Risk sharing, finance, and institutions in international portfolios

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ABSTRACT

We develop a standard model to show how transaction costs in international investment affect conventional tests of consumption risk sharing, both in a multilateral and a bilateral setting. We implement the tests in a novel international data set on bilateral holdings of equity, bonds, foreign direct investment (FDI) and bank loans. In our data, high foreign capital holdings are associated with international consumption risk sharing as implied by our theory. This is especially true of investment in equity or bonds, but not of foreign direct investment or bank loans. In our model, the implication is that transaction costs are higher for FDI and international loans. The discrepancy could reflect technological differences, but also the prospect of expropriation, perhaps most stringent for FDI or loans. We argue that expropriation risk is endogenous to both the borrower's institutions and its openness to international markets. The detrimental impact of poor institutions is muted in open economies, where the possibility of subsequent exclusion from world markets deters expropriation of foreign capital. We show the implied effects of institutions prevail in both the cross section of consumption risk sharing and in observed international investment patterns.

1 Introduction

Where do individuals choose to hold capital? What class of assets do they use? And what does their strategy achieve? Typical answers to these questions almost unanimously show that the international allocation of capital depends on the institutional and regulatory context, and observed investment does not seem to achieve much by way of diversification. The extent of international risk sharing appears to remain limited, and, according to Lewis (1996), largely driven by de jure restrictions to international capital flows. We argue that these conclusions, while true, obscure empirical regularities implying conditional relations between the regulatory environment, institutions, the composition of international investment portfolio, and the extent of risk sharing.

Our purpose is to improve in two dimensions the conventional test of international consumption risk sharing introduced by Lewis (1996).[1] First, do gains in terms of consumption smoothing depend on the magnitude and the composition of international investment across various asset classes? If differences exist, why do they arise? Second, can one use information on bilateral capital flows to investigate the extent of risk insurance between pairs of countries? This possibility provides an attractive alternative to considering the multilateral problem faced by a small open economy, especially when data on bilateral financial linkages are becoming readily available.

We frame the paper around a simple model of international investment with incomplete markets, inspired from Lewis (1996). The model purports to motivate the consumption risk sharing conditions we test, both multilaterally and bilaterally. It also provides an illustration of the reason that risk diversification could differ across asset classes. We assume domestic purchases of foreign assets entail payment of a transaction cost, potentially different across asset classes. But this is the only source of heterogeneity. In particular, equity, bonds, foreign direct investment (FDI), or bank loans are all assumed to confer identical control on the invested project, or to encapsulate identical information on the lender.

This is a strong assumption. But our aim is not to develop a general equilibrium theory of dynamic portfolio choice. Instead, we need tractable theoretical guidance to introduce asset-specific investment in conventional tests of international risk sharing. The model shows that holdings of foreign assets with high transaction costs deliver little consumption risk sharing. As a result, domestic consumption does not decouple from domestic resources, as it would under complete markets and perfect risk sharing. We show the result holds true in the conventional multilateral setup, and extend it to a bilateral framework.

We then turn to the empirical analysis, and bring to bear a novel data set with information on bilateral

[1] The paper takes consumption risk sharing, income insurance and risk diversification as synonymous.

asset holdings between 23 source and 54 host countries. Total bilateral holdings break down into three main components: portfolio investment (i.e., equity and bonds), direct investment, and bank loans. We find that large values for overall international investment correspond to better risk diversification, as implied by our model. This is exclusively delivered by portfolio investment, not by FDI or bank loans. The result is true both multilaterally and bilaterally.

In the model, the implication is that transactions costs are higher for FDI or international loans. There could well be exogenous, technological reasons for this discrepancy. Here we pursue the (noncompeting) argument that expropriation risk, or more generally, poor institutions, generate costly frictions in international investment. In particular, institutional quality conditions the extent of consumption risk sharing, but in a way that depends on the borrowing economy's openness to world markets. The dependence arises because investment alienability is endogenous to the possibility of retaliation. Economies that are open to international markets expose themselves to dynamic retaliation if they choose to expropriate foreign capital. Closed economies, in contrast, benefit from relative impunity, though that does not come without other costs.

A nonlinearity should therefore exist in the data. In open economies, the institutional risk that plagues foreign capital is muted, even if institutions are poor. In closed economies, the sensitivity of investment to the institutional environment is particularly prevalent and international investment patterns could be governed by concerns that are orthogonal to international diversification motives. A nonlinearity should prevail between the extent of consumption risk sharing and the quality of institutions: The relation should depend on the level of openness at the borrowing end. Closed economies should experience less risk sharing overall, but it is only when closedness is complemented by poor institutions that measured income insurance should drop significantly. Institutions matter for risk sharing directly, but also via an interaction with the level of openness, i.e., a nonlinearity.

The same nonlinearity should presumably also prevail in the relation between institutional quality and effectively observed international investment patterns. Closed economies with poor institutions pose serious risks, it is highly costly to invest there, and little capital flow should be observed. In constrast, open economies receive international investment, even those with relatively poor institutions. Less capital flows to economies with poor institutions, but the effect is muted in open economies. Investors anticipate that detrimental actions are less likely, thanks to the possibility of dynamic retaliation. The anticipation acts to diminish effective transaction costs, and capital flows to these countries, with end effects on consumption insurance.

We show both nonlinearities are present and significant in our data set. The finding suggests that

expropriation, say, is particularly costly, and thus effectively seldom implemented, in open economies. The argument is consistent with Ju and Wei (2006), who propose a model in which agents circumvent poor institutions via capital outflows in portfolio investment, but capital inflows in other forms, such as FDI. It is also in line with Gourinchas and Jeanne (2006), who show that openness can function as a disciplining device on a country's institutional quality.

FDI is particularly relevant to the issue of expropriation. At one end of the spectrum, FDI is often construed to be more likely to be confiscated by rogue governments, because unlike equity installed physical assets can readily be claimed by local authorities. Direct investment is then especially inappropriate as a vector of investment to countries with poor institutions. However, the value of FDI is often argued to reside in the know-how and competences of the foreign investors themselves, which vanishes in case of expropriation. In this case, FDI is especially attractive when considering investment to economies with poor institutions. Albuquerque (2003) and Daude and Fratzscher (2008) offer supportive evidence that FDI decreases with the quality of the recipients' institutions, whereas Wei (2006, 2000) and Faria and Mauro (2004) suggest the relation is increasing.

The nonlinear relation we document between international investment patterns and institutions offers an explanation that accounts for the diversity in empirical conclusions, because it implies that sampling is crucial. A data set focused on open or closed economies is likely to yield estimates at opposite ends of the spectrum, because the putative alienability of direct investment is endogenous to and conditioned by openness to international markets. In fact, Albuquerque (2003) focuses on countries in which credit ratings are available, thus presumably relatively open. Sampling could contribute to explaining why he finds a negative link between FDI and the quality of institutions. He focuses on open economies, in which the deterrent effect of dynamic retaliation is prevalent.

The paper is organized as follows. Section 2 presents the model used to motivate our (multilateral and bilateral) tests for risk sharing. Section 3 describes the data, implements our tests and discusses the results. Section 4 shows the nonlinear relation between institutions, consumption risk sharing, and international investment patterns. Section 5 concludes.

2 Testing risk sharing

We describe how we adapt the conventional test for consumption risk sharing introduced by Lewis (1996) to our purposes. In particular, we show how transaction costs on the asset market act to increase the dependence of domestic consumption on domestic income, and how the result extends to a bilateral approach.

2.1 *Multilateral test*

We consider a two-country world formed by the domestic economy H, and the rest of the world F. A representative consumer in each country maximizes utility of consumption $U\left[C\left(s_t\right)\right]$, where s_t denotes the state of the economy at time t. A social planner maximizes

$$\sum_t \rho^t \sum_{s_t} \pi\left(s_t\right) \left\{\omega\ u\left[C^H\left(s_t\right)\right] + \left(1-\omega\right)\ u\left[C^F(s_t)\right]\right\} \tag{1}$$

where ρ denotes the subjective discount rate, ω is the welfare weight associated to the domestic economy and $\pi\left(s_t\right)$ is the probability that state s_t occurs. The resource constraint writes

$$C^H\left(s_t\right) + C^F(s_t) = Y^H(s_t) + Y^F(s_t) \tag{2}$$

As argued in Lewis (1996), a social planner in a production economy would choose an efficient stream of output over time and maximize the very same objective function. It does not matter for our purposes whether $Y^H(s_t)$ and $Y^F(s_t)$ are determined endogenously or fixed exogenously. As is well known, optimality conditions require that

$$\begin{aligned} \omega\ \rho^t\ u'\left[C^H\left(s_t\right)\right] &= \lambda\left(s_t\right) \\ \left(1-\omega\right)\ \rho^t\ u'\left[C^F\left(s_t\right)\right] &= \lambda\left(s_t\right), \end{aligned} \tag{3}$$

where $\lambda\left(s_t\right)$ is the Lagrangian multiplier on the budget constraint. Eq. (3) equates marginal utilities across countries, with predictions on the international correlation in consumption. These predictions are largely invalidated in the data, an anomaly famously coined a "quantity puzzle" by Backus, Kehoe, and Kydland (1992). Eq. (3) also implies that marginal utilities in both economies do not depend on any domestic variables, but only on the uninsurable component of uncertainty, i.e., one that depends on world factors.

To be precise, Lewis (1996) also allows for nonseparability between tradable and nontradable consumption, so that domestic marginal utility depends on the domestic consumption of nontradables. Our country coverage makes that decomposition empirically impossible. But we cannot reject perfect risk sharing amongst the open economies in our sample. Controlling for consumption in nontradable goods would presumably only reinforce this conclusion.

Eq. (3) immediately implies that consumption growth rates in both economies should only depend on a world factor, and in particular not on country-specific income. Assuming Constant Relative Risk Aversion utility and taking logarithms, a first-differenced version of Eq. (3) implies

$$\ln\left[\frac{C^H\left(s_t\right)}{C^H\left(s_{t-1}\right)}\right] = \ln\left[\frac{C^F\left(s_t\right)}{C^F\left(s_{t-1}\right)}\right] = -\frac{1}{\sigma}\ln\left[\frac{1}{\rho}\frac{\lambda\left(s_t\right)}{\lambda\left(s_{t-1}\right)}\right], \tag{4}$$

where σ denotes risk aversion, common across both economies. The expression implies consumption growth rates are perfectly correlated internationally. A corollary, explored in a vast literature, is that consumption growth in each country varies only with world factors. Lewis (1996) proposes to test the claim in a panel of countries $i = H, F$, estimating β in

$$gc_t^i = \alpha_t + \beta \; gy_t^i + \varepsilon_t^i, \tag{5}$$

where $gx_t^i = gx^i(s_t)$ denotes the log growth rate of x in state s_t. α_t captures the world factors embedded in the Lagrangian multiplier and the discount rate, and ε_t^i denotes measurement error or preference shocks. Perfect risk sharing implies $\beta = 0$ with consumption growth independent on domestic income. We call Eq. (5) a test for multilateral risk sharing because its findings say nothing about the partner with which a particular economy shares risk. Lewis (1996) obtains significant and large estimates of β in her sample of 72 countries, and in each G7 economy taken in isolation, indicating a rejection of perfect risk sharing.

