International Risk Sharing in Emerging Economies*

Carlos A. Yépez†

This version: April 16, 2020

Abstract

This study investigates the apparent lack of insurance against country-specific risk observed internationally. Using a sample of 21 emerging and 21 advanced economies over the period 1980–2014, I document new evidence from international co-movements of prices and quantities suggesting that risk sharing is worse in emerging economies than in advanced economies. I then extend a standard international business cycle model to assess the implications of the *"cycle is the trend"* hypothesis for international risk sharing. I show that shocks to trend productivity growth provide a compelling explanation for the distinct risk-sharing features of emerging market economies. The findings of this study are relevant for the conduct of stabilization policy, as it critically depends on the nature of the shocks that affect an economy.

Keywords: International Finance, Emerging Market Economy, Business Cycles, Open Economy.

JEL codes: E32, F31, F41

*I am grateful to anonymous referees, Emine Boz, Mick Devereux, Charles Engel, Fabio Ghironi, Gita Gopinath, Jonathan Heathcote, Sylvain Leduc, Fabrizio Perri, Kei-Mu Yi, George Hall, Blake LeBaron, Catherine Mann, Raphael Schoenle, Dan Tortorice, Loukas Karabarbounis, and seminar participants at Bank of Mexico, Boston College, Brandeis University, Brown University, Midwest Macroeconomics Meetings, University of Toronto (RCEF), and the 13th ZEW Summer Workshop in International Business Cycles for helpful discussions, comments, and suggestions. All errors and omissions are my own.

†Department of Economics. University of Manitoba. Rm. 644 Fletcher Argue Bldg., Winnipeg, Manitoba. Canada R3T 5V5. E-mail: Carlos.Yepez@umanitoba.ca

1 Introduction

Most literature that examines international co-movements of aggregate fluctuations does so from the perspective of advanced economies (AEs). Less is known about international business cycles from the perspective of emerging market economies (EMEs).[1] One enduring question in international economics searches for an explanation for the apparent lack of international consumption risk sharing among countries, which is at odds with the prediction that countries should better share consumption risk through international trade and financial integration. More importantly, little is known about the extent to which EMEs are insured against consumption risk. Risk sharing is of policy relevance because, all else being equal, larger consumption risk suggests larger welfare gains for governments trying to mitigate that risk. Therefore, in this study, I analyze international consumption risk sharing from the perspective of EMEs and make two novel contributions to the literature. First, I document new empirical facts that indicate an apparent lower degree of risk sharing in EMEs than in AEs. Second, I extend a standard international real business cycle (IRBC) with both transitory and trend growth shocks to productivity and employ it to show that the relative importance of trend shocks is key for explaining the distinct international risk-sharing features observed in EMEs.

The empirical contribution of this study is that it provides evidence suggesting a lower degree of risk sharing in EMEs. Using a sample of 21 EMEs and 21 AEs during the period 1980–2014, I document four new facts related to international co-movements of prices and quantities. First, a real depreciation is associated with a worsening (not an improvement) in the ratio of domestic-to-foreign consumption (the Backus–Smith condition); this behavior is more severe in EMEs (mean correlation of -0.46) than in AEs (mean correlation of -0.08). Second, real exchange rates are counter-cyclical in EMEs (mean correlation of -0.39), while they are somewhat acyclical in AEs (mean correlation of -0.06). This observation is counter to the prediction that a positive productivity shock brings about a depreciation in international prices.

Third, real exchange rate volatility relative to income volatility is lower in EMEs (mean of 3.38) than in advanced ones (mean of 3.72). This fact suggests a relatively weaker international price adjustment mechanism in EMEs. Fourth, international investment correlations are substantially lower in EMEs (mean correlation of 0.03) than in AEs (mean correlation of 0.58). This fact also points toward a negligible synchronization of investment spending from the perspective of EMEs than predicted by the standard IRBC model with full risk sharing.

[1] Notable exceptions are the empirical studies of Agenor et al. 2000 and Kose and Prasad 2010.

The theoretical contribution of this study is that it provides an explanation for why the greater severity of risk sharing in EMEs than in AEs. To explain the observed patterns of international co-movements in both EMEs and AEs, I extend a standard IRBC model (Backus et al. 1993, henceforth BKK 1993) with both transitory and trend growth shocks to productivity. Specifically, this study examines the international risk-sharing implications of the *"cycle is the trend"* hypothesis of EME business cycles (Aguiar and Gopinath, 2007) within a general equilibrium framework. This study also investigates the validity of another leading explanation for risk sharing in production economies, namely, the inelastic trade hypothesis of Corsetti et al. 2008. I show that although inelastic trade still holds in a basic one-sector environment without deviations from the law of one price, it is still not a good explanation for the distinct risk-sharing features observed in EMEs. Last, I study the implications of asymmetric trade for consumption risk sharing by examining the effect of increasing the level of openness in the EME. I find that as the economy becomes more open, the more it is exposed to consumption risk.

Overall, the theoretical findings suggest that, for the representative EME, shocks to trend growth offer a compelling explanation for its lower degree of international risk sharing. Importantly, these findings are relevant for the conduct of policy in EMEs. For instance, monetary policy makers do not face a trade-off between price and output stability when the the shocks hitting the economy are of a permanent nature.

Literature Review

The seminal work of Cole and Obstfeld 1991 showed that international price adjustment through financial market integration provides the required insurance against consumption risk across countries. Similarly, the canonical IRBC model (Backus et al. 1993) suggests that an increase in financial integration should improve the scope for risk sharing across countries. Specifically, when financial markets are complete, the real exchange rate appreciates in response to a drop in domestic consumption, and hence, provides insurance through international price adjustment. Puzzlingly, this prediction is not borne out by the data in AEs (Backus and Smith 1993).

Extant literature that examines international business cycles from the perspective of EMEs has focused on documenting the empirical properties of quantity co-movements (Kose et al. 2003, Kose et al. 2009, Kose and Prasad 2010, and Uribe and Schmitt-Grohé 2017). One important aspect that has been overlooked by this literature is the extent to which EMEs are insured against consumption risk through real exchange rate adjustment, which is the object of this study.

Two influential studies examining the role of price elasticities and non-tradables for consumption risk sharing are Benigno and Thoenissen 2008 and Corsetti et al. 2008. In both studies, the key transmission mechanism that accounts for the absence of risk sharing relies on specific assumptions about the degree of substitutability between goods. Specifically, Corsetti et al. 2008 argues that inelastic trade between domestic and foreign goods, elastic trade between tradables and non-tradables, and departures from the law of one price explain imperfect risk sharing in (advanced) production economies. By contrast, Benigno and Thoenissen 2008 assume that trade between countries is elastic, substitution between tradable and non-tradable goods is inelastic, and there are no deviations from the law of one price. Importantly, both studies highlight the key role of one or other form of low trade elasticities, which effectively reduce the scope of insurance against consumption risk across countries.[2]

Other studies have proposed co-integrated total factor productivity (TFP) shocks to explain the real exchange rate volatility puzzle (Rabanal et al. 2011), as well as the role of non-tradables as an explanation for the risk-sharing puzzle (Akkoyun et al. 2017). However, these contributions have done so within the context of AEs. I add to the above literature by exploring the risk-sharing role of stochastic trends in productivity within the context of EMEs.

The rest of this paper is organized as follows. Section 2 discusses the empirical evidence of consumption risk sharing for a cross-section of 42 countries during the period 1980–2014. Section 3 presents the model and describes the key mechanism. Section 4 discusses the quantitative results of different risk-sharing mechanisms. Finally, section 5 concludes.

2 Empirical Facts

The data sample is composed of a cross-section of 42 countries. I collect national income accounts (NIPA) data, and import and export data from the World Development Indicators (WDI). Import and export shares are from UN Comtrade and price data are from International Financial Statistics (IFS). The frequency is annual and the period is 1980–2014. The statistics are computed from the cyclical component of the HP-filtered data. I classify the countries as EMEs or AEs following Kose et al. 2009. In other words, EMEs are characterized by rapid growth and industrialization, while AEs have lower and steady growth and are already industrialized. Each data subsample contains 21 countries. The NIPA comprise per capita data

[2]Within their framework, Corsetti et al. 2008 also identify high persistence of shocks combined with higher trade elasticity as a mechanism to explain low risk-sharing.

based on constant dollars (base year 2005). Following Kose et al. 2007, I construct a world-country equivalent from a trade-weighted average of G7 economies. The G7 economies account for approximately 50% of global nominal GDP, which makes it a sensible candidate for a world benchmark. [3] [4]

I measure consumption risk sharing using several empirical relationships identified by previous studies (Backus and Smith 1993, Obstfeld and Rogoff 1996, Kose et al. 2009, Baxter 2012) as follows. First, the co-movement between the real exchange rate and relative consumption between countries, is predicted to be positive and strong (Backus and Smith, 1993). In other words, downturns caused by a negative productivity shock (e.g., periods when domestic consumption falls) should be associated with an appreciation of the real exchange rate. However, in the data, this co-movement is negative (the Backus–Smith condition). Second, the co-movement of the real exchange rate with output is predicted to be positive and strong in the case of full risk sharing. Third, the volatility of the real exchange rate relative to income volatility in the data is much higher than that predicted by open economy models. Last, international investment correlations of each country relative to the world (where x^* indicate the world equivalent) should be tightly correlated, according to open economy theory.

