The new macroeconomic quadrilemma – Mundell's trilemma in the era of financial instability

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Agenda

I. An review of Mundell trilemma, vintage 1960s.

II. Overview of Aizenman, Chinn & Ito [ACI] **extensions of the trilemma into the post Bretton Woods quadrilemma: the proliferation of in-between regimes, where financial stability has been added to the trilemma goals.**

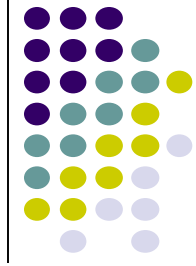
III. Notwithstanding Rey's 'Dilemma' conjecture, the generalized trilemma retains its validity into the 21st century.

Introduction

- **Lucas,** Macroeconomic priorities, AEA address, 2003
- 'Macroeconomics central problem of depression prevention has been solved, for all practical purposes.'
- Lucas (1987, Ch. III): the gains from macroeconomic stabilization are trivial [about 0.1 of 1 % of consumption].
- Overall, the profession took these results seriously in the 1990s and early 2000s – the alleged great moderation was credited by A. Greenspan for the 'smart macro policies' adopted by US and other OECD countries.
- Crises and Volatility were viewed as the problem of Emerging Market Economies [**Krugman:** 1997-8 East Asian Crisis as a reflection of "crony capitalism"].

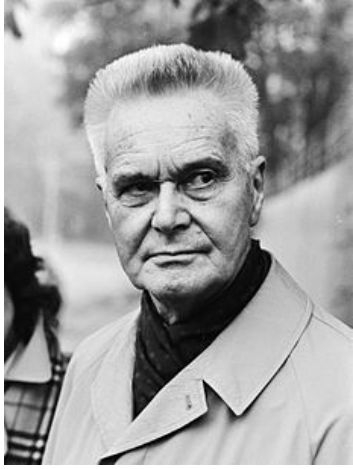
Well, if only… In a way, all of us are now in the same boat, trying to emerge from the Global Financial Crisis and the EZ crisis, events that illustrated vividly the 'too optimistic' take of leading economists on macroeconomics.

Key points



1. Framing the Trilemma as a binary choice of ‘corner options’ fitted well the Bretton Woods [BW] 1945-1970 regime, at times of limited financial openness and controlled financial stability.
2. Yet, the original Trilemma does not fit well the post BW world -- growing number of countries prefer ‘in-between’ regimes. Following crises, financial stability has been added to the original trilemma policies [financial integration, monetary independence, and exchange rate stability], and the Trilemma morphed into Quadrilemma.
3. We outline an extension of the Trilemma into the post BW system.
4. We tested and overall validated a version the ‘Modern Quadrilemma.’

Key points, cont.



Jan Tinbergen, a Dutch economist who shared the first Nobel Prize in Economics [in 1969] derived] the policy assignment result: The number of goals a policymaker can pursue can be no greater than the number of instruments the policymaker can control.

5. In line with *Tinbergen's result,* the added policy tools needed to control financial instability include swap lines [mostly for OECD countries], buffers like IR/GDP and SWF [mostly for Emerging Market Economics, EME], and Macro prudential regulation.
6. Notwithstanding Rey's *Dilemma, not Trilemma argument*, the extended Trilemma remains valid into the 21th century.

The economic Trilemma (aka the *impossible economic trinity*), vintage 1960s

- Among Mundell's seminal contributions in the 1960s was the derivation of the Trilemma in the context of an open economy extension of the IS-LM Neo-Keynesian model, AKA the Mundell-Fleming model.