It is easy to see how the introduction of asset-specific transaction costs must result in estimates of β further away from zero. The intuition is straightforward: In our model, transaction costs render risk sharing more difficult, and thus idiosyncratic consumption growth becomes more dependent on idiosyncratic income changes. Transaction costs in international investment can simply reflect different tax treatments, intermediation fees, or liquidity premia across countries and asset classes. They could also arise from information frictions. For instance, Portes, Rey, and Oh (2001) and Portes and Rey (2005) find that information asymmetries matter less for standardized financial assets such as Treasury bonds, than for information-sensitive equity or corporate bonds. Thus they validate at least partly the possibility that τ should depend on a. In fact, financial transaction costs offer a parsimonious and frequent means of introducing market incompleteness in general equilibrium models of dynamic portfolio choice. Coeurdacier (2008) for instance, shows financial transaction costs help rationalize the equity home bias.

Formally, consider the decentralized problem of consumers in each economy faced with a cost $0 < \tau(a) < 1$ levied on international transactions in asset a:

$$E\left\{\sum_t \rho^t \; u\left(C_t^H\right)\right\}, \tag{6}$$

subject to

$$C_t^H + r_t b_t^H + \sum_a \chi_{Ht}(a) \; q_t^H(a) + \sum_a \chi_{Ht}^F(a) \; q_t^F(a) = b_{t-1}^H + \sum_a \chi_{Ht-1}(a) \left[q_t^H(a) + Y_t^H\right] + \sum_a \left[1 - \tau(a)\right] \chi_{Ht-1}^F(a) \left[q_t^F(a) + Y_t^F\right],$$

where we have omitted s_t for ease of exposition. Following Lewis (1996), b_t^H denotes the domestic holdings of a riskless bond and r_t is its price. We let $\chi_{Ht}(a)$ and $\chi_{Ht}^F(a)$ denote the time t domestic holdings of domestic and foreign asset a, respectively. a indexes different types of assets (portfolio, FDI, or bank loans), which we assume all pay the output stream of their economy of origin, Y_t^H or Y_t^F. The three classes of assets are therefore assumed to differ only in terms of $\tau(a)$ and their prices $q_t^H(a)$ or $q_t^F(a)$.

The assumption is simplifying and does away with the vast differences between the three assets we consider, not least in terms of information content or the control afforded by asset ownership. For instance, Razin, Sadka, and Yuen (1998) argue that FDI is the preferred form of financing in the presence of information frictions because it provides hands-on control on the investment and helps alleviating imperfect information. With the additional hypothesis that FDI entails a fixed cost, Goldstein and Razin (2005) show that countries with lower information asymmetries receive more portfolio investment and relatively less FDI.

Ours is, however, not a full-fledged theory of endogenous portfolio choice, and our contribution is mostly empirical. We merely seek to establish how estimates of β in Eq. (5) respond to impediments to international capital flows that could be asset-specific. Optimal investment in the foreign asset a implies

$$\begin{aligned} \frac{1}{1-\tau(a)} &= \rho E\left\{\frac{u'\left(C_t^H\right)}{u'\left(C_{t-1}^H\right)}\frac{q_t^F(a)+Y_t^F}{q_{t-1}^F(a)}\right\} \\ &= \rho\left\{cov\left[\frac{u'\left(C_t^H\right)}{u'\left(C_{t-1}^H\right)}\frac{q_t^F(a)+Y_t^F}{q_{t-1}^F(a)}\right]+E\left[\frac{u'\left(C_t^H\right)}{u'\left(C_{t-1}^H\right)}\right]E\left[\frac{q_t^F(a)+Y_t^F}{q_{t-1}^F(a)}\right]\right\}. \end{aligned} \tag{7}$$

The expected ratio of marginal utilities $E\left[\frac{u'\left(C_t^H\right)}{u'\left(C_{t-1}^H\right)}\right]$ is pinned down by the riskless rate, by virtue of the optimal choice of b_t^H. An asset with relatively large $\tau(a)$ must therefore either deliver relatively high expected returns, or provide relatively attractive hedging opportunities, i.e., returns that covary positively with the ratio of marginal utilities $\frac{u'\left(C_t^H\right)}{u'\left(C_{t-1}^H\right)}$.

How do high values of $cov\left(\frac{u'\left(C_t^H\right)}{u'\left(C_{t-1}^H\right)};\frac{q_t^F(a)+Y_t^F}{q_{t-1}^F(a)}\right)$ translate into estimates of β in Eq. (5)? We follow the Appendix in Lewis (1996) and consider the definition of the OLS estimate of β in the domestic version of Eq. (5):

$$\hat{\beta}=\frac{cov(gc_t^H;gy_t^H)}{var(gy_t^H)}. \tag{8}$$

Ceteris paribus, high values of $\hat{\beta}$ obtain when the growth rates in local consumption and output are positively related. Fast consumption growth means low values for the growth in marginal utility $\frac{u'\left(C_t^H\right)}{u'\left(C_{t-1}^H\right)}$. Therefore, large positive values of $\hat{\beta}$ obtain for negative correlations between $\frac{u'\left(C_t^H\right)}{u'\left(C_{t-1}^H\right)}$ and the value of domestic output growth relative to the world average, since Eq. (5) controls for world output fluctuations.

In a two-country world, gy_t^H is relatively high when output growth takes relatively low values in the foreign economy. Because all assets pay the income stream from their country of origin, a direct implication is that foreign returns in general are relatively low. In other words, $\hat{\beta}$ is estimated to take large positive values in states of the world where foreign returns and the ratio of marginal utilities co-move positively. Ceteris paribus, such positive co-movements tend to be true for assets with high transaction costs.

In short, international portfolios that are long in assets with high transaction costs are associated with high values for $\hat{\beta}$ in Eq. (5). We do not observe directly the transaction costs associated with the international holdings of various assets. But we do observe their quantities and we can investigate how the magnitude and composition of international portfolios affects $\hat{\beta}$. In particular, we estimate

$$gc_t^i = \alpha_t + \beta_1 \; gy_t^i + \beta_2 \; \phi_i(a) \cdot gy_t^i + \varepsilon_t^i, \tag{9}$$

where $\phi_i(a)$ denotes a measure of financial openness in country i, potentially specific to asset a. Eq. (9) is estimated on a panel of country-specific growth rates in both consumption and output. The estimation is a conventional test for multilateral risk sharing, augmented to account for the possibility that consumption insurance should vary across countries i, in particular because of financial openness and effectively observed foreign investment. The possibility is summarized by $\phi_i(a)$, which is assumed to be time-invariant.

Estimates of β_2 capture the extent to which risk sharing correlates with financial integration; nonzero estimates could stem from a variety of sources. First, they can reflect the fact that country i faces borrowing constraints across all asset classes, with $\phi_i(a) = \phi_i$ a measure of de jure capital controls on all asset types. Lewis (1996) fails to reject perfect risk sharing when controls are included for both consumption in local nontradable goods and current account restrictions. A burgeoning literature, pioneered by Asdrubali, Sorensen, and Yosha (1996), has extended her approach to investigate the magnitude and determinants of consumption risk sharing. For instance, Kalemli-Ozcan, Sorensen, and Yosha (2001, 2003), Demyanyk, Ostergaard, and Yosha (2007), and Corcoran (2008) relate consumption insurance to the specialization of production across U.S states and countries, or to measures of financial openness.

Estimates of β_2 can also reflect the fact that country i engages in little international investment because of market incompleteness of another type than simple aggregate capital controls, for instance ones that are specific to one class of assets. The possibility calls for measures of $\phi_i(a)$ that capture the scale of foreign asset holdings (of one type or another) relative to country i's economic size. Such measures quantify de facto international financial linkages as opposed to Lewis's de jure controls. Finally, estimates of β_2 could reflect the composition of international portfolios, long in one class of assets or another with potentially different values of $\tau(a)$. Such a possibility calls for measures of $\phi_i(a)$ that reflect the allocation of foreign assets in country i across a assets.

2.2 *Bilateral test*

We now assume the world consists of three economies, indexed by $i = H, F, R$. As our purpose is to focus on a bilateral dimension, we want to differentiate situations in which country H shares risk with F or with R.

Consider first the case in which countries H and F choose to share risk bilaterally, and ignore the opportunities afforded by the rest of the world. By analogy with a two-country world, perfect bilateral risk sharing between H and F implies $\beta = 0$ in

$$gc_t^H - gc_t^F = \beta \ \left(gy_t^H - gy_t^F\right) + \eta_{HFt}, \tag{10}$$

with $\eta_{HFt} = \varepsilon_t^H - \varepsilon_t^F$. Eq. (10) abstracts from the possibility of risk sharing with country R. Instead, it spells out a necessary condition for perfect, bilateral risk sharing between countries H and F. With complete markets, consumption growth in both countries is perfectly correlated with α_t, a measure of uncertainty in the aggregate formed by H and F.

The alternative hypothesis in Eq. (10) does therefore embed the possibility that countries H and F share risk with each other, but to an heterogeneous extent. Such would, for instance, be the case if a country acquired the full set of Arrow-Debreu securities, but the other chose not to. In a multilateral context, we allow for this possibility empirically in Eq. (9), where the extent of risk sharing can depend on the magnitude and composition of international investment arising from country i. By analogy, we now describe how Eq. (10) can be augmented to account for the possibility that risk sharing is heterogeneous across country pairs. In particular, we let the extent of bilateral risk sharing depend on the nature of bilateral capital linkages, using an argument similar to that developed in Eqs. (7) and (8).

The potential presence of asset-specific transaction costs continues to bias estimates of β in Eq. (10) away from zero. As in the multilateral case, estimates of β take high values whenever the growth rate in consumption marginal utility in country H correlates negatively with relative output growth there. Because reference output is by construction $Y_t^H + Y_t^F$, this corresponds to a positive correlation with relative output growth in country F, and thus with relatively high returns there. Now, optimal portfolio choice in country H continues to imply Eq. (7), where transaction costs correlate positively with the covariance between $\frac{u'\left(C_t^H\right)}{u'\left(C_{t-1}^H\right)}$ and $\frac{q_t^F(a)+Y_t^F}{q_{t-1}^F(a)}$. Ceteris paribus, a positive correlation implies that estimates of β still increase in $\tau(a)$. As before, the expected intertemporal marginal rate of substitution in consumption is again pinned down by the riskfree rate. Foreign expected returns could also adjust to compensate for the presence of transaction costs.

In a three-country world however, Eq. (10) is not a necessary and sufficient condition for bilateral risk sharing. In reality, diversification could well happen in partnership with the rest of the world R, instead of bilaterally. In fact, estimates of β would still be zero if both economies H and F chose to share risk with R, because both economies' consumption plans would be decoupled from the realizations of their idiosyncratic income. We need to introduce controls for the incentive to diversify risk bilaterally as opposed to multilaterally.

