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Financial Reforms and Low-Income Households' Impact on International Consumption Risk Sharing

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Abstract

Complete financial markets allow countries to share their consumption risks internationally, thereby creating welfare gains through lower volatility of aggregate consumption. Using a panel of 116 countries between 1970–2019, I show that a higher share of low-income households reduce consumption risk sharing, especially so in less-developed countries. Moreover, I find that a broad range of financial market reforms and financial integration have a positive impact on international consumption risk sharing in poorer developing countries, while in emerging market countries, financial market development, financial reforms, and capital account openness has an impact. In advanced economies, financial (stock and bond) market development as well as financial integration improves international risk sharing. A lack of financial reforms, a lower degree of financial integration and a high share of low-income households thus contribute to the degree of risk sharing being lower in developing countries than in advanced economies.

JEL Classifications: C23, E02, E21, E44, F38, F62, G15

Keywords: International Consumption Risk Sharing, Financial Liberalization, Financial Integration, Low-Income Households

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1 Introduction

If markets are complete, countries can pool their resources and eliminate differences in consumption growth between themselves, according to conventional macroeconomic theory. International consumption risk sharing thus enables consumption smoothing, which creates welfare gains through lower aggregate consumption volatility. In reality, aggregate consumption is highly sensitive to domestic income shocks. The empirical evidence shows fairly limited international consumption risk sharing among countries, and especially in developing countries, see, e.g., Kose et al. (2009), Bai and Zhang (2012), and Flood et al. (2012). Common explanations for this observation include financial market incompleteness, frictions, and transaction costs. Kollmann (2012) and Cociuba and Ramanarayanan (2019) show theoretically that the low levels of international risk sharing can be explained by limited asset market participation.

Although the literature on international consumption risk sharing in advanced economies is abundant[1], risk sharing in developing economies has received much less attention. The main constraints on international risk sharing in developing countries have not yet been identified, and there is disagreement regarding the empirical relationship between international risk sharing and financial market development and integration. Corcoran (2007) points to the importance of financial integration for improving international risk sharing in developing countries, while Kose et al. (2009), Flood et al. (2012), and Fuleky et al. (2018) conclude that emerging markets and developing countries seem unable to benefit from this.

This paper therefore aims to identify determinants of international consumption risk sharing with a focus on developing countries. As consumption growth in developing countries is generally volatile, and much more so than in advanced economies, there are large potential welfare gains from increased consumption smoothing, especially in less developed countries. To this end, I study international consumption risk sharing in a panel of 116 developing and advanced economies during 1970–2019. Using panel estimators that account for cross-sectional dependence, I empirically look at the degree of international consumption risk sharing, its evolution over time, and its relation to low incomes, financial reforms, and integration.

I first show that countries share on average 34% of consumption risks internationally, which is in line with or slightly higher than estimates by Kose et al. (2009), Bai and Zhang (2012), and Fuleky et al. (2018). International risk sharing is higher in the latter part of my sample. This can explain why my estimates are higher than in the previous literature, as the previous studies considered a less recent time period. The emerging and less developed economies share around 23–32% of their consumption risks internationally, whereas advanced economies share on average between 50–70%.

[1] The literature starts with Backus et al. (1992), Obstfeld (1993), Stockman and Tesar (1995).

High poverty rates in developing economies may exclude a large share of the population from international financial market participation and thereby lower international risk sharing. Antonakakis and Scharler (2012) show that poor credit availability lowers international risk sharing for advanced economies. Unfortunately, historical time series on financial market access or credit availability do not exist for developing countries. I will therefore use the poverty headcount ratio to proxy for the lower bound of the share of individuals excluded from the international asset markets due to poverty. My second addition to the risk sharing literature is showing empirically that a larger share of low-income households reduces international consumption risk sharing in emerging and less developed economies.

Thirdly, in contrast to the findings of Kose et al. (2009) and Flood et al. (2012), I show that conventional risk sharing determinants such as capital account openness and total external liabilities to GDP, but also financial market reforms and development, affect developing countries' risk sharing capacities. Further, I show that the type of financial reforms and integration that facilitate international consumption risk sharing depends on the level of development in the countries. In less developed countries, a broader measure of financial liberalization, an index of domestic financial reform, has the greatest impact on risk sharing. In addition to considering the capital account, the financial reform index includes six further dimensions of financial sector policy regarding credit controls and reserve requirements, interest rate controls, entry barriers, state ownership, policies on securities markets, and banking regulations. As the financial market restrictions are generally more stringent and extend to a broader number of sectors in many less developed economies, this index is more suitable as a proxy for financial openness in these countries than measures looking solely at the capital account. In emerging markets, financial market (stock and bond market) development has a substantial positive impact on risk sharing, and the broader financial reform index and capital account openness also seem to affect risk sharing positively. In advanced economies, it is instead financial market development and de facto financial integration, as measured by total external liabilities to GDP, that improve risk sharing the most. My main conclusion is thus that a higher share of low-income households, financial market restrictions, and lower financial integration significantly reduce international consumption risk sharing.

The second aim of this paper is to exploit the cross-sectional dependence between countries. Most economies are likely influenced by unobserved common factors such as global business cycles or financial globalization (Chudik and Pesaran, 2013). Cross-sectional dependence has, despite its recurrence, been largely overlooked in the international risk sharing literature except by Fuleky et al. (2018). I allow for a common unobserved factor in the data, which is allowed to have a differential impact on risk sharing in the different countries. Once I control for cross-sectional dependence, the international risk sharing coefficient is higher, especially in the less developed and advanced economy samples (20% and 10% higher in the

respective samples). I find that global economic and financial uncertainty and monetary policy can explain around 30% of the variation in the unobserved common component. The unobserved factor thus picks up short-term factors that have a heterogeneous impact on risk sharing in the different countries.

The rest of the paper is structured as follows: Section 2 presents the theoretical framework of international consumption risk sharing. Section 3 outlines the empirical implementation strategy. Section 4 presents the data. The results are presented and discussed in Section 5, and Section 6 concludes.

2 International Risk Sharing

2.1 Full risk sharing

The empirical consumption risk sharing specification was originally developed by Mace (1991) and Lewis (1996). The underlying theoretical framework of full consumption risk sharing can be derived from the Arrow-Debreu equilibrium as outlined in Mace (1991). Consider a social planner's problem of maximizing utility over I countries with representative agents with state-contingent utility functions $U_i(c_{it}(s^t), s^t)$ where $i = 1, \ldots, I$ is the country index, and $c_{it}(s^t)$ is country i consumption at time t given the state of nature s^t. The state of nature affects both consumption and the utility function, for instance, through a preference change.

Utility is maximized subject to the representative agents' resource constraints. By combining the first order conditions for two distinct countries i and j, we have that for all dates t and all states of natures s^t

$$\frac{U_i^c(c_{it+1}(s^{t+1}))}{U_i^c(c_{it}(s^t))} = \frac{U_j^c(c_{jt+1}(s^{t+1}))}{U_j^c(c_{jt}(s^t))} = \frac{\lambda_{t+1}(s^{t+1})}{\lambda_t(s^t)} = \lambda(s) \quad \forall\, i, j, t \tag{1}$$

where $U_i^c(.)$ denotes the marginal utility of consumption, and $\lambda_t(s^t)$ is the Lagrange multiplier on the resource constraint. Eq. (1) implies that if markets are complete, marginal utility growth should be identical for all agents and countries at all times. In an international setting, this implies that relative shocks to home or foreign output should not affect the relative consumption growth rates. All shocks should be equally shared across countries, and only global shocks should matter for consumption growth. Hence the consumption allocation is said to satisfy full consumption risk sharing if the ratio of marginal utilities of consumption between any two countries is constant across all t and s^t.

If we assume that preferences are of constant relative risk aversion (CRRA) form and add a country- and time-specific preference shock $b_{it}(s^t)$ to the utility function, we can, after

some algebra and rearrangement (see Appendix A), write the full risk sharing condition as

$$\Delta \ln(c_{it}) = \Delta \ln(C_t) + \frac{1}{\sigma}\left(\Delta b_{it} - \Delta B_t\right) \tag{2}$$

where C_t and B_t represent population averages of consumption and preference shocks, and Δ denotes changes such that $\Delta \ln(c_{it}) = \ln(c_{it}(s^t)) - \ln(c_{it-1}(s^{t-1}))$. The full consumption risk sharing equation thus states that if markets are complete, country-specific consumption growth should only be dependent on global consumption growth and the idiosyncratic and global preference changes.

2.2 Partial risk sharing

The previous section assumes complete financial markets and full capital mobility. However, in reality, limited contract enforceability and home bias provide an impediment to risk sharing, and capital mobility is often restricted by capital controls and indirect barriers. Financial markets, especially in developing countries, are also subject to further financial market restrictions. There is also a growing theoretical macroeconomic literature that shows that asset market exclusion restricts risk sharing. Kollmann (2012) shows that if the share of hand-to-mouth households (who are excluded from international financial markets) is high, it can be an explanation for the low international risk sharing we observe empirically. Cociuba and Ramanarayanan (2019) similarly show that asset market segmentation, where only a fraction of the households participate, can also be an explanation for low international risk sharing.

There is a substantial empirical literature that has rejected the hypothesis of full international risk sharing, and estimates for the degree of risk being shared internationally range between 10-60%.[2] However, the empirical results regarding the effect of financial access, financial development, and financial integration on risk sharing are inconclusive. Artis and Hoffmann (2008) and Bai and Zhang (2012), who compare international consumption risk sharing during periods of different degrees of financial globalization, find that risk sharing was not significantly higher during periods of higher financial integration. Flood et al. (2012) and Kose et al. (2009) found some evidence that financial integration improves international risk sharing in advanced economies, but not in developing countries. Kose et al. (2009) note that capital flows to emerging markets tend to be concentrated in procyclical portfolio debt (instead of more stable FDI and portfolio equity flows), which could prevent these economies from benefiting from financial openness in terms of risk sharing. Imbs (2006), Corcoran (2007), Artis and Hoffmann (2012), and Hevia and Servén (2018), however, found that financial linkages increase consumption correlations in samples including both advanced

[2]See Mace (1991), Backus et al. (1992), Obstfeld (1993), Lewis (1996), Kose et al. (2009), Artis and Hoffmann (2012), Fuleky et al. (2018) and Hevia and Servén (2018).

and developing countries. Artis and Hoffmann (2012) point to increased international capital income flows as a channel through which international consumption risk sharing has increased.