The Trilemma states that market forces impose scarcity of policy instruments. A country may simultaneously choose any two, but not all of the following three policy goals –

1. monetary independence, MI

2. exchange rate stability, ERS

3. and financial integration, FI

The Global Finance and Monetary Regime after WWII followed the Bretton Woods 1944 agreement:

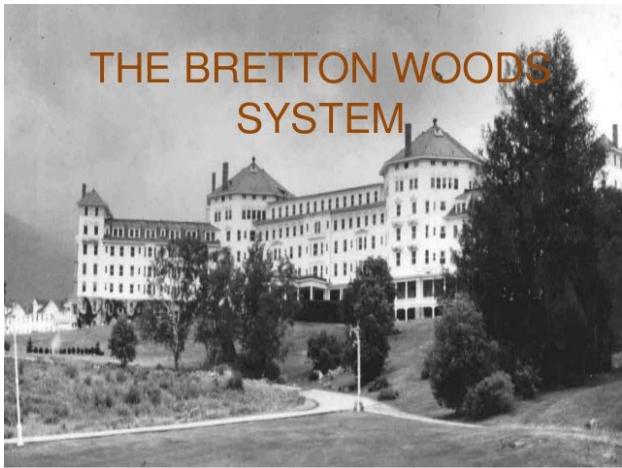
Financial regime:

Stringent capital controls prevent capital flows

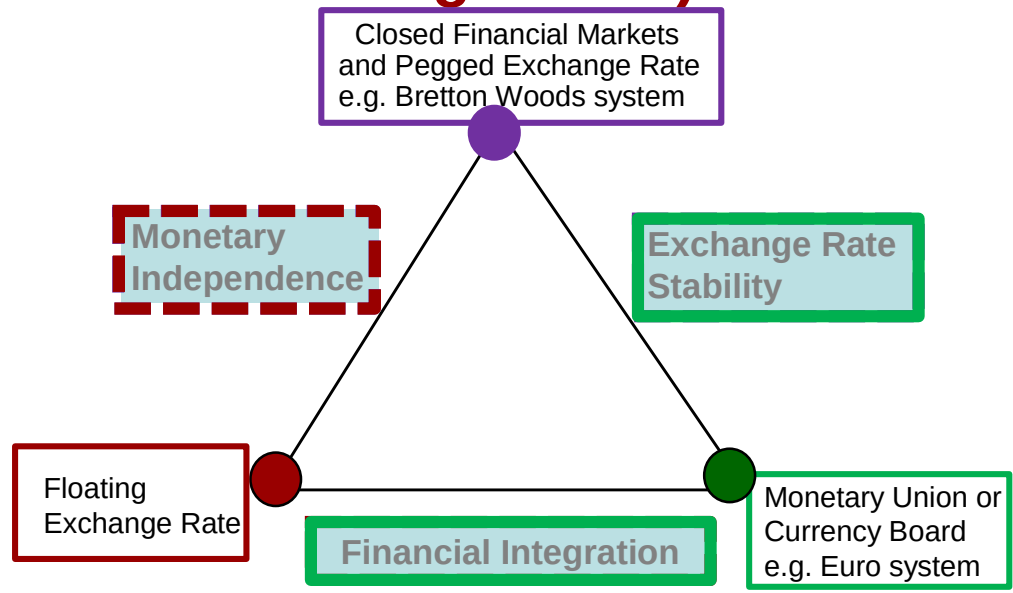
Exchange rate regime:

Fixed exchange rate, the US$ the global encore.

Under these circumstances, countries enjoyed monetary independence, as their bonds were not traded across borders.



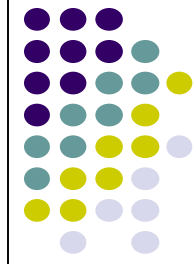
The Economic trilemma
(follows from the Mundell–Fleming model)



The trilemma was framed as a binary choice between 3 stark policy options: a country simultaneously may choose any two, but not all, of the following three:

