{GDP}^i - \Delta \log(\text{GDP}^i - \text{I}^i)$ on $\Delta \log \text{GDP}^i$. Similarly, we measure the fraction of shocks smoothed via the current account surplus ("investment abroad") as the slope in the regression of $\Delta \log \text{GDP}^i - \Delta \log(\text{GDP}^i - \text{CA}^i)$ on $\Delta \log \text{GDP}^i$. Due to non-linearity (and to the way we correct for heteroskedasticity and autocorrelation) the smoothing from the current account and from investment will not add up to the smoothing from saving but conceptually it is a decomposition of this smoothing.

The results, displayed in Table 10, for the full sample, indicate that the bulk of smoothing is achieved via domestic investment, not the current account and not through net exports. The finding that shocks to output are smoothed via domestic net physical investment is consistent with the procyclical behavior of investment in aggregate US data; see Blanchard and Fischer (1989).

Table 10

Smoothing through Domestic Net Physical Investment, Current Account and via Net Exports among OECD Countries for years 1971-2003

	EMU	EU	OECD–EU
Net Investment	43	37	33
	(4)	(4)	(6)
Current account	−10	−7	3
	(3)	(3)	(4)
Net Exports	−3	−4	3
	(3)	(2)	(3)

Notes. EMU: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, and Portugal. EU: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Portugal, Sweden, and UK. OECD–EU: Australia, Canada, Japan, New Zealand, US, Norway, and Switzerland. Percentages of shocks absorbed at each level of smoothing. Standard errors in brackets. We measure the fraction of shocks smoothed via domestic net physical investment by estimating the coefficient in the regression of $\Delta \log \text{GDP}^i - \Delta \log(\text{GDP}^i - \text{I}^i)$ on $\Delta \log \text{GDP}^i$. Similarly, the coefficient in the regression of $\Delta \log \text{GDP}^i - \Delta \log(\text{GDP}^i - \text{CA}^i)$ on $\Delta \log \text{GDP}^i$ measures the fraction of shocks smoothed via investment abroad and the coefficient in the regression of $\Delta \log \text{GDP}^i - \Delta \log(\text{GDP}^i - (\text{X}^i - \text{M}^i))$ on $\Delta \log \text{GDP}^i$ measures the fraction of shocks smoothed via net exports.

Table 11 considers the smoothing from domestic investment by subperiods. In the 1970s investment contributed highly to income smoothing while the impact declined in the

1980s and 1990s and for the 1999-2003 period the impact is only 11 percent in the EMU and insignificant in the EU. In the OECD the decline is smaller and net investment still smooth 25 percent of shocks. This may be a reflection of lack of capital market integration "forcing" countries to invest savings domestically.

Table 11 Net Investment Smoothing among OECD Countries

	EMU	EU	OECD–EU
1971-1980	61	65	60
	(9)	(7)	(12)
1981-1990	39	34	30
	(7)	(6)	(10)
1991-1999	35	31	18
	(4)	(4)	(7)
1999-2003	11	6	25
	(5)	(4)	(10)

Notes. EMU: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, and Portugal. EU: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Portugal, Sweden, and UK. OECD–EU: Australia, Canada, Japan, New Zealand, US, Norway, and Switzerland. Percentages of shocks are absorbed at each level of smoothing. Standard errors in brackets. We measure the fraction of shocks smoothed via domestic net physical investment by estimating the coefficient in the regression of $\Delta \log \text{GDP}^i - \Delta \log(\text{GDP}^i - \text{I}^i)$ on $\Delta \log \text{GDP}^i$.

Table 12 considers the role of the current account. Surprisingly, the current account contributed negatively, or not at all, before 1999. In the period after 1999 there is no effect in the EMU (reflecting that overall saving is not contributing to consumption smoothing) but for the OECD this channel contributes 35 percent to consumption smoothing. This result indicates that the Feldstein-Horioka "puzzle" is becoming less serious as countries invest their saving world-wide.[19]

[19] Blanchard and Giavazzi (2002) argue that the Feldstein-Horioka puzzle is a thing of the past in the Euro area.