In developing countries where the incomes of many households are low, poverty might prevent individuals from saving and participating in asset markets. As the consumption growth of individuals with tight budget constraints is largely dependent on the change in these individuals' disposable income, a large share of hand-to-mouth consumers in the population implies that fewer individuals can pool their consumption risks through international financial markets. Leblebicioglu (2009) shows theoretically that credit constraints and heterogeneity in international credit market access can explain why developing countries have not been able to benefit from international financial integration in terms of consumption risk sharing. This is also consistent with the findings of Antonakakis and Scharler (2012), which show that international risk sharing is lower in advanced countries where credit constraints are more binding. Even though the relative contribution of low-income households to aggregate consumption is smaller than for wealthier households, if a considerable share of the population falls into this low-income category, which is often the case in developing countries, these households' contribution to aggregate consumption is non-negligible.

Risk sharing is also fluctuating over time. Kose et al. (2009) note this in both cross-section and rolling regressions over their sample 1960-2004, with risk sharing being relatively high (around 40-50% globally) in the 1970s and '80s and then substantially lower during and after the '90s. However, Fuleky et al. (2018) note that once they allow for general heterogeneity in their model, they do not find any dramatic change in risk sharing when comparing the period 1960-1990 and 1990-2004. Kalemli-Ozcan et al. (2014) found that international risk sharing varies over the business cycle and can even turn negative during severe economic crises, e.g., due to austerity programs.

3 Method

3.1 Empirical specification

Baseline regression

Equation (2) can be used for testing the international consumption risk sharing relationship using the following empirical specification:

$$\Delta\ln(c_{it}) - \Delta\ln(C_t) = \alpha_i + \beta_i\big(\Delta\ln(y_{it}) - \Delta\ln(Y_t)\big) + \epsilon_{it} \tag{3}$$

where c_{it} and y_{it} denote per capita consumption and GDP of country i in year t, and C_t and Y_t denote global per capita consumption and GDP in year t. Individual country effects that

capture time-invariant heterogeneity are represented by α_i, and ϵ_{it} is an error term that has a time-varying component that captures both idiosyncratic and global preference shocks as well as potential measurement errors. To allow for partial risk sharing, GDP changes are included like in Mace (1991). As it is not possible to insure against global shocks, global consumption and GDP changes are subtracted from the country-specific growth rates like in Lewis (1996).

For notational simplicity I let $\Delta\tilde{c}_{it} = \Delta ln\,(c_{it}) - \Delta ln\,(C_t)$ and $\Delta\tilde{y}_{it} = \Delta ln\,(y_{it}) - \Delta ln(Y_t)$. With this simplification, the international consumption risk sharing model can be written as

$$\Delta\tilde{c}_{it} = \alpha_i + \beta_i \Delta\tilde{y}_{it} + \epsilon_{it} \tag{4}$$

Full risk sharing implies that the change in domestic consumption should be uncorrelated with changes in domestic output growth. This implies testing the hypothesis $\beta_i = 0$. Asdrubali et al. (1996) argue that even if the null hypothesis of full risk sharing is rejected, β_i can still be interpreted as a measure of market incompleteness and represent the share of consumption risk not shared internationally. As the estimate for β_i is typically between 0 and 1, $1 - \beta_i$ can be seen as a measure of international consumption risk sharing, where 0 indicates no risk sharing and 1 denotes perfect risk sharing.

Determinants of international risk sharing

To characterize the effect of financial markets and low incomes on international consumption risk sharing, equation (4) is extended by parametrizing β as a linear function of the country- and time-varying parameters of interest. Now, $\beta_{it} = \beta_i + \mu_i x'_{it}$ where μ_i contains the coefficients and x_{it} contains the country- and time-varying characteristics. The extended risk sharing equation is thus

$$\Delta\tilde{c}_{it} = \alpha_i + \beta_i \Delta\tilde{y}_{it} + \mu_i x'_{it} \Delta\tilde{y}_{it} + \epsilon_{it} \tag{5}$$

The degree of risk sharing is now equal to $(1 - \beta_i - \mu_i x'_{it})$. Estimates of $\mu_i x'_{it}$ capture the extent to which aggregate international risk sharing is affected by financial markets or low-income households. If the sign on μ_i is positive, then the higher the value of x_{it}, the lower amount of risk sharing there is. The coefficient on headcount poverty is expected to be positive, as a higher share of low-income households is expected to reduce risk sharing. As financially open economies are expected to share more risk internationally, the coefficient on financial development, liberalization, and integration should be negative.

3.2 WG and CCEP estimators

The most basic panel estimator used is the within-group (WG) or fixed effects estimator. However, an issue generally overlooked in the risk sharing literature is that many countries are subject to common factors, such as globalization or financial innovation. If there is some unobserved common factor casting a heterogeneous influence on output and consumption growth, this will appear in the residual and cause error cross-sectional dependence. To correct for the cross-sectional dependence, the consumption risk sharing relationship is augmented by a common factor loading in the panel regression error. The error term ϵ_{it} therefore consists of an unobserved common factor f_t with the factor loading γ_i, and ε_{it}, which is i.i.d. in both time and space. As I allow for heterogeneous cross-sectional dependence, γ_i can differ between countries. Hence

$$\epsilon_{it} = \varepsilon_{it} + \gamma_i f_t \tag{6}$$

Using (6), the international risk sharing model can be written as

$$\Delta\tilde{c}_{it} = \alpha_i + \beta_i \Delta\tilde{y}_{it} + \gamma_i f_t + \varepsilon_{it} \tag{7}$$

To exploit the cross-sectional dependence in the data, the Common Correlated Effect (CCE) estimator developed by Pesaran (2006) is used. The CCE estimator filters the country-specific regressors by the common cross-sectional averages, such that asymptotically, as N tends to infinity, the differential effects of the unobserved common factors are eliminated. In practice, this means that the time-varying unobserved common factor is approximated by the cross-sectional averages of the dependent variable and the individual-specific regressors.[3] The CCE estimator for the baseline model can thus be estimated as:

$$\Delta\tilde{c}_{it} = \alpha_i + \beta_i \Delta\tilde{y}_{it} + \theta_i^1 \overline{\Delta c_t} + \theta_i^2 \overline{\Delta y_t} + \varepsilon_{it} \tag{9}$$

where the bar denotes cross-sectional averages of the series. The CCE estimator is thus equation (4) augmented with the cross-sectional averages of the regressors and the dependent variable, and can be estimated with OLS. For the model with determinants, the regression equation for the CCE estimator is:

$$\Delta\tilde{c}_{it} = \alpha_i + \beta_i \Delta\tilde{y}_{it} + \mu_i x'_{it} \Delta\tilde{y}_{it} + \theta_i^1 \overline{\Delta c_t} + \theta_i^2 \overline{\Delta y_t} + \theta_i^3 \overline{x'_t \Delta y_t} + \varepsilon_{it} \tag{10}$$

[3] Pesaran (2006) shows that the unobserved component f_t can be approximated by

$$f_t = \frac{1}{\bar{\gamma}} \left[\bar{y}_t - \beta \bar{x}_t - \bar{\eta} - \bar{\varepsilon}_t \right] \tag{8}$$

where $\bar{y}$, $\bar{x}$ and $\bar{\gamma}$ are the respective cross-sectional averages of the dependent and independent variables and the factor loading on the unobserved component, and $\bar{\eta}$ the average fixed effect. The estimates are unbiased for samples as small as N=30 and T=20, as long as the number of unobserved factors do not exceed the number of individual specific regressors and a constant.

If the individual slope coefficients are identical, the observations can be pooled over the cross-sectional units. Pesaran (2006) denotes this pooled CCE estimator CCEP. Even though the slope coefficients on the estimated parameters are the same for all cross-sections in the panel, the slope coefficient of the common unobserved factor is allowed to differ across countries.[4]

4 Data

The full sample consists of an unbalanced panel of 116 countries from 1970 to 2019. The sample (listed in Appendix B along with some descriptive statistics) contains 30 advanced economies, 39 emerging market (EM) countries, and 47 less-developed countries (LDC).[5] For the main analysis, annual country-level PPP-adjusted real consumption, real output (GDP), and population data were collected from Penn World Table 10.0 (Feenstra et al., 2015).[6] Global per capita GDP and consumption growth rates are defined as the respective aggregated growth rates.

Ideally, I would like to study the impact of hand-to-mouth consumers on international risk sharing, but unfortunately, such time series are unavailable. The share of low-income households (LIR) is therefore represented by national headcount poverty rates, which denote the percentage of the population living below the national poverty line. The national poverty line is defined as half the median household income of the total population, averaged over time.[7] The data are collected from the World Bank database Povcalnet (2021). However, more households than just those below the poverty line are likely hand-to-mouth households and are too savings constrained to participate in financial asset markets, so this ratio should be seen as a lower bound of the hand-to-mouth households in the country.

For financial development, liberalization, and integration, I use four different measures with varying sample coverage. Financial market development (FM) is proxied by the Financial Market Development index by Čihák et al. (2012), which looks at the debt security and stock market depth, efficiency, and access, and ranges between zero and one. Financial liberalization is proxied by Abiad et al.'s (2010) Index of Financial Reform ($FinRef$). The index looks at seven financial sector policy dimensions: credit controls and reserve requirements, interest rate controls, entry barriers, state ownership, policies on securities markets,

[4] Eq. (4) already includes the cross-sectional consumption and output growth averages, but this cross-sectional dependence correction is identical for all countries. As the countries included in the sample are arguably heterogeneous with respect to economic and political structure, the common factor could have a differential effect on risk sharing in the different countries. Thus, even though the equation for international risk sharing by construction corrects for *homogeneous* cross-sectional dependence, there can still be *heterogeneous* error cross-sectional dependence in the panel.

[5] Advanced countries are those classified as high income countries by the World Bank since 1990. The emerging markets are countries commonly listed as emerging markets.

