

# Has Consumption Risk Sharing Increased in Asia (and Elsewhere)?

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What impact has financial globalization had on risk sharing? In theory, financial globalization should improve international consumption risk sharing. While the answer to this question is of utmost policymaking concern, results in the empirical literature are inconclusive. The paper surveys the extant literature and tries to identify which factors influence the answer: i) consumption risk sharing seems to have increased among industrialized countries but much less in the emerging world. ii) The increase in risk sharing is generally found to be stronger in studies that focus on the trends rather than purely cyclical variation in the data. iii) globalization has not only affected consumption responses to output shocks but also the structure of these shocks themselves. This, in turn, has affected the measurement of risk sharing. The paper examines the relevance of these points on a sample of East Asian Economies. My results indicate that risk sharing in East Asia has started to increase once the region had recovered from the Asian crisis.

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## I. Introduction

The last decades saw an unprecedented growth in international capital and trade flows. This wave of globalization encompassed not only industrialized economies but also the emerging world. For emerging markets,

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gross foreign asset positions — the cross-country average of the ratio between the sum of international assets and liabilities and GDP — increased from below 80 to roundabout 250 percent of GDP over the period from 1985 to 2004.

Better diversification of individual consumption risks is one of the key functions of financial markets and was a key intellectual impetus behind the financial liberalizations that we have seen around the world over the last quarter century. From a theoretical point of view, increased international gross holdings of financial assets should ultimately lead to improved international consumption risk sharing. However, while international gross holdings have indeed exploded, the empirical evidence for better international risk sharing seems — at least at first sight — inconclusive. In this paper I review the extant literature and seek to identify the factors that lead different strands of this literature to come to different conclusions with respect to the impact of financial globalization on risk sharing. I then bring to bear the insights distilled from this review on a sample of Asian countries.

Three factors seem particularly important in determining the answer to the question asked in the title of the paper: first, the sample of countries. Financial globalization seems to have had a much more pronounced effect on risk sharing among industrialized economies than among emerging economies. Poor, developing countries seem to have remained almost completely excluded from the risk sharing benefits from globalization.

Secondly, the effect of globalization on consumption patterns is much more readily detectable in trend movements in the data rather than at the business cycle frequency. I argue that this is in line with the predictions of theoretical models: on the one hand, the welfare benefits from insuring against trend (permanent) shocks should be much bigger. Hence, for a given marginal cost of buying insurance in financial markets, we should see that improvements in risk sharing show up in the lower frequency at first.

A third point I focus on is that globalization is likely to affect not only the way in which households, regions and countries insure against shocks but that it is likely to alter the structure of the shocks themselves. If international risk sharing is incomplete — which it certainly was and, in spite of globalization, still is — then extant measures of risk sharing such as consumption correlations or conditional consumption volatilities will be affected by the nature of the shocks. As I will argue, this may blur or even offset the impact that financial globalization has on such

indicators.

This third point seems particularly relevant in the Asian context. Since the Asian crisis of the late 1990s, business cycle patterns in East Asia have undergone substantial changes. Increased bilateral trade within the region has contributed to the emergence of a more synchronized regional business cycle pattern that, at the same time appears increasingly distinct from that of western economies (see Kose, Otrok, and Prasad 2008; Kim, Lee, and Park 2009; He and Liao 2011; Hoffmann and Liao 2011). In evaluating how financial globalization has impacted on international consumption risk sharing by Asia's emerging economies, it therefore seems imperative to take account of these shifts. I do so by building on the framework we developed in Artis and Hoffmann (2008b) which allows to purge consumption-based measures of international risk sharing from changes in the international comovement of growth trends and cycles. I find that, even controlling for the marked changes in the region's business cycle patterns, risk sharing in Asia has started to increase after the recovery from the Asian crisis. While this increase has clearly happened a lot later than among industrialized economies, to my knowledge this is the first evidence on improved risk sharing among a sample of predominantly emerging economies.

The remainder of this paper is structured as follows: the next section provides a brief outline of the theoretical backdrop. Section three then offers an interpretative review of the literature that illustrates my three points above: to what extent risk sharing has been increased by financial globalization depends a) on the country sample, b) on the frequency at which we examine the data, and c) on the concurrent impact of globalization on the patterns of international business cycle comovement. In Section four, I then illustrate the relevance of these points for a sample of Asian economies. Section five concludes.

## **II. Consumption-based Measures of Risk Sharing<sup>1</sup>**

The point of departure of virtually all empirical studies in the field is a benchmark model with complete financial markets and frictionless trade in goods. In such a model, marginal utility growth in country or region  $k$  equals the growth in the shadow price of consumption and is therefore equalized across countries:

<sup>1</sup> This section draws on Artis and Hoffmann (2008b).

$$\frac{u'_k(C_{t+1}^k)}{u'_k(C_t^k)} = \frac{\mu_{t+1}}{\mu_t}, \quad (1)$$

where  $u'(\cdot)$  is the period utility function,  $C_t^k$  measures consumption in country  $k$  and  $\mu_t$  the shadow price of consumption. A first implication of this equation is that marginal utility growth should be perfectly correlated across countries. To the extent that variability of marginal utility can directly be associated with consumption fluctuations (as is the case under CRRA utility), this implies that international consumption correlations should be close to unity. Studies that have focused on this implication of the model have generally documented the consumption correlation or 'quantity' puzzle (Backus, Kehoe, Kydland 1992): international consumption correlations tend to be lower than the corresponding output correlations. However, as discussed in our earlier work, if consumption is subject to measurement error or preference shocks, consumption correlations could be low for other reasons than just a failure to share risk.