The diversification motive is directly related to the synchronization of output fluctuations in countries H and F. In particular, bilateral insurance gains are nonexistent if $gy_t^H = gy_t^F$, and they increase in the discrepancy between the two. This simple intuition suggests a parsimonious addition to Eq. (10), that consists in controlling for the desirability of diversification between each country pair. Modify Eq. (10) to obtain

$$\Delta gy_t^{HF} - \Delta gc_t^{HF} = \alpha_{HF} + \gamma\ \Delta gy_t^{HF} - \eta_{HFt}, \tag{11}$$

where $\Delta gx_t^{HF} = gx_t^H - gx_t^F$ denotes the international difference in gx_t computed bilaterally between countries H and F and $\gamma = 1 - \beta$. The only difference with Eq. (10) is the inclusion of country pair fixed effects, α_{HF}. The dependent variable now captures the magnitude of risk sharing between H and F given the desirability of consumption insurance there. Third-party effects are captured by the additional fixed effects in Eq. (11), which effectively account for permanent differences between countries H and F and the rest of the world. The intercept controls for the average values of Δgy_t^{HF} (or of $\Delta gy_t^{HF} - \Delta gc_t^{HF}$), computed across all alternative pairings involving either H or F. From the standpoint of risk sharing, the intercept controls for the average desirability of diversifying with alternative partners, provided it is time-invariant. The approach is similar to the "multilateral resistance" term introduced in Anderson and van Wincoop (2003).

Now, transaction costs still act to hamper perfect risk sharing, i.e., drive estimates of β away from zero. Given the definition of γ in Eq. (11), high values of $\tau(a)$ now correspond to low estimates of γ, away from one, the complete market case.

The intuition is straightforward. If countries H and F choose to share risk, not with each other but solely with the rest of the world, and if they do so perfectly, then $\gamma = 0$. Then, the differential in consumption Δgc_t^{HF} is zero, but so presumably is Δgy_t^{HF} because otherwise direct bilateral risk sharing would be desirable. If it is bilaterally that H and F share risk, $\gamma = 1$ because then Eq. (11) regresses (nonzero) output growth differentials on themselves. Finally, if neither multilateral nor bilateral risk sharing occurs, the dependent variable in Eq. (11) is akin to noise, as consumption tracks output fluctuations in both economies. Then, $\gamma = 0$. Estimates for γ capture the extent of bilateral risk sharing, at least under the

hypothesis that income insurance is motivated by the intensity of the bilateral synchronization in business cycles. The argument follows from Imbs (2005).

Eq. (11) reflects the well known result that diversification motives imply investment whose magnitude increases in hedging opportunities. Ceteris paribus, negatively correlated fundamentals (Δgy_t^{HF} away from zero) should imply high capital cross-holdings, and, as a result, consumption paths that are insured against output shocks in either economy (Δgc_t^{HF} close to zero). The intuition is best seen recognizing the left-hand side of Eq. (11) as the international difference in savings growth rates $gs_t^i = gy_t^i - gc_t^i$, since $\Delta gy_t^{HF} - \Delta gc_t^{HF} = \left(gy_t^H - gc_t^H\right) - \left(gy_t^F - gc_t^F\right) = \Delta gs_t^{HF}$. Then γ captures the response of the relative accumulation of savings between countries H and F to an increase in home relative to foreign income. If H and F share risk, a positive home income shock should not be consumed in H, but rather saved, so that γ takes high values. We are grateful to an anonymous referee for pointing out this interpretation.

As in the multilateral case, Eq. (11) can be augmented in a manner that identifies the channels of bilateral risk sharing. We estimate

$$\begin{aligned} \Delta gy_t^{HF} - \Delta gc_t^{HF} &= \alpha_{HF} + \gamma_1\ \Delta gy_t^{HF} + \gamma_2\ \phi_{HF}(a) \cdot \Delta gy_t^{HF} \\ &\quad +\gamma_3\ X_{HF} \cdot \Delta gy_t^{HF} - \eta_{HFt}, \end{aligned} \tag{12}$$

where $\phi_{HF}(a)$ denotes measures of financial openness between countries H and F, and X_{HF} captures alternative channels whereby two countries could achieve bilateral consumption insurance. Most prominent is the intensity in goods trade between the two countries. Cole and Obstfeld (1991) show that, under specific parametric conditions, movements in the terms of trade could perfectly insure away idiosyncratic fluctuations, and effectively render asset trade redundant. Bilateral trade in goods and in assets are also highly correlated, so it is important to ensure the effects we show work via assets trade. Goods trade is also potentially endogenous to business cycles synchronization. We follow a large literature and instrument trade with standard gravity variables.

Like the multilateral test in Eq. (9), the extent of bilateral risk sharing is identified via a panel dimension. Now, however, each individual observation corresponds to a country pair HF, and the panel traces the time variation in output and consumption growth differentials for each country pair. As in the multilateral case, we continue to allow for some variation in the extent of bilateral risk sharing that depends on bilateral financial linkages and openness to goods trade. The two possibilities are summarized by $\phi_{HF}(a)$ and X_{HF}, which are assumed to be time-invariant.

Estimates of γ_2 capture how bilateral risk sharing is related to the nature, magnitude, or composition of bilateral financial linkages. Negative values for γ_2 reflect less than perfect risk sharing, which in Eq.

(12) happens for $\gamma = 1$. They could correspond to market incompleteness at the aggregate level, or in a way that depends on which asset is purchased abroad. In particular, $\phi_{HF}(a) = \phi_{HF}$ captures the overall magnitude of capital flows between H and F, as a proportion of the investing country's size. At a more disaggregated level, $\phi_{HF}(a)$ could reflect the importance of a given type of asset, as a proportion of the investing economy's size, or as a proportion of total investment.

The approach assumes the variance-covariance matrix of fundamentals is exogenous, i.e., that output co-fluctuations are not affected by international investment patterns. In the working version of this paper, we invoke the results of a large literature on the determinants of business cycles synchronization to isolate the component of Δgy_t^{HF} that is arguably exogenous to financial integration and show that our empirical results are robust. In particular, we instrument Δgy_t^{HF} with the intensity of bilateral goods trade and the nature of the exchange rate regime between H and F, and $\phi_{HF}(a)$ with an index of legal origins, an index of anti-director rights, the measure of the soundness of banks, and the index of disclosure all introduced by La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998). We estimate the resulting system using three-stage least squares. None of our results is affected.

3 Documenting risk sharing

To what extent is risk sharing related to the size and composition of cross-border investment? In this section, we implement both our multilateral and bilateral tests, and we detail how the estimations of Eqs. (9) and (12) are performed in practice. We start with a description of our data set.

3.1 *Data*

We build a comprehensive database of bilateral capital stock holdings across a broad set of mature and emerging market economies. We inform all three categories of the capital account: FDI, portfolio investment, and bank loans. The data pertaining to FDI stem from information released by UNCTAD (United Nations Conference on Trade and Development), and detail bilateral FDI flows and stocks between large sets of both industrialized and developing countries. The data are annual from 1980, in US dollars, and cover capital held by about 90 reporting countries in virtually the complete universe of destinations. We omit missing observations and, in particular, exclude country pairs without observations over the past ten years. These data are not without problem. For instance, some of the FDI flows reported by UNCTAD are effectively the result of interpolation exercises combined with a fitted gravity model. In their seminal work on the net foreign wealth of nations, Lane and Milesi-Ferretti (2001, 2006) propose to alleviate these concerns using stock instead of flow information. We follow the same route.

Data on global equity and bond holdings are taken from the International Monetary Fund's Coordinated Portfolio Investment Survey (CPIS) for the years 2001, 2002, and 2003. CPIS provides information about foreign portfolio investment for around 70 reporting countries. Portfolio investment is broken down between equity and debt, with information on the residence of the issuer and the destination of the investment. CPIS data are not perfect. For instance, they do not provide a currency breakdown of bilateral investments, nor do they identify domestic security holdings by domestic residents. As with any unique data source, ascertaining whether low values reflect reality or merely reporting omissions is impossible. There is nothing to compare these data with. The problem is particularly acute for emerging markets or developing economies. But CPIS is simply the most exhaustive survey of bilateral portfolio investment holdings there is.

Information on bank loans are taken from the International Locational Banking Statistics (ILB) database constructed by the Bank of International Settlement (BIS). The data are an aggregate of the assets and liabilities of all banks in 32 reporting countries, vis-à-vis borrowing and lending institutions in more than one hundred partner countries. Assets and liabilities capture mostly loans and deposits, but could also include other transactions that fall under portfolio or direct investment. To minimize the overlap, we focus on interbank claims only; that is, on the assets and liabilities pertaining to investments between banks. The number of reporting countries is smallest in these data. We make use of the availability of both assets and liabilities data to partly make up for the limitation. In particular, (bank) assets held in nonreporting countries are approximated by (bank) liability information in reporting countries.

Data collection is generally based on the residence principle, which could imply that countries report asset holdings in their direct counterpart, but not in the country where the asset is ultimately invested. This gives enormous predominance to financial centers, not necessarily reflecting true bilateral holdings. Like most of the literature making use of these data, we therefore exclude financial hubs. See, for instance, Lane and Milesi-Ferretti (2004).

In constructing our measures of international financial linkages, we focus on a cross section of bilateral capital holdings, measured as an average over 1999-2003. The averaging is meant to help smooth out yearly fluctuations in international capital holdings and, in particular, high frequency fluctuations due to valuation changes. The lack of a reliable long time series is undoubtedly a limitation of our approach, but we are constrained by data availability, which is also the reason for imposing time-invariant $\phi_i(a)$ and $\phi_{HF}(a)$ in our theoretical section. We observe positive cross-border holdings for most country pairs, though a minority are effectively equal to zero. Given the small number of zero entries, we do not use a censoring model in the main text. We verify that taking censoring into account affects our results minimally.

At the receiving end, we ultimately have reliable information on the magnitude and composition of

capital across 54 borrowing economies. At the lending end, bilateral data are less reliable. For instance, while CPIS, UNCTAD, and ILB all report the stock of foreign capital held in, say, Iran, how much Iranian capital is invested in the rest of the world is harder to infer, and patchy. As a result, we focus the bilateral sample on 23 lending countries with membership to the Organization for Economic Cooperation and Development (OECD). Such sampling is prudent, given that our estimation cannot control for all the heterogeneity in economies borrowing from the developing world. (In particular, we can only have host specific random effects). And there is much more heterogeneity, especially in terms of institutional quality, at the borrowing end because most developing countries are borrowers.

Things are different in the multilateral approach, where heterogeneity across borrowers is simply averaged away. Identification here rests exclusively on the cross section of lenders, which we would like to maximize. Combining the three data sources, we have reliable information on the stock of capital held abroad for 42 lending economies. The sample is broader than just OECD members. We construct the sample of 42 lenders using data on 23 OECD economies, whose foreign holdings are observed directly. For the remaining 19 developing economies, we infer foreign holdings on the basis of the observed liabilities observed there for source, reporting economies. In theory, we should have the relevant data on $54-23=31$ countries; we only retain the 19 for which no bilateral linkage with a large, developed, G7 economy was missing. Why not use all 42 lending economies in the bilateral approach? Because some of the measurement error embedded in bilateral holdings is averaged away in the multilateral approach, but potentially obscures our bilateral results. Appendix A lists the countries in both samples.