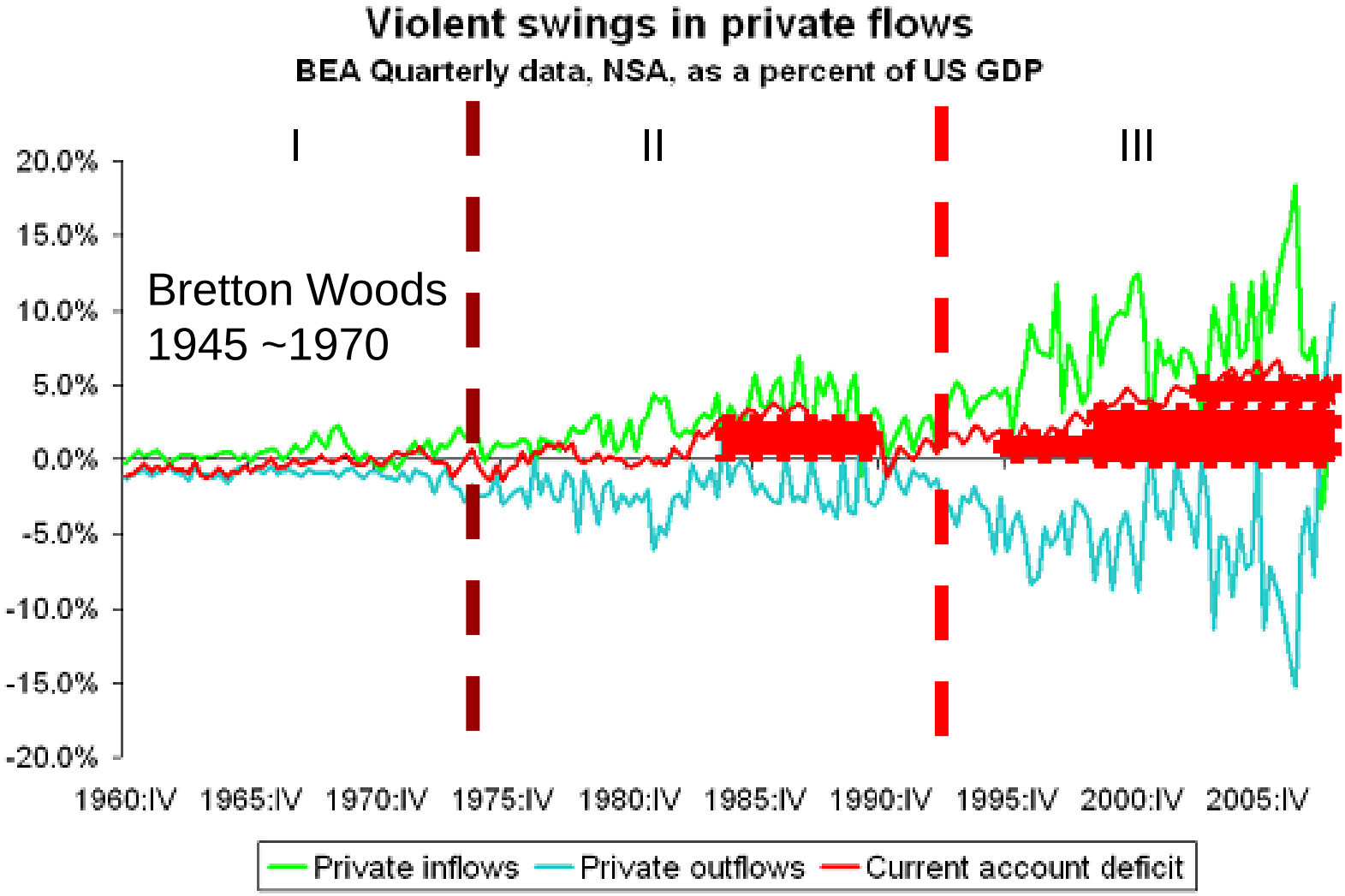
- Fixed exchange rate, providing exchange rate stability.
- Monetary autonomy, allowing setting domestic interest rates.
- Unrestricted financial integration with the global financial market.

Framing the Trilemma as a binary choice of 'corner options' fitted well the BW regime, and provided sharp predictions.



- Yet, following the collapse of the BW system in early 1970s, the OECD countries transitioned toward greater exchange rate flexibility, rapid financial integration, dismantling capital controls.
- The outcome: large increase in gross financial flows and exchange rate volatility, financial deepening and the proliferation of financial instruments aiming at hedging the exposure to greater exchange rate volatility.