This is why much of the literature has focused on a second implication of Equation (1): since growth in the shadow price is common to all countries, the difference between marginal utility growth in two countries, while not necessarily zero, should be statistically independent of any country-specific risk-variables, notably relative endowments. This reasoning has led a large number of researchers to consider regressions of the form

$$\Delta \hat{c}_t^k = \mathbf{b}' \mathbf{X}_t^k + \varepsilon_t^k$$

where  $\mathbf{X}_t^k$  is a vector of time-varying country characteristics that capture idiosyncratic risk, such as relative output growth; lower case letters denote logarithms and the hat denotes idiosyncratic growth rates, so that  $\hat{c}_t^k = \Delta c_t^k - \Delta c_t^*$  is the growth rate of consumption in country  $k$  relative to the world growth rate  $\Delta c_t^*$ . Under full insurance all elements of the coefficients vector  $\mathbf{b}$  should then be zero.<sup>2</sup> As we discussed in Artis and Hoffmann (2008b), the key advantage of this regression-based formulation vs. the correlation-based measures is that it is robust even if consumption is driven by unobserved factors, such as measurement error and preference shocks — provided these factors are uncorrelated with the idiosyncratic risk characteristics  $\mathbf{X}_t^k$ .

<sup>2</sup> Mace (1991) and Cochrane (1991) were the first authors to investigate regression of this type in household-level data.

In the macroeconomic literature, most researchers have specialized  $\mathbf{X}_t^k$  to contain mainly relative output growth rates, estimating the regression

$$\hat{c}_t^k = b\hat{y}_t^k + \mu^k + \varepsilon_t^k, \quad (2)$$

where  $\Delta\hat{y}^k$  is the idiosyncratic growth rate of output in country  $k$  and  $\mu^k$  is a country fixed effect. Artis and Hoffmann (2008b) call this equation the ‘basic risk sharing regression.’ If financial markets are complete, the coefficient estimate of  $b$  should be zero or close to zero: a country’s consumption patterns (relative to the rest of the world) should be independent of its business cycle (*i.e.*, output growth) movements. In the data, panel estimates of  $b$  are typically between zero and one. Starting with Asdrubali, Sørensen and Yosha (1996), many researchers have therefore used  $b$  as a measure of risk sharing that indicates what fraction of idiosyncratic risk remains unshared. A typical estimate of  $b$  obtained from a panel of regions within a country (say US federal states) is around 0.25, which suggests that roughly a quarter of idiosyncratic output fluctuations remain uninsured among a country’s regions. Based on data from industrialized countries, most studies find that between 60 and 80 percent of idiosyncratic fluctuations appear to remain uninsured with the exact value depending somewhat on the country sample and the time period. When comparing these estimates from international data to the ones typical obtained for the regions within (industrialized) countries,<sup>3</sup> it becomes apparent that there is a lack of international consumption risk sharing.

As financial globalization has progressed, however, we would expect that this ‘lack of risk sharing’ has become less severe. The growth in international gross asset positions should help diversify national output risks and therefore help decouple relative consumption movements from idiosyncratic business cycle movements — the estimate of  $b$  obtained from international data should have declined over time.

As I argue in the next section, the evidence to this effect appears — at least at first sight — rather inconclusive. However, I argue that there is a lot of structure in these results and the section will therefore also seek to identify the factors that drive differences in results across dif-

<sup>3</sup>I emphasize ‘industrialized’ here. Evidence for intra-national risk sharing in emerging economies is relatively sparse but results for countries such as China indicate that emerging markets typically also have lower levels of intra-national risk sharing. See *e.g.*, Xu (2008).

ferent studies.

### III. Has Consumption Risk Sharing Increased? – A Synthesis of the Literature

This section attempts to synthesize the results from recent studies that have examined whether consumption risk sharing has increased with financial globalization. I identify three dimensions which drive differences in the results among these studies: i) the country sample, ii) the frequency of the data they focus on, and iii) whether they account for the possibility that globalization also affects the structure of shocks.

#### A. Country Samples

Probably the first study to systematically explore the impact of financial globalization on risk sharing among industrialized countries is Sørensen *et al.* (2007). These authors run the basic risk sharing regression (2) as a sequence of cross-sectional regressions

$$\hat{c}_t^k = b(t)\hat{y}_t^k + \varepsilon_t^k$$

so that they obtain a time-varying sequence of risk sharing coefficients  $\{b(t)\}$ . While the individual estimates of  $\{b(t)\}$  fluctuate very strongly, a smoothed sequence shows a downward trend. Sørensen *et al.* further examine the link between globalization and risk sharing by explicitly conditioning the estimate of  $b(t)$  on the growth international asset positions. To this end they specify regressions in which they interact idiosyncratic output growth with measures of international asset positions:

$$\hat{x}_t^k = b_0\hat{y}_t^k + b_1 \times FA_t^k \times \hat{y}_t^k + \gamma FA_t^k + \varepsilon_t^k$$

where  $FA_t^k$  is country  $k$ 's asset position at time  $t$  and  $\hat{x}_t^k = \Delta x_t^k - \Delta x_t^*$  stands, in turn, for relative income or relative consumption growth. In these specifications, the coefficient  $b_1$  is generally found to be negative, suggesting that higher international cross-holdings of assets do indeed go in hand with better international risk sharing. However, the results are somewhat sensitive to the exact definition of  $FA$  and to whether  $x_t^k$  is chosen to be income or consumption: the evidence in favor of international asset holdings increasing the independence of income (GNP) flows from output is somewhat stronger than that for consumption risk

sharing as a whole. This is interesting, because earlier studies found that the lack of international capital income flows (as opposed to a lack of international credit or loan flows) is one of the main reasons for the perceived lack of international risk sharing: as discussed in Sørensen and Yosha (1998) and Becker and Hoffmann (2006), the extent of consumption smoothing through credit markets is similar within and between countries.