Annual total private consumption and gross domestic product (GDP) are taken from the World Development Report issued by the World Bank. Growth rates are measured in real, per capita terms and converted in 2000 US dollars at market exchange rates. We have information between 1961 and 2003, although some countries have shorter samples. We estimate Eq. (9) on a panel of 42 countries by 41 years, or a maximum of $1,722$ observations. The bilateral sample, in turn, contains data for 23 lending economies and 54 borrowing economies, or a maximum of 966 independent country pairs. We therefore estimate Eq. (12) on a maximum of $39,606$ observations. What with missing or zero observations on international capital cross-holdings, and incomplete time coverage on consumption or output, we typically end up with about a third of that sample size.

Obstfeld (1995) argues that insurable income should be computed net of investment and government consumption, because both are absent from the model, and consumption should be that of private households. In Appendix B, we investigate the robustness of our results in an alternative data set, released by the United Nations Statistical Yearbook (UNSTATS), where these alternative measures can be computed. We

are grateful to Aidan Corcoran for making these data available to us. Nominal consumption, investment, government consumption, and output come from UNSTATS. Growth rates are computed in real, per capita terms, using national consumer price indices from the IMF and population measures from the Penn World Tables. See Corcoran (2008) for details. The data cover 1971-2004, are focused on OECD economies, and are converted into US dollars using 2000 PPP exchange rates, which come from the Penn World Tables. Exchange rates are potentially important, for our bilateral approach rests directly on international comparisons, as opposed to country-specific measures in the conventional multilateral framework. PPP exchange rates are also used in several recent contributions, e.g., Sorensen, Wu, Yosha, and Zhu (2007), Kose, Prasad, and Terrones (2007), or Hoffman and Shcherbakova (2008).

Eq. (9) is estimated on a panel of 20 countries over 34 years, for a maximum of 680 observations. Eq. (12) introduces a bilateral dimension, for a maximum of $35,670$ observations. Once again however, limits on the availability of bilateral data on cross-holdings mean our end sample is substantially smaller.

We use a broad set of indicators for the institutional quality of countries, focusing on those measures proxying repudiation and corruption. We draw from the World Bank Doing Business database, information put together by Transparency International and the International Country Risk Guide (ICRG), and the indexes constructed by La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998). Appendix C lists our variables and their definitions.

3.2 *Multilateral evidence*

This subsection discusses how we estimate Eq. (9). We present results pertaining to three definitions of $\phi_i(a)$. We first reproduce Lewis's approach using standard de jure measures of overall financial openness, focusing on those compiled by Kaminsky and Schmukler (forthcoming) for reasons of coverage. We then introduce proxies for the magnitude of international investment normalized by the economic size of source country i. At the aggregate level, we compute $\phi_i(a) = \phi_i^{Hold}$ as the total value of capital held abroad by country i relative to its GDP. We then decompose aggregate holdings into different assets and compute

$$\phi_i^{Hold}(a) = \frac{k_i(a)}{GDP_i}, \tag{13}$$

where $a = \{FDI, Portfolio, Loans\}$, and $k_i(a)$ denotes foreign assets a held in economy i. These controls, which we label "holdings," assess whether the scale of international investment in asset a is associated with consumption risk sharing.

Our third measures focus on the composition of international investment. We compute the shares of each asset into overall capital, i.e.,

$$\phi_i^{Share}(a) = \frac{k_i(a)}{\sum_a k_i(a)}. \tag{14}$$

We label these controls "shares," which are scale independent. Unlike holdings, they are not computed from one data source only, and could therefore contain measurement error arising from one data set or another. However, they provide direct evidence on the role of portfolio composition. Clearly, while $\phi_i^{Hold}(a)$ could take perfectly correlated values across a, by definition $\phi_i^{Share}(a)$ cannot.

Panel A in Table 1 reports some brief summary statistics. On the basis of the de jure index constructed by Kaminsky and Schmukler (forthcoming), our sample of 42 lending economies is relatively open, with an average value of 0.66 when full openness corresponds to one. We do, however, cover the whole spectrum of possible values, so that our cross section is informative. In proportion of GDP, it is portfolio investment that dominates foreign holdings in this sample, followed closely by bank loans. Similarly, our measures of portfolio shares suggest the average portfolio we observe is composed of 44% of equity and debt contracts, as against 30% for bank loans and 26% for FDI.

Insert Table 1 near here

Table 2 shows our results. We focus on a panel of lending countries for which we observe gross foreign capital holdings, and their various components. The results in Column (1) suggest that income insurance is imperfect among the 42 countries forming our sample. Estimates of β are positive and significant on the basis of the whole sample, while in our model perfect risk sharing should imply $\beta = 0$. But as in Lewis (1996), conditioning in Column (2) on the degree of (de jure) financial openness has a direct impact on β. On the basis of the point estimates of β_2, failure to reject perfect consumption risk sharing is more likely in the sample of countries with above-mean (de jure) financial openness. In contrast, estimates of β are indistinguishable from unity in the complementary sample of relatively closed economies. In our theory, such significant differences have direct implications on the extent of risk sharing in the data.

Insert Table 2 near here.

These results confirm Karen Lewis's conclusions in our sample, and they continue to hold once effective capital holdings are introduced to capture financial integration, in Column (3). The rows reporting null hypotheses in Table 2 show the P-values corresponding to the hypothesis of perfect risk sharing from Eq. (9), $H_0 : \beta_1 + \beta_2 \ \phi_i(a) = 0$. The argument is as follows. If a country is entirely closed financially, $\phi_i(a) = 0$, and the null hypothesis for perfect risk sharing is $H_0 : \beta_1 = 0$. For economies with some

international investment, $\phi_i(a) > 0$, and the hypothesis becomes $H_0 : \beta_1 + \beta_2\ \phi_i(a) = 0$. Because $\phi_i(a)$ is a continuous variable across i, the two rows in the table evaluate $\phi_i(a)$ at its mean and 90th percentile values, respectively. The two threshold values are chosen arbitrarily, with a view to illustrating the quantitative importance of $\phi_i(a)$. In particular, we seek to evaluate whether perfect risk sharing prevails in highly integrated subsamples, which we choose to identify with top decile values of $\phi_i(a)$. In fact, Panel A of Table 2 suggests perfect risk sharing (as implied by our model) cannot be rejected at average or top levels of financial openness in the considered sample.

Lewis (1996) also controls for consumption in local nontradable goods to find evidence supportive of perfect income insurance, a conclusion also reached in Tesar (1993). Our country coverage makes that decomposition empirically impossible. But we cannot reject perfect risk sharing amongst the most open economies in our sample. Controlling for consumption in nontradable goods would presumably only reinforce this conclusion. In fact, the first three Columns in Table 2 suggest Lewis's findings obtained because financially open economies invest more abroad, seemingly for the purpose of diversifying risk.

But they remain silent as to which class of asset achieves such diversification. The rest of the table answers this question. Specifications (4)-(6) in Panel A indicate that risk sharing is harder to reject (β_2 is negative) with large holdings of any of the three types of capital. We fail to reject the null of perfect risk sharing for above-average values $\phi_i^{Hold}(a)$, for any a. Turning to Panel B, the negative and significant coefficient on ϕ_i^{Share}(Portfolio) in Column (2) suggests that it is in countries integrated via portfolio investment that risk sharing is high. Investment patterns heavy in equity or bonds tend to achieve consumption insurance, which, in our model, means we cannot reject the null that $H_0 : \beta_1 + \beta_2\ \phi_i^{Share}(\text{Portfolio}) = 0$. Once again, this interpretation is only valid within our theory, but the estimates of β_2 in Columns (1) and (3) indicate that countries investing a higher share of loans or of FDI are less likely to achieve risk sharing. The result obtains irrespective of the overall amount of capital cross-holdings $\phi_i^{Hold} = \frac{\sum_a k_i(a)}{GDP_i}$. For instance, the implied value of $\beta_1 + \beta_2\ \phi_i^{Share}$(FDI) in Column (1) is large and significantly positive when ϕ_i^{Share}(FDI) is larger than its median value across countries. But it is barely significant for small FDI holdings. In fact, it is solely portfolio investment that is significantly associated with risk sharing. In Table 2 Panel B, we fail to reject perfect risk sharing only for top decile values of ϕ_i^{Share}(Portfolio).

Overall, Table 2 stresses that the extent of consumption insurance is heterogeneous across countries, in a way that correlates with financial openness. We reproduce Karen Lewis's seminal result, and show it is not only because of legal restrictions to capital flows that risk sharing is limited in the data. Under our model's assumptions, the countries that are most invested abroad are also those that achieve high, or

even perfect, income insurance in some subsamples. On the basis of a cross section of investing economies, we find that foreign direct investment and bank loans have a special status amongst the classes of assets we observe. While portfolio investment is unambiguously associated with risk diversification, the opposite tends to be true of FDI or loans. Table B1 largely confirms these results in the alternative data constructed from UNSTATS. There, the special status of portfolio investment is apparent on the basis of both measures of cross-holdings, $\phi_i^{Hold}(a)$ and $\phi_i^{Share}(a)$.

We next use the full bilateral dimension of our data to verify how our results depend on recipient countries' characteristics, which is impossible in a multilateral setting. Given our data sources, the cross section of borrowing economies is by construction substantially broader than lender heterogeneity, and thus potentially more informative.

3.3 *Bilateral evidence*

Eq. (12) introduces a bilateral dimension in tests of consumption risk sharing, which we now discuss empirically. In practice, the symmetry between borrowing and lending economies featured in the model of Section 2 is far from supported in the data. The overwhelming majority of lending economies are developed, homogeneous, OECD countries, while developing countries form the majority of borrowers with vastly more diverse characteristics. Eq. (12) is identified in a panel of country pairs, which given this asymmetry finds most of its variation at the receiving, borrowing end. To minimize noise we now restrict the cross section of investing economies to 23 OECD countries. It is unlikely that much reliable information is contained in the remaining lenders in our data, as capital originating from developing economies is harder to measure. In addition, the multilateral approach just described focuses on a broader cross section of lenders, but limits the impact of measurement error by averaging investment across destination markets.

We use our data to capture $\phi_{HF}(a)$ in three broad categories. We first introduce a measure of the scale of bilateral investment. Following the multilateral approach, we compute $\phi_{HF}(a) = \phi_{HF}^{Hold}$, the total stock of assets held between countries H and F as a proportion of source GDP. Second, we bring to bear the bilateral dimension of our data and obtain a measure of the effective allocation of capital across available destinations,

$$\phi_{HF}^{Alloc}(a) = \frac{k_{HF}(a)}{\sum_i k_{Hi}(a)}, \tag{15}$$

where $a = \{FDI, Portfolio, Loans\}$, and $k_{Hi}(a)$ denotes foreign assets a held in country i by H. This allocation measure highlights the cross section of destinations in which a given type of asset is invested. We normalize bilateral holdings of a given asset class by the total investment in the same asset held in

the source country. The measure underlines how heterogeneity in the characteristics of recipient economies within a given asset class affects its international allocation.

But it ignores composition issues across asset types, which is the focus of our third measure. We compute

$$\phi_{HF}^{Share}(a) = \frac{k_{HF}(a)}{\sum_a k_{HF}(a)}. \tag{16}$$

The variable simply extends the share measure to a bilateral context. As before, $\phi_{HF}^{Share}(a)$ is scale independent, but might conflate measurement error present in different data sets. It is also the best variable to evaluate the relation between portfolio composition and consumption risk sharing.