Table 1 summarizes the key moments from the two sub-samples of the time-series data. Panel A provides the statistics using the G7 block to represent the foreign country. Panel B takes the U.S. as the foreign country. The empirical evidence indicates that, in contrast to AEs, EMEs exhibit the following properties. 1) The Backus–Smith statistic is strongly negative. 2) Real exchange rates are countercyclical. 3) Real exchange rate volatility relative to income volatility is lower than in AEs. 4) International investment correlations are uncorrelated.

Furthermore, the empirical evidence presented here more widely establishes other four previously documented facts associated with consumption risk. 5) International consumption correlations are low and often negative in EMEs (mean correlation of

[3] When calculating the international statistics of each G7 country, I replace the particular G7 country with a trade-weighted aggregate of the six remaining G7 countries plus China. As documented in Appendix A (Tables 7A–8B), the empirical findings remain robust even if I change the representative AE, that is, the results are consistent when the foreign block is represented by i) the U.S., and ii) a trade-weighted aggregate of each country's main trading partners.

[4] See Appendix A for the list of countries and country groups. Because a larger and longer data sample is available, annual frequency is used to calculate the statistics. The empirical findings are robust at quarterly frequency using a smaller and shorter sample available for EMEs. Additional statistics are available upon request from the author. When HP filtering, I use a smoothing parameter of $\lambda = 100$ at annual frequency as in Backus et al. (1993). Furthermore, the findings are qualitatively robust to an alternative HP smoothing parameter ($\lambda = 6.25$).

−0.08), while they are strong and positive in AEs (mean correlation of 0.53). 6) Counter-cyclical trade balance ratios are stronger in EMEs (correlation of −0.45) than in AEs (correlation of −0.31). 7) There is a more volatile trade balance ratio in EMEs (with a mean of 2.74) than in AEs (with mean of 0.96). 8) There is excess volatility of consumption relative to income in EMEs (with mean relative volatility of 1.15). To place these facts in perspective, in the standard IRBC model, consumption risk sharing is associated with positive international consumption co-movements between countries (counter to fact (5)), at least one pro-cyclical trade balance ratio (counter to fact (6)), and similar volatility of trade balance between countries (counter to fact (7)). Finally, as implied by the permanent income hypothesis, the lower the volatility of consumption relative to the volatility of income, the more households are insured against consumption risk (counter to fact (8)).

Overall, the empirical evidence of this study is consistent with the notion that international consumption risk sharing is lower in EMEs than in AEs.[5]

3 Methodology

3.1 Model

The theoretical model extends the two-country, two-good, open economy general equilibrium framework of BKK (1993) with transitory and trend growth shocks to productivity, in which there is one AE and one EME under a structure of incomplete markets.

The model represents a simplified (one-sector) version of the two-sector (tradables, non-tradables) incomplete-market open economy models of Corsetti et al. 2008 (henceforth CDL 2008) and Benigno and Thoenissen 2008. Notably, in our model, the law of one price holds and there is only a tradable sector.

The world economy is composed of a large (advanced) open economy (A) and a small (emerging) open economy (E). Hence, there may be spillover effects from A to E, but not in the opposite direction. Asset trade is limited to a single, non-contingent, internationally exchanged bond that is issued by country A.

[5]The statistics are robust under alternative filtering techniques, such as first difference and band-pass filtering.

3.1.1 Production

Each country $i = \{E, A\}$ produces tradable *intermediate* goods using the following technology.

$$Y_{i,t} = e^{z_{i,t}}(K_{i,t})^{\alpha}(Z_{i,t} \cdot L_{i,t})^{1-\alpha} \tag{1}$$

The transitory component of productivity follows an AR(1): $z_{i,t} = \rho_i z_{i,t-1} + \epsilon_{i,t}$, with $\epsilon_{i,t} \sim N(0, \sigma_i^2)$. In addition, each country i's production has labor-augmenting technology that follows a unit root process

$$\ln(Z_{i,t}) = \ln(G_{i,t}) + \ln(Z_{i,t-1}) \quad \text{with } G_{i,t} = e^{g_t^i}.$$

Both countries are subject to stochastic shocks to trend growth. The shock g_t^i follows an AR(1) process with a deterministic drift

$$g_t^i = (1\text{-}\rho_g^i)\mu_g + \rho_g^i g_{t-1}^i + \epsilon_{i,t}^g \text{ with } \epsilon_{i,t}^g \sim N(0, \sigma_{i,g}^2).$$

I stationarize equation (1) along the balanced growth path using detrended variables $\hat{V}_{i,t}^j = \frac{V_t^j}{Z_{i,t-1}^j}$ to obtain[6]

$$\hat{Y}_{i,t} = e^{z_{i,t}}(\hat{K}_{i,t})^{\alpha}(e^{g_{i,t}}L_{i,t})^{1-\alpha}$$

Final producers in each of the economies are competitive. They purchase home (h) and foreign (f) tradable goods at prices $\{P_{hi,t},\ P_{fj,t}\}$ where $i, j = \{A, E\}$ and $i \neq j$.

The final goods basket in each economy combines both intermediate goods to produce country-specific non-tradable final consumption and investment goods

$$\hat{O}_{i,t} = \left[a_{hi}^{\frac{1}{\omega}}\hat{C}_{hi,t}^{\frac{\omega-1}{\omega}} + a_{fj}^{\frac{1}{\omega}}\hat{C}_{fj,t}^{\frac{\omega-1}{\omega}}\right]^{\frac{\omega}{\omega-1}}. \tag{2}$$

where $\hat{O}_{i,t} = \hat{C}_{i,t} + \hat{I}_{i,t}$.

The parameter $\omega > 0$ captures the (constant) trade elasticity of substitution. The parameter $a_{hi} \in (0, 1)$ is the share of country i's domestic good in the consumption basket. Similarly, $a_{fj} = 1 - a_{hi}$ denotes the relative share of foreign goods consumed by country i. Following the literature, I assume home bias ($a_{hi} > 1/2$). Heterogeneity in openness between countries is determined by $a_{hi} \neq a_{hj}$. As in Heathcote and Perri 2013, GDP ($\hat{Y}_{i,t}^c$) is measured using intermediate output ($\hat{Y}_{i,t}$) in units of country i's final consumption-investment good $\hat{Y}_{i,t}^c = \frac{P_{hi,t}}{P_{i,t}}\hat{Y}_{i,t}$. Hence, the national income identity is given by $\hat{NX}_{i,t} = \hat{Y}_{i,t}^c - \hat{O}_{i,t}$.

[6]For simplicity of exposition, in what follows, I use stationarized versions of all the equations.

3.1.2 Households

The representative household in country $i = \{E, A\}$ chooses a composite bundle of consumption $C_{i,t}$ and labor $L_{i,t}$ to maximize the expected stream of lifetime utility. The household's problem is

$$\max_{\hat{C}_{i,t}, L_{i,t}} E_t \sum_{t=0}^{\infty} \beta e^{g_t^i \mu(1-\gamma)} U(\hat{C}_{i,t}, L_{i,t}).$$

Period utility is given by $U(\hat{C}_{i,t}, L_{i,t}) = \frac{[\hat{C}_{i,t}^{\mu}(1-L_{i,t})^{1-\mu}]^{1-\gamma}}{1-\gamma}$ where $0 < \mu < 1$ is the consumption share, and $\gamma > 0$ is the risk aversion parameter.

3.1.3 Prices and demand functions

The price index of the domestic final good in each economy $i = \{E, A\}$ is given by

$$P_{i,t} = \left[a_{hi} P_{hi,t}^{1-\omega} + a_{fj} P_{fj,t}^{1-\omega}\right]^{\frac{1}{1-\omega}}, \tag{3}$$

where $i, j = \{A, E\}$ and $i \neq j$.

Given price indexes, quantities, and elasticities, the demand functions for each country i are

1) demand for domestic goods:

$$\hat{C}_{hi,t} = a_{hi} \left(\frac{P_{hi,t}}{P_{i,t}}\right)^{-\omega} \hat{O}_{i,t},$$

2) demand for foreign goods:

$$\hat{C}_{hj,t} = a_{fj} \left(\frac{P_{fj,t}}{P_{i,t}}\right)^{-\omega} \hat{O}_{i,t}.$$

3.1.4 Aggregate resource constraint and capital accumulation

The aggregate resource constraint of country i is given by

$$P_{i,t}\hat{C}_{i,t} + P_{i,t}\hat{I}_{i,t} + P_{hi,t}\hat{B}_{i,t} \leq P_{hi,t}\hat{Y}_{i,t} + e^{g_t^i} P_{hi,t} Q_{hi,t} \hat{B}_{i,t+1}, \tag{4}$$

where $\hat{C}_{i,t}$ is final consumption, $\hat{I}_{i,t}$ is aggregate investment, $\hat{Y}_{i,t}$ is aggregate intermediate output, and $Q_{h,t}$ is the price of debt $B_{i,t}$ at which country i borrows and lends in international financial markets.