[6] The varying quality of international consumption data is a major drawback and caution is warranted, especially with national accounts data provided by countries with weak statistical capacity. The sample only contains countries with an average World Bank Statistical Capacity Index above 50. The index ranges between 0-100, where 100 denotes very high statistical capacity.

[7] The data are only collected every 3-4 years and are linearly intrapolated to annual series.

banking regulations, and capital account restrictions. Liberalization scores for each category are combined in a graded index between zero and one. An alternative measure of financial liberalization is the Chinn and Ito (2006) index which measures a country's degree of capital account openness ($KaOpen$). It is based on binary variables that codify restrictions on cross-border financial transactions reported in IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) and ranges between zero and one. Finally, we use a de facto measure of financial integration, the ratio of foreign liabilities to GDP ($Liab$) at the beginning of the year by Lane and Milesi-Ferretti (2007), which is both a measure of the internationalization and depth of the financial market.

For the unobserved common component analysis, the US Effective Federal Funds rate, US real M2 growth (%), and the Global Stock Price Volatility Index are collected from the Federal Reserve Bank of St. Louis FRED database. Subsample output growth volatility is defined as the standard deviation of Δy across the sample countries. I also use the Economic Policy Uncertainty (EPU) Index by Baker et al. (2018) that measures policy-related economic uncertainty, which is based on newspaper coverage of policy-related economic uncertainty, disagreement among economic forecasters, and expiring tax agreements in the US.

5 Results

5.1 The baseline risk sharing regression

The baseline risk sharing equation (4) is first estimated on an unbalanced panel for the full sample and subsamples over the years 1970–2019. The results for the WG and CCEP estimators are presented in Table 1.[8] The coefficient on idiosyncratic output growth, $\Delta\tilde{y}_{it}$, is positive as expected and clearly significant in all cases. If we measure international risk sharing (IRS) as $1 - \hat{\beta}$, where $\hat{\beta}$ is the estimated coefficient on $\Delta\tilde{y}_{it}$, the results suggest that countries share on average 32-34% of consumption risks internationally. This is in line with Kose et al. (2009) and Fuleky et al.'s (2018) CCE-corrected estimates but higher than Bai and Zhang (2012). The corresponding number in less-developed and emerging market countries is 32% and 22%, respectively (similar to or slightly higher than in Kose et al. (2009)). Kose et al. (2009) hypothesize that one possible reason for the low consumption risk sharing levels in developing economies is that capital flows to the emerging markets are generally procyclical. This procyclicality prevents these countries from using the capital flows to smooth their consumption, as capital leaves the country when it is needed the most. This could instead aggravate the dependence of consumption changes on domestic output fluctuations and suppress international risk sharing. In advanced economies, risk

[8]The MG and CCEMG results are presented in Table A-4 in the Appendix, and Table A-3 presents the country-specific CCE risk sharing coefficients to illustrate the degree of international risk sharing in each country. The CCEMG estimator is the simple average of the individual CCE estimators.

sharing is significantly higher at around 62-69%. The finding that developing countries share significantly less risk internationally than advanced countries is in line with earlier findings, but the risk sharing coefficient of 69% is high compared to previous estimates (advanced country estimates by Kose et al. (2009), Bai and Zhang (2012), and Fuleky et al. (2018) are all around 40%). However, if we compare the degree of risk shared at the beginning of the sample (1970–1999) to the end (2000–2019) in Table 2, we note that international risk sharing is much higher in the latter period both globally and in the advanced countries. This can also explain why the risk sharing estimates found previously are lower, as those studies focus on an older sample that ended much earlier than 2019. Risk sharing in the latter period in emerging markets is also higher at 30%, while it is lower in the LDCs compared to the full sample period. Once we allow for slope heterogeneity with CCEMG estimators presented in Table A-4 in the appendix, like in Fuleky et al. (2018), the degree of risk shared among advanced economies is around 50%.[9] However, Table A-5 shows that in the more recent years (2000–2019), the advanced country risk sharing is 61% even when taking slope heterogeneity into account. This therefore suggests that risk sharing in advanced economies has increased compared to previous periods surveyed when also accounting for heterogeneity.

As can be seen from Table 1, Pesaran's 2015 test for cross-sectional dependence (CD) rejects the null hypothesis of no cross-sectional dependence for the WG estimator in all samples. Despite the correction for homogeneous cross-sectional dependence in the risk sharing specification, the basic estimators still suffer from cross-sectional dependence, implying that the CCE estimators are preferred. The CCEP risk sharing estimates for the advanced and less developed countries are much higher, by 10% and 20% respectively (although the difference is not significant), than the WG estimates. Chow tests evaluating the null hypothesis of structural parameter stability suggest that there are structural differences between the subsamples. More weight should thus be given to the subsample analysis.

The common factor

If we assume that there is only one unobserved common component (although there can be several), approximated by $\hat{f}_t$ in equation (8), this factor $\hat{f}_t$ can be identified up to a scaling factor ($\bar{\gamma}$). The common factors for the subsamples are presented in Figure 1. The figure shows that the common components for the subsamples differ somewhat, with the biggest difference of the common component being between the advanced economies and the rest of the countries in the sample.

Global economic uncertainty and monetary policy are factors that could affect risk sharing internationally, but the aggregate impact could vary between countries. I therefore regress the common factor $\hat{f}_t$ on potential determinants such as the output growth volatility (StDev

[9] A Hausman test of slope heterogeneity produced a negative test statistic, so no conclusion can be drawn since the statistic is assumed to follow a χ^2 distribution.

Δy), US monetary policy measures like the Fed Funds rate and US real M2 growth (which are generally perceived as global monetary policy measures), and uncertainty measures like the global stock price volatility and the Economic Policy Uncertainty (EPU) Index. As Table 3 shows, the uncertainty and monetary policy variables explain around 16-38% of the variation in the common factor. It thus seems like the latent factor, to some extent, captures the short-run effects of the global financial business cycle on risk sharing. This is somewhat related to the findings of Artis and Hoffmann (2012) and Becker and Hoffmann (2006), who distinguish between consumption risk sharing patterns over the long-term through international financial markets and short-term via savings and dissavings. My results, however, indicate that short-run variation in advanced economies (and developing economies) comes not only from savings and dissavings but also partially from global monetary policy and uncertainty.

5.2 Determinants of international risk sharing

The analysis is now extended to eq. (10) to see how international consumption risk sharing is affected by low-income population ratios (LIR), financial market development (FM), financial liberalization (proxied either by the Financial reform index ($FinRef$) or the capital account openness index ($KaOpen$)), and financial integration (proxied by total external liabilities to GDP ($Liab$)), all described in Section 4. As Pesaran's CD tests indicate that all models suffer from cross-sectional dependence, only the results for the CCEP estimators are presented.

Full sample

The extended models including interaction terms for the low-income ratios and different financial market measures in the full sample are presented in Table 4. The estimated coefficients on the idiosyncratic output variation $\Delta\tilde{y}$ are all significantly positive.

The interaction coefficient with LIR is significantly positive, suggesting that a higher low-income ratio is associated with lower international risk sharing. This is in line with the theoretical literature (see, e.g., Kollmann (2012) and Cociuba and Ramanarayanan (2019)) that finds that hand-to-mouth consumers or asset market segmentation reduce risk sharing.

Next, we note that the interaction terms with the different financial liberalization and integration measures are all negative as expected and significant. There is thus some evidence that financial (stock and bond) market development (FM), financial reforms ($FinRef$), capital account openness ($KaOpen$), and financial integration ($Liab$), significantly enhance international consumption risk sharing. The interaction coefficients on FM, $FinRef$, and $KaOpen$ are all relatively large and of similar size, while de facto financial integration only has a limited risk sharing impact as the interaction coefficient on $Liab$ is fairly small. The previous literature has generally looked at broader financial integration measures like capital

account openness and external liabilities to GDP, and has found that it is mostly de facto integration like external liabilities to GDP that enhances risk sharing (see, e.g., Kose et al. (2009)). As the FM is directly related to the channel through which international risk sharing at the household level occurs, it is the most appropriate financial development measure to look at within the international risk sharing context.[10] However, as it is a fairly recent measure, it has not yet been used in this context.

When I control for financial integration, low-income ratios, and cross-sectional dependence, the risk sharing coefficient IRS rises slightly to around 35–40%.

LDC, EM, and advanced economies

Next, we look at the less-developed (LDC), emerging market (EM), and advanced country subsamples presented in Table 5. The results suggest that international risk sharing in both LDCs and EMs is lower when the share of low-income households is higher as the interaction terms including LIR are significantly positive in both subsamples, although only at the 10% level in EM. In advanced economies, the low-income ratio impact is also negative but insignificant.

When it comes to financial access and liberalization, we note that different types of financial liberalization and reforms affect risk sharing in the different subsamples. In LDCs, where financial market development is fairly low but domestic financial reforms are more common (see the Appendix, Figures A-1–A-4), the results suggest that financial market development does not affect risk sharing. Instead, domestic financial reforms have a substantial positive impact on risk sharing as the interaction coefficient with $FinRef$ is significantly negative. Moreover, there is some weak evidence that financial depth ($Liab$) also positively impacts risk sharing. Only using capital account openness or external liabilities for gauging financial openness in LDCs, as in the previous literature (see, e.g., Kose et al. (2009)), might, however, be misleading, as there are other important financial market restrictions affecting risk sharing in these countries. Noteworthy is that risk sharing in the LDCs is higher when the financial reform measure is used for financial openness, thus highlighting the relevance of using a broader financial integration measure in LDCs. In LDCs, there thus seem to be welfare gains from financial reforms on entry barriers, state ownership, interest rate controls, securities and credit markets through better consumption smoothing opportunities.

In EMs, financial market development has a significantly positive impact on risk sharing as the interaction term with FM is negative. There is also some weak evidence that financial reforms and capital account openness have some positive risk sharing impact as well, as the interaction terms with $FinRef$ and $KaOpen$ are significantly negative at the 10% level. These results stand in contrast with previous studies like Flood et al. (2012), Bai and Zhang

[10] Relatedly, Volosovych (2013) points to income risk sharing via portfolio diversification as one of the main channels through which international risk sharing occurs.