Panel B in Table 1 reports some brief summary statistics. Contrary to Panel A of the table, minimal values of zero are now possible, because we are considering bilateral cross-holdings. In addition, all three values for $\phi_{HF}^{Alloc}(a)$ have identical mean, because the average number of borrowing countries is the same across all three asset classes. However, the composition of international portfolios is slightly different when considering a bilateral dimension. In particular, while debt and equity continue to hold the lion's share, around 43% on average, it is nowFDI that comes second, with an average share of 30%. Bank loans are now relatively less prevalent, with 27% of the average portfolio.

Measurement error is a potentially damaging issue in estimating Eq. (12), where a bilateral dimension is of the essence. Suppose data in country i is mismeasured: The corresponding error affects all country pairs where i is involved and thus creates heteroskedasticity of such a kind that addressing it directly and explicitly is beyond the scope of this paper.[2] We follow two avenues. First, we allow for clustered standard errors, along the source dimension. Second, we include country-pair fixed effects, which encapsulate unobserved country-specific factors. Such intercepts soak up precisely the kind of heteroskedastic measurement error could create in Eq. (12). Alternatively, we include intercepts specific to each source, or host, country, and cluster the standard errors accordingly, with no changes on the end results. See Spolaore and Wacziarg (2009) for a detailed exposition of the argument. These authors also show how fixed effects account for the presence of repeated variables in the cross section formed by Eq. (12).

Our approach to dealing with measurement error has two desirable side effects. First, the inclusion of country-pair specific intercepts in Eq. (12) also accounts for permanent differences between countries H and F and the rest of the world, a convenient control for third-party effects. Second, Petersen (2008) discusses adequate corrections for cross-sectional dependence in residuals, a feature frequent in financial

[2] Under specific assumptions on the nature of uncertainty, the general method of moments can be used to tackle the issue of heteroskedasticity. See Clark and van Wincoop (2001). Their approach, however, is not applicable to the present context.

data. Using Monte Carlo simulation, he suggests clustering standard errors along the dimension suspected of dependence provides satisfactory estimates. In the present instance, our bilateral panel focuses on the international allocation of assets across destination markets. It is likely that standard errors are correlated within source investing economies, and it is therefore natural (and efficient) to cluster our standard errors accordingly.

Table 3 presents our results. Specification (1) suggests that income insurance, albeit not perfect, is present in the whole sample. The estimate of γ_1 is significantly positive, though also significantly away from one (the perfect risk sharing case). Interestingly from Column (2), risk sharing (as defined in our model) is significantly more prevalent when the total stock of asset cross-holdings is high. Column (3) suggests the difference cannot be ascribed to goods trade, even though γ_3 is also positive and (weakly) significant as predicted by Cole and Obstfeld (1991). The rows describing null hypotheses report the P-values associated with the hypothesis of perfect risk sharing, $H_0 : \gamma_1 + \gamma_2 \ \phi_{HF}(a) + \gamma_3 \ X_{HF} = 1$. Once again, we choose to evaluate $\phi_{HF}(a)$ and X_{HF} at their mean and 90th percentile values, respectively. Full consumption risk sharing exists for relatively few country pairs, but pertains to the most financially open ones, for top decile values of ϕ_{HF}^{Hold}.

Insert Table 3 near here

Specifications (4) to (9) in Panel A introduce the allocation measures. As in the multilateral case, countries that are recipients of large invested amounts unanimously appear to experience significantly more risk sharing, no matter the type of asset used. In particular, estimates of γ_2 are always significantly larger for high values of FDI, $Portfolio$, or $Loans$. Once again, γ_3 comes out systematically positive and significant, as if goods trade afforded some international consumption risk sharing. But the control affects estimates of γ_2 only marginally, with slightly smaller point estimates when bilateral trade is included. In our model, these results mean that the countries that are high recipients of OECD foreign direct investment, portfolio investment, or bank loans tend to also achieve significant risk sharing, of comparable amounts across asset classes.

The identities of these countries might be similar across asset classes. After all, portfolio investment, FDI, and bank loans could all be headed to overlapping sets of borrowing countries. Panel B takes up that question and introduces the share variables. By definition, these isolate different sets of borrowing countries and thus make it possible to investigate putative differences between types of assets. Columns (1) to (6) in Panel B suggest FDI and bank loans continue to have a special status. International investment in the form of equities or bonds is associated with significant increase in the extent of risk insurance, as testified

by positive and significant estimates of γ_2 in Specifications (3) and (4). In contrast, international portfolios heavy in FDI or bank loans once again appear to be associated with lower risk sharing. Hypothesis testing shows that it is only for top decile values of ϕ_{HF}^{Share}(Portfolio) that we cannot reject the null of perfect bilateral risk sharing at a 5% confidence level in Column (3). The result obtains no matter the intensity of bilateral goods trade (with estimates of γ_3 always positive and significant), and irrespective of the overall magnitude of asset holdings, ϕ_{HF}^{Hold}.

Table 3 confirms our findings in a bilateral setting. We also verify that our results are robust across samples. They continue to hold in samples focused on the post-Bretton Woods period, and when the universe of borrowing countries is reduced to OECD economies, albeit somewhat less significantly. These results are not reported for the sake of brevity, but they suggest our conclusions are not driven by outliers in the time or the country dimensions. And Table B2 confirms them in the alternative data we construct on the basis of UNSTATS information. There, the importance of goods trade in achieving consumption insurance appears to be muted, but we continue to find evidence of a special status of portfolio investment. In particular, Columns (3) and (4) of Panel B suggest that perfect risk sharing cannot be rejected, at conventional confidence levels, for top decile values of ϕ_{HF}^{Share}(Portfolio). The same is not true of ϕ_{HF}^{Share}(FDI) or ϕ_{HF}^{Share}(Loans).

According to the theory we developed in Section 2, and under the assumptions maintained there, these results suggest international investment in the form of FDI or loans entails transaction costs whose magnitude translates into poor risk diversification performance. In contrast, international trade in equities or bonds appears to be less costly, and thus is associated with consumption insurance. This is intuitive, as equities or bonds are presumably traded on liquid markets, and transactions are relatively standardized. Such is not the case for FDI or bank loans. There, high transaction costs are a possibility, for instance, in case of expropriation, which would effectively translate into $\tau(a)$ reaching its maximal value of one. In what follows we contend that at least a component of $\tau(a)$ is endogenous to institutional conditions in the borrowing economy and, in particular, to the likelihood for expropriation. We next examine the possibility empirically.

4 The role of institutions

We start with an empirical confirmation that measures of institutional quality limit bilateral risk diversification as implied by Eq. (12). The analysis takes the standard indices of institutional quality as exogenous, and simply assumes high corruption or poor contract enforcement, say, directly imply high values of $\tau(a)$.

But this is a static argument. In reality, expropriation, repudiation, and corruption have dynamic consequences. International markets can decide to sanction and ostracize a guilty party, by excluding it from world trade or global capital markets. A large literature is dedicated to evaluating the costs of such an exclusion.[3] But one thing is for sure. A closed economy cannot be further ostracized, and thus might hesitate less when choosing to renege on previous commitments, holding the quality of institutions constant. In other words, for a given value of an index of institutional quality, the likelihood of actions detrimental to foreign investors is endogenous to openness.

Such dynamic threat could well deter borrowers from acting to the detriment of foreign investors, even though measured institutional quality suggests they could. In other words, $\tau(a)$ could remain relatively low even though institutions are not conducive of international investment, provided the borrowing economy is open to international markets. In what follows, we test this possibility in two contexts. First, we show that our measures of risk sharing remain high in corrupt, yet open, economies. Then in subsection 4.2, we show that international capital in general continues to flow to countries with poor institutions, provided they are also open.

4.1 *Risk sharing and institutions*

We first verify our approach confirms recent results in the literature that poor institutions act to hamper international risk diversification. To do so, we augment Eq. (12) with measures I_F of institutional quality in the borrowing economy, and estimate

$$\begin{aligned} \Delta gy_t^{HF} - \Delta gc_t^{HF} &= \alpha_{HF} + \gamma_1\ \Delta gy_t^{HF} + \gamma_2\ I_F \cdot \Delta gy_t^{HF} \\ &\quad +\gamma_3\ X_{HF} \cdot \Delta gy_t^{HF} + \eta_{it}, \end{aligned} \tag{17}$$

with a higher I_F indicating a better institutional quality, such as the quality of contract enforcement, or repudiation risk. We anticipate positive values for γ_2, as would happen if effective risk diversification were increasing with the quality of institutions (because perfect risk sharing obtains for $\gamma = 1$). This is similar to findings in Volosovych (2006), who provides evidence that an index of investor protection is a significant determinant of the estimated amount of risk sharing, although in a multilateral framework.

The possibility that openness and institutional quality can be substitutes in enabling international risk sharing calls for a triple interaction term in Eq. (12). We want to test whether the link between

[3] See, among many others, chapter 6 in Obstfeld and Rogoff (1996).

institutional quality and risk sharing depends on the openness of countries. In particular, we estimate

$$\begin{aligned} \Delta gy_t^{HF} - \Delta gc_t^{HF} &= \alpha_{HF} + \gamma_1\ \Delta gy_t^{HF} + \gamma_2\ I_F \cdot \Delta gy_t^{HF} \\ &\quad +\gamma_3\ X_{HF} \cdot \Delta gy_t^{HF} + \gamma_4\ I_F \cdot X_{HF} \cdot \Delta gy_t^{HF} + \eta_{it}. \end{aligned} \tag{18}$$

Here X_{HF} still denotes a measure of openness between countries H and F, as predicted by an instrumentation on standard gravity variables. If openness and institutional quality affect risk sharing positively, we should observe $\gamma_2 > 0$ and $\gamma_3 > 0$. But if the (detrimental) effects of (poor) institutions are muted in open economies, we should observe $\gamma_4 < 0$.

Panel C in Table 1 reports some summary statistics pertaining to the measures of institutional quality we use here. The indexes all increase with the perceived quality of institutions, and, across all four measures, the sample contains substantial cross sectional dispersion. Table 4 presents our results. Specifications (1), (3) and (5) paint a clear picture: Low institutional quality significantly hampers consumption insurance. In all cases, γ_2 is positive, and as a result it is harder to reject risk sharing in samples with good institutions, regardless of bilateral trade intensity. However, our estimates imply that some risk sharing continues to be possible even with borrowers with less than median institutions. The point estimates imply γ continues to be significantly nonzero in subsamples with low values of indexes of institutional quality. How is this possible?

Insert Table 4 near here

We argue it is the conjunction of poor institutions and closedness to international markets that makes risk sharing truly impossible. Poor institutions in open markets barely prevent diversification, because expropriation, though possible in principle, is rarely exacted in practice lest retaliation in international markets occurs. Specifications (2), (4) and (6) add the interaction term described in Eq. (18), and show the conjecture holds in our data. Estimates of γ_4 are negative in all three cases, and significantly so in two of them.