To close the incomplete markets model, we assume interest elastic debt following Schmitt-Grohe and Uribe 2003. The price of debt is given by $Q_{hi,t}^{-1} = 1 + r_t^* +$

$\psi(e^{[\hat{B}_{i,t+1}-\bar{B}]}-1)$, where $\psi=0.001$ captures the sensitivity of the world interest rate r_t^* to debt changes.

Last, each of the economies' capital accumulation follows a standard law of motion

$$e^{g_t^i}\hat{K}_{i,t+1}=\hat{I}_{i,t}+(1-\delta)\hat{K}_{i,t}. \tag{5}$$

3.1.5 Competitive Equilibrium

The competitive equilibrium of the model is obtained by solving the decentralized economy problem for each country $i,j=\{E,A\}$, $i\neq j$. The representative household's problem is

$$\max_{\hat{C}_{i,t},L_t} E_t\sum_{t=0}^{\infty}\beta e^{g_t^i\mu(1-\gamma)}U(\hat{C}_{i,t},L_{i,t})$$

subject to the aggregate resource constraint *(4)*, capital accumulation *(5)*, and the technology shock matrix $\Lambda_t=\Omega\Lambda_{t-1}+\epsilon_t$.

Given the state of the world $s=\{\hat{B}_{i,t},\hat{K}_{i,t};\Lambda_t\}$, the recursive general equilibrium is defined as

i) a set of household and production decision rules

$$\left\{\hat{C}_{i,t}(s),\hat{K}_{i,t+1}(s),L_{i,t}(s),\hat{B}_{i,t+1}\right\},$$

ii) a set of price functions

$$\{P_{i,t},Q_{hi,t}(s)\},$$

such that given prices (ii) and technology *(1)*, the allocations (i) solve the household and production problems; and

iii) the goods market clears

$$\hat{Y}_{i,t}=\hat{C}_{hi,t}+\hat{C}_{fj,t},$$

iv) the bond market clears

$$\hat{B}_{i,t}+\hat{B}_{j,t}=0.$$

The dynamic equilibrium holds in all states, given the realizations of aggregate shocks at time t.

3.2 Calibration

This section describes the calibration of the benchmark model in which one country is a (small) EME (E) and the other is a (large) AE (A). A period in the model is a year. As in AG2007, I choose México as the representative EME. To close the calibration setup, I use the U.S. as the representative (large) AE.

Table 2 summarizes the parameter values of the model. One set of parameters is assumed to be common to both countries, while another set of parameters is idiosyncratic. The common parameters are as follows. The capital shares are $\alpha = 0.32$; the annual depreciation rate is $\delta = 0.10$; the discount factor is $\beta = 0.92$, implying a quarterly real interest rate of 2%; the trade elasticity of substitution is set to $\omega = 1.5$, a standard value used in the literature; the home bias parameter is $a_h = 0.75$, implying an import ratio of 25%; and the sensitivity of interest rates to debt is set to a low value of $\psi = 0.001$.

The preference parameters are as follows. The risk aversion parameter is $\gamma = 2$; the consumption exponent is $\mu = 0.36$, implying that the long-run fraction of time devoted to labor is one-third.

The technology matrix Λ_t is given by

$$\Lambda_t = \begin{bmatrix} \lambda_t^E \\ \lambda_t^A \end{bmatrix} = \begin{bmatrix} 1 & 1 & \rho_g^{A,E} & \rho_z^{A,E} \\ 0 & 0 & 1 & 1 \end{bmatrix} \begin{bmatrix} \ln Z_t^E \\ z_t^E \\ \ln Z_t^A \\ z_t^A \end{bmatrix}$$

where z_t^i denotes the temporary component of productivity, and $\ln Z_t^i$ is the permanent component of productivity in each country $i = \{A, E\}$.

The calibration strategy for productivity processes draws on Chen and Crucini 2016. First, I calibrate the temporary and permanent productivity processes of the (large) AE (A) from the closed economy specification of the model (i.e., the case in which home bias $a_h = 1$). Specifically, I set the deterministic growth rate to that implied by the annual growth rate of the Solow residual in the U.S. data at $\mu_g = 1.008$ during the sample period. Next, I pick the temporary persistence of productivity at $\rho_z^A = 0.75$, temporary TFP volatility at $\sigma_z^A = 0.02$, and permanent TFP volatility at $\sigma_g^A = 0.06$ to match the correlation of the trade balance ratio with output, output volatility, and consumption volatility in the data, respectively. Last, for tractability, I set the permanent persistence of productivity at $\rho_g^A = 0.13$ to correspond to the annual estimate for this parameter by Amdur and Kiziler 2014.

Second, I calibrate country E parameters from the open economy specification of the (benchmark) model. To ensure a balanced growth path in both countries, I set a common deterministic trend component at $\mu_g = 1.008$ as in country A. The persistence of transitory productivity in country E is set to $\rho^z = 0.75$ as in country A.[7] Next, I calibrate the idiosyncratic parameters of country E for the case of México. I simulate the model iteratively to set five parameters $\left\{\sigma_z^E, \sigma_g^E, \rho_g^E, \rho_z^{A,E}, \rho_g^{A,E}\right\}$, that is, the standard deviations of the temporary and permanent components of productivity, the persistence of the permanent component of productivity, and temporary and permanent spillovers. The matched moments are output volatility, consumption volatility, correlation of the trade balance with output, international output correlation, and correlation of the interest rate with output, respectively. Finally, Heathcote and Perri 2002 finds that innovations between countries tend to be correlated. Therefore, I empirically estimate the correlation of innovations to account for common components in productivity. I do this by HP-filtering the cyclical and trend components of the Solow residual (henceforth, SR) in the data, and setting the correlations of innovations of temporary and permanent components of productivity to the annual estimates $\epsilon_z = -0.17$ and $\epsilon_g = 0.48$, respectively.

The calibration exercise implies that country E has higher volatility of temporary TFP at $\sigma_z^E = 0.07$ than country A has, lower volatility of permanent TFP at $\sigma_g^E = 0.03$, and higher persistence in the permanent component of TFP at $\rho_g^E = .04$. Last, consistent with the notion of one country representing a (small) EME, I allow for one-way spillovers from the U.S. to México; I set the transitory component to $\rho_z^{A,E} = -0.5$ and the permanent component to $\rho_g^{A,E} = -0.9$ to match the international output correlation between these two countries at 0.1, as in the data.

3.3 Mechanism: Shocks to Trend Growth

Given the calibrated model, the trend shock mechanism works as follows. In response to an expected rise in the growth rate of productivity, firms in the EME respond by sharply increasing investment spending, becoming net borrowers in international markets. The surge in firms' demand for both domestic and foreign intermediate goods also leads to an appreciation of the real exchange rate, which—added to the relative increase in consumption spending due to higher productivity—leads to a negative co-movement between consumption growth and real exchange rate movements, and hence, lower risk sharing.[8]

[7] As argued by Chen and Crucini 2016, I use symmetry with respect to transitory persistence for two reasons: one is tractability and parsimony in calibration, the other is that the implied high persistence is close to the equivalent annual estimate for México in Aguiar and Gopinath 2007.

[8] A more detailed discussion of the shocks to trend mechanism is available in the technical appendix.

Sensitivity to the relative importance of shocks to trend growth. Figures B1 to B3 in Appendix B examine the sensitivity of key cyclical properties of the model to the volatility of the permanent component of productivity shocks relative to the transitory component ($\frac{\sigma_g}{\sigma_z}$).

Figure B1 shows that when the relative volatility of trend shocks is about 1.25, both co-movements of the real exchange rate (rer) with relative consumption and the rer with income switch signs are from positive to negative. Importantly, the co-movements become monotonically more negative as the volatility of the permanent component of productivity increases. Furthermore, the trade balance ratio becomes highly volatile when the economy is more prone to shocks to trend. Last, the trade balance ratio becomes monotonically more counter-cyclical as the permanent component of productivity becomes more important than the transitory one.

Figure B2 shows that when $\frac{\sigma_g}{\sigma_z}$ is greater than 1.6, international consumption correlations become lower than international output correlations, which is consistent with the data. Furthermore, these co-movements can even become negative for sufficiently large values of the relative volatility of permanent productivity shocks.

Figure B3 shows that as the relative volatility of the permanent component of productivity shocks increases, the response of consumption relative to income increases monotonically.

Overall, the simulations suggest there is a crucial role to be played by trend shocks in explaining the distinct risk sharing and international co-movement features observed in EMEs.

4 Results and Discussion

In this section, first, I present and discuss the quantitative implications of shocks to trend growth. Next, I examine alternative mechanisms of international risk sharing.

The benchmark model calibration corresponds to the case of México *vis-à-vis* the U.S. In addition, I discuss the implications of trend shocks for the case of Canada *vis-à-vis* the U.S, where Canada is the representative (small) AE.