Table 12

Current Account Smoothing among OECD Countries

	EMU	EU	OECD–EU
1971-1980	−14	−7	3
	(6)	(3)	(4)
1981-1990	−13	−15	−6
	(7)	(5)	(6)
1991-1999	1	0	4
	(5)	(4)	(5)
1999-2003	−5	−6	35
	(5)	(2)	(11)

*Notes.*EMU: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, and Portugal. EU: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Portugal, Sweden, and UK. OECD–EU: Australia, Canada, Japan, New Zealand, US, Norway, and Switzerland. Percentages of shocks are absorbed at each level of smoothing. Standard errors in brackets. We measure the fraction of shocks smoothed via domestic net physical investment by estimating the coefficient in the regression of $\Delta \log \text{GDP}^i - \Delta \log(\text{GDP}^i - \text{CA}^i)$ on $\Delta \log \text{GDP}^i$ measures the fraction of shocks smoothed via the current account surplus.

We use a similar regression to see if net exports smooth income: the coefficient in the regression of $\Delta \log \text{GDP}^i - \Delta \log(\text{GDP}^i - (\text{X}^i - \text{M}^i))$ on $\Delta \log \text{GDP}^i$ measures the fraction of shocks. The results—see Table 13—show that until very recently, net exports played no role in consumption smoothing. However, for the OECD countries there has been a large contribution to consumption smoothing through net exports since 1999.

Table 13

Net Export Smoothing among OECD Countries

	EMU	EU	OECD–EU
1971-1980	−4	−8	4
	(5)	(4)	(9)
1981-1990	−8	−7	1
	(6)	(5)	(5)
1991-1999	2	2	−3
	(4)	(3)	(5)
1999-2003	5	1	23
	(5)	(2)	(11)

Notes. EMU: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, and Portugal. EU: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Portugal, Sweden, and UK. OECD–EU: Australia, Canada, Japan, New Zealand, US, Norway and, Switzerland. Percentages of shocks absorbed at each level of smoothing. Standard errors in brackets. We measure the fraction of shocks smoothed via domestic net physical investment by estimating the coefficient in the regression of $\Delta \log \text{GDP}^i - \Delta \log(\text{GDP}^i - (\text{X}^i - \text{M}^i))$ on $\Delta \log \text{GDP}^i$ measures the fraction of shocks smoothed via net exports.

Table 14 examines if the results are different when the time-period considered is three years, rather than one. SY found that consumption smoothing was significantly lower at the three-year frequency, in particular due to smoothing through corporate saving being of short duration.[20] Comparing the results with those of Table 1, we see slightly less risk sharing at the longer horizon but not significantly less so.[21]

[20] Becker and Hoffmann (2006) perform a more systematic examination of risk sharing at different frequncies.

[21] This sample includes only one observation per country so the results are imprecisely estimated as indicated by the large standard error. Clearly more observations are needed to corroborate that this result reflects more than transitory conditions.

Table 14

Income and Consumption Smoothing (percent) by National Accounts Categories.

Three-Year Frequency of Observation.

	EMU	EU	(OECD–EU)
	1971-2003	1971-2003	1971-2003
Factor Income (β_f)	1	-2	-3
	(2)	(2)	(2)
Depreciation (β_d)	−4	−4	−6
	(2)	(2)	(2)
Transfers (β_τ)	0	1	0
	(2)	(1)	(1)
Saving (β_s)	34	31	48
	(5)	(4)	(7)
Not Smoothed (β_u)	69	74	61
	(5)	(4)	(6)