(2012), Kose et al. (2009), and Corcoran (2007), which concluded that financial integration has not enhanced risk sharing in developing or EM countries. However, these studies looked at the effect of financial openness as measured by total net foreign assets to GDP or compared risk sharing during periods of higher and lower financial globalization. Instead, my analysis covers a longer time period and accounts for different types of financial integration, particularly the stock and bond market development (FM) and domestic financial reforms ($FinRef$), which are more directly related to households' financial market access.

In advanced economies, financial market development (FM) and de facto financial integration ($Liab$) are positively associated with international risk sharing. It is convincing to see that stock and bond market development (FM) has a substantial impact on risk sharing, as this is the measure most directly related to households' international risk sharing channel. The financial liability result confirms the findings of Kose et al. (2009), who found that de facto financial openness (proxied by external liabilities to GDP) improves risk sharing in advanced economies. However, the size of the coefficient on $Liab * \Delta\tilde{y}$ is tiny, indicating a very limited although statistically significant economic impact of financial depth. There is some suggestive evidence that financial reforms and capital account openness also support risk sharing, as these interaction terms are significant at the 10% level. As the capital accounts in most advanced economies are close to fully open, and financial restrictions are rather modest, it is therefore not very surprising that the effect of financial liberalization on international risk sharing is less relevant.

A higher share of hand-to-mouth consumers and less financial liberalization and integration thus significantly lower international consumption risk sharing. When controlling for financial liberalization and integration and low-income households, risk sharing in LDCs increases slightly to around 33–41%, in EMs to around 21–27%, and in advanced economies to 67–73%. As financial liberalization and integration are lower and low-income ratios are higher in developing countries than in advanced ones, this contributes to the empirically observed gap in international risk sharing between developing and advanced economies. These results thus suggest that there are potential welfare gains through improved consumption risk sharing from increased financial liberalization, financial integration, and poverty reduction in developing countries.

5.3 Robustness

Next, some robustness checks are conducted. One potential concern is that low-income ratios are endogenously affected by financial liberalization or international consumption risk sharing. Similar results are obtained, however, when lagged values of the low-income ratios or other determinants are used, shown in Table A-6 in Appendix D, implying that the endogeneity concern is unfounded. The conclusion is also robust to using further lags of

LIR. The results are furthermore robust to the exclusion of individual countries one by one, subsample modifications, and to the exclusion of China (not reported).

Another concern is that I have not correctly identified the set of countries that pool their consumption risks. I therefore estimate the degree of risk shared only between countries within different subsamples, presented in Table A-7 in the Appendix. The degree of risk shared only among the advanced or developing countries does not differ significantly from the risk sharing with the rest of the world.

6 Conclusion

This paper empirically examines international consumption risk sharing and its determinants using a panel of 116 countries between 1970–2019. I show that about 34% of consumption risks are shared internationally. Advanced economies share on average between 50–70% of their consumption risks internationally, whereas the emerging and less developed economies share around 23–32%.

My first contribution is showing empirically that a higher share of low-income households is associated with lower international consumption risk sharing in emerging markets, but especially in less-developed countries. High poverty rates prevent individuals from saving and taking part in international financial markets, which in turn reduces risk sharing.

Secondly, I show that financial liberalization, proxied by financial market development, domestic financial reforms, capital account openness, and financial integration, represented by total external liabilities to GDP, are positively associated with international consumption risk sharing. However, the economic impact and the types of financial liberalization and integration that affect risk sharing vary between different economies. A wide range of financial sector reforms influences risk sharing in less-developed countries, where financial markets generally are more restricted and less developed. In emerging market economies, which are generally more financially open, financial (stock and bond) market development matters more. In advanced economies, financial market development and de facto financial integration have a significant impact. Thus, financial reforms seem to matter for risk sharing in countries with more closed financial systems. When the financial market is already fairly open, the risk sharing impact of further reforms or liberalization is more limited, and what matters is the stock and bond market depth, access, and efficiency.

A high share of low-income households, lack of financial market reforms, and a less developed stock and bond market can partly explain why risk sharing is lower in developing countries than in advanced ones. There are thus potential welfare gains to be achieved through improved risk sharing in developing countries from continuing financial market reforms and development, deepening financial integration, and poverty reduction.

Finally, and on a more technical note, although the risk sharing equation by construction corrects for *homogeneous* cross-sectional dependence, the international risk sharing relationship is still subject to *heterogeneous* cross-sectional dependence. Around 30% of this common component can be explained by global economic uncertainty and monetary policy.

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Tables

	Full sample		LDC		EM		Advanced	
	WG	CCEP	WG	CCEP	WG	CCEP	WG	CCEP
$\Delta\tilde{y}$	0.676***	0.661***	0.734***	0.680***	0.782***	0.766***	0.377***	0.311***
	(0.032)	(0.034)	(0.035)	(0.040)	(0.038)	(0.039)	(0.065)	(0.068)
IRS	0.324***	0.339***	0.266***	0.320***	0.218***	0.234***	0.623***	0.689***
	(0.032)	(0.034)	(0.035)	(0.040)	(0.038)	(0.039)	(0.065)	(0.068)
R^2	0.517	0.571	0.528	0.593	0.664	0.717	0.304	0.493
CD	16.60***		5.79***		6.68***		25.93***	
Chow			2.13***	2.19***	2.13***	2.19***	2.13***	2.19***
N	116		47		39		30	
Obs.	4,733		1,735		1,523		1,475	

Note: Estimation of equation (4) for the WG estimator and (9) for the CCEP. Standard errors clustered by country are in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10% levels, respectively. $IRS = 1 - \hat{\beta}$. CD is the cross-sectional dependence test statistic, and Chow is the Chow test for structural parameter stability in the subsamples, with H_0: structural stability. Sample: 1970-2019.

Table 1: Basic international consumption risk sharing estimates

	Full sample		LDC		EM		Advanced	
	1970-1999	2000-2019	1970-1999	2000-2019	1970-1999	2000-2019	1970-1999	2000-2019
$\Delta\tilde{y}$	0.712***	0.530***	0.777***	0.573***	0.782***	0.705***	0.351***	0.230***
	(0.042)	(0.058)	(0.046)	(0.080)	(0.041)	(0.059)	(0.083)	(0.058)
IRS	0.288***	0.470***	0.223***	0.247***	0.218***	0.295***	0.649***	0.770***
	(0.042)	(0.058)	(0.046)	(0.080)	(0.041)	(0.059)	(0.083)	(0.058)
R^2	0.622	0.487	0.659	0.484	0.737	0.686	0.478	0.494
N	114	115	45	46	39	39	30	30
Obs.	2,479	2,254	851	884	753	770	875	600

Note: Estimation of equation (9) using CCEP. Standard errors clustered by country are in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10% levels, respectively. $IRS = 1 - \hat{\beta}$.

Table 2: Consumption risk sharing before and after year 2000

	All	LDC	EM	Advanced
StDev Δy_i	-0.221*	-0.178	-0.173*	0.012
	(0.118)	(0.120)	(0.088)	(0.110)
Fed Funds rate	-0.055*	-0.115**	-0.010	0.069
	(0.03)	(0.06)	(0.03)	(0.04)
EPU Index	-0.005	-0.001	0.001	-0.02***
	(0.005)	(0.007)	(0.005)	(0.006)
Real M2 growth	-0.107***	-0.128**	-0.032	-0.040
	(0.033)	(0.058)	(0.036)	(0.046)
Stock price volatility	0.04**	0.025	-0.001	0.066**
	(0.019)	(0.031)	(0.020)	(0.025)
R^2	0.27	0.20	0.16	0.38
Obs	49	49	49	49

Note: Dependent variable: the common factor. Standard errors in parentheses, symbols ***, ** and * denote significance at 1%, 5% and 10% levels, respectively. Model includes a constant. Sample: 1970-2019.

Table 3: Determinants of the common factor

	(i)	(ii)	(iii)	(iv)	(v)
$\Delta\tilde{y}$	0.528***	0.690***	0.837***	0.739***	0.653***
	(0.051)	(0.047)	(0.057)	(0.051)	(0.036)
$LIR * \Delta\tilde{y}$	0.570***				
	(0.155)				
$FM * \Delta\tilde{y}$		-0.361**			
		(0.159)			
$FinRef * \Delta\tilde{y}$			-0.363**		
			(0.146)		
$KaOpen * \Delta\tilde{y}$				-0.229**	
				(0.097)	
$Liab * \Delta\tilde{y}$					-0.007***
					(0.002)
LIR	-0.039***				
	(0.011)				
FM		-0.009			
		(0.010)			
$FinRef$			0.030***		
			(0.010)		
$KaOpen$				0.006	
				(0.005)	
$Liab$					-0.000
					(0.000)
IRS	0.363***	0.398***	0.353***	0.377***	0.361***
	(0.055)	(0.055)	(0.091)	(0.073)	(0.042)
R^2	0.623	0.589	0.659	0.586	0.584
N	111	114	85	112	116
Obs.	3,743	3,822	2,269	4,481	4,561
Years	1981-2019	1981-2019	1970-2005	1970-2019	1970-2019

Note: Estimation of equation (10) using CCEP. Standard errors clustered by country in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10% levels, respectively. IRS=$1 - \hat{\beta} - \hat{\mu}\bar{\bar{x}}$, where $\bar{\bar{x}}$ denotes the cross-sectional and time average of x_{it}. As not all series are available for all countries or the full sample period, N and T varies between the models.