For the case of México, I examine three model specifications: i) transitory shocks and one-way spillover (NTS); ii) transitory and trend shocks without spillover effects (TS); and iii) the benchmark specification, which combines TS with one-way spillover *effects* and correlations of innovations (BM). Table 3 summarizes the results.

In terms of the volatilities of the trade balance and the real exchange rate, all the specifications are broadly consistent with the excess relative volatilities in EMEs. I note that in terms of relative volatilities, the main quantitative effect of trend shocks (TS) is to increase the relative volatility of quantities. In particular, the calibrated larger volatility of the trend component of productivity in México is associated with excessive volatility of the trade balance ratio. Conversely, the relative volatility of investment underestimates the data, and investment is more sensitive to changes in the interest rate (R), which does not fluctuate much in this type of model with free capital mobility. Importantly, adding one-way spillover effects (temporary and permanent) accounts for the excessive relative consumption volatility in country (E), as well as the excessive relative volatility of investment in country (A).

Next, I examine international co-movements and note that in this dimension, shocks to trend growth play a crucial role. In particular, specifications TS and BM show that trend shocks go a long way to matching key patterns of international correlations (signs and rankings). First, the Backus–Smith correlation turns strong and negative, and the real exchange rate turns strongly counter-cyclical. Furthermore, in the specifications with trend shocks, international consumption correlations are lower than international output correlations, which is consistent with the data but at odds with the prediction of the standard IRBC model (the "quantity puzzle"). I also find that trend shocks are associated with more negative international investment correlations. Finally, the model is consistent with the stylized facts of counter-cyclical interest rates in EMEs and strongly counter-cyclical trade balances in EMEs *vis-à-vis* AEs.[9] By contrast, the NTS specification with one-way (temporary) spillover shows important counter-factual implications. Notably, the quantity puzzle reappears. Furthermore, with transitory shocks, the risk-sharing channel is positive, as indicated by the strong and positive Backus–Smith statistic, and the real exchange rate becomes pro-cyclical. Last, the trade balance in country (A) becomes counter-factually pro-cyclical.

The results above indicate that shocks to trend growth play a crucial role in explaining the cyclical properties of risk sharing and international business cycles in EMEs.

Next, in Table 4 I examine the quantitative implications of shocks to trend growth in matching the international business cycle properties of Canada as a representative (small) AE, hereafter denoted as country C.

I follow the calibration strategy discussed in the previous section and pick the temporary and permanent TFP shock parameters to match key moments in the data. For simplicity, I assume symmetry in the persistence of the permanent component of productivity across AEs, that is, $\rho_g^C = \rho_g^A$. Next, I pick $\left\{\sigma_z^C, \sigma_g^C, \rho_z^{A,C}, \rho_g^{A,C}\right\}$ to match output volatility, consumption volatility, international consumption correlations, and the correlation of the trade balance with output in Canada. Hence, for

[9]Note that the ranking applies for the representative EME and AE, not for the specific case studied here.

the specification with trend shocks (TS), I set $\sigma_z^C = 0.05$, $\sigma_g^C = 0.05$, $\rho_z^{A,C} = 0.1$, and $\rho_g^{A,C} = 0$, respectively. In addition, the correlations of innovations for the temporary and permanent components of TFP are set to the estimates from the HP-filtered cyclical and trend components in the data, namely, $\epsilon_z^{A,C} = -0.1$ and $\epsilon_g^{A,C} = 0.8$, respectively. Finally, I evaluate an alternative specification with transitory shocks and inelastic trade (LE), in which I set the trade elasticity to $\omega = 0.6$.

The quantitative results suggest that although both the TS and the LE specifications imply a low and negative BS statistic, the LE specification delivers stronger positive international correlations of output, consumption, and investment, as observed in AEs. Furthermore, the LE specification implies a highly volatile relative exchange rate. However, the excess volatility comes at the expense of weaker relative volatility of consumption in both countries and a strongly pro-cyclical trade balance ratio in the country C relative to the TS specification. In summary, the results for the case of AEs suggest that both the inelastic trade channel and the trend shock hypothesis show advantages and disadvantages when trying to explain international business cycles.

Overall, the findings from the benchmark model lend credence to the validity of the *"cycle is the trend"* hypothesis. In other words, shocks to trend productivity provide a compelling explanation for the apparent lower degree of risk sharing in EMEs.

4.1 Alternative mechanisms

To further examine the validity of the *"cycle is the trend"* hypothesis for EMEs, I consider two alternative mechanisms associated with international risk sharing: inelastic trade and asymmetric trade shares.[10]

Corsetti et al. 2008 argue that inelastic trade between foreign and domestic goods is the likely explanation for the lack of risk sharing observed in AEs. Imposing inelastic trade on the benchmark model results in a negative Backus–Smith statistic as well as a counter-cyclical exchange rate, which is consistent with the data. However, inelastic trade comes at the expense of other counter-factual predictions, such as a higher volatility of consumption in the AE than in the EME, and a larger drop in the volatility of the trade balance ratio in the EME.

I also examine the role of asymmetric trade in risk sharing. In other words, to what extent does more openness in the EME impact risk sharing? The benchmark

[10]The alternative mechanisms examined are related to structural parameters of the standard IRBC model. The robustness of the alternative mechanisms analyzed in this study is presented in detail in the technical appendix.

model predicts that the effect of the trade share asymmetry is to move the international co-movements of prices and quantities in the EME marginally closer to the data, suggesting that the more open the EME, the lower the scope for risk sharing.[11]

More importantly, I find that although inelastic trade, trade share asymmetries, and trend shocks take the model closer to the data in terms of lower risk sharing, shocks to trend growth provide a more convincing explanation for risk sharing and international business cycles in EMEs.

5 Conclusion

A widely expected benefit of global trade and financial integration is improved sharing of macroeconomic risk across countries. Puzzlingly, this prediction is not borne out by the data. Most of the literature that seeks to explain the apparent lack of international risk sharing is focused on the perspective of AEs. However, much less is known about this critical issue from the perspective of EMEs.

This study examines risk sharing in EMEs and makes two contributions. On the empirical side, I document several international statistics that are consistent with the notion of a lower degree of risk sharing in EMEs than in AEs.

On the theoretical side, I explain the observed lack of international risk sharing by investigating the validity of the *"cycle is the trend"* hypothesis (Aguiar and Gopinath, 2007) within an otherwise standard international business cycle framework. The model calibration is disciplined by the data and the simulation results ascribe a prominent role to the stochastic trend component of productivity in EMEs. I also analyze two alternative mechanisms of international risk sharing, namely, 1) low trade elasticity and 2) asymmetric trade shares. My findings suggest that among the different mechanisms, stochastic shocks to trend growth provide a more compelling explanation for the lower degree of international risk sharing observed in EMEs than in AEs.

As EMEs rely heavily on international capital flows, a better understanding of the interplay between shocks to trend productivity growth and other distinct features of EMEs (e.g., volatile and counter-cyclical country-risk premium and sovereign default) is critical to guide the implementation of effective stabilization policy in these countries. This topic is proposed for future research.

[11] A theoretical discussion of the impact of asymmetric trade on risk sharing is available in the technical appendix.

References

Agenor, P., McDermott, C., and Prasad, E. (2000). Macroeconomic fluctuations in developing countries: Some stylized facts. *The World Bank Economic Review*, 14(2):251–285.

Aguiar, M. and Gopinath, G. (2007). Emerging market business cycles: The cycle is the trend. *Journal of Political Economy*, 115(1).

Akkoyun, H. C., Arslan, Y., and Kilinc, M. (2017). Risk sharing and real exchange rate: The role of non-tradable sector and trend shocks. *Journal of International Money and Finance*, 73(A):232–248.

Amdur, D. and Kiziler, E. E. (2014). Trend shocks and the countercyclical us current account. *Canadian Journal of Economics*, 47(2):494–516.

Backus, D., Kehoe, P., and Kydland, F. (1993). International business cycles: Theory and evidence. *National Bureau of Economic Research*, Working Papers(w4493).

Backus, D. and Smith, G. (1993). Consumption and real exchange rates in dynamic economies with non-traded goods. *Journal of International Economics*, 35(3-4):297–316.

Baxter, M. (2012). International risk sharing in the short run and in the long run. *Canadian Journal of Economics*, 45(2):376–393.

Benigno, G. and Thoenissen, C. (2008). Consumption and real exchange rates with incomplete markets and non-tradable goods. *Journal of International Money and Finance*, 27:926–948.

Chen, K. and Crucini, M. (2016). Trends and cycles in small open economies: making the case for a general equilibrium approach. *Journal of Economic Dynamics and Control*, 72:179–168.

Cole, H. and Obstfeld, M. (1991). Commodity trade and international risk sharing: How much do financial markets matter? *Journal of Monetary Economics*, 28(1):3–24.

Corsetti, G., Dedola, L., and Leduc, S. (2008). International risk sharing and the transmission of productivity shocks. *Review of Economic Studies*, 75(2):443–473.

Heathcote, J. and Perri, F. (2002). Financial autarky and international business cycles. *Journal of Monetary Economics*, 3(49):601–627.

Heathcote, J. and Perri, F. (2013). Assessing international efficiency. *Handbook of International Economics*, 4(Ch. 9):523–584.