A much broader sample of countries is examined in Kose, Prasad, and Terrones (2009). These authors confirm earlier results concerning the increase in risk sharing among industrialized countries. They do not find an increase in risk sharing among developing countries, however. There also does not seem to be a pronounced increase in risk sharing among emerging economies. These findings lead Kose, Prasad and Taylor (2011) to examine the role of threshold effects in financial integration: they convincingly show that a country will only be able to benefit from financial globalization if its political and economic institutions and its level of domestic financial development exceed a certain minimum level.

A similar form of non-linearities in the effects of financial globalization on risk sharing is explored by Imbs and Fratzscher (2009). Their sample also comprises of a broad set of economies, including industrialized economies, emerging markets and developing countries. Fratzscher and Imbs focus on the interaction between institutional development and (financial) openness. While they find that bad institutions do indeed lower international risk sharing, they also show that greater financial openness tends to mitigate this impact of bad institutions.

A number of studies have looked at the development of risk sharing in different world regions. Kalemli-Ozcan, Sørensen, and Yosha (2005) examine the impact of financial integration among EU economies, finding that risk sharing has increased substantially. Artis and Hoffmann (2008a) focus on the low frequency interaction between relative consumption and output and also come to the conclusion that risk sharing has increased substantially among EU members. Interestingly, however, risk sharing among EU members is not generally higher than among the group of industrialized countries at large. However, it started to increase earlier and the risk sharing occurs through different channels, increasingly through capital income flows. Gerlach and Hoffmann (2010) look at what they call the 'pivotal' role that the creation of EMU has played for increased risk sharing among industrialized countries at large: they find that risk sharing of non-EMU members with EMU members has increased following the inception of the common currency but that risk

sharing among non-EMU industrialized countries has decreased in turn. This seems to suggest that the creation of the common currency has created a big common financial market that facilitates risk sharing globally.

First important evidence on risk sharing in the Asia-Pacific region is provided in Kim, Kim, and Wang (2004) and Kim, Kim, and Wang (2006). These authors show that risk sharing among Asian economies is actually very low, much lower than among industrialized economies. Also, they do not find a substantial increase in this country group during the 1990s. However, their sample ends in 2000, so that it remains unclear whether risk sharing in the Asian Pacific has increased in the period since.

#### *B. Risk Sharing: Permanent vs. Transitory Shocks*

Most empirical studies use annual data, so that the basic risk sharing regression above is effectively formulated in annual growth rates. This setup tends to emphasize the interaction between relative consumption and relative output shocks at the business-cycle frequency. However, from a theoretical point of view, there are a number of reasons to believe that it should matter for international risk sharing if a shock is perceived to be permanent or transitory—at least if financial markets are not entirely complete. I will review some of these reasons below, after discussing the empirical evidence.

Already in the seminal paper by ASY, the authors looked at versions of the risk sharing regression in which the data were differenced at longer horizons. Becker and Hoffmann (2006) identified permanent and transitory shocks in a cointegrated vector autoregression model (VECM). More recently Asdrubali and Kim (2008) have suggested an elegant decomposition of risk sharing into a long-term (insurance) and a short-term (smoothing) component based on the distinction between the within and between panel estimators. All of these studies find that permanent (*i.e.*, low frequency) idiosyncratic fluctuations in output among industrialized countries are much less well insured than permanent shocks. Becker and Hoffmann (2006) identify this pattern as a main cause of the lack of international risk sharing: whereas transitory disturbances are almost completely smoothed in credit markets in both regional data (*i.e.*, within countries) and between countries, permanent idiosyncratic shocks remain almost completely uninsured between countries but are at least partially insured among *e.g.*, US federal states.



The data sets used in these studies generally end in the late 1990s, which does not allow them to explore systematically how financial globalization has affected international risk sharing of permanent shocks. We explored this issue in detail in Artis and Hoffmann (2006, 2008b). Using a setup similar to the one used by Sørensen *et al.* (2007) discussed above, but focussing on regressions in relative log-levels rather than first differences, Artis and Hoffmann (2006) document a very strong link between the growth in the international cross-holdings of financial assets and improvements in risk sharing for a set of 23 OECD countries. Their log-level specification can be interpreted as a regression with an infinite differencing horizon that describes the sensitivity of relative consumption to relative output at frequency zero. The intuition is analogous to that of the basic risk sharing regression: in a world with perfect *ex ante* risk sharing, fluctuations in relative quantities of output should not have an impact on relative consumption levels. Formulating the risk sharing regression in (log-) levels and estimating it as a sequence of cross-sectional regressions, *i.e.*,

$$c_t^k - c_t^* = b^{LR}(t)[y_t^k - y_t^*] + \varepsilon_t^k$$

Artis and Hoffmann (2006) can show that the 'long-run' risk sharing coefficient shows a clear downward trend from the late 1980s onwards. Hence, the improvement in the sharing of permanent idiosyncratic shocks show up even without a need to condition the estimates on international asset positions or a need to filter the estimates of  $b^{LR}(t)$  — as is often the case in the differenced regression.