Notes. EMU: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, and Portugal. EU: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Portugal, Sweden, and UK. OECD–EU: Australia, Canada, Japan, New Zealand, US, Norway and, Switzerland. Percentages of shocks absorbed at each level of smoothing. Standard errors in brackets. β_f is the GLS estimate of the slope in the regression of $\Delta \log \text{GDP}^i - \Delta \log \text{GNI}^i$ on $\Delta \log \text{GDP}^i$, β_d is the slope in the regression of $\Delta \log \text{GNI}^i - \Delta \log \text{NI}^i$ on $\Delta \log \text{GDP}^i$, and similarly for β_τ and β_s. β_u is the coefficient in the regression of $\Delta \log(\text{C}^i + \text{G}^i)$ on $\Delta \log \text{GDP}^i$. We interpret the β-coefficients as the incremental percentage amounts of smoothing achieved at each level, and β_u is the percentage of shocks not smoothed. "ΔX_t" here refers to $X_t - X_{t-3}$ for any variable X. Non-overlapping observations.

ASY and SY found evidence that smoothing from cross-ownership of assets is much more "permanent" than smoothing from saving. In Table 15 we examine smoothing from factor income in the upper panel and from saving in the lower panel by sub-periods. In the EMU we find a very large smoothing effect from factor income for 2000–2002. Due to the short sample this is only suggestive but the result is accordance with our prior expectations. On the other hand, it is

puzzling why factor income flows provided negative risk sharing at this frequency for the OECD countries.[22]

Table 15

Factor Income and Total Saving Smoothing among OECD Countries. Three-Year Frequency of Observation.

	EMU	EU	OECD–EU
Panel A: Factor Income			
1982-1990	–7	–5	–2
	(4)	(3)	(4)
1991-1999	5	1	–14
	(4)	(4)	(6)
2000-2002	30	18	–11
	(5)	(5)	(3)
Panel B: Total Saving			
1982-1990	42	30	27
	(9)	(8)	(11)
1991-1999	36	36	58
	(6)	(7)	(17)
2000-2002	–12	–10	89
	(2)	(1)	(6)

Notes. EMU: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, and Portugal. EU: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, Portugal, Sweden, and UK. OECD–EU: Australia, Canada, Japan, New Zealand, US, Norway and, Switzerland. Percentages of shocks absorbed at each level of smoothing. Standard errors in brackets. Factor income smoothing is the GLS estimate of the slope in the regression of $\Delta \log \text{GDP}^i - \Delta \log \text{GNI}^i$ on $\Delta \log \text{GDP}^i$, similarly the total saving smoothing is calculated by regressing $\Delta \log \text{DNI}^i - \Delta \log \text{CON}^i$ on $\Delta \log \text{GDP}^i$. "ΔX_t" here refers to $X_t - X_{t-3}$ for any variable X. Non-overlapping observations.

[22] These results are mainly suggestive and we choose to end the sample in 2002 because this break-up into sub-periods gives the strongest contrast between the 1990s and the 2000s.

Tables 16–17 and Tables 18–19 study if income smoothing from factor income and consumption smoothing, respectively, vary systematically with time, interest rates etc. Sørensen, Wu, Yosha, and Zhu (2005) showed that risk sharing increase with holdings of foreign assets and we do not revisit that issue. Instead we follow M´elitz and Zumer (1999) and examine if smaller countries obtain more risk sharing and if risk sharing depends on the world (U.S.) interest rate. A country with large net holdings of bonds will receive a larger amount of income from these when interest rates are high, typically leading to higher income smoothing for such countries. We further examine if risk sharing is correlated with the average output of countries, with the aggregate business cycle (the output of our total sample filtered through a Hodrick-Prescott filter), and with the country level interest rate. We show results for an early (1971–1987) and a late (1988–2003) sample. We also include a dummy variable for EMU countries—this allows to examine if the different results found for the EMU remains when we allow explanatory variables to determine the amount of risk sharing.

For income smoothing from international factor income we find that richer (higher output) countries obtained significantly less income smoothing in the early part of the sample. This result also hold for the later sample (Table 17) but no longer with statistical significance. The world interest rate seems to have no effect, while the trend is insignificant but negative in the early sample and positive and significant in the later sample—this isn't surprising given our earlier results. Our other interaction variables are not significant in the early sample but for the later sample the EMU dummy is (near) significant at the standard five percent level.