Kose, M. and Prasad, E. (2010). *Emerging markets*. Brookings Institution Press, Washington, D.C.

Kose, M., Prasad, E., and Terrones, M. (2003). How does globalization affect the synchronization of business cycles? *American Economic Review Papers and Proceedings*, 93(2):57–62.

Kose, M., Prasad, E., and Terrones, M. (2007). *How does financial globalization affect risk sharing? Patterns and channels*. IMF. Working paper No: 07/238.

Kose, M., Prasad, E., and Terrones, M. (2009). Does financial globalization promote risk sharing? *Journal of Development Economics*, 89:258–270.

Obstfeld, M. and Rogoff, K. (1996). *Foundations of international macroeconomics*. The MIT Press, Cambridge, MA.

Rabanal, P., F., R.-R. J., and Tuesta, V. (2011). Cointegrated tfp processes and international business cycles. *Journal of Monetary Economics*, 58(2):156–171.

Schmitt-Grohe, S. and Uribe, M. (2003). Closing small open economy models. *Journal of International Economics*, 61:163–185.

Uribe, M. and Schmitt-Grohé, S. (2017). *Open economy macroeconomics*. Princeton University Press.

A Tables

	$\rho(rer, \frac{c}{c^*})$	$\rho(\frac{nx}{y}, y)$	$\rho(c, c^*)$	$\rho(i, i^*)$	$\rho(rer, y)$	$\frac{\sigma_c}{\sigma_y}$	$\frac{\sigma_{rer}}{\sigma_y}$	$\sigma_{\frac{nx}{y}}$
Emerging Economies (n=21)								
mean	-0.46	-0.45	-0.08	0.03	-0.39	1.15	3.38	2.74
median	-0.48	-0.48	-0.02	0.04	-0.41	1.13	2.74	2.12
s.e.	(0.22)	(0.32)	(0.28)	(0.23)	(0.24)	(0.31)	(1.92)	(1.76)
Advanced Economies (n=21)								
mean	-0.08	-0.31	0.53	0.58	-0.06	0.93	3.72	0.96
median	-0.05	-0.39	0.56	0.64	0.04	0.94	3.60	0.96
s.e.	(0.31)	(0.33)	(0.23)	(0.23)	(0.26)	(0.20)	(1.28)	(0.35)
Panel A								
Emerging Economies (n=21)								
mean	-0.45	-0.45	-0.10	-0.14	-0.50	1.21	3.60	2.74
median	-0.40	-0.48	-0.10	-0.13	-0.48	1.24	3.34	2.12
s.e.	(0.25)	(0.32)	(0.26)	(0.21)	(0.21)	(0.30)	(1.92)	(1.76)
Advanced Economies (n=20)								
mean	-0.33	-0.31	0.38	0.35	-0.14	0.95	5.49	0.96
median	-0.32	-0.39	0.40	0.38	-0.09	0.96	5.56	0.96
s.e.	(0.22)	(0.33)	(0.29)	(0.25)	(0.21)	(0.20)	(1.88)	(0.35)
Panel B								

Table 1. Within and across-country statistics (1980–2014). Statistics are measured from the cyclical component of the HP-filtered series at annual frequency with smoothing parameter 100. Standard errors are in brackets. Panel A: Foreign country and the real exchange rate are trade-weighted aggregates of G7 countries (Canada, France, Germany, Italy, Japan, the U.K., and U.S.). Panel B: Foreign country is the U.S.[12] Data sources: Quantities from WDI. Prices from IFS.

[12] Advanced economies that belong to the G7 are excluded from their own foreign country aggregate. Thus, for each G7 country, the trade-weighted aggregate is calculated based on G6+China.

Preferences and technology		
Risk aversion	γ	2.00
Consumption share	μ	0.36
Discount factor	β	0.92
Capital share	α	0.32
Elasticity of substitution	ω	1.50
Share of Home-traded goods	a_h	0.75
Depreciation rate	δ	0.10
Elasticity of discount factor	ψ	0.00
Productivity processes		
Persistence (TFP temp.)	ρ^z	0.75
Spillover (TFP temp.)	$\rho_z^{A,E}$	-0.50
Spillover (TFP perm.)	$\rho_g^{A,E}$	-0.90
Persistence (E) (TFP perm.)	ρ_g^E	0.04
Persistence (A) (TFP perm.)	ρ_g^A	0.13
Deterministic trend	μ_g	1.01
Standard deviation (E), (TFP temp.)	σ_z^E	0.07
Standard deviation (A), (TFP temp.)	σ_z^A	0.02
Standard deviation (E), (TFP perm.)	σ_g^E	0.03
Standard deviation (A), (TFP perm.)	σ_g^A	0.06
Correlation of innovations (SR, temp.)	ϵ_z	-0.17
Correlation of innovations (SR, perm.)	ϵ_g	0.48

Table 2. Parameter values

	Data	*NTS*	*TS*	*BM*
Standard deviations				
$\sigma_{C_{MEX}}/\sigma_{Y_{MEX}}$	1.4	0.4	0.6	1.4
$\sigma_{C_{US}}/\sigma_{Y_{US}}$	0.9	0.4	0.8	0.8
$\sigma_{I_{MEX}}/\sigma_{Y_{MEX}}$	3.7	1.0	1.6	0.9
$\sigma_{I_{US}}/\sigma_{Y_{US}}$	2.8	0.8	1.1	3.0
$\sigma_{TBY_{MEX}}$	2.2	1.4	5.6	6.7
$\sigma_{RER_{MEX}}/\sigma_{Y_{MEX}}$	4.4	1.8	2.7	1.6
International correlations				
$\rho(RER_{MEX}, \frac{C_{MEX}}{C_{US}})$	-0.6	0.8	-0.7	-0.8
$\rho(RER_{MEX}, Y_{MEX})$	-0.6	0.4	-0.4	-0.5
$\rho(R^*, Y_{MEX})$	-0.4	-0.4	-0.7	-0.4
$\rho(Y_{MEX}, Y_{US})$	0.1	0.1	-0.1	0.1
$\rho(C_{MEX}, C_{US})$	-0.1	0.5	-0.2	-0.6
$\rho(I_{MEX}, I_{US})$	0.0	-0.5	-0.9	-0.9
$\rho(TBY_{MEX}, Y_{MEX})$	-0.5	-0.2	-0.7	-0.6
$\rho(TBY_{US}, Y_{US})$	-0.6	0.2	-0.4	-0.4

Table 3. Quantitative results: México *vis-à-vis* U.S.

NTS: Model with transitory shocks and spillover, TS: Model with shocks to trend and no spillovers, BM: Model with shocks to trend and spillovers. Statistics are measured from the cyclical component of the HP-filtered series at annual frequency.

	Data	*NTS*	*TS*	*LE*
Standard deviations				
$\sigma_{Y_{CAD}}$	2.5	2.5	2.5	2.1
$\sigma_{Y_{US}}$	2.0	2.0	2.3	2.0
$\sigma_{C_{CAD}}/\sigma_{Y_{CAD}}$	0.8	0.4	0.6	0.4
$\sigma_{C_{US}}/\sigma_{Y_{US}}$	0.9	0.4	0.7	0.5
$\sigma_{I_{CAD}}/\sigma_{Y_{CAD}}$	2.4	0.9	0.7	0.5
$\sigma_{I_{US}}/\sigma_{Y_{US}}$	2.8	0.6	0.8	0.6
$\sigma_{TBY_{CAD}}$	1.1	2.8	3.2	0.7
$\sigma_{RER_{CAD}}/\sigma_{Y_{CAD}}$	2.3	1.5	1.2	3.0
International correlations				
$\rho(RER_{CAD}, \frac{C_{CAD}}{C_{US}})$	-0.2	0.8	-0.1	-0.0
$\rho(RER_{CAD}, Y_{CAD})$	0.1	0.2	0.5	-0.8
$\rho(Y_{CAD}, Y_{US})$	0.9	0.6	0.6	0.9
$\rho(C_{CAD}, C_{US})$	0.8	0.8	0.7	1.0
$\rho(I_{CAD}, I_{US})$	0.6	0.0	-0.5	0.8
$\rho(TBY_{CAD}, Y_{CAD})$	0.0	-0.3	0.1	0.7
$\rho(TBY_{US}, Y_{US})$	-0.6	0.4	-0.5	-0.6

Table 4. Quantitative results: Canada *vis-à-vis* U.S.

NTS: Model without shocks to trend, TS: Model with shocks to trend, LE: Model with low trade elasticity. Statistics are measured from the cyclical component of the HP-filtered series at annual frequency.