Similar results are obtained by Kose, Prasad, and Terrones (2009) who run regressions based on 3 and 5 year growth rates and Matsumoto, Flood, and Marion (2009) who look at the time-varying volatilities of consumption shares. These studies also find a very clear increase in risk sharing — at least among industrialized economies.

All of these studies seem to suggest that the increase in international risk sharing is more readily detected once one focuses on the lower frequency of the data. This, in turn, is consistent with what theory would suggest: first, insuring against permanent shocks carries much higher welfare gains, a point made in a substantial literature that I do not attempt to survey here (see *e.g.*, Athanasoulis and van Wincoop 2000). Therefore, for a given cost of insuring in financial markets, households, regions, and countries will tend to buy insurance against permanent shocks first. Secondly, smoothing of transitory shocks can be achieved

using a rather limited menu of assets (*e.g.*, bond or loans) whereas insurance against permanent idiosyncratic fluctuations requires more sophisticated, state-contingent assets, such as *e.g.*, equity (see Baxter and Crucini 1995). Indeed, while bonds or loans have been internationally traded on a considerable scale even before the recent wave of financial globalization, the decline in equity portfolio home bias is a relatively recent phenomenon. It is therefore consistent with these shifting patterns of international asset ownership that they first and foremost lead to an improved diversification of persistent idiosyncratic risks, whereas transitory fluctuations seem to have been smoothed rather well all along (see *e.g.*, Becker and Hoffmann 2006).

The question that arises against the backdrop of these results is why the simple risk sharing regression (2) has generally had a harder time detecting the increase in international risk sharing. I address this point next.

### *C. Globalization, Risk Sharing, and Business Cycle Patterns*

All studies of international risk sharing that I have discussed so far take the structure of international shocks as given. From a theoretical point of view, however, correlations and conditional volatilities of consumption will themselves be a function of the structure of shocks. If, furthermore, trend (permanent) and cyclical (transitory) fluctuations in output constitute different risks — *e.g.*, because they can only be insured using different assets — then the process of financial globalization could itself have an impact on the structure of economic shocks. Kalemli-Ozcan, Sørensen, and Yosha (2001, 2003) have shown very persuasively that better access to finance leads countries to adopt a more specialized industry structure: if shocks are predominantly sectoral, then specialization will lead to very volatile output fluctuations. Hence, in the absence of access to insurance, a country may choose to adopt a much more balanced mix of industries. This will tend to stabilize output. If consumption can be shielded from output fluctuations using financial markets, however, then comparative advantage can be fully exploited, leading to more volatile output shocks. There may be other channels through which economic integration can affect international business cycle patterns. Frankel and Rose (1998) have shown that bilateral trade openness and business cycle synchronization are positively related. This could be due to demand spillovers or due to vertical specialization along the supply chain. Major shifts in the cross-country pattern of business cycles over the last two

decades have been documented by a number of studies. From the mid-1980s till at least the onset of the recent financial crisis, the volatility of business cycles has declined globally (Stock and Watson 2005), a phenomenon often referred to as the ‘great moderation.’ More recently we have also seen the emergence of regional business cycles such as in the Euro area (Artis and Zhang 1997, 1999; Artis, Krolzig, and Toro 2004) and in the Asia-Pacific region (Kose, Otrok, and Prasad 2008; Kim, Lee, and Park 2009; Fujiwara and Takahashi 2011; Hoffmann and Liao 2011).

Whether or not such changes in international business cycle patterns are driven by globalization themselves or whether they occur concurrently, though possibly independently — my argument here will be that such shifts may blur or even offset the impact of financial globalization on extant consumption-based indicators of risk sharing. This can potentially explain why a number of studies have actually not identified an increase in consumption correlations or a drop in conditional consumption volatilities — the coefficient  $b$  — over the last two decades.<sup>4</sup>

The next section lays out a stylized framework that allows me to confront these issues. The gist of my argument is simple: if financial markets are incomplete, then consumption correlations and conditional volatilities will themselves be a function of the structure of shocks. If, furthermore, trend (permanent) and cyclical (transitory) fluctuations in output constitute different risks — *e.g.*, because they can only be insured using different assets — then the basic risk sharing coefficient  $b$  will be a weighted sum of the degrees to which either type of shock is insured. The weights in this sum will be a function of the relative importance of trend and cyclical fluctuations. If shifts in international business cycle patterns — changes in the volatility of cycles, increased synchronization *etc.* — changes these weights, this may blur or even offset the impact of financial globalization on  $b$ .