Financial integration from 1970s
→ heightened exposure to financial volatility



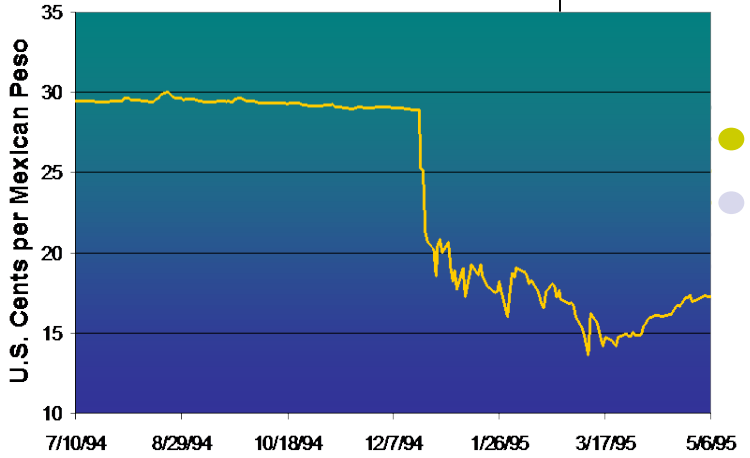
Meanwhile, Emerging Markets (EMEs)

- experimented in the early 1990s with greater financial openness, while maintaining exchange rate stability as a policy goal.
- An unintended consequence of the deeper financial integration was a string of sudden stops of inflows of capital, capital flights, and deleveraging crises.
- Depleted international reserves forced exchange rate depreciations, inducing countries towards the middle ground of the trilemma:

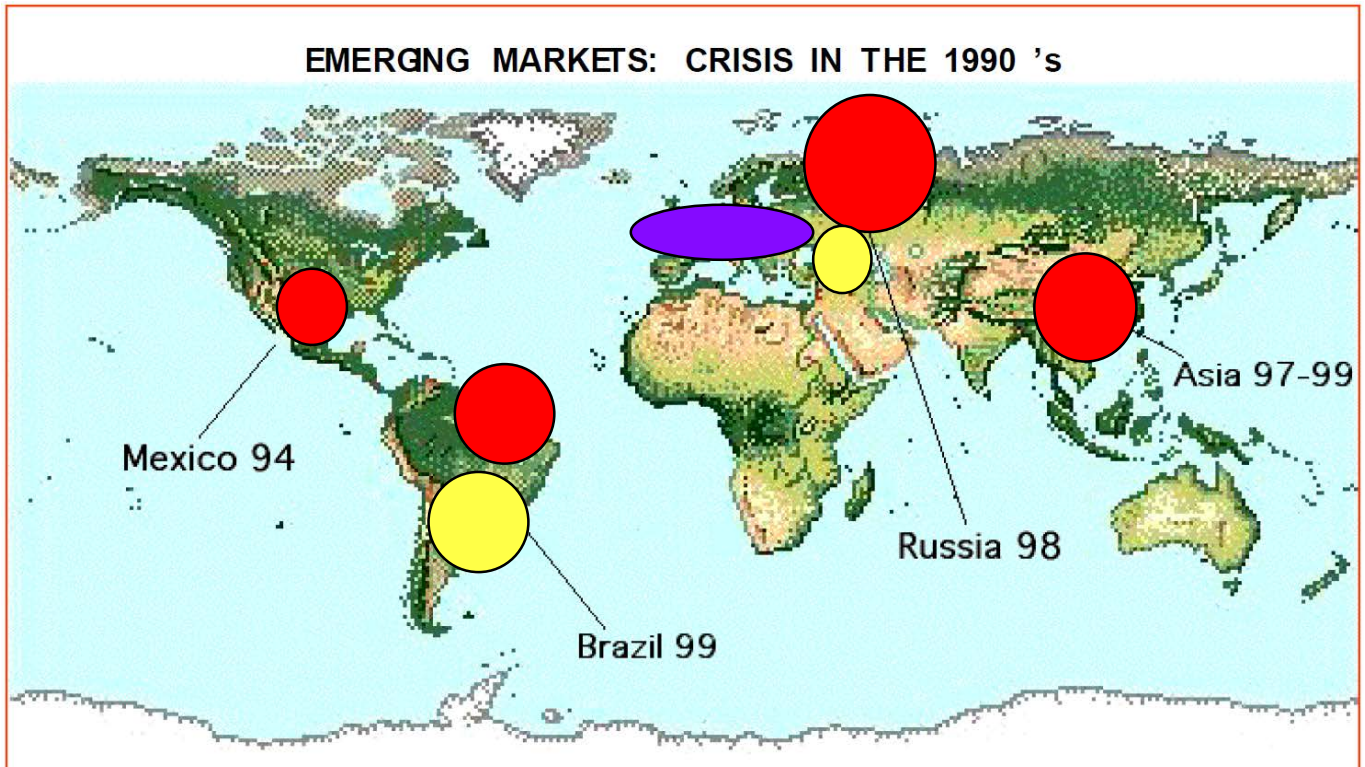
1. Managed exchange rate flexibility.
2. Controlled financial integration.
3. Limited monetary autonomy.