Table 4: CCEP Consumption risk sharing estimates for the full sample

	Less developed countries					Emerging markets					Advanced economies				
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)	(xiii)	(xiv)	(xv)
$\Delta\tilde{y}$	0.551***	0.593***	0.804***	0.676***	0.791***	0.659***	0.855***	0.873***	0.837***	0.775***	0.289***	0.473***	0.550***	0.435***	0.341***
	(0.063)	(0.046)	(0.075)	(0.067)	(0.068)	(0.059)	(0.071)	(0.069)	(0.053)	(0.051)	(0.083)	(0.098)	(0.135)	(0.071)	(0.075)
$LIR * \Delta\tilde{y}$	0.428**					0.337*					0.220				
	(0.210)					(0.189)					(0.288)				
$FM * \Delta\tilde{y}$		0.872					-0.342***					-0.422***			
		(0.943)					(0.121)					(0.139)			
$FinRef * \Delta\tilde{y}$			-0.535**					-0.181*					-0.325*		
			(0.235)					(0.093)					(0.162)		
$KaOpen * \Delta\tilde{y}$				-0.038					-0.139*					-0.184*	
				(0.141)					(0.073)					(0.095)	
$Liab * \Delta\tilde{y}$					-0.167*					-0.019					-0.004***
					(0.084)					(0.020)					(0.001)
LIR	-0.016					-0.038***					-0.100***				
	(0.022)					(0.011)					(0.028)				
FM		-0.099					0.008					0.000			
		(0.060)					(0.013)					(0.010)			
$FinRef$			0.068**					0.022					-0.009		
			(0.030)					(0.013)					(0.013)		
$KaOpen$				0.008					0.004					0.003	
				(0.008)					(0.004)					(0.006)	
$Liab$					-0.007					-0.001					-0.000
					(0.005)					(0.002)					(0.000)
IRS	0.364***	0.377***	0.408***	0.337***	0.334***	0.269***	0.239***	0.211***	0.228***	0.241***	0.677***	0.731***	0.671***	0.705***	0.674***
	(0.068)	(0.046)	(0.102)	(0.077)	(0.108)	(0.064)	(0.076)	(0.085)	(0.066)	(0.063)	(0.088)	(0.119)	(0.188)	(0.120)	(0.090)
R^2	0.618	0.602	0.681	0.590	0.593	0.745	0.742	0.776	0.736	0.727	0.597	0.547	0.510	0.528	0.528
N	45	46	28	46	47	39	39	32	38	39	27	29	25	28	30
Obs.	1,425	1,429	642	1,664	1,675	1,279	1,278	802	1,477	1,481	1,039	1,115	825	1,340	1,405
Years	1981-2019	1981-2019	1970-2005	1970-2019	1970-2019	1981-2019	1981-2019	1970-2005	1970-2019	1970-2019	1981-2019	1981-2019	1970-2005	1970-2019	1970-2019

Note: Estimation of equation (10) using CCEP. Standard errors clustered by country are in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10% levels, respectively. $IRS = 1 - \hat{\beta} - \hat{\mu}\bar{\bar{x}}$, where $\bar{\bar{x}}$ denotes the cross-sectional and time average of x_{it}.

Table 5: CCEP Consumption risk sharing estimates in the subsamples

Figures

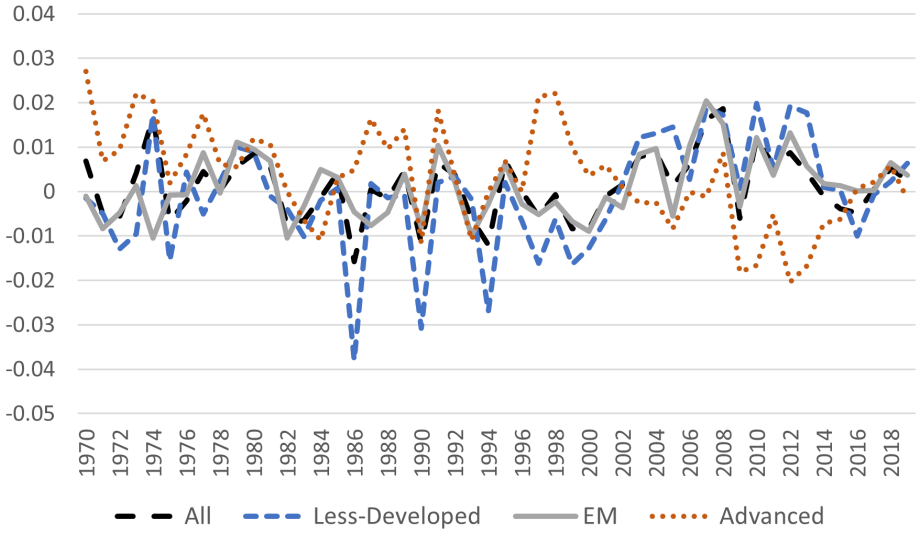


Figure 1: The common factor in the different samples

Appendix

Appendix A. Derivation of the IRS equation

This appendix derives the international consumption risk sharing equation used as a base for the empirical analysis. The underlying theoretical framework of full consumption risk sharing can be derived from the Arrow-Debreu equilibrium as outlined in Mace (1991) and Krueger (2004): Consider a social planner's problem of maximizing utility over I countries with representative agents with state contingent utility functions $U_i(c_{it}(s^t), s^t)$, where $i = 1, \ldots, I$ is the country index, $c_{it}(s^t)$ is the consumption in country i at time t given the state of nature s^t. The state of nature affects both consumption as well as the utility function, for instance through a change of preferences. The social planner's objective is to maximize

$$\sum_i \sum_t \sum_{s^t} \alpha_i \beta^t \pi_t(s^t) U_i(c_{it}(s^t), s^t) \tag{A-1}$$

subject to the resource constraints

$$\sum_i c_{it}(s^t) \leq \sum_i y_{it}(s^t) \quad \forall \ s^t \tag{A-2}$$

where α^i is the social planner's weight on country i utility, β is the discount rate, $\pi_t(s^t)$ is the probability of state s^t occurring in time t and $y_{it}(s^t)$ is the output level of country i at time t in state s^t.

The first order condition for any country i is

$$\alpha_i \beta^t \pi_t(s^t) U_i^c(c_{it}(s^t), s^t) = \lambda_t(s^t) \tag{A-3}$$

where $U_i^c(.)$ denotes the derivative of $U_i(.)$ w.r.t. consumption and $\lambda_t(s^t)$ is the Lagrange multiplier on the resource constraint.

If we assume that preferences are of a Constant Relative Risk Aversion (CRRA) form and allow the utility function of the representative consumer to also feature a country and time specific preference shock $b_{it}(s^t)$, we can write the utility function as

$$U_i(c_{it}(s^t), s^t) = exp\ (b_{it}(s^t)) \frac{c_{it}(s^t)^{1-\sigma} - 1}{1 - \sigma} \tag{A-4}$$

The first order condition for any country i at any time t can now be written as

$$\alpha_i \beta^t \pi_t(s^t) exp\ (b_{it}(s^t)) c_{it}(s^t)^{-\sigma} = \lambda_t(s^t) \tag{A-5}$$

Taking logs of equation (A-3) yields

$$\ln(c_{it}(s^t)) = \frac{1}{\sigma}\ln(\alpha_i) - \frac{1}{\sigma}\ln\left(\frac{\lambda_t(s^t)}{\beta^t \pi_t(s^t)}\right) + \frac{1}{\sigma} b_{it}(s^t) \tag{A-6}$$

In order to simplify the expression above, first note that the cross country average of (A-6) can be written as

$$\frac{1}{N}\sum_i \ln(c_{it}(s^t)) = \frac{1}{\sigma N}\sum_i b_{it}(s^t) + \frac{1}{\sigma N}\sum_i \ln(\alpha_i) - \frac{1}{\sigma}\ln\left(\frac{\lambda_t(s^t)}{\beta^t \pi_t(s^t)}\right) \tag{A-7}$$

This relationship in equation (A-7) can in turn be used to substitute out $\frac{1}{\sigma}\ln\big(\frac{\lambda_t(s^t)}{\beta^t \pi_t(s^t)}\big)$ from equation (A-6). Moreover, by denoting the population averages as[1] $\frac{1}{N}\sum_i b_{it}(s^t) = B_t(s^t)$, $\frac{1}{N}\sum_i \ln(c_{it}(s^t)) = \ln(C_t(s^t))$ and $\frac{1}{N}\sum_i \ln(\alpha_i) = \ln(\alpha)$ equation (A-6) can be rewritten as

$$\ln(c_{it}(s^t)) = \frac{1}{\sigma}\big(b_{it}(s^t) - B_t(s^t)\big) + \frac{1}{\sigma}\big(\ln(\alpha_i) - \ln(\alpha)\big) + \ln(C_t(s^t)) \tag{A-8}$$

When taking first differences of equation (A-8) the term $\frac{1}{\sigma}\big(\ln(\alpha_i) - \ln(\alpha)\big)$ disappears. By suppressing the dependence on s^t and denoting $\Delta\ln(c_{it}) = \ln(c_{it}(s^t)) - \ln(c_{it-1}(s^{t-1}))$, the equation can be written as the full risk sharing condition for the preferences specified above

$$\Delta\ln(c_{it}) = \Delta\ln(C_t) + \frac{1}{\sigma}\big(\Delta b_{it} - \Delta B_t\big) \tag{A-9}$$

[1] This derivation involves some abuse of notation, as the last two expressions are sums of logs instead of logs of sums.

Appendix B. Data sample and descriptive statistics

This appendix lists all the countries in the sample, separated for each subsample, some descriptive statistics in Table A-1, a correlation matrix in Table A-2 and scatter plots of the different determinants in Figures A-1 to A-4.

List of countries in the sample

Less developed countries (47):

Albania, Armenia, Azerbaijan, Bangladesh, Belarus, Bhutan, Bolivia, Burkina Faso, Cambodia, Cameroon, Dominican Republic, Ecuador, El Salvador, Eswatini, Ethiopia, Fiji, Georgia, Ghana, Guatemala, Guinea, Honduras, Jamaica, Kenya, Kyrgyzstan, Laos, Lesotho, Madagascar, Malawi, Moldova, Mongolia, Montenegro, Mozambique, Namibia, Nepal, Niger, Nigeria, Paraguay, Rwanda, Senegal, Sri Lanka, Suriname, Tajikistan, Tanzania, Uganda, Ukraine, Uzbekistan and Zambia.

Emerging Market countries (39):

Argentina, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Croatia, Czech Republic, Egypt, Estonia, Hungary, India, Indonesia, Jordan, Latvia, Lithuania, Macedonia, Malaysia, Mexico, Morocco, Pakistan, Panama, Peru, Philippines, Poland, Romania, Russia, Serbia, Slovakia, South Africa, South Korea, Thailand, Tunisia, Turkey, Uruguay, and Vietnam.