The point estimates in Columns (2), (4) and (6) of Table 4 illustrate how in our sample the only countries in which consumption risk is virtually nondiversified are ones in which institutions are poor and goods markets are closed. Elsewhere, and in particular where institutions are poor but trade is high, our point estimates imply consumption risk sharing is present and significant (i.e., statistically different from zero). The quality of institutions is related to risk sharing as a whole: Holding openness constant, γ is higher for good institutions. The findings are consistent with Kose, Prasad, and Terrones (2007), who uncover little evidence of risk sharing in the developing world taken as a whole.

Table 5 illustrates these nonlinearities in a more vivid manner. We now split our sample four ways according to threshold values for both openness and institutional quality, and we estimate the original test in Eq. (11) on each subsample. The threshold values for institutional quality are reported in the table, and were chosen to ensure four nonempty subsamples. Separate estimates of γ are now directly available for different subsamples, which clarifies where some insurance continues to be possible. We also use a measure of financial openness taken from Kaminsky and Schmukler (forthcoming), reasoning that the dynamic retaliation mechanism we underline could equally be at work via financial markets.

We verify that a sample split along the openness dimension does not separate our data into samples with fundamentally distinct institutions. In other words, we check that openness incorporates information that is different from mere institutional quality. No significant differences exist in institutions across closed and open economies, across the three indices we use in Table 5. Isolating closed (or open) economies is different from focusing on countries with poor (or good) institutions.

Insert Table 5 near here

The table illustrates how the only countries where consumption risk is virtually nondiversified are ones in which institutions are poor and financial markets are closed. Elsewhere, and in particular where institutions are poor but financial markets are open, consumption risk sharing is present and significant. It is even higher within closed economies endowed with good institutions, where γ is not significantly different from its value in samples of open economies with good institutions. In both subsamples, we fail to reject the null hypothesis of perfect risk sharing that $\gamma = 1$.[4]

Tables 4 and 5 provide support for the conjecture that the quality of institutions and openness are substitutes in enabling risk diversification. Our interpretation, valid only under our assumptions, is that financial assets continue to be available to investors willing to diversify risk in, say, corrupt economies that are open. It is only when they are closed that diversification effectively plummets in the data. We now turn to the question of whether the effects of institutions are also conditional on the degree of openness when it comes to the determinants of capital holdings themselves. If risk sharing depends on both institutions and openness (and their interaction), it stands to reason the international allocation of capital itself should display a similar nonlinearity.

[4] The fact that risk sharing is higher in financially open economies is found elsewhere in the literature. For instance, Bekaert, Harvey and Lundblad (2006) show that consumption volatility is lower in countries with liberalized capital accounts.

4.2 *Capital flows and institutions*

The impact of institutions on international capital flows is quickly becoming a well-charted research area. For instance, Kho, Stulz, and Warnock (2006) show that poor governance in host countries increases the home bias vis-à-vis them. Lane and Milesi-Ferretti (2004) show that rich countries with developed stock markets have larger assets and liabilities of equity. Alfaro, Kalemli-Ozcan, and Volosovych (forthcoming) argue the main reason that capital does not flow from rich to poor country is the quality of institutions at the borrowing end.

We do not propose to have the definitive word on how institutional quality affects the magnitude of international capital flows. Our purpose is more focused. We seek to establish whether the international allocation of capital depends on institutions, openness, and an interaction between the two. Do institutions affect investment patterns in a way that depends on openness to world markets? If they did, it would imply the substitutability just shown for the extent of risk sharing also applies to observed capital flows. In a sense, that would be strongly suggestive that risk sharing happens because there are cross-holdings of capital, because both share the same nonlinear property in the data.

We speculate risk sharing is still possible in open economies, even those with poor institutions, because $\tau(a)$ is effectively lower, thanks to the threat of dynamic retaliation. In contrast, capital invested in economies that are both closed and have poor institutions must reflect motives different from mere diversification strategies because of high anticipated values of $\tau(a)$. Inasmuch as it originates from different values of the transaction costs $\tau(a)$, the nonlinearity documented for risk sharing patterns in sub-section 4.1 should also obtain in international investment patterns. We now check whether it is the case.

We refer to the empirical approaches that have been tried and tested in the literature on the determinants of international capital flows. In particular, we follow Wei (2000, 2006) and Lane and Milesi-Ferretti (2004), and we estimate in pure cross section

$$\phi_{HF}^{Alloc}(a) = \alpha_H + \tilde{\alpha}_F + \delta_1 \; Op_F \cdot I_F + \delta_2 \; Op_F + \delta_3 \; I_F + \delta' Z_{HF} + \varepsilon_{HF}, \tag{19}$$

where Z_{HF} denotes a vector of controls for bilateral investment patterns between lending country H and borrowing country F. Op_F denotes the index of current account openness compiled by the International Monetary Fund (which takes value one in open economies) and I_F is an index of institutional quality, e.g., corruption. We focus on the allocation measure $\phi_{HF}^{Alloc}(a)$ because we seek to identify the determinants of investment allocation across destination markets for a given asset class a. We control for source specific intercepts α_H, and destination specific random effects $\tilde{\alpha}_F$. Because our focus is on the cross section formed

by borrowing economies, this is the most we can do. See Daude and Fratzscher (2008) for a more general setting.

We are interested in the sign of δ_1, which captures whether the combination of institutional quality and market openness in borrowing countries matters. Negative estimates mean the detrimental effects of poor institutions on the ability to attract foreign capital are muted in open economies. Our focus stands in stark contrast with a large literature, some of it briefly mentioned above, which has mostly taken interest in the signs of δ_2 or δ_3.

In Table 6 we present estimation results for all values of a in Eq. (19). It is always true that δ_1 is significantly negative. The substitutability between institutions and openness that we documented in sub-section 4.1 for risk sharing also seems to exist in the determinants of international investment patterns. It is reassuring that openness should mitigate the detrimental effects of poor institutions as regards both the observed magnitude of capital flows and the extent of consumption risk sharing. It suggests both phenomena are closely related in the data, as they are in the model.

The results in Table 6 go some way toward explaining some of the discrepancies in the literature as regards the expropriability of FDI. Several recent studies have linked poor institutions to FDI. Albuquerque (2003) reasons that direct investment is hardest to expropriate, because it contains intangible know-how whose value would vanish with confiscation. It should therefore be a privileged vector of investment in economies likely to expropriate foreign investment. He uses the argument to explain why FDI is directed in particular at developing economies, and presents some evidence that countries with low credit ratings tend to be recipients of larger FDI flows. Hausmann and Fernandez-Arias (2000) confirm that a higher share of FDI seems to go to poorer countries and often ones with weaker institutions. Daude and Fratzscher (2008) use information on FDI, portfolio investment, and loans to find that countries with poor institutions are mostly recipient of FDI.

Insert Table 6 near here

The significance of δ_1 suggests sampling is of the essence when it comes to assessing the total effects of corruption on international investment. A sample biased toward open economies (for instance, ones in which credit ratings are available) is more likely to imply a positive total impact of institutions, especially if the specification is linear. The end effect of institutions on capital has to do with the relative magnitudes of the estimates for δ_1 and δ_3, along with average in-sample realizations of I_F and Op_F. We leave a precise answer to this question to the literature concerned more directly with it.

Table 6 shows that corrupt and closed economies have difficulties borrowing relative to open ones. Given a level of corruption, capital goes first to open economies and, in general, appears to shun closed and corrupt borrowers. That is consistent with the conjecture that international investment is particularly sensitive to institutional risk, so that investors avoid at all costs countries in which low institutional quality cannot be mitigated by putative market sanctions. It is also consistent with the conjecture that, whatever investment remains headed toward corrupt and closed economies, it could be governed by other motives than portfolio diversification.

This subsection provides evidence of a significant relation linking international investment patterns, and the associated extent of consumption risk sharing, to the interaction of institutional quality and trade openness. Institutions matter when attracting capital, but poor institutions lose most of their deterrent in open economies, where a market sanction becomes possible. We conclude that standard diversification strategies could continue to motivate international investment toward countries with poor institutions, provided they are also open. If they are closed, expropriation concerns take over and prevent consumption risk sharing.

5 Conclusion

We use a simple model to show how transaction costs on international investment alter standard consumption risk sharing relations. Financial assets that entail large transaction costs are associated with little international risk sharing, in the sense that the representative investor's consumption plans remain significantly correlated with her idiosyncratic income. We show the result holds true in the conventional consumption insurance test introduced by Lewis (1996), and extend it to a bilateral context.

We implement the model-implied tests on multilateral and bilateral data. In both cases, international risk sharing is far from perfect. But the fact averages away important differences. Lewis (1996) shows that diversification was hampered by de jure restrictions to international capital flows. We show the result extends to effectively measured investment. Under our assumptions, countries that trade financial assets also appear to be diversified, in that they manage to unhinge domestic consumption from domestic production, in some cases perfectly. The bulk of risk sharing is related to the international holdings of equities and bonds. By contrast, portfolios heavy in foreign direct investment or bank loans do not appear to provide much diversification, at least on the basis of observed aggregate consumption behavior.

The model suggests the differences arise because transaction costs are high for FDI and international bank loans. Transaction costs could well vary because of technological, exogenous differences between asset

classes. We pursue an alternative, noncompeting explanation, and argue transaction costs are endogenous to borrowers' economic circumstances. The likelihood of expropriation or contract repudiation, especially worrisome for FDI or bank loans, depends on the quality of institutions at the borrowing end. But because of the prospect of dynamic retaliation on international markets, the deterrent impact of poor institutions is muted in open economies. Given institutional quality, closed countries cannot be excluded from anything and engage in expropriation more readily, which investors anticipate. As a result, consumption risk sharing and international capital flows in economies endowed with poor institutions should still be apparent, provided they are also open to world markets. We show both nonlinearities prevail in our data. Openness and institutions seem to act as substitutes when it comes to attracting capital for the purpose of risk diversification.