Emerging Markets' experience -- Financial liberalization in the 1990s, followed by deep crises.

Mexico (1994-95), Thailand and East Asia in 1997, Russia (1998), Brazil (1999), Argentina and Turkey (2000-01), etc.



The Mexican crisis, 1994-5



Following the collapse of the BW system, growing share of EMs and developing countries experimented with in-between regimes,

raising questions regarding the validity and the relevance of Mundell's binary choice Trilemma.

Fischer (1998, 2001) conjectured in the late 1990s that the bi-polar choices, i.e. the corners of the Trilemma triangles remain the stable and probably preferable attractors:

"I shall assume that countries will in the course of their development want to liberalize the capital account and integrate into global capital markets. This view is based in part on the fact that the most advanced economies all have open capital accounts; it is also based on the view that the potential benefits of integration into the global capital markets—including the benefits obtained by allowing foreign competition in the financial sector—outweigh the costs."

“even among the countries not listed as emerging, there has been a shift towards hard pegs on one side, and more flexible exchange rate regimes on the other.”

Exchange Rate Regimes: Is the Bipolar View Correct? – S. Fischer 1/6/2001 http://www.imf.org/external/np/speeches/2001/010601a.htm

Testing properly the Trilemma paradigm remains a challenge.

1. While by now some view the Trilemma as truism, most countries are not at the vertices of the Trilemma.
2. The Trilemma framework does not impose an exact functional restriction on the association between the three Trilemma policy variables with respect to configurations outside the three Trilemma vertices.
3. Measuring the degree of financial integration, exchange rate flexibility & monetary independence remains a challenge.
4. Capital mobility has often been difficult to operationalize and to measure in practice.

Obstfeld et al. (2004, 05, 08) sidesteps some of these difficulties by taking a historical perspective

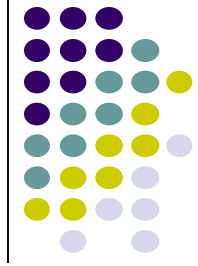
by evaluating the transmission of interest rate shocks in various regimes, and over time contrasting different regimes that were close to the three Trilemma vertices. Overall, the results are in line with the Trilemma prediction.

1. During fixed-exchange rate episodes (the gold standard period), a pronounced & rapid transmission of interest-rate shocks is found, in line with the prediction that fixed exchange rate with capital mobility, nullifies monetary independence.

2. In contrast, during the Bretton Woods era, fixed exchange rates did not provide much of a constraint on domestic interest rates, a by-product of widespread capital controls.

3. In the post-BW era, the reversion to the more globalized pattern is manifested through an increased interest-rate transmission among fixed-rate countries. Non-peg countries, have enjoyed considerably higher monetary independence than countries with pegs.

Against this background, in a string of papers Aizenman, Chinn and Ito (ACI) aimed at testing a generalized version of the Trilemma hypothesis



I. We constructed continuous measures of the trilemma, normalized between 0 and 1, the bi-polar ends of the original Trilemma.

II. We tested the continuous version of a linear trilemma, where the sum of the three trilemma variables adds up to a constant-- a rise in one trilemma variables is traded off by the drop in the sum of the other two.

III. We extended the Trilemma hypothesis adding concerns related to the growing exposure to financial and regime instability -- financial stability may be added as a 4^{th} policy dimension – the trilemma morphed into a quadrilemma.