Advanced economies (30):

Australia, Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovenia, Spain, Sweden, Switzerland, Taiwan, United Kingdom and United States.

Note: The countries in the full sample accounted for 97.5% of 2014 global GDP. The former Sovjet Union countries are included as of 1995 onwards.

Descriptive Statistics

Table A-1 with the descriptive statistics includes the mean, standard deviation (sd), number of observations, number of countries and the start and end year for each of the data series.

The correlation matrix in Table A-2 shows pairwise correlations for the dependent and the independent variables included in the analysis. The correlation between the deviations of log consumption and output growth from their global averages, $\Delta\tilde{c}$ and $\Delta\tilde{y}$, is fairly high at 0.735, but the dependent variable ($\Delta\tilde{c}$) is otherwise not highly correlated with any of the international consumption risk sharing determinants (LIR, FM, $FinRef$, $KaOpen$, or $Liab$) as the absolute correlation coefficient between $\Delta\tilde{c}$ and any of the determinants is at most 0.079. The risk sharing determinants are however fairly highly correlated. The absolute correlation coefficient between the determinants is on average 0.345, and the pairwise correlation ranges from 0.095 (between LIR and $Liab$) to at most 0.6759 (between $FinRef$ and $KaOpen$).

	Total sample						
	mean	sd	Obs.	N	Start	End	Source
$\Delta\tilde{c}$	0.006	0.05	4733	116	1970	2019	Feenstra et al. (2015)
$\Delta\tilde{y}$	0.006	0.06	4733	116	1970	2019	Feenstra et al. (2015)
LIR	0.191	0.14	3743	111	1981	2019	Povcalnet (2021)
FM	0.245	0.25	3901	114	1980	2019	Čihák et al. (2012)
FinRef	0.524	0.30	2269	85	1973	2005	Abiad et al. (2010)
KaOpen	0.505	0.36	4481	112	1970	2019	Chinn and Ito (2006)
Liab	1.877	9.41	4643	116	1970	2019	Lane and Milesi-Ferretti (2007)

	Less developed countries				**Emerging Markets**				**Advanced Economies**			
	mean	sd	Obs.	N	mean	sd	Obs.	N	mean	sd	Obs.	N
$\Delta\tilde{c}$	0.002	0.07	1735	47	0.011	0.05	1523	39	0.005	0.03	1475	30
$\Delta\tilde{y}$	0.002	0.07	1735	47	0.012	0.05	1523	39	0.005	0.04	1475	30
LIR	0.198	0.15	1425	45	0.214	0.16	1279	39	0.155	0.11	1039	27
FM	0.034	0.06	1457	46	0.273	0.19	1301	39	0.483	0.25	1143	29
FinRef	0.396	0.25	642	28	0.465	0.30	802	32	0.682	0.27	825	25
KaOpen	0.329	0.28	1664	46	0.471	0.35	1477	38	0.760	0.31	1340	28
Liab	0.747	0.54	1704	47	0.827	0.67	1505	39	4.321	16.65	1434	30

Note: $\Delta\tilde{c}$ and $\Delta\tilde{y}$ are the deviations of log consumption and output growth from their global averages. *LIR* represents a low-income ratio, the national headcount poverty rate, *FM* is an index of Financial Market (stock and debt security) development, *Finref* is a Financial Reform index, *KaOpen* is a capital account openness index, and *Liab* represent total external liabilities to GDP. See Section 4 for more information about the variables.

Table A-1: Data

	$\Delta\tilde{c}$	$\Delta\tilde{y}$	***LIR***	***FM***	***FinRef***	***KaOpen***	***Liab***
$\Delta\tilde{c}$	1						
$\Delta\tilde{y}$	0.7352	1					
LIR	-0.0790	-0.0255	1				
FM	-0.0128	-0.0195	-0.2161	1			
FinRef	0.0732	0.0790	-0.3232	0.5306	1		
KaOpen	0.0393	0.0327	-0.2013	0.4769	0.6759	1	
Liab	-0.0296	-0.0011	-0.0954	0.1735	0.4368	0.3206	1

Note: Pairwise correlations for each of the variables. $\Delta\tilde{c}$ and $\Delta\tilde{y}$ are the deviation of log consumption and output growth from their global averages. *LIR* represents a low-income ratio, the national headcount poverty rate, *FM* is an index of Financial Market (stock and debt security) development, *Finref* is a Financial Reform index, *KaOpen* is a capital account openness index, and *Liab* represent total external liabilities to GDP. Full sample covering 1970-2019.

Table A-2: Correlation Matrix for the full sample

Scatterplots

The Figures A-1 to A-4 display scatterplots of per country averages of the risk sharing determinants in the different subsamples.

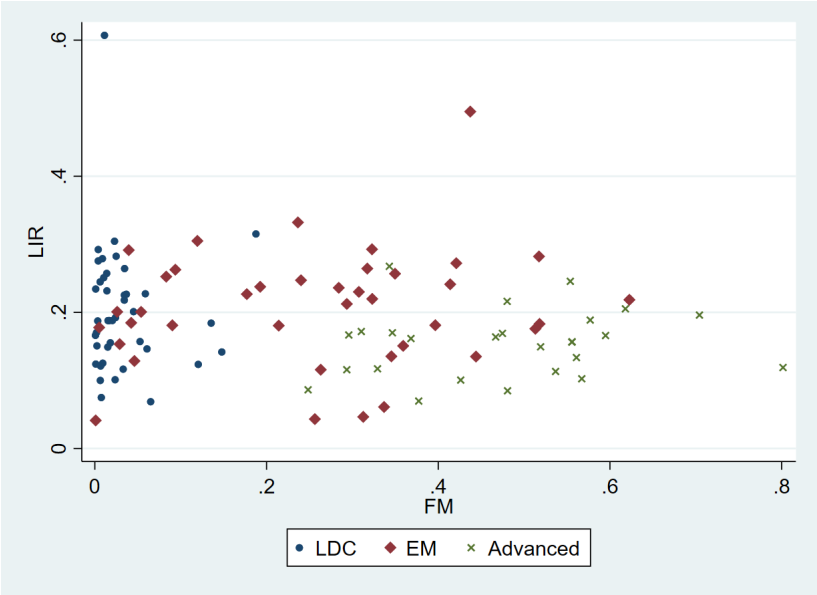
Figure A-1 shows the scatter of the Low-income ratios (LIR) and the Financial Market Development Index (FM). In the less developed countries (LDC), all countries have fairly low FM scores while the LIRs range between just below 10% and up to 80%. In the emerging markets (EM) we see fairly similar low-income ratios but much higher financial market scores, whereas in the advanced countries most of the countries have a high financial market score (ranging between 0.25 and 0.8, where 0 indicates no development and 1 indicates full financial market development), and with much lower low-income ratios.

Figure A-2 shows the scatter of the Financial Reform index ($FinRef$) and Financial Market Development (FM) index. The figure illustrates that the two IRS-determinants are fairly highly correlated for the advanced economy countries, which generally score fairly highly on both measures. However, some of the LDCs that generally have low FM-scores can still score fairly highly on the financial reform index. For the EMs there is no clear general correlation between the $Finref$ and FM scores; some countries with high scores on the $FinRef$ index have a low FM score, and vice versa.

Figure A-3 reveals that the country averages for the $FinRef$ and the capital account openness index $KaOpen$ are fairly highly correlated in all three subsamples; a higher $FinRef$ tends to be associated with a higher $KaOpen$ score. The LDCs tend to have lower $FinRef$ and $KaOpen$ scores, advanced economies tend to have higher $FinRef$ and $KaOpen$ scores, while in the EMs there are both countries with a high $FinRef$ and $KaOpen$ score, and countries with a low $FinRef$ and $KaOpen$ score.

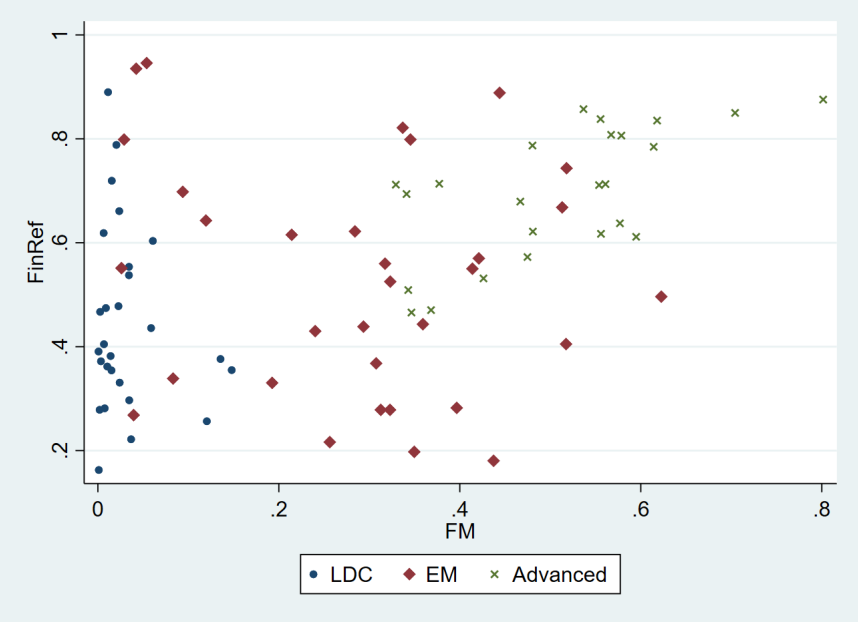
Finally, Figure A-4 shows that most LDCs and EMs have fairly low ratios of external liabilities to GDP, on average about 75% and 83% respectively. In the advanced economies

the ratio is much higher in some, but not all countries, compared to the developing countries. There appears to be a slight positive correlation between $Liab$ and $KaOpen$ in the LDCs and EMs. In the advanced economies this applies also to most countries, although there are a few countries with very high external liabilities to GDP but fairly low capital account openness.