#### **IV. Partial Insurance in a Permanent Income Model**

In this section, I briefly describe the framework by Artis and Hoffmann (2008b), which builds on Crucini (1999). In this model, a country can buy into a world mutual fund that pays world average output as a dividend. Therefore, income growth is a weighted sum of domestic and world

<sup>4</sup> See *e.g.*, the results in Imbs (2006) and Bai and Zhang (2005). Heathcote and Perri (2004) even report that international consumption correlations have decreased for the U.S.

average output growth:

$$\Delta inc_t^k = (1 - \omega)\Delta y_t^k + \omega\Delta y_t^{*P}.$$

Here,  $\omega$  measures the fraction of country  $k$ 's wealth held in the mutual fund — the index of financial globalization used in this paper. We further assume that, once income is observed, the country can fully smooth the effect of any transitory fluctuations in consumption through borrowing and lending so that

$$\Delta c_t^k = \Delta inc_t^{kP} = (1 - \omega)\Delta y_t^{kP} + \omega\Delta y_t^{*P}, \quad (3)$$

where the superscript 'P' denotes the permanent component. This simple setup captures the idea that permanent and transitory shocks constitute different sources of risk. Diversifying the risks with permanent idiosyncratic output shocks requires access to a state-contingent asset — the world mutual fund. If  $\omega=0$ , then there is no international diversification and the country obtains no insurance against permanent idiosyncratic output shocks, whereas if  $\omega=1$ , insurance against such shocks will be complete. In general, we expect  $0 < \omega < 1$ , reflecting our assumption that due to various frictions it is costly to obtain insurance in international financial markets. This is what Artis and Hoffmann (2008b) and Heathcote *et al.* (2007) call partial insurance. Conversely, the setup assumes that the effect of transitory shocks to income on consumption can be completely eliminated, *e.g.*, through international borrowing and lending. This is a usual assumption underlying the entire class of permanent-income models.

For the world as whole it holds that  $\Delta c^* = \Delta inc^{*P} = \Delta y^{*P}$ , so that we can rewrite Equation (3) as

$$\hat{c}_t^k = (1 - \omega)\hat{y}_t^{kP}. \quad (4)$$

where the hat, again, denotes the idiosyncratic growth rate of the respective variable (*e.g.*,  $\hat{y}_t^{kP} = \Delta y_t^{kP} - \Delta y_t^{*P}$ ). Equation (4) suggests a regression of relative output growth rates on relative growth rates in permanent output:

$$\hat{c}_t^k = b_p \hat{y}_t^{kP} + \xi_t^k \quad (5)$$

in which, under the null of our model,  $b_p = (1 - \omega)$ . Secondly, the model

implies that the coefficient  $b_T$  in the regression

$$\hat{c}_t^k = b_T \hat{y}_t^{kT} + v_t^k, \tag{6}$$

where  $\Delta \hat{y}^T = \Delta \hat{y} - \Delta \hat{y}^P$ , should equal zero — transitory variation in relative outputs should not have an impact on relative consumption. In dealing with the data, we do not wish to impose  $b_T$  directly. According to Artis and Hoffmann (2008b) ‘the assumption that transitory fluctuations can actually be smoothed away completely whereas insurance against permanent shocks is generally incomplete is just a metaphor for saying that existing financial markets make it harder for countries to insure against permanent shocks than against transitory fluctuations.’

Artis and Hoffmann (2008b) call  $b_P$  and  $b_T$  the ‘structural’ risk sharing coefficients. It is then easy to show that the coefficient of the basic risk sharing regression (2) can be written as

$$b = b_P \frac{\text{var}(\hat{y}^P)}{\text{var}(\hat{y})} + b_T \frac{\text{var}(\hat{y}^T)}{\text{var}(\hat{y})}. \tag{7}$$

where the hat again denotes the idiosyncratic growth rate of the respective variable. For convenience, here and in the remainder of the paper, we drop the country and time indexes to denote cross-country averages of the respective moments. From this equation it is now easy to see that a decline in the structural risk sharing coefficients can be offset (or, for that matter, reinforced) by changes in the ratios  $\text{var}(\hat{y}^P)/\text{var}(\hat{y})$  and  $\text{var}(\hat{y}^T)/\text{var}(\hat{y})$ . In the simple permanent-income model here it should be the case that  $b_T = 0$  — a restriction that is also close to what is found in the data, both in our earlier analysis of industrialized countries and in the empirical analysis for Asia below. Then, with  $b_T = 0$  and  $b_P = (1 - \omega)$  we can write (7)

$$b = (1 - \omega)\phi, \tag{8}$$

where  $\phi = \text{var}(\hat{y}^P)/\text{var}(\hat{y})$  is the share of permanent fluctuations in the variance of country-specific output growth. Following Artis and Hoffmann (2008b), I refer to  $\phi$  as the long-term variance ratio.

Based on this decomposition, it is now possible to trace changes in  $b$  over time. Specifically,  $b$  may have increased even though  $(1 - \omega)$  has actually decreased: if  $\phi$  increases enough, this effect could offset the

impact of financial globalization on  $b$ . In our earlier work, we suggest to interpret  $\phi$  as an indicator of the strength of Deaton-esque effects: if contemporaneous output growth is less volatile than long-term output growth, so that  $\phi > 1$ , this implies that changes in output today are likely to be followed by larger changes tomorrow. A permanent-income consumer, however, will anticipate these long-run changes, implying that her consumption (in relation to output) today reacts by more than  $1 - \omega$ . This overshooting of consumption, however, is nothing else than optimizing behaviour in a permanent-income model — and not a failure to share risk. But this overshooting will tend to increase the volatility of consumption conditional on output today relative to the case where  $\phi = 1$ , *i.e.*, where output volatility today,  $\text{var}(\hat{y})$ , just equals trend output volatility,  $\text{var}(\hat{y}^P)$ .

Clearly, as patterns of international business cycle comovement change, this will tend to alter the relative importance of trend growth and cyclical components in the country-specific components of output growth. In the next section, I therefore apply this framework to data from a group of economies in Asia.