A Tables

Moment	$\rho(\frac{c}{c^{G7}}, rer)$	$\rho(y, y^{G7})$	$\rho(c, c^{G7})$	$\rho(i, i^{G7})$	$\rho(rer, y)$
Argentina	-0.72	-0.21	-0.34	0.00	-0.66
Brazil	-0.49	0.25	-0.64	0.10	-0.39
Chile	-0.73	0.24	0.06	0.36	-0.54
China P.R.	-0.36	-0.17	-0.24	-0.52	-0.12
Colombia	-0.64	0.08	-0.25	-0.24	-0.29
Egypt	-0.07	-0.18	-0.05	-0.08	-0.46
India	-0.49	0.21	-0.02	0.28	-0.47
Indonesia	-0.41	-0.25	-0.75	-0.10	-0.59
Israel	-0.48	0.06	-0.02	-0.21	-0.41
Jordan	-0.56	-0.28	0.04	0.04	-0.63
Korea (Rep)	-0.70	0.36	0.08	0.16	-0.63
Malaysia	-0.68	-0.18	-0.30	-0.20	-0.66
Mexico	-0.76	0.21	-0.01	0.40	-0.68
Morocco	-0.22	0.28	0.08	0.38	-0.16
Pakistan	-0.21	0.23	0.02	-0.02	0.10
Peru	-0.31	-0.14	-0.16	-0.18	-0.31
Philippines	-0.17	0.17	0.35	0.06	-0.04
South Africa	-0.33	0.46	0.13	0.15	-0.06
Thailand	-0.74	-0.02	-0.11	0.04	-0.66
Turkey	-0.28	0.35	0.45	-0.03	-0.36
Venezuela	-0.24	0.11	0.01	0.13	-0.10
Mean	**-0.46**	**0.07**	**-0.08**	**0.03**	**-0.39**
Median	**-0.48**	**0.11**	**-0.02**	**0.04**	**-0.41**
Std. Dev.	0.22	0.23	0.28	0.23	0.24

Table 5A. Emerging market economies: Across-country moments (1980–2014) of price and quantity growth rates. Time series are HP-filtered at annual frequencies. Foreign country and the real exchange rate are trade-weighted aggregates of *G7* countries (Canada, France, Germany, Italy, Japan, UK, US). Data sources: Quantity data at market prices from WDI. Price data from IFS (GDP deflator data used for Argentina, Israel, Pakistan, and Turkey). Trade weights are averages of G7-country specific share of trade relative to G7 aggregate over the sample period.

Moment	$\rho(\frac{c}{c^{G6+}}, rer)$	$\rho(y, y^{G6+})$	$\rho(c, c^{G6+})$	$\rho(i, i^{G6+})$	$\rho(rer, y)$
Australia	-0.31	0.59	0.36	0.34	0.13
Austria	0.19	0.70	0.28	0.76	0.07
Belgium	0.16	0.84	0.48	0.82	-0.17
Canada	0.10	0.67	0.78	0.75	0.10
Denmark	-0.05	0.50	0.13	0.51	0.15
Finland	-0.53	0.76	0.68	0.59	-0.40
France	0.22	0.78	0.67	0.80	0.05
Germany	-0.14	0.46	0.28	0.48	0.05
Greece	-0.48	0.41	0.31	0.30	-0.26
Ireland	-0.06	0.68	0.82	0.60	0.02
Italy	-0.29	0.86	0.63	0.66	-0.36
Japan	0.16	0.60	0.31	0.75	0.43
Netherlands	0.34	0.67	0.56	0.64	0.04
New Zealand	-0.55	0.22	0.56	0.06	-0.24
Norway	0.17	0.24	0.17	0.15	0.17
Portugal	-0.46	0.54	0.37	0.42	-0.35
Spain	-0.59	0.77	0.80	0.81	-0.52
Sweden	-0.21	0.82	0.82	0.77	-0.18
Switzerland	0.20	0.81	0.82	0.86	0.24
The U.K.	0.31	0.73	0.66	0.39	-0.43
U.S.	0.17	0.68	0.70	0.69	0.27
Mean	**-0.08**	**0.63**	**0.53**	**0.58**	**-0.06**
Median	**-0.05**	**0.68**	**0.56**	**0.64**	**0.04**
Std. Dev.	0.31	0.18	0.23	0.23	0.26

Table 5B. Advanced market economies: Across-country moments (1980–2014) of price and quantity growth rates. Time series are HP-filtered at annual frequencies. Foreign country and the real exchange rate are trade-weighted aggregates of *G7* countries (excluding own country, if a G7 member, in which case, the trade-weighted aggregates are calculated for *G6+China*). Data sources: Quantity data at market prices from WDI. Price data from IFS (GDP deflator data used for the U.K). Trade weights are averages of G7-country specific share of trade relative to G7 aggregate over the sample period.

Moment	$\rho(\frac{nx}{y}, y)$	$\frac{\sigma_c}{\sigma_y}$	$\frac{\sigma_i}{\sigma_y}$	$\sigma_{\frac{nx}{y}}$	$\frac{\sigma_{rer}}{\sigma_y}$
Argentina	-0.93	1.12	2.89	2.95	3.24
Brazil	-0.47	1.24	2.67	1.67	5.62
Chile	-0.73	1.28	3.28	2.41	2.43
China P.R.	-0.26	0.92	2.74	2.12	2.34
Colombia	-0.65	1.10	5.55	1.76	4.99
Egypt	-0.07	0.70	5.57	2.40	9.66
India	-0.36	0.92	3.01	1.25	3.19
Indonesia	-0.33	1.43	2.68	3.29	3.32
Israel	-0.17	1.65	4.66	1.20	2.91
Jordan	0.19	1.44	2.80	8.46	1.64
Korea (Rep)	-0.72	1.53	3.25	1.84	3.73
Malaysia	-0.84	1.51	4.43	4.52	2.12
Mexico	-0.48	1.45	3.66	2.00	5.17
Morocco	0.18	1.03	2.13	1.61	2.14
Pakistan	-0.20	1.41	3.03	2.17	2.46
Peru	-0.53	1.05	2.51	2.25	1.49
Philippines	-0.38	0.53	3.88	2.12	2.39
South Africa	-0.66	1.24	3.78	1.47	5.41
Thailand	-0.84	1.00	3.50	5.12	1.45
Turkey	-0.67	1.66	3.77	1.64	2.74
Venezuela	-0.51	1.12	3.10	5.20	2.47
Mean	**-0.45**	**1.21**	**3.47**	**2.74**	**3.38**
Median	**-0.48**	**1.24**	**3.25**	**2.12**	**2.74**
Std. Dev.	0.32	0.30	0.93	1.76	1.92

Table 6A. Emerging market economies: Within-country moments and real exchange rate volatility (1980–2014). Time series are HP-filtered at annual frequencies. The real exchange rate is a trade-weighted aggregate of *G7* countries. Data sources: Quantity data at market prices from WDI. Price data from IFS. The base year is 2005.

Moment	$\rho(\frac{nx}{y}, y)$	$\frac{\sigma_c}{\sigma_y}$	$\frac{\sigma_i}{\sigma_y}$	$\sigma_{\frac{nx}{y}}$	$\frac{\sigma_{rer}}{\sigma_y}$
Australia	-0.29	0.86	3.42	0.84	5.31
Austria	0.35	0.79	2.57	0.59	5.22
Belgium	-0.36	0.70	4.52	0.69	5.75
Canada	0.10	0.79	2.38	0.96	2.37
Denmark	-0.61	1.21	3.99	0.96	3.55
Finland	-0.36	0.88	2.61	1.07	2.08
France	-0.41	0.89	3.14	0.49	5.16
Germany	0.20	0.73	2.33	0.68	5.17
Greece	-0.66	1.03	2.73	1.11	1.69
Ireland	-0.23	0.93	2.83	1.98	1.51
Italy	-0.44	1.17	2.97	1.00	4.52
Japan	-0.16	0.63	2.72	0.69	5.27
Netherlands	-0.45	1.04	3.05	0.56	3.60
New Zealand	-0.47	1.03	3.48	1.09	3.60
Norway	-0.58	1.25	3.78	1.14	2.63
Portugal	-0.63	1.00	2.89	1.25	2.59
Spain	-0.85	1.21	3.46	1.43	3.68
Sweden	-0.15	1.00	3.06	0.84	3.09
Switzerland	0.28	0.58	2.30	1.22	3.57
The U.K.	-0.59	1.19	2.44	0.67	4.03
U.S.	-0.57	0.93	3.00	0.58	3.80
Mean	**-0.33**	**0.94**	**3.03**	**0.95**	**3.72**
Median	**-0.41**	**0.93**	**2.97**	**0.96**	**3.60**
Std. Dev.	0.33	0.20	0.58	0.35	1.28

Table 6B. Advanced market economies: Within-country moments and real exchange rate volatility (1980–2014). Time series are HP-filtered at annual frequencies. The real exchange rate is a trade-weighted aggregate of *G7* countries (excluding own country, if member of G7. In which case, the trade-weighted aggregates are calculated for *G6+China*). Data sources: Quantity data at market prices from WDI. Price data from IFS. The base year is 2005.