See http://web.pdx.edu/~ito/trilemma_indexes.htm for these papers and the data

The Trilemma Indexes

Monetary Independence, MI, where *i* refers to home and *j* to the base country.

$$MI = 1 - \frac{corr(i_i, i_j) + 1}{2}$$

Exchange Rate Stability

$$\boldsymbol{ERS} = \frac{0.01}{0.01 + stdev(\Delta(\log(exch\_rate))}$$

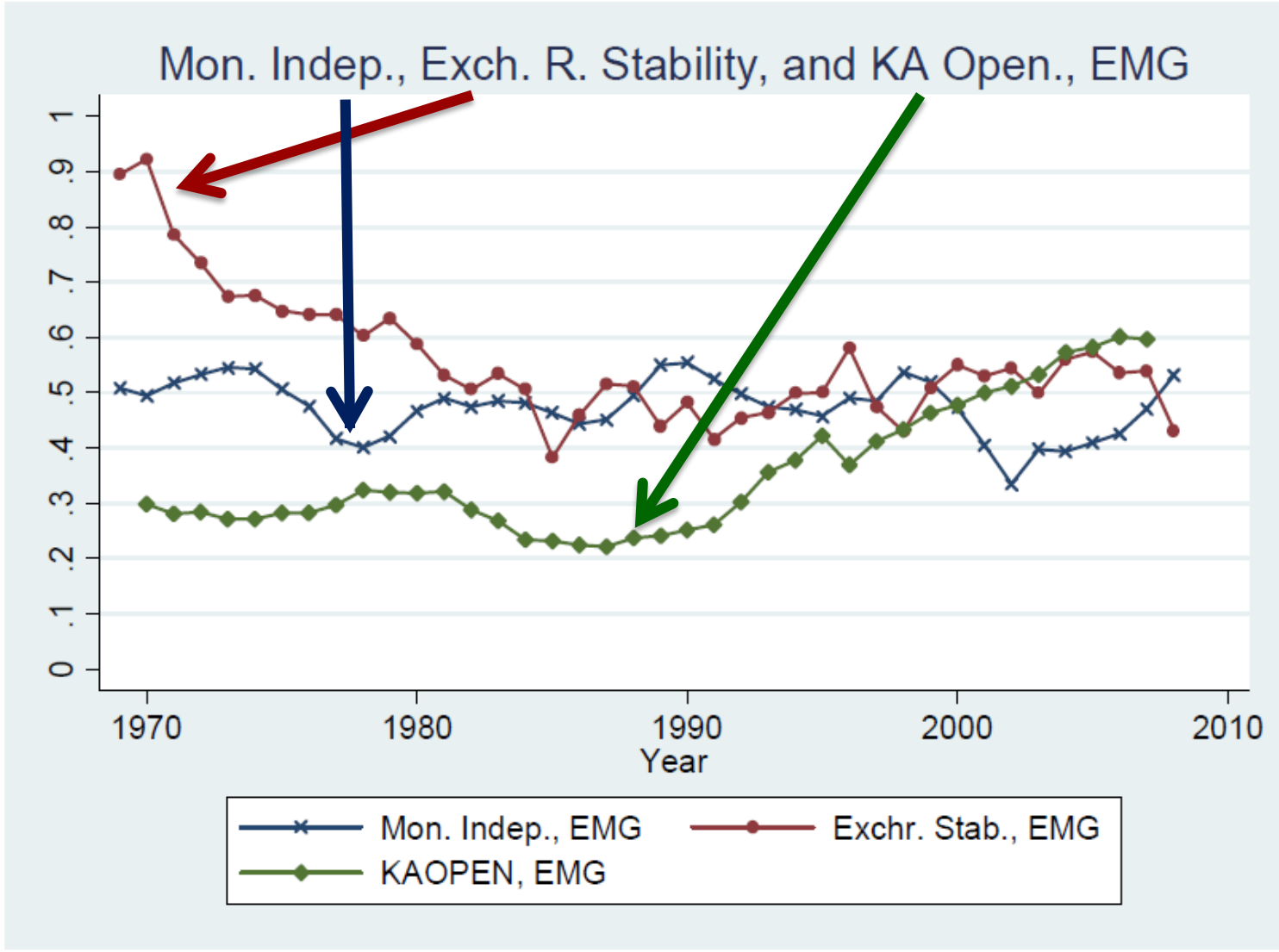
Financial Openness

KAOPEN = Chinn-Ito (2006) index of capital account openness, based on IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*

All three indexes are normalized b/w 0 and 1. For all indexes, higher values indicate higher extents of achievement in each of the three policy goals.