Appendix A. Country sample

Emerging market economies	**Mature economies**
Argentina	Australia
Chile	Austria
Colombia	Canada
Costa Rica	Denmark
Cyprus	Finland
Egypt	France
Hong Kong	Germany
Hungary	Greece
Indonesia	Iceland
Israel	Ireland
Korea	Italy
Malta	Japan
Mauritius	Netherlands
Mexico	New Zealand
Pakistan	Norway
Philippines	Portugal
Poland	Spain
Singapore	Sweden
South Africa	Switzerland
Uruguay	United Kingdom
Venezuela	United States

Appendix B: Robustness, using UNSTATS Data

Table B1: Multilateral risk sharing - $gc_t^i = \alpha_t + \beta_1\ gny_t^i + \beta_2\ \phi_i(a) \cdot gny_t^i + \varepsilon_{it}$

Panel A		De jure	De Facto	Holdings		
	(1)	(2)	(3)	(4)	(5)	(6)
gny_t^i	0.2446^{***} (0.067)	0.2565^{***} (0.076)	0.2987^{***} (0.087)	0.1827^{**} (0.082)	0.3035^{***} (0.075)	0.2413^{***} (0.082)
Interactions						
De jure		-0.0164 (0.115)				
ϕ_i^{Hold}			-0.0298^{*} (0.017)			
ϕ_i^{Hold}(FDI)				0.1197^{*} (0.059)		
ϕ_i^{Hold}(Portfolio)					-0.0541^{***} (0.009)	
ϕ_i^{Hold}(Loans)						0.0067 (0.072)
H_0: $\beta_1 + \beta_2\ \phi_i(a) = 0$ (Mean)	-	0.00	0.00	0.00	0.00	0.00
H_0: $\beta_1 + \beta_2\ \phi_i(a) = 0$ (90%)	-	0.01	0.12	0.00	0.00	0.05
R^2	0.17	0.17	0.17	0.17	0.18	0.17
Number of Observations	550	550	550	550	550	550

Panel B	Shares		
	(1)	(2)	(3)
gny_t^i	0.1933	0.7556***	0.1936
	(0.121)	(0.129)	(0.120)
Interactions			
ϕ_i^{Hold}	−0.0217	−0.0089	−0.0295
	(0.016)	(0.013)	(0.017)
ϕ_i^{Share}(FDI)	0.3617		
	(0.237)		
ϕ_i^{Share}(Portfolio)		−0.8966***	
		(0.264)	
ϕ_i^{Share}(Loans)			0.5278
			(0.453)
H_0: $\beta_1 + \beta_2\ \phi_i(a) = 0$ (Mean)	0.00	0.00	0.00
H_0: $\beta_1 + \beta_2\ \phi_i(a) = 0$ (90%)	0.00	0.10	0.00
R^2	0.18	0.20	0.18
Number of observations	550	550	550

Notes: All regressions include source effects. gny_t^i denotes the growth rate in output net of investment and government consumption; gc_t^i denotes the growth in private households consumption. De Jure is financial openness in the source economy as implied by Kaminsky and Schmukler (forthcoming). ϕ_i^{Hold} are holdings of overall financial assets or the respective category measured in proportion of source country GDP, ϕ_i^{Share} are measured as a proportion of total holdings. The rows with null hypotheses report P values associated with the hypothesis of perfect risk sharing, H_0: $\beta_1 + \beta_2\ \phi_i(a) = 0$, for mean or top decile values of $\phi_i(a)$. Numbers in parentheses are standard errors, clustered by source country. *, **, and *** correspond to 10%, 5%, and 1% significance level, respectively.

Table B2: Bilateral risk sharing

$$\Delta gny_t^{HF} - \Delta gc_t^{HF} = \alpha_{HF} + \gamma_1\ \Delta gny_t^{HF} + \gamma_2\ \phi_{HF}(a) \cdot \Delta gny_t^{HF} + \gamma_3\ X_{HF} \cdot \Delta gny_t^{HF} + \eta_{HFt}$$

Panel A	Allocation					
	(1)	(2)	(3)	(4)	(5)	(6)
Δgny_t^{HF}	0.9057*** (0.023)	0.9236*** (0.026)	0.9056*** (0.023)	0.9231*** (0.026)	0.9060*** (0.232)	0.9247*** (0.026)
Interactions						
ϕ_{HF}^{Hold}						
ϕ_{HF}^{Alloc} (FDI)	0.0459 (0.349)	0.0653* (0.031)				
ϕ_{HF}^{Alloc} (Portfolio)			0.0479 (0.034)	0.0649* (0.030)		
ϕ_{HF}^{Alloc} (Loans)					0.0427 (0.036)	0.0665** (0.029)
X_{HF}		−7.7788 (5.014)		−7.4700 (4.948)		−8.3427 (5.072)
H_0: $\gamma_1 + \gamma_2\ \phi_{HF}(a) + \gamma_3\ X_{HF} = 1$ (Mean)	0.00	0.01	0.00	0.01	0.00	0.01
H_0: $\gamma_1 + \gamma_2\ \phi_{HF}(a) + \gamma_3\ X_{HF} = 1$ (90%)	0.00	0.03	0.00	0.03	0.00	0.03
R^2	0.84	0.85	0.84	0.85	0.84	0.85
Number of observations	4,908	4,697	4,908	4,697	4,908	4,697

Panel B	Shares					
	(1)	(2)	(3)	(4)	(5)	(6)
Δgny_t^{HF}	0.9359*** (0.038)	0.9373*** (0.039)	0.8706*** (0.042)	0.8751*** (0.046)	0.9235*** (0.039)	0.9289*** (0.042)
Interactions						
ϕ_{HF}^{Share} (FDI)	−0.0652 (0.100)	−0.0545 (0.100)				
ϕ_{HF}^{Share} (Portfolio)			0.0952 (0.077)	0.0911 (0.073)		
ϕ_{HF}^{Share} (Loans)					−0.0647 (0.139)	−0.0804 (0.139)
ϕ_{HF}^{Hold}		−5.0263** (1.754)		−4.9506** (1.786)		−5.2349** (1.811)
X_{HF}		4.0759 (6.808)		5.0936 (7.189)		5.6596 (6.385)
H_0: $\gamma_1 + \gamma_2\ \phi_{HF}(a) + \gamma_3\ X_{HF} = 1$ (Mean)	0.00	0.01	0.00	0.01	0.00	0.01
H_0: $\gamma_1 + \gamma_2\ \phi_{HF}(a) + \gamma_3\ X_{HF} = 1$ (90%)	0.02	0.05	0.17	0.19	0.01	0.01
R^2	0.84	0.85	0.84	0.85	0.84	0.85
Number of observations	4,908	4,697	4,908	4,697	4,908	4,697

Notes: All regressions include country-pair effects, and standard errors are clustered by source country. Δgny_t^{HF} denotes the international difference in net output growth rates; and Δgc_t^{HF} the international difference in household consumption growth rates. X_{HF} denotes bilateral trade intensity, as predicted by bilateral distance, geographic area, and the presence of a common border. ϕ_i^{Hold} are holdings of overall financial assets of the respective category measured in proportion of source country GDP, ϕ_i^{Share} are measured as a proportion of total holdings. The rows with null hypotheses report P values corresponding to the hypothesis of perfect risk sharing, H_0: $\gamma_1 + \gamma_2\ \phi_{HF}(a) + \gamma_3\ X_{HF} = 1$, for mean or top decile values of $\phi_{HF}(a)$ and X_{HF}. Numbers in parentheses are standard errors. *, **, and *** correspond to 10%, 5%, and 1% significance level, respectively.

Appendix C. Variable definitions and sources

Variable	Definition	Source
Bilateral FDI stocks	FDI asset holdings of source country i in host country j in million US dollar	United Nations Conference on Trade and Development (UNCTAD)
Bilateral portfolio equity and portfolio debt stocks	average 2001-2003 holdings of source country i in host country j in million US dollar	Coordinated Portfolio Investment Survey (CPIS), (IMF)
Bilateral loans	aggregate assets and liabilities of banks in reporting countries vis-à-vis banking and non-banking institutions in host countries	International Locational Banking Statistics (ILB) (BIS)
Distance	log bilateral great circle distance in miles between economic centers of source country and host country	Andy Rose (http://faculty.haas.berkeley.edu/arose/)
Common language	dummy equal to one if both countries speak the same language and zero otherwise	Andy Rose (http://faculty.haas.berkeley.edu/arose/)
Property rights	index that goes from 0 to 5, with higher values representing bad protection of property rights	Heritage Foundation
Expropriation risk	index goes from 0 to 10, with high values = low risk	International Country Risk Guide (ICRG)
Repudiation risk	index goes from 0 to 10, with high values = low risk	International Country Risk Guide (ICRG)
Days of enforcement	the time of dispute resolution—in calendar days—counted from the moment the plaintiff files the lawsuit in court until settlement or payment.	World Bank – Doing Business Database
WDR corruption	index goes from 1 to 8, with higher values indicating higher levels of corruption	World Bank (Wei, 2000)
TI corruption	value of index goes from 0 to 10, with higher values indicating higher levels of corruption	Transparency International (Wei, 2000)

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Table 1: Summary statistics.

Panel A: Multilateral sample (in percent)				Panel B: Bilateral sample (in percent)			
	Mean	Min	Max		Mean	Min	Max
De jure	0.66	0.0	1.0				
ϕ_i^{Hold}	176.4	5.2	834.0	ϕ_{HF}^{Hold}	1.0	0.0	17.2
ϕ_i^{Hold}(FDI)	42.7	0.1	281.0	ϕ_{HF}^{Alloc} (FDI)	7.4	0.0	100.0
ϕ_i^{Hold}(Portfolio)	79.5	0.1	652.8	ϕ_{HF}^{Alloc} (Portfolio)	7.4	0.0	100.0
ϕ_i^{Hold}(Loans)	54.2	2.0	462.8	ϕ_{HF}^{Alloc} (Loans)	7.4	0.0	100.0
ϕ_i^{Share}(FDI)	26.3	0.9	60.7	ϕ_{HF}^{Share} (FDI)	30.1	0.0	100.0
ϕ_i^{Share}(Portfolio)	44.1	1.3	78.9	ϕ_{HF}^{Share} (Portfolio)	42.9	0.0	96.9
ϕ_i^{Share}(Loans)	29.6	2.8	84.2	ϕ_{HF}^{Share} (Loans)	27.0	0.0	99.2

Panel C: Institutions			
	Mean	Min	Max
Expropriation	9.4	7.4	10.0
Repudiation	9.0	6.2	10.0
Corruption	2.9	1.3	5.5
Enforcement	6.7	3.8	8.9

Notes: Panels A and B report percentages of GDP for the holding measures, of total financial assets for the share measures, and of total assets in each category for the allocation measures. Panel C uses effective index numbers.

Table 2: Multilateral risk sharing - $gc_t^i = \alpha_t + \beta_1\ gy_t^i + \beta_2\ \phi_i(a) \cdot gy_t^i + \varepsilon_{it}$

Panel A		De jure	De facto	Holdings		
	(1)	(2)	(3)	(4)	(5)	(6)
gy_t^i	0.4927*	0.9011***	0.6311***	0.6514***	0.6297***	0.5352**
	(0.271)	(0.072)	(0.213)	(0.205)	(0.210)	(0.255)
Interactions						
De jure		−0.4866*				
		(0.254)				
ϕ_i^{Hold}			−0.2156			
			(0.151)			
ϕ_i^{Hold}(FDI)				−0.8883		
				(0.580)		
ϕ_i^{Hold}(Portfolio)					−0.3381	
					(0.256)	
ϕ_i^{Hold}(Loans)						−0.2383*
						(0.261)
H_0: $\beta_1 + \beta_2\ \phi_i(a) = 0$ (Mean)	-	0.00	0.32	0.40	0.21	0.18
H_0: $\beta_1 + \beta_2\ \phi_i(a) = 0$ (90%)	-	0.15	0.62	0.66	0.87	0.89
R^2	0.68	0.69	0.72	0.72	0.73	0.69
Number of observations	1,344	1,111	1,344	1,344	1,344	1,344

Panel B	Shares		
	(1)	(2)	(3)
gy_t^i	0.2626	1.6226***	0.1768
	(0.411)	(0.232)	(0.322)
Interactions			
ϕ_i^{Hold}	−0.1828	−0.0842	−0.1308
	(0.148)	(0.117)	(0.641)
ϕ_i^{Share}(FDI)	1.7386		
	(1.108)		
ϕ_i^{Share}(Portfolio)		−1.9067***	
		(0.603)	
ϕ_i^{Share}(Loans)			1.6946***
			(0.641)
H_0: $\beta_1 + \beta_2\ \phi_i(a) = 0$ (Mean)	0.00	0.00	0.00
H_0: $\beta_1 + \beta_2\ \phi_i(a) = 0$ (90%)	0.00	0.24	0.00
R^2	0.74	0.82	0.79
Number of observations	1,344	1,344	1,344

Notes: All regressions include source and year effects. De jure is financial openness in the source economy as implied by Kaminsky and Schmukler (forthcoming). ϕ_i^{Hold} are holdings of financial assets as a ratio of source country GDP. ϕ_i^{Share} are measured as a proportion of total holdings. The row with null hypotheses report P values associated with the hypothesis of perfect risk sharing, H_0: $\beta_1 + \beta_2\ \phi_i(a) = 0$, for mean or top decile values of $\phi_i(a)$. Numbers in parentheses are standard errors, clustered by source country. *, **, and *** correspond to 10%, 5%, and 1% significance level, respectively.