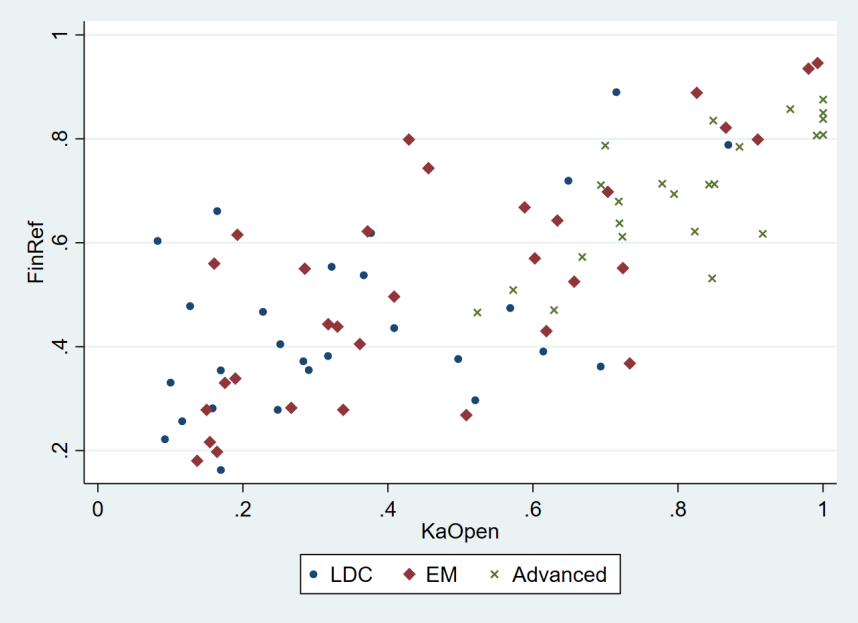
Notes: Scatter plot of country averages of the low-income ratios (LIR) and Financial Market Development index (FM) for the less developed countries (LDC), emerging markets (EM) and advanced economies (Advanced). Sample period: 1980-2019.

Figure A-1: Low-income ratios (LIR) and Financial Market Development index (FM)



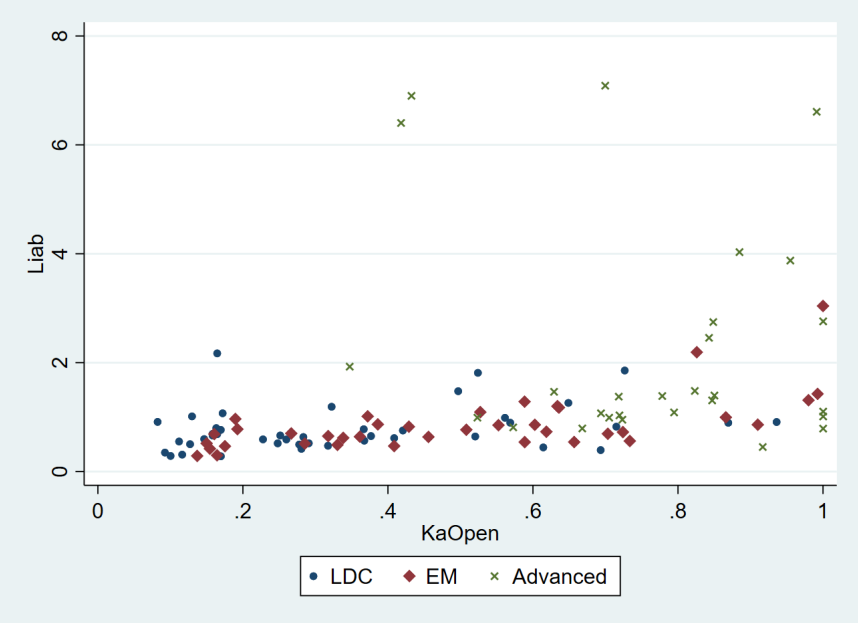
Notes: Scatter plot of country averages of the financial reform index ($FinRef$) and Financial Market Development index (FM) for the less developed countries (LDC), emerging markets (EM) and advanced economies (Advanced). Sample period: 1970-2005.

Figure A-2: Financial Reform index ($FinRef$) and Financial Market Development (FM)



Notes: Scatter plot of country averages of the financial reform index ($FinRef$) and capital account openness index ($KaOpen$) for the less developed countries (LDC), emerging markets (EM) and advanced economies (Advanced). Sample period: 1970-2005.

Figure A-3: Financial Reform index ($FinRef$) and Capital Account Openness ($KaOpen$)



Notes: Scatter plot of country averages external liabilities to GDP (*Liab*) and capital account openness index (*KaOpen*) for the less developed countries (LDC), emerging markets (EM) and advanced economies (Advanced). Sample excludes the outlier Luxembourg. Sample period: 1970-2019.

Figure A-4: External Liabilities to GDP (*Liab*) and Capital Account Openness (*KaOpen*)

Appendix C. Country-specific β coefficients and MG estimates

This appendix provides country-specific estimates of the international consumption risk sharing coefficients in Table A-3, and mean group (MG) and CCE mean group (CCEMG) estimates for both the full sample period in Table A-4 and for sample splits into periods before and after the turn of the millennium in Table A-5.

To illustrate how the degree of international risk sharing differs for each individual country, the results from the individual CCE risk sharing regressions used to calculate the CCEMG estimator are presented in Table A-3. Most of the estimated coefficients are significant, of expected sign and between zero and one. However, there seems to be substantial heterogeneity in the estimated slope coefficients. If 1-$\hat{\beta}_i$ is used as a measure of the degree of consumption risk sharing for each individual country i, most countries seem to be sharing between 0 to 80% of their consumption risk internationally.

Table A-4 shows that the degree of risk sharing once we take slope heterogeneity into account is around 30% in the full sample, around 25-28% in the LDCs, 22% in the EMs and around 47-53% in the advanced economies. All estimates are highly significant with the expected sign. As Pesaran's 2015 test for cross-sectional dependence (CD) rejects the null hypothesis of no cross-sectional dependence for the MG estimators in all subsamples, this implies that the CCEMG estimators are preferred over the MG estimators.

Table A-5 compares international risk sharing in the beginning of the sample (1970–1999) to the end of the sample (2000–2019). International risk sharing in both the full sample and the subsamples is much higher in the latter sample period. This is the case especially in the full and the advanced economy subsample where international risk sharing is estimated to be 41% and 61% respectively in the period 2000–2019. These results thus suggest that risk sharing has increased compared to previous periods also if we account for slope heterogeneity.

Country	$\hat{\beta}_i$	se_i	Country	$\hat{\beta}_i$	se_i	Country	$\hat{\beta}_i$	se_i
Albania	**0.675**	(0.128)	Ghana	**0.512**	(0.115)	North Macedonia	**0.678**	(0.130)
Argentina	**1.040**	(0.061)	Greece	**0.645**	(0.087)	Norway	0.046	(0.038)
Armenia	**0.505**	(0.172)	Guatemala	**0.473**	(0.079)	Pakistan	**0.971**	(0.102)
Australia	**0.322**	(0.097)	Guinea	**0.913**	(0.096)	Panama	**0.627**	(0.122)
Austria	**0.774**	(0.090)	Honduras	**0.420**	(0.105)	Paraguay	**0.281**	(0.131)
Azerbaijan	**0.555**	(0.110)	Hong Kong	**0.288**	(0.076)	Peru	**0.919**	(0.053)
Bangladesh	**0.908**	(0.086)	Hungary	**0.895**	(0.139)	Philippines	**0.702**	(0.059)
Belarus	**0.573**	(0.166)	Iceland	**0.604**	(0.090)	Poland	**0.745**	(0.143)
Belgium	**0.567**	(0.089)	India	**0.849**	(0.050)	Portugal	**0.748**	(0.107)
Bhutan	**0.509**	(0.150)	Indonesia	**0.668**	(0.063)	Romania	**0.954**	(0.112)
Bolivia	**0.489**	(0.100)	Ireland	**0.298**	(0.073)	Russia	**0.491**	(0.069)
Bosnia & Herzegovina	**0.785**	(0.102)	Israel	**0.796**	(0.146)	Rwanda	**0.876**	(0.144)
Botswana	**0.381**	(0.094)	Italy	**0.830**	(0.072)	Senegal	**0.530**	(0.082)
Brazil	**0.961**	(0.066)	Jamaica	**0.581**	(0.124)	Serbia	**0.831**	(0.153)
Bulgaria	**1.172**	(0.086)	Japan	**0.699**	(0.064)	Singapore	0.084	(0.060)
Burkina Faso	**1.107**	(0.110)	Jordan	**0.736**	(0.088)	Slovakia	**0.915**	(0.142)
Cambodia	0.119	(0.094)	Kenya	**0.974**	(0.109)	Slovenia	**0.638**	(0.153)
Cameroon	**0.834**	(0.086)	Kyrgyzstan	**0.436**	(0.131)	South Africa	**0.564**	(0.078)
Canada	**0.380**	(0.065)	Laos	**0.838**	(0.144)	South Korea	**0.632**	(0.064)
Chile	**0.883**	(0.079)	Latvia	**1.063**	(0.156)	Spain	**0.867**	(0.070)
China	**0.679**	(0.089)	Lesotho	**0.676**	(0.112)	Sri Lanka	**0.946**	(0.090)
Colombia	**0.823**	(0.072)	Lithuania	**0.836**	(0.112)	Suriname	**1.188**	(0.360)
Costa Rica	**0.652**	(0.099)	Luxembourg	0.035	(0.057)	Sweden	**0.620**	(0.080)
Croatia	**0.621**	(0.132)	Madagascar	**0.504**	(0.096)	Switzerland	**0.521**	(0.081)
Cyprus	**0.522**	(0.085)	Malawi	**0.710**	(0.088)	Taiwan	**0.616**	(0.080)
Czech Republic	**0.768**	(0.128)	Malaysia	**0.677**	(0.065)	Tajikistan	**1.036**	(0.162)
Denmark	**0.815**	(0.113)	Malta	**0.359**	(0.072)	Tanzania	**0.860**	(0.059)
Dominican Republic	**0.219**	(0.106)	Mexico	**0.814**	(0.065)	Thailand	**0.719**	(0.082)
Ecuador	**0.825**	(0.080)	Moldova	**1.044**	(0.142)	Tunisia	**0.866**	(0.085)
Egypt	**0.798**	(0.070)	Mongolia	**0.891**	(0.179)	Turkey	**0.596**	(0.085)
El Salvador	**0.703**	(0.160)	Montenegro	**0.705**	(0.130)	Uganda	**0.817**	(0.077)
Estonia	**0.843**	(0.111)	Morocco	**0.781**	(0.080)	Ukraine	**0.841**	(0.083)
Eswatini	**0.728**	(0.114)	Mozambique	**0.836**	(0.188)	United Kingdom	**0.630**	(0.109)
Ethiopia	**0.784**	(0.095)	Namibia	0.433	(0.254)	United States	**0.670**	(0.067)
Fiji	**0.412**	(0.108)	Nepal	**0.600**	(0.079)	Uruguay	**0.945**	(0.063)
Finland	**0.529**	(0.062)	Netherlands	**0.721**	(0.095)	Uzbekistan	**0.610**	(0.174)
France	**0.841**	(0.062)	New Zealand	**0.523**	(0.091)	Vietnam	**0.370**	(0.175)
Georgia	**1.246**	(0.523)	Niger	**1.020**	(0.133)	Zambia	**0.759**	(0.099)
Germany	**0.773**	(0.119)	Nigeria	**1.089**	(0.251)			