For consumption smoothing through saving we find in Table 18 that richer countries tended to obtain more consumption smoothing but the result isn't statistically significant. The world interest rate had a significant negative impact on consumption smoothing while the trend was clearly positive. EMU countries obtained dramatically less consumption smoothing as did large countries. In the later sample—shown in the Table 19—these results still obtain, indicating that these patterns are robust. In the later sample we further find that consumption smoothing through saving is positively—and significantly—correlated with the country-level interest rate.

Overall, our results show that the ability to smooth consumption internationally is strongly dependent on country characteristics such as wealth and size and on international conditions such a world interest rates. A deeper study of this is far beyond the present paper but these results serve to demonstrate that the different patterns of risk sharing found for the EMU countries are not simply capturing variables such as size and wealth that were left out in the earlier tables.

4 Concluding Remarks

TO COME

Table 16

Factor Income Smoothing (percent) by National Accounts Categories with the Interaction Variables for period 1971-1987 for the OECD

$\Delta \log \text{GDP}$	0	0	–1	0	0	0	0	0	0
	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
$\Delta \log \text{GDP}^*\text{GDP}^{ave}$	–11								–14
	(5)								(6)
$\Delta \log \text{GDP}^*\text{RINT}^{w}$		0							0
		(1)							(0)
$\Delta \log \text{GDP}^*\text{TREND}^{agg}$			–3						–4
			(2)						(3)
$\Delta \log \text{GDP}^*\text{EXCH}^{i}$				3					3
				(3)					(3)
$\Delta \log \text{GDP}^*\text{CYCLE}^{agg}$					1				1
					(1)				(1)
$\Delta \log \text{GDP}^*\text{EMU}$						–4			–3
						(4)			(4)
$\Delta \log \text{GDP}^*\text{RINT}^{i}$							1		1
							(0)		(0)
$\Delta \log \text{GDP}^*\text{POP}^{ave}$								3	1
								(2)	(3)

Notes: The dependent variable is $\Delta \log \text{GDP}^i - \Delta \log \text{GNI}^i$. GDP^{ave} refers to real gdp per capita averaged over the sample for each country. RINT^{w} is the world real interest rate. EXCH is the real exchange rate relative to US. CYCLE^{agg} is HP-filtered real aggregate per capital of the countries in the sample. EMU is a dummy variable for members of the EMU. RINT is to the real interest rate (the nominal interest rate minus the rate of inflation). POP^{ave} is the population averaged across the sample for each country. See text for the sample of countries included.

Table 17

Factor Income Smoothing (percent) by National Accounts Categories with the Interaction Variables for period of 1988-2003 for the OECD

$\Delta \log \text{GDP}$	–1	–2	–1	–2	–1	–2	–1	–2	–2
	(1)	(2)	(1)	(1)	(1)	(1)	(1)	(2)	(2)
$\Delta \log \text{GDP}^*\text{GDP}^{ave}$	–10								–9
	(7)								(7)
$\Delta \log \text{GDP}^*\text{RINT}^{w}$		1							1
		(1)							(1)
$\Delta \log \text{GDP}^*\text{TREND}^{agg}$			6						10
			(1)						(5)
$\Delta \log \text{GDP}^*\text{EXCH}^{i}$				–11					7
				(10)					(4)
$\Delta \log \text{GDP}^*\text{CYCLE}^{agg}$					–1				1
					(0)				(1)
$\Delta \log \text{GDP}^*\text{EMU}$						8			9
						(4)			(5)
$\Delta \log \text{GDP}^*\text{RINT}^{i}$							0		0
							(1)		(1)
$\Delta \log \text{GDP}^*\text{POP}^{ave}$								3	4
								(2)	(3)

Notes: The dependent variable is $\Delta \log \text{GDP}^i - \Delta \log \text{GNI}^i$. GDP^{ave} refers to real gdp per capita averaged over the sample for each country. RINT^{w} is the world real interest rate. EXCH is the real exchange rate relative to US. CYCLE^{agg} is HP-filtered real aggregate per capital of the countries in the sample. EMU is a dummy variable for members of the EMU. RINT is to the real interest rate (the nominal interest rate minus the rate of inflation). POP^{ave} is the population averaged across the sample for each country. See text for the sample of countries included.