## V. Econometric Implementation

### A. Constructing Permanent Components

To estimate the risk sharing regressions (5) and (6), I need an econometric measure of the permanent component of domestic and foreign output growth. Again I follow our previous work in Artis and Hoffmann (2008b) and construct  $y^P$  from a log-linearized relation for the present-value of output:

$$y_t^P = \log[Y_t^P] \approx y_t + \sum_{k=1}^{\infty} R^k \mathbf{E}(\Delta y_{t+k}). \quad (9)$$

where  $R = (1+r)^{-1}$  is a discount factor to be fixed. I choose  $r = 0.02$ . I then specify processes for  $\Delta y_t$  and  $\Delta y_t^*$  to proxy for the expectations involved in (9). Like in our earlier work, I follow Crucini (1999) and first consider separate AR(1)–processes for  $\Delta y$  and  $\Delta y^*$  respectively. I then also estimate a VAR(1) for the joint dynamics of home and world output growth. See Artis and Hoffmann (2008b) for the details.<sup>5</sup>

<sup>5</sup>Unlike Artis and Hoffmann (2008b), I do not include relative consumption growth rates in the VAR though. The reason is that, though in principle infor-

*B. Data and Estimation*

The analysis in this paper is based on annual data from the Penn World Table, release 6.3 (PWT 6.3.). The sample ranges from 1973 to 2007. All data are in constant international prices. The sample covers the following Asian economies:

1. China, 2. Hong Kong, 3. Indonesia, 4. Japan, 5. Korea, 6. Malaysia, 7. The Philippines, 8. Singapore, 9. Taiwan, 10. Thailand, and 11. Vietnam.

I report results for two (equal length) sub-periods: 1973-1989 and 1990-2007. The former is the pre-globalization period whereas the period after 1990 has been marked by a wave of financial liberalization around the world. However, for the Asian economies, the financial crisis of 1997/1998 clearly is expected to mark a watershed. Therefore, I further split the period of global liberalization into the sub-periods 1990-1996 and — excluding the crisis and its immediate aftermath — a period covering the years 2000-2007.

Following my earlier work with Mike Artis, I estimated all risk sharing regressions with a panel two-stage least squares procedure. First, the respective risk sharing equation is estimated by panel OLS, controlling for country-fixed effects. To control for heteroscedasticity, all variables are then weighted by the country-specific variance of the first stage residuals and the model is re-estimated.<sup>6</sup>

**VI. Empirical Results**

*A. Baseline Regressions*

Table 1 presents the results of the basic risk sharing regression for the  
mative about future output growth, consumption in these countries is likely to be measured with a lot of noise over our sample period.

<sup>6</sup>Note that in all the panel specifications here, variables are expressed in growth rates relative to the group (of Asian economies) average. This is effectively equivalent to including time effects and therefore also controls for the joint impact of any global fluctuations (outside Asia) on these economies. However, it should be noted that this setup—very much as in virtually all empirical consumption risk sharing studies—affects the interpretation of the estimated coefficients: the estimated coefficients capture the extent of risk sharing within the group of economies in the sample and have no direct implications for the extent of risk sharing with countries or regions outside this group.

**TABLE 1**  
BASIC RISK SHARING REGRESSIONS

1973-89	1991-2007	1990-96	2000-2007
Estimate of $b$			
0.66072 (10.7812)	0.63185 (11.4806)	0.7751 (6.5864)	0.28041 (3.2597)

Notes: Panel regressions of the form  $\hat{c}_t^k = b\hat{y}_t^k + \delta + \mu^k + \varepsilon_t^k$  where  $\delta$ ,  $\mu^k$ , and  $\varepsilon_t^k$  are the constant term, the country (region) fixed effect and the residual term respectively. The hat denotes idiosyncratic growth rates. Numbers in parentheses are  $t$ -statistics based on the weighted least squares procedure described in the main text.

four sub-periods. The estimated coefficient for the period 1973-1989 is 0.66, suggesting that roughly one third of idiosyncratic shocks actually got shared among the countries in the sample. This is almost the same number that is obtained for the period 1990-2007 however. Here we estimate  $b=0.63$ , which is not significantly different from the value obtained for the previous 18 years. Splitting the post-1990 period into the period before the Asian crisis — 1990-1996 — even reveals a coefficient of 0.77. This suggests that actually less risk got shared between East Asia's economies in the first half of the 1990s than before. Overall, these estimates are very much in line with those reported by Kim, Kim, and Wang (2006) and they would suggest that risk sharing in Asia has not increased.

Turning to the last part of the sample period, however, we do see a marked drop in our estimate of  $b$ . This number now appears to suggest extremely high levels of risk sharing — roughly three quarters of an idiosyncratic output shock would appear to be shared among East Asian economies. This value for  $b$  is in the order of magnitude of the estimates obtained for risk sharing among the regions of highly developed industrialized economies (see *e.g.*, Asdrubali, Sørensen, and Yosha 1996).