Note: Estimations of equation (9) for the individual countries. Coefficients significant at 5% level in bold, standard errors in parentheses. The risk sharing coefficient for each country i is $1 - \hat{\beta}_i$. Sample 1970-2019.

Table A-3: Estimated β coefficients from the individual CCE regressions for each country

	Full sample		Less developed econ.		Emerging markets		Advanced econ.	
	MG	CCEMG	MG	CCEMG	MG	CCEMG	MG	CCEMG
$\Delta\tilde{y}$	0.706***	0.698***	0.754***	0.716***	0.781***	0.776***	0.533***	0.474***
	(0.023)	(0.022)	(0.040)	(0.038)	(0.026)	(0.026)	(0.041)	(0.040)
IRS	0.294***	0.302***	0.246***	0.284***	0.219***	0.224***	0.467***	0.526***
	(0.023)	(0.022)	(0.040)	(0.038)	(0.026)	(0.026)	(0.041)	(0.040)
R^2	0.405	0.420	0.424	0.478	0.303	0.315	0.561	0.639
CD	13.96***		5.11***		6.28***		18.9***	
N	116		47		39		30	
Obs.	4,733		1,735		1,523		1,475	
Years	1970-2019		1970-2019		1970-2019		1970-2019	

Note: Estimation of eq. (4) for the Mean Group (MG) and eq. (9) for the Common Correlated Effects Mean Group (CCEMG) estimators, with nonparametric standard errors in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10% levels, respectively. $IRS = 1 - \hat{\beta}$. CD is the cross-sectional dependence test statistic, with H_0: no cross-sectional dependence.

Table A-4: MG and CCEMG international consumption risk sharing estimates

	Full sample		Less developed econ.		Emerging markets		Advanced econ.	
	1970-1999	2000-2019	1970-1999	2000-2019	1970-1999	2000-2019	1970-1999	2000-2019
$\Delta\tilde{y}$	0.787***	0.590***	0.777***	0.615***	0.791***	0.721***	0.560***	0.387***
	(0.045)	(0.028)	(0.087)	(0.053)	(0.043)	(0.037)	(0.078)	(0.046)
IRS	0.213***	0.410***	0.223***	0.385***	0.209***	0.279***	0.440***	0.613***
	(0.045)	(0.028)	(0.087)	(0.053)	(0.043)	(0.037)	(0.078)	(0.046)
R^2	0.368	0.480	0.385	0.500	0.318	0.340	0.595	0.680
N	106	114	41	45	35	39	30	30
Obs	2,459	2,252	841	882	743	770	875	600

Note: Estimation of equation (9) using the CCEMG estimator, with nonparametric standard errors in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10% levels, respectively. $IRS = 1 - \hat{\beta}$.

Table A-5: CCEMG international risk sharing estimates before and after 2000

Appendix D. Robustness estimations

This appendix includes some robustness checks. First, we use lagged values of the determinants to rule out concerns that low-income ratios are endogenously affected by financial liberalization or international consumption risk sharing. If international financial market participation takes place at the expense of the poorer individuals or if the gains from financial liberalization are concentrated mostly among the higher income individuals in the country, this could worsen poverty. Table A-6 presents the results where the lagged values of the low income ratios LIR and the financial integration and liberalization measures FM, $FinRef$, $KaOpen$ and $Liab$ are used instead of the contemporaneous ones in the full sample. The results using the lagged values are fairly similar to the ones in the main analysis in Table 4, implying that the endogeneity concern is unfounded. The conclusion is also robust to using two and three year lags of the low-income ratios.

Next, Table A-7 presents the degree of risk shared only between countries within different subsamples, in order to rule out that I have not correctly identified the set of countries that pool their consumption risks. The degree of risk shared only among the advanced, emerging market or less developed countries does not differ significantly from the risk sharing with the rest of the world in Table 1 in the main analysis. When I do this analysis for all the developed countries and the OECD countries, I find that the developing countries share about 28% and the OECD countries share between 37-48% of their consumption risks between each other. Furthermore, the lower panel of Table A-7 reveals that although the degree of risk shared between different geographical regions differs somewhat, the results are still in line with the results for the different country groups. Africa, with mostly less developed countries, share the least consumption risks among themselves (around 28%). The European countries (and especially EMU countries), of which the majority are advanced economies, are the ones to share most risks among themselves (around 46% and 58% respectively). The Euro crisis is a good example of how the negative output shocks were "shared" with the other EMU countries, and from the results can also be seen that the EMU countries share more consumption risks among themselves than among all the EU countries. The degree of risk shared only between the Western Hemisphere countries is fairly low at only 29%. The Asian and Pacific countries share around 46% of their consumption risks internationally, similar to the Middle East and Central Asian counties.

	(i)	(ii)	(iii)	(iv)	(v)
$\Delta\tilde{y}$	0.554***	0.696***	0.844***	0.722***	0.653***
	(0.052)	(0.049)	(0.058)	(0.051)	(0.037)
$LIR_{-1} * \Delta\tilde{y}$	0.453***				
	(0.155)				
$FM_{-1} * \Delta\tilde{y}$		-0.414**			
		(0.160)			
$FinRef_{-1} * \Delta\tilde{y}$			-0.388**		
			(0.149)		
$KaOpen_{-1} * \Delta\tilde{y}$				-0.220**	
				(0.094)	
$Liab_{-1} * \Delta\tilde{y}$					-0.008***
					(0.002)
LIR_{-1}	0.004				
	(0.011)				
FM_{-1}		-0.005			
		(0.010)			
$FinRef_{-1}$			0.022**		
			(0.009)		
$KaOpen_{-1}$				0.005	
				(0.004)	
$Liab_{-1}$					0.000
					(0.000)
R^2	0.617	0.589	0.660	0.576	0.581
N	111	114	85	112	116
Obs.	3,670	3,742	2,210	4,386	4,476

Note: Estimation of equation (10) using CCEP, with standard errors clustered by country in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10% levels, respectively. As not all series are available for all countries or for the full sample period, N and T between the different models vary.

Table A-6: Consumption risk sharing estimates using lagged values for the determinants

	Developing		LDC		EM		EM & Advanced		Advanced		OECD	
	WG	CCEP	WG	CCEP	WG	CCEP	WG	CCEP	WG	CCEP	WG	CCEP
$\Delta\tilde{y}$	0.737***	0.719***	0.785***	0.700***	0.780***	0.785***	0.605***	0.606***	0.316***	0.305***	0.497***	0.483***
	(0.028)	(0.033)	(0.032)	(0.040)	(0.034)	(0.038)	(0.055)	(0.059)	(0.066)	(0.066)	(0.081)	(0.085)
IRS	0.263***	0.281***	0.215***	0.300***	0.220***	0.215***	0.395***	0.394***	0.684***	0.695***	0.503***	0.517***
	(0.028)	(0.033)	(0.032)	(0.040)	(0.034)	(0.038)	(0.055)	(0.059)	(0.066)	(0.066)	(0.081)	(0.085)
R^2	0.561	0.615	0.577	0.682	0.661	0.736	0.503	0.563	0.225	0.366	0.414	0.492
N	86	86	47	47	39	39	69	69	30	30	38	38
Obs.	3,217	3,217	1,711	1,711	1,506	1,506	2,980	2,980	1,474	1,474	1,679	1,679

	Asia & Pacific		Western Hemisphere		Middle East & Central Asia		Africa		Europe		EMU	
	WG	CCEP	WG	CCEP	WG	CCEP	WG	CCEP	WG	CCEP	WG	CCEP
$\Delta\tilde{y}$	0.533***	0.539***	0.740***	0.713***	0.628***	0.573***	0.791***	0.724***	0.732***	0.536***	0.418***	0.423***
	(0.081)	(0.073)	(0.062)	(0.069)	(0.116)	(0.112)	(0.033)	(0.042)	(0.052)	(0.089)	(0.084)	(0.076)
IRS	0.467***	0.461***	0.260***	0.287***	0.372***	0.427***	0.209***	0.276***	0.268***	0.464***	0.582***	0.577***
	(0.081)	(0.073)	(0.062)	(0.069)	(0.116)	(0.112)	(0.033)	(0.042)	(0.052)	(0.089)	(0.084)	(0.076)
R^2	0.400	0.490	0.549	0.649	0.496	0.679	0.605	0.731	0.678	0.786	0.313	0.524
N	21	21	20	20	11	11	21	21	41	41	20	20
Obs.	969	969	937	937	346	346	835	835	1,533	1,533	870	870

Note: Estimation of equation (4) for the WG estimator and (9) for the CCEP. Standard errors clustered by country are in parentheses. Symbols ***, ** and * denote significance at 1%, 5% and 10% levels, respectively. $IRS = 1 - \hat{\beta}$. Sample: 1970-2019.

Table A-7: International consumption risk sharing estimates for risk sharing only within the subsample