Moment	$\rho(\frac{c}{c^{US}}, rer)$	$\rho(y, y^{US})$	$\rho(c, c^{US})$	$\rho(i, i^{US})$	$\rho(rer, y)$
Argentina	-0.73	-0.06	-0.26	0.05	-0.67
Brazil	-0.44	0.34	-0.32	-0.01	-0.47
Chile	-0.77	0.16	-0.28	-0.05	-0.69
China P.R.	-0.22	0.12	0.20	0.06	-0.17
Colombia	-0.68	-0.02	-0.38	-0.20	-0.58
Egypt	0.20	-0.08	-0.14	0.23	-0.37
India	-0.17	0.23	-0.03	0.01	-0.63
Indonesia	-0.32	-0.40	-0.50	-0.45	-0.69
Israel	-0.48	0.03	-0.07	-0.45	-0.48
Jordan	-0.36	0.08	0.48	-0.19	-0.66
Korea (Rep)	-0.62	0.09	-0.20	-0.37	-0.73
Malaysia	-0.72	-0.32	-0.47	-0.40	-0.76
Mexico	-0.76	0.12	-0.08	-0.01	-0.65
Morocco	-0.37	0.11	-0.10	-0.25	-0.25
Pakistan	-0.23	0.14	0.25	-0.13	-0.39
Peru	-0.37	0.10	-0.01	-0.15	-0.27
Philippines	-0.34	-0.17	-0.10	-0.37	-0.25
South Africa	-0.40	0.35	0.11	0.02	-0.15
Thailand	-0.83	-0.30	-0.42	-0.39	-0.87
Turkey	-0.53	0.36	0.24	0.18	-0.47
Venezuela	-0.34	-0.01	-0.12	-0.08	-0.29
Mean	**-0.45**	**0.04**	**-0.10**	**-0.14**	**-0.50**
Median	**-0.40**	**0.09**	**-0.10**	**-0.13**	**-0.48**
Std. Dev.	0.25	0.21	0.26	0.21	0.21

Table 7A. Emerging market economies: Across-country moments (1980–2014) of price and quantity growth rates. Time series are HP-filtered at annual frequencies. Foreign country is the U.S. Data sources: Quantity data at market prices from WDI. Price data from IFS.

Moment	$\rho(\frac{c}{c^{US}}, rer)$	$\rho(y, y^{US})$	$\rho(c, c^{US})$	$\rho(i, i^{US})$	$\rho(rer, y)$
Australia	-0.40	0.63	0.29	0.35	-0.02
Austria	-0.07	0.36	-0.01	0.16	-0.08
Belgium	-0.15	0.55	-0.01	0.14	-0.30
Canada	-0.34	0.92	0.77	0.59	0.07
Denmark	-0.25	0.68	0.46	0.73	0.12
Finland	-0.56	0.71	0.63	0.45	-0.31
France	-0.15	0.47	0.38	0.17	-0.08
Germany	-0.30	0.26	0.06	0.06	-0.09
Greece	-0.50	0.35	0.14	0.03	-0.33
Ireland	-0.25	0.58	0.63	0.56	-0.02
Italy	-0.40	0.60	0.36	0.15	-0.41
Japan	-0.09	0.36	-0.02	0.28	0.15
Netherlands	0.00	0.53	0.41	0.40	-0.09
New Zealand	-0.67	0.55	0.71	0.61	-0.07
Norway	0.03	0.59	0.57	0.55	0.13
Portugal	-0.49	0.14	-0.14	-0.23	-0.43
Spain	-0.65	0.46	0.39	0.24	-0.51
Sweden	-0.44	0.81	0.66	0.55	-0.17
Switzerland	-0.23	0.63	0.56	0.50	0.01
The U.K.	-0.62	0.82	0.82	0.69	-0.44
Mean	**-0.33**	**0.55**	**0.38**	**0.35**	**-0.14**
Median	**-0.32**	**0.57**	**0.40**	**0.38**	**-0.09**
Std. Dev.	0.22	0.19	0.29	0.25	0.21

Table 7B. Advanced market economies: Across-country moments (1980–2014) of price and quantity growth rates. Time series are HP-filtered at annual frequencies. Foreign country is the US. Data sources: Quantity data at market prices from WDI. Price data from IFS.

Moment	$\rho(\frac{c}{c*}, rer)$	$\rho(y, y*)$	$\rho(c, c*)$	$\rho(i, i*)$	$\rho(rer, y)$
Argentina	-0.26	0.01	-0.04	0.20	-0.42
Brazil	0.31	0.41	-0.25	0.24	0.05
Chile	-0.60	0.38	0.02	0.36	-0.54
China P.R.	-0.12	-0.08	-0.20	-0.39	-0.05
Colombia	-0.59	0.02	-0.36	0.79	-0.49
Egypt	-0.09	-0.05	-0.02	0.20	-0.50
India	-0.25	0.31	-0.05	0.46	-0.28
Indonesia	-0.34	0.10	-0.56	0.17	-0.72
Israel	-0.74	0.03	0.37	0.12	-0.38
Jordan	-0.48	-0.18	0.18	-0.15	-0.55
Korea (Rep)	-0.58	0.39	0.07	0.07	-0.71
Malaysia	-0.70	-0.04	-0.22	-0.18	-0.74
Mexico	-0.66	0.13	-0.06	0.05	-0.38
Morocco	-0.10	0.27	0.03	0.66	0.01
Pakistan	-0.55	0.27	0.16	-0.03	-0.43
Peru	0.22	0.04	-0.02	-0.13	0.38
Philippines	-0.37	0.04	0.09	-0.17	-0.31
South Africa	-0.29	0.50	0.06	0.16	0.07
Thailand	-0.83	0.28	0.15	0.21	-0.87
Turkey	-0.41	0.26	-0.03	0.16	-0.26
Venezuela	-0.49	0.00	-0.21	0.13	-0.36
Mean	**-0.38**	**0.15**	**-0.04**	**0.14**	**-0.36**
Median	**-0.41**	**0.10**	**-0.02**	**0.16**	**-0.38**
Std. Dev.	0.30	0.19	0.21	0.28	0.31

Table 8A. Emerging market economies: Across-country moments (1980–2009) of price and quantity growth rates. Time series are HP-filtered at annual frequencies. Foreign country and real exchange rates are trade-weighted aggregates for each country's main trading partners within the sample (n=42). Data sources: Quantity data at market prices from WDI. Price data from IFS (GDP deflator data used for Argentina, Israel, Pakistan, and Turkey). Trade weights are averages over the sample period computed from UN Comtrade.

Moment	$\rho(\frac{c}{c*}, rer)$	$\rho(y, y*)$	$\rho(c, c*)$	$\rho(i, i*)$	$\rho(rer, y)$
Australia	-0.07	0.54	0.41	0.42	0.28
Austria	0.04	0.88	0.48	0.84	-0.17
Belgium	-0.34	0.95	0.76	0.84	0.21
Canada	0.10	0.90	0.78	0.69	0.06
Denmark	-0.03	0.67	0.18	0.64	0.43
Finland	-0.16	0.87	0.75	0.80	0.16
France	0.21	0.87	0.81	0.89	0.42
Germany	0.35	0.65	0.46	0.59	0.36
Greece	-0.01	0.76	0.54	0.68	0.14
Ireland	0.74	0.67	0.81	0.60	0.61
Italy	-0.33	0.93	0.90	0.82	0.10
Japan	0.01	0.32	0.01	0.11	0.15
Netherlands	0.22	0.83	0.73	0.76	0.35
New Zealand	-0.54	0.34	0.62	0.32	-0.23
Norway	0.15	0.37	0.30	0.33	0.52
Portugal	-0.25	0.76	0.64	0.61	0.16
Spain	-0.14	0.94	0.92	0.91	0.03
Sweden	0.14	0.85	0.69	0.72	0.32
Switzerland	0.25	0.86	0.86	0.83	0.49
The U.K.	0.47	0.77	0.78	0.67	-0.11
U.S.	-0.25	0.83	0.77	0.54	-0.09
Mean	**0.03**	**0.74**	**0.63**	**0.65**	**0.20**
Median	**0.01**	**0.83**	**0.73**	**0.68**	**0.16**
Std. Dev.	0.30	0.20	0.24	0.21	0.23

Table 8B. Advanced market economies: Across-country moments (1980–2009) of price and quantity growth rates. Time series are HP-filtered at annual frequencies. Foreign country and real exchange rates are trade-weighted aggregates for each country's main trading partners within the sample (n=42). Data sources: Quantity data at market prices from WDI. Price data from IFS (GDP deflator data used for the U.K.). Trade weights are averages over the sample period computed from UN Comtrade.