These estimates reveal an interesting pattern: on the one hand, it seems that risk sharing has not substantially increased among Asian economies in the first part of the period of world-wide globalization, *i.e.*, before the Asian crisis of 1997/98. This is in line with earlier findings for these countries covering the same period. On the other hand, once Asia had recovered from the crisis, the impact of financial globalization on risk sharing is extremely strong. This pattern contrasts sharply with extant results on industrialized countries for which we find a more gra-



**TABLE 2**  
SHARING OF PERMANENT AND TRANSITORY IDIOSYNCRATIC RISK

Specification for $\hat{y} = \Delta y - \Delta y^*$	1973-89	1990-2007	1990-96	2000-2007
Permanent component: $b_p$				
AR(1)	0.46 (8.44)	0.27 (6.04)	0.45 (3.81)	0.18 (2.86)
VAR(1)	0.47 (8.06)	0.14 (4.20)	0.49 (3.94)	0.33 (2.80)
Transitory component: $b_T$				
AR(1)	-0.42 (-2.35)	0.002 (0.028)	0.08 (0.45)	-0.07 (-0.81)
VAR(1)	-0.09 (-0.53)	0.004 (0.09)	0.10 (0.57)	0.15 (1.30)

Notes: Panel regressions of the form  $\hat{c}_t^k = b_p \hat{y}_t^{kP} + \delta + \mu^k + \varepsilon_t^k$  and  $\hat{c}_t^k = b_T \hat{y}_t^{kT} + \delta + \mu^k + \varepsilon_t^k$  where  $\delta$ ,  $\mu^k$ , and  $\varepsilon_t^k$  are the constant term, the country (region) fixed effect and the residual term respectively. Numbers in parentheses are  $t$ -statistics based on the weighted least squares procedure described in the main text. The first column identifies which specification for  $\hat{y} = \Delta y - \Delta y^*$  was used in the construction of permanent and transitory components.

dual increase that is detectable from the late 1980s onwards (see *e.g.*, Artis and Hoffmann 2006, 2008b; Sørensen *et al.* 2007).

As I have argued before, however, this pattern should not be taken at face value until we have controlled for concurrent changes in the patterns of comovement of national business cycles among our sample countries. Clearly, the Asian crisis and the rapid structural transformation of Asia's economies over the last 20 years makes such an analysis appear particularly relevant.

*B. Insurance of Permanent and Transitory Shocks*

Table 2 presents the results of the modified risk sharing regressions that differentiate between permanent and transitory components. For each subperiod, we report results based on the two methods of constructing the permanent and transitory components discussed in the previous section: one in which home and foreign output growth follow univariate AR (1) processes and one in which they are jointly determined by a VAR(1). The latter allows for the possibility of spillovers in business cycles, so that foreign growth rates may affect expectations of future output growth at

home and *vice-versa*.

The estimates of  $b_p$  are reported in the first panel. For the pre-1990 period they are around 0.45, suggesting that slightly more than 50 percent of permanent idiosyncratic shocks got shared among the countries in this sample during this period. For the period after 1990, I detect a marked drop in  $b_p$ . However this drop seems too strong to be plausible: based on both the AR and the VAR, the estimate of  $b_p$  is now around 0.15. Clearly, this could be affected by the large common shocks of the Asian crisis. Splitting the sample again and excluding the crisis years themselves, shows that this is indeed the case: now, for the 1990-1996 subperiod, I find estimates of  $b_p$  that are very similar to the pre-1990 period. Conversely, For the post-2000 period there is a sharp drop: based on the AR(1) I estimate  $b_p=0.17$  — similar to the baseline estimate in Table 1. For the (richer) VAR(1) specification, I find  $b_p=0.34$ .

Turning to the second panel, it is apparent that all estimates of  $b_T$ , the extent of risk sharing of the transitory shocks, are generally zero and insignificant. This corroborates the results in Artis and Hoffmann (2008b) on a new sample of Asian economies here, confirming the assumption of the simple model of partial insurance in which transitory shocks can be completely smoothed through borrowing and lending.<sup>7</sup>

Over the last decade, following the Asian crisis, many Asian economies have pursued deliberate policies of reserve accumulation. These stocks of foreign reserves could act as a buffer-stock of precautionary savings that allows countries to smooth idiosyncratic shocks.<sup>8</sup> It is worth noting, however, that intertemporal smoothing is ultimately only possible with respect to transitory shocks. The results here, however, suggest that it is predominantly insurance against permanent shocks — and not improved smoothing of transitory shocks — that accounts for the improvements in risk sharing (here widely understood as the sum of all smoothing and insurance mechanisms). *Prima facie*, the pattern I document here would therefore suggest that is mainly improved capital market integration and not so much the use of government currency reserves that has contributed to improved risk sharing among Asian economies.<sup>9</sup>

<sup>7</sup>The finding is also consistent with Kim, Kim, and Wang (2006) who decompose output shocks into an income and a consumption smoothing component, following ASY 1996. They find that during their sample period — which ends in 2000 — risk sharing among Asian economies was predominantly achieved through consumption smoothing.

<sup>8</sup>Choi and Baek (2006) provide evidence of a link between portfolio-flow volatility and reserve accumulation.

**TABLE 3**  
BUSINESS CYCLE VOLATILITY AND RISK SHARING REGRESSIONS

	Business cycle volatility $\text{var}(\hat{y})^{1/2}$	Trend volatility $\text{var}(\hat{y}^p)^{1/2}$	Long-Run variance ratio $\phi = \frac{\text{var}(\hat{y}^p)}{\text{var}(\hat{y})}$	Implied degree of globalization $b_{adj} = b / \phi$
1973-1989	0.034	0.040	1.390	0.475
1990-2007	0.032	0.066	4.244	0.149
1990-1996	0.019	0.022	1.394	0.556
2000-2007	0.022	0.020	0.812	0.345

Notes: The table presents the impact of changes in business cycle and long-run volatility ( $\text{var}(\hat{y})$  and  $\text{var}(\hat{y}^p)$  respectively) on the risk sharing coefficient. Calculations of permanent components  $\hat{y}^p$  based on the VAR. For the calculation of  $b_{adj} = b / \phi$  the estimates of  $b$  from table 1 were used.