Table 3: Bilateral risk sharing

$$\Delta gy_t^{HF} - \Delta gc_t^{HF} = \alpha_{HF} + \gamma_1\ \Delta gy_t^{HF} + \gamma_2\ \phi_{HF}(a) \cdot \Delta gy_t^{HF} + \gamma_3\ X_{HF} \cdot \Delta gy_t^{HF} + \eta_{HFt}$$

Panel A	Holdings			Allocation					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δgy_t^{HF}	0.6127*** (0.143)	0.5596*** (0.139)	0.5107*** (0.172)	0.5570*** (0.134)	0.5060*** (0.167)	0.5492*** (0.145)	0.4877*** (0.165)	0.5818*** (0.142)	0.5119*** (0.172)
Interactions									
ϕ_{HF}^{Hold}		12.275*** (3.469)	7.497*** (2.358)						
ϕ_{HF}^{Alloc} (FDI)				0.9773*** (0.324)	0.6767** (0.269)				
ϕ_{HF}^{Alloc} (Portfolio)						1.0191** (0.397)	0.8438*** (0.264)		
ϕ_{HF}^{Alloc} (Loans)								0.5466** (0.200)	0.4068*** (0.125)
X_{HF}			21.012* (11.672)		20.911* (11.708)		22.098** (8.448)		23.704** (10.224)
H_0: $\gamma_1 + \gamma_2\ \phi_{HF}(a) + \gamma_3\ X_{HF} = 1$ (Mean)	-	0.01	0.03	0.00	0.02	0.01	0.01	0.01	0.01
H_0: $\gamma_1 + \gamma_2\ \phi_{HF}(a) + \gamma_3\ X_{HF} = 1$ (90%)	-	0.35	0.16	0.07	0.08	0.02	0.03	0.01	0.02
R^2	0.56	0.59	0.61	0.59	0.62	0.60	0.62	0.58	0.61
Number of observations	11,516	11,410	11,043	11,516	11,043	11,516	11,043	11,516	11,043

Panel B	Shares					
	(1)	(2)	(3)	(4)	(5)	(6)
Δgy_t^{HF}	0.7138*** (0.116)	0.6059*** (0.156)	0.2176 (0.203)	0.1047 (0.181)	0.8008*** (0.122)	0.7058*** (0.149)
Interactions						
ϕ_{HF}^{Share} (FDI)	−0.3875 (0.249)	−0.3619 (0.235)				
ϕ_{HF}^{Share} (Portfolio)			0.7610*** (0.206)	0.7730*** (0.155)		
ϕ_{HF}^{Share} (Loans)					−0.8549*** (0.130)	−0.9219*** (0.137)
ϕ_{HF}^{Hold}		7.105*** (2.398)		10.015*** (2.151)		11.498*** (3.913)
X_{HF}		21.044** (9.485)		18.484** (7.573)		17.916 (13.207)
H_0: $\gamma_1 + \gamma_2\ \phi_{HF}(a) + \gamma_3\ X_{HF} = 1$ (Mean)	0.02	0.01	0.00	0.00	0.00	0.00
H_0: $\gamma_1 + \gamma_2\ \phi_{HF}(a) + \gamma_3\ X_{HF} = 1$ (90%)	0.02	0.01	0.07	0.03	0.00	0.00
R^2	0.58	0.63	0.66	0.72	0.64	0.69
Number of observations	11,516	11,043	11,516	11,043	11,516	11,043

Notes: All regressions include country-pair effects, and standard errors are clustered by source country. X_{HF} denotes bilateral trade intensity, as predicted by bilateral distance, geographic area and the presence of a common border. ϕ_i^{Hold} are holdings of overall financial assets of the respective category measured in proportion of source country GDP, ϕ_i^{Share} are measured as a proportion of total holdings. The rows with null hypotheses report P values corresponding to the hypothesis of perfect risk sharing, H_0: $\gamma_1 + \gamma_2\ \phi_{HF}(a) + \gamma_3\ X_{HF} = 1$, for mean or top decile values of $\phi_{HF}(a)$ and X_{HF}. Numbers in parentheses are standard errors. *, **, and *** correspond to 10%, 5%, and 1% significance level, respectively.

Table 4: Nonlinearities: Bilateral risk sharing

$$\Delta gy_t^{HF} - \Delta gc_t^{HF} = \alpha_{HF} + \gamma_1\ \Delta gy_t^{HF} + \gamma_2\ I_F \cdot \Delta gy_t^{HF} + \gamma_3\ X_{HF} \cdot \Delta gy_t^{HF} + \gamma_4\ I_F \cdot X_{HF} \cdot \Delta gy_t^{HF} + \eta_{HFt}$$

	(1)	(2)	(3)	(4)	(5)	(6)
Δgy_t^{HF}	−0.0989	−0.3150	−1.3670***	−1.472***	0.0846	−0.0147
	(0.174)	(0.205)	(0.372)	(0.429)	(0.225)	(0.269)
Nonlinearity						
$I_F \cdot X_{HF}$		−8.137***		−5.781		−7.309**
		(1.443)		(11.269)		(3.471)
Interactions						
Enforcement	0.1080***	0.1435***				
	(0.015)	(0.021)				
Repudiation			0.2290***	0.2402***		
			(0.030)	(0.036)		
Corruption					0.1229***	0.1465***
					(0.021)	(0.032)
X_{HF}	18.224	73.282***	9.1340	64.024	17.476	51.008**
	(14.391)	(13.534)	(8.961)	(110.69)	(12.870)	(23.154)
R^2	0.65	0.66	0.72	0.72	0.63	0.63
Number of observations	9,597	9,597	11,008	11,008	11,008	11,008

Notes: All regressions include country-pair effects, and standard errors are clustered by source country. X_{HF} denotes bilateral trade intensity, as predicted by bilateral distance, geographic area and the presence of a common border. Enforcement denotes the index of contract enforcement computed by La Porta, Lopez-de-Silanes, Shleifer and Vishny (1998). Repudiation comes from the International Country Risk Guide and corruption from the World Development Report. All values increase in the quality of the institutional environment. Numbers in parentheses are standard errors. *, **, and *** correspond to 10%, 5%, and 1% significance level, respectively.

Table 5: Bilateral risk sharing: Sample splits - financial openness

$$\Delta gy_t^{HF} - \Delta gc_{tt}^{HF} = \alpha_{HF} + \gamma\ \Delta gy_t^{HF} + \eta_{HFt}$$

	Closed		Open	
	Low	High	Low	High
Enforcement	0.0869*** (0.014)	0.9112*** (0.064)	0.5311*** (0.102)	0.8970*** (0.055)
H_0: $\gamma = 1$	0.00	0.18	0.00	0.06
Number of observations	1,149	941	4,329	2,901
	High risk	Low risk	High risk	Low risk
Repudiation	0.0694*** (0.015)	0.8937*** (0.060)	0.2335* (0.122)	0.9148*** (0.027)
H_0: $\gamma = 1$	0.00	0.08	0.00	0.01
Number of observations	871	1,779	1,894	5,336
	High	Low	High	Low
Corruption	0.0714*** (0.014)	0.8831*** (0.073)	0.5175*** (0.109)	0.9207*** (0.085)
H_0: $\gamma = 1$	0.00	0.11	0.00	0.14
Number of observations	711	1736	3453	3777

Notes: The table reports estimates of γ in Eq. (11). All regressions include country-pair effects, and standard errors are clustered by source country. Sample splits pertain to host economies. Closed and open samples refer to financial openness as measured by the index compiled by Kaminsky and Schmukler (forthcoming). Enforcement captures enforceability of contracts as implied by the index introduced by La Porta, Lopez-de-Silanes, Shleifer and Vishny (1998); low enforcement means a value below 8. Repudiation risk is measured by the index computed by the International Country Risk Guide; high repudiation risk means a value below 9. Corruption stems from the World Development Report, high means an indicator below 2.5. H_0: $\gamma = 1$ reports P values corresponding to the hypothesis of perfect risk sharing, $\gamma = 1$. Numbers in parentheses are standard errors. *, **, and *** correspond to 10%, 5%, and 1% significance level, respectively.

Table 6: Nonlinearities: Capital flows

$$\phi_{HF}^{Alloc}(a) = \alpha_H + \tilde{\alpha}_F + \delta_1\, Op_F \cdot I_F + \delta_2\, Op_F + \delta_3\, I_F + \delta' Z_{HF} + \varepsilon_{HF}$$

	(1)	(2)	(3)	(4)	(5)	(6)
	FDI	FDI	Portfolio	Portfolio	Loans	Loans
$Op_F \cdot I_F$	-0.0131^{**} (0.006)	-0.0162^{***} (0.007)	-0.0128^{***} (0.005)	-0.0109^{**} (0.050)	-0.0155^{**} (0.007)	-0.0232^{***} (0.010)
Op_F	0.0560^{**} (0.025)	0.0711^{**} (0.034)	0.0623^{***} (0.030)	0.0568^{***} (0.025)	0.0704^{***} (0.029)	0.1067^{***} (0.044)
I_F	0.0001 (0.002)	0.0088^{**} (0.004)	0.0006 (0.001)	0.0065^{*} (0.003)	-0.0001 (0.001)	0.0096^{**} (0.004)
Per capita GDP		-0.8889 (0.688)		-0.5563 (0.411)		-1.5699^{**} (0.644)
GDP		0.0223^{***} (0.008)		0.0269^{***} (0.006)		0.0194^{***} (0.008)
Distance		-0.0223^{***} (0.010)		-0.0168^{***} (0.006)		-0.0311^{***} (0.007)
Language		0.0343^{***} (0.014)		0.0212^{*} (0.010)		0.0149 (0.011)
Source effects	Yes	Yes	Yes	Yes	Yes	Yes
(Random) host effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	658	639	658	639	658	639

Notes: I_F denotes the corruption index compiled by the World Development Report. Op_F is the index of Current Account openness as collected by the Annual Report on Exchange Arrangements and Exchange Restrictions. Language takes value one when both source and host countries share the same language. Numbers in parentheses are standard errors, clustered by host country. *, **, and *** correspond to 10%, 5%, and 1% significance level, respectively.