B Figures

Figure B1. Sensitivity of dynamic properties of real exchange rate and trade balance ratio

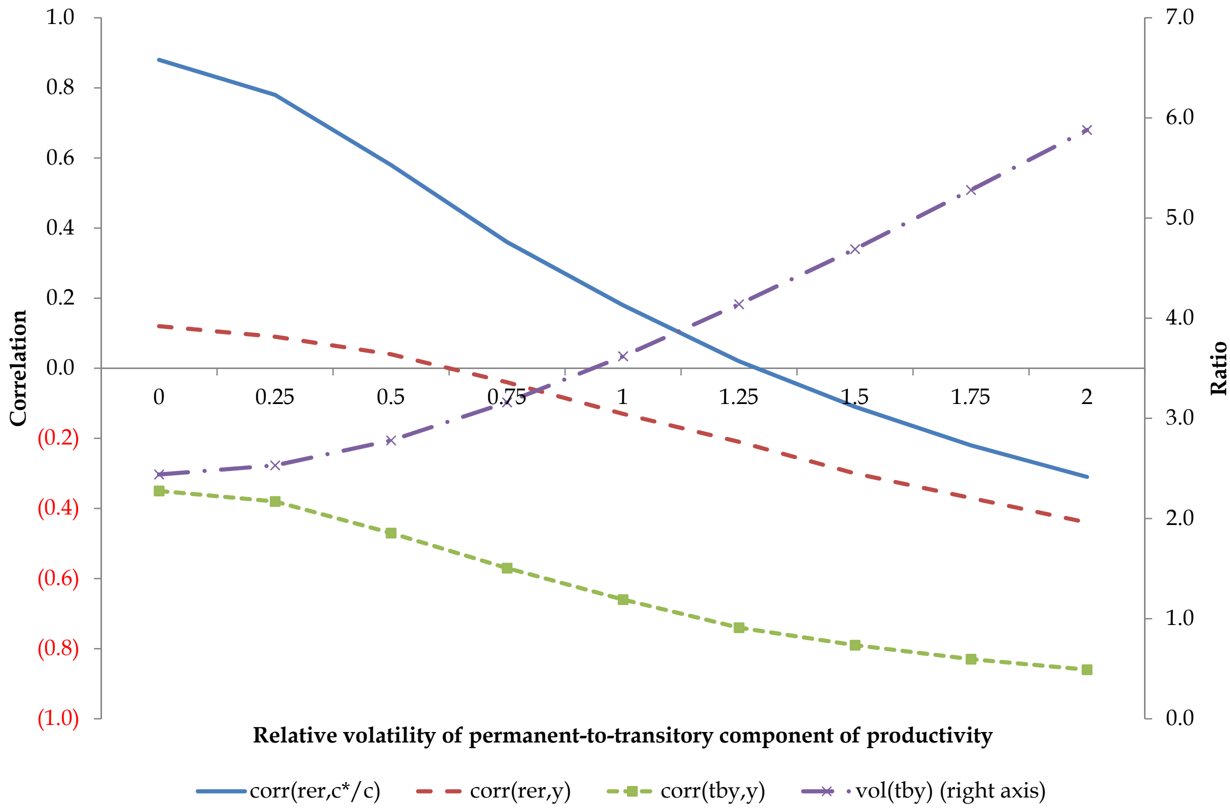


Figure B2. Sensitivity of international output and consumption co-movements

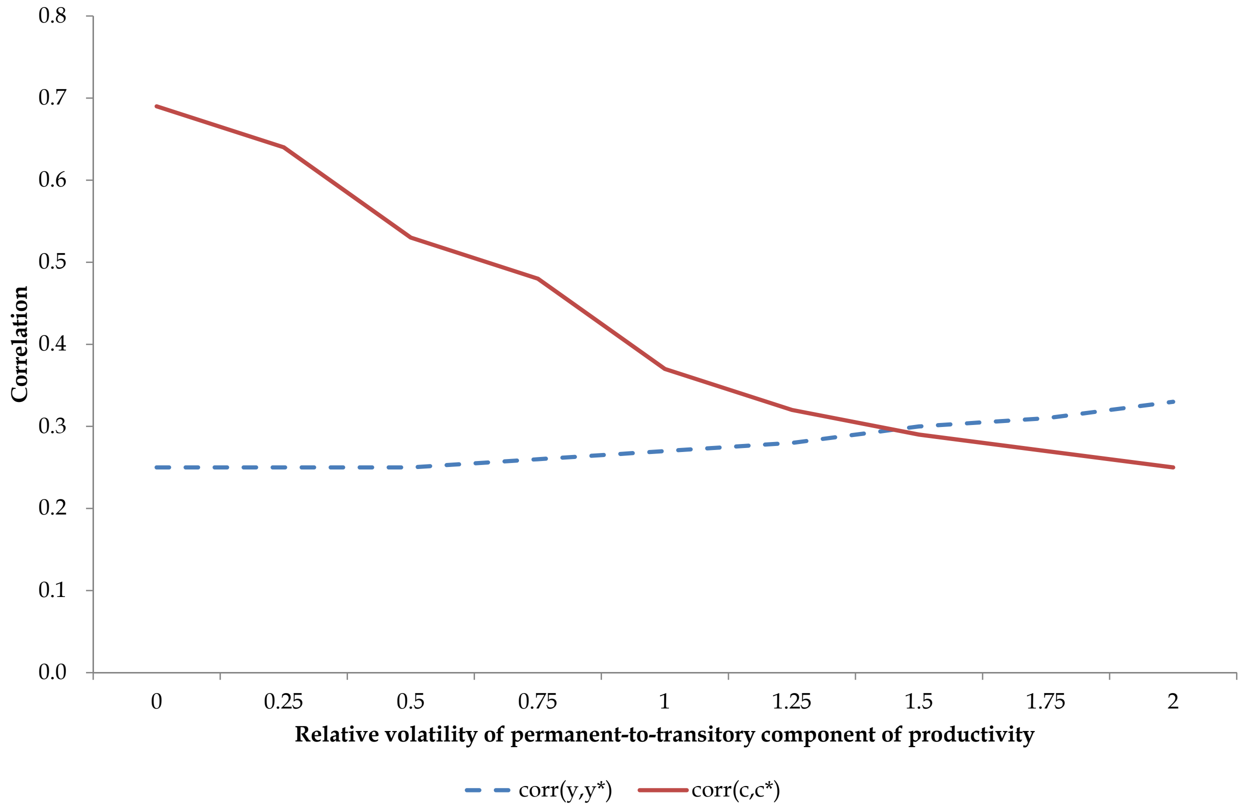
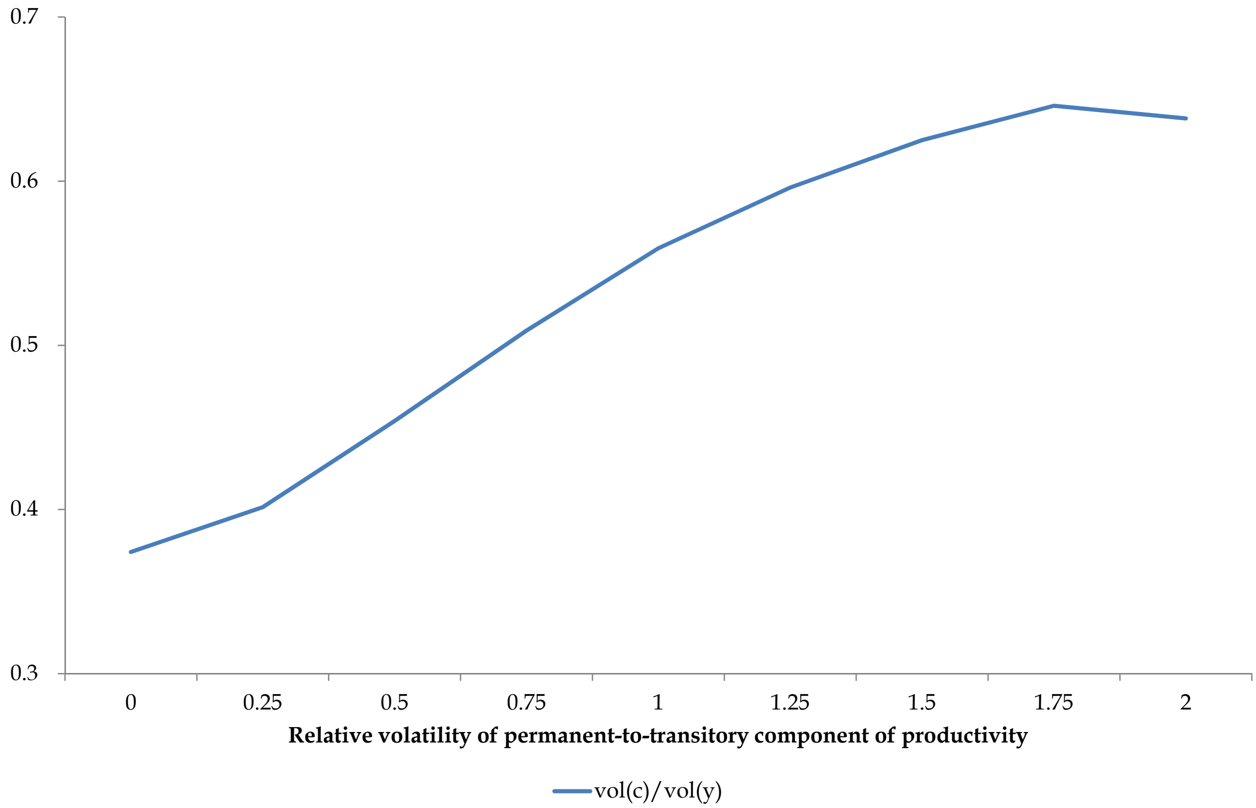


Figure B3. Sensitivity of volatility of consumption relative to income volatility



Data availability statement

The data used in this study are available from the corresponding author upon reasonable request.