Summing up, the findings in this subsection corroborate the patterns, I documented in Table 1: till the onset of the Asian crisis, risk sharing among Asian economies was rather low. However, it seems that financial globalization clearly made its impact felt in terms of better international risk sharing, following the recovery from the crisis. It is interesting to see that this pattern does not seem to be affected by controlling for changes in the structure of business cycles.

*C. Changes in Business Cycle Patterns*

I further assess the importance of changes in business cycles patterns in Table 3. For each subperiod, the table reports the standard deviations of output growth, trend growth and the long-run variance ratio,  $\phi$ . Following Artis and Hoffmann (2008b), the last column gives a business-cycle adjusted measure of risk sharing,  $b_{adj} = b / \phi$ . As is easily apparent

<sup>9</sup> Still, my results do not allow me to entirely rule out a role of reserves for improved risk sharing. The sample on which my construction of permanent and transitory components is based is necessarily rather short. It is therefore possible that some transitory but long-lived shocks get classified as permanent. These transitory shocks could in principle also be smoothed through intertemporal smoothing, including the use of reserves. Conversely, international reserve holdings have by now reached levels that would allow many Asian economies to smooth idiosyncratic shocks over very long horizons. A detailed study of the use of international reserves for risk sharing (e.g., during the recent global crisis) is a very interesting area for future research.

from Equation (8), this is the value of the risk sharing coefficient  $b$  which should prevail if  $b_T=0$ , so that under the null of the model,  $b_{adj}$  should be equal to  $b_p=(1-\omega)$ . Hence, very much as  $b_p$ , the coefficient  $b_{adj}$  should give us the degree of international risk sharing corrected for the underlying changes in the relative importance of trend and cyclical variation in (idiosyncratic) output growth.

First, the table clearly shows the impact of the Asian crisis on volatility: while output growth for the whole period 1990-2007 does not appear much higher than in the pre-1990 period, this blurs differences across subperiods:<sup>10</sup> as can be seen from the third and fourth rows of the table, both in the 1990-96 and in the 2000-2007 periods,  $\text{var}(\hat{y})$  is actually lower than in the pre-1990 period. Hence, with the exception of the crisis years, (idiosyncratic) business cycle volatility in Asia actually seems to have declined.<sup>11</sup>

In spite of this decline in volatility, till the eve of the Asian crisis, the values of  $\phi$  show that the relative importance of trend and cyclical variation seems to have remained virtually constant between the pre-1990 and the 1990-96 periods. The business-cycle adjusted risk sharing coefficient displays a slight increase between the two periods.

The period after the end of the crisis and the turn of the millenium then sees a huge drop in trend relative to output growth volatility which is reflected in a much lower value of  $\phi$  (0.8 instead of 1.39). This drop in  $\phi$  could reflect an increased synchronization of trend movements among Asia's emerging economies that sometimes has been referred to as de-coupling (see Kose, Otrok, and Prasad 2008; Kim, Lee, and Park 2009; He and Liao 2011; Hoffmann and Liao 2011). Hence, it would seem that the enormous drop in the baseline coefficient  $b$  that I documented in Table 1 for this subperiod is indeed partly explained by changes in the structure of business cycles. However, as the adjusted coefficient in the last column of Table 3 (as well as the estimates of  $b_p$  in Table 2) show, this drop in  $\phi$  is not sufficient to explain all of the drop in  $b$ : the coefficients  $b_p$  and  $b_{adj}$  have fallen as well — risk sharing in Asia has started to increase after the Asian crisis.

<sup>10</sup> Clearly, the crisis years have a huge impact on the estimate of permanent components, leading to a huge increase in  $\text{var}(\hat{y}^p)$  and a jump in  $\phi$ .

<sup>11</sup> Since  $\text{var}(\hat{y})=\text{var}(\Delta y)-2\text{cov}(\Delta y, \Delta y^*)+\text{var}(\Delta y^*)$ , this is consistent with the emergence of more regionally synchronized business cycles in Asia.

## **V. Conclusion**

The subprime crisis and the global recession that followed it have made many observers critical of the benefits of financial globalization. One of these benefits should be that international risk sharing has actually increased. In this paper, I have reviewed recent empirical work on this link between risk sharing and globalization, arguing that differences in empirical results across studies can be explained by three main factors: first, the country sample. Papers that have focused on industrialized countries alone have generally found somewhat stronger evidence in favour of more risk sharing, whereas emerging markets and developing countries seem to have been largely excluded from reaping the risk sharing benefits of financial globalization. Secondly, the impact of financial globalization on risk sharing is generally found to be stronger in studies that have looked at the lower-frequency movements of consumption and output. As I have argued here and elsewhere, this is consistent with a range of theoretical models all of which predict that the benefits of risk sharing should be higher in the low frequency, while at the same time, these risks are harder to insure given the usual menu of available assets. Third, to the extent that risk sharing is incomplete, the structure of shocks — or business cycles — matters for extant measures of consumption risk sharing. Building on some of my earlier work with various coauthors, I have illustrated the relevance of these points on a sample of Asian countries. My results suggest that globalization has affected business cycle patterns in Asia, but that it has also increased risk sharing since the beginning of the millenium, after the region's recovery from the Asian crisis. To my knowledge, this is the first evidence to suggest that there risk sharing increased substantially among a sample of emerging economies.

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