Table 18

Saving Smoothing (percent) by National Accounts Categories with the Interaction Variables for period 1971-1987 for the OECD

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\Delta \log \text{GDP}$	56	57	55	56	55	57	56	55	62
	(3)	(4)	(3)	(3)	(3)	(3)	(3)	(3)	(4)
$\Delta \log \text{GDP}^{*}\text{GDP}^{ave}$	34								35
	(28)								(28)
$\Delta \log \text{GDP}^{*}\text{RINT}^{w}$		–2							–5
		(1)							(2)
$\Delta \log \text{GDP}^{*}\text{TREND}^{agg}$			1						20
			(7)						(11)
$\Delta \log \text{GDP}^{*}\text{EXCH}^{i}$				–13					–3
				(11)					(11)
$\Delta \log \text{GDP}^{*}\text{CYCLE}^{agg}$					–1				0
					(2)				(2)
$\Delta \log \text{GDP}^{*}\text{EMU}$						–34			–35
						(15)			(14)
$\Delta \log \text{GDP}^{*}\text{RINT}^{i}$							0		0
							(1)		(1)
$\Delta \log \text{GDP}^{*}\text{POP}^{ave}$								–20	–18
								(9)	(10)

Notes: The dependent variable is $\Delta \log \text{GDP}^{i} - \Delta \log \text{GNI}^{i}$. GDP^{ave} refers to real gdp per capita averaged over the sample for each country. RINT^{w} is the world real interest rate. EXCH is the real exchange rate relative to US. CYCLE^{agg} is HP-filtered real aggregate per capital of the countries in the sample. EMU is a dummy variable for members of the EMU. RINT is to the real interest rate (the nominal interest rate minus the rate of inflation). POP^{ave} is the population averaged across the sample for each country. See text for the sample of countries included.

Table 19

Saving Smoothing (percent) by National Accounts Categories with the Interaction Variables for period 1988-2003 for the OECD

$\Delta \log$ GDP	65	74	70	67	68	70	62	64	64
	(3)	(4)	(3)	(3)	(4)	(3)	(3)	(3)	(4)
$\Delta \log$ GDP*GDP^{ave}	121								86
	(23)								(23)
$\Delta \log$ GDP*RINT^{w}		–5							–5
		(2)							(2)
$\Delta \log$ GDP*TREND^{agg}			17						38
			(7)						(12)
$\Delta \log$ GDP*EXCH^{i}				–14					–9
				(16)					(16)
$\Delta \log$ GDP*CYCLE^{agg}					–1				3
					(1)				(2)
$\Delta \log$ GDP*EMU						–45			–26
						(16)			(14)
$\Delta \log$ GDP*RINT^{i}							6		5
							(1)		(1)
$\Delta \log$ GDP*POP^{ave}								–32	–23
								(8)	(8)

Notes: The dependent variable is $\Delta \log \text{GDP}^{i} - \Delta \log \text{GNI}^{i}$. GDP^{ave} refers to real gdp per capita averaged over the sample for each country. RINT^{w} is the world real interest rate. EXCH is the real exchange rate relative to US. CYCLE^{agg} is HP-filtered real aggregate per capital of the countries in the sample. EMU is a dummy variable for members of the EMU. RINT is to the real interest rate (the nominal interest rate minus the rate of inflation). POP^{ave} is the population averaged across the sample for each country. See text for the sample of countries included.

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