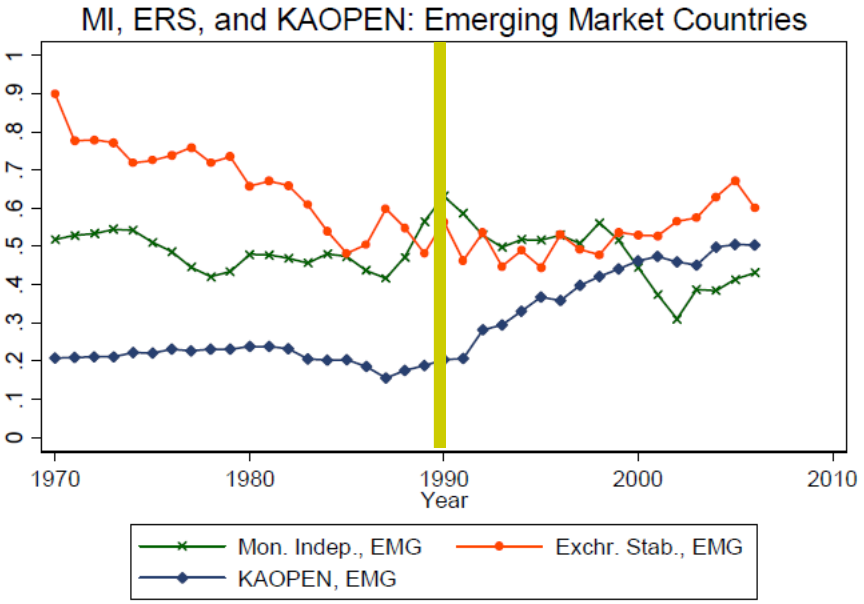
EMs Trilemma configurations

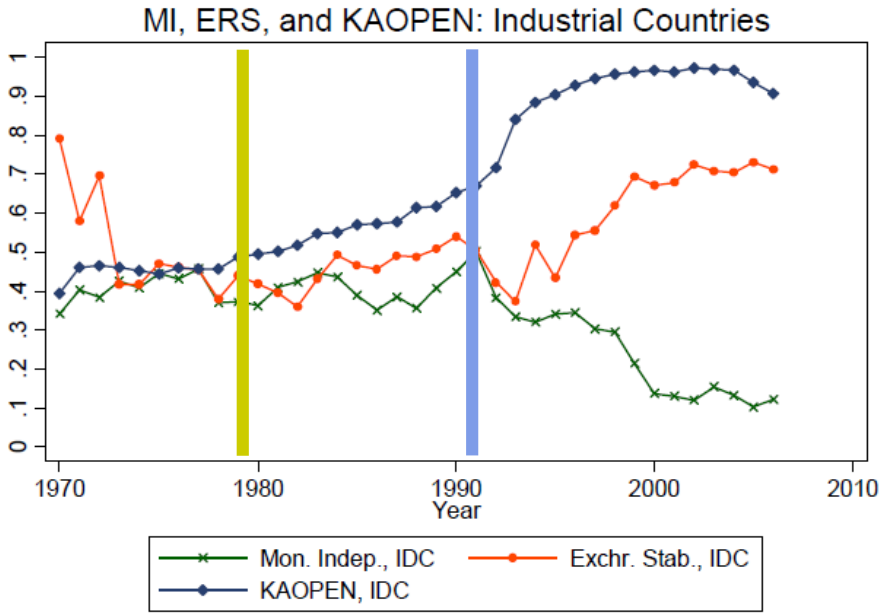
1970- 2010 Convergence to the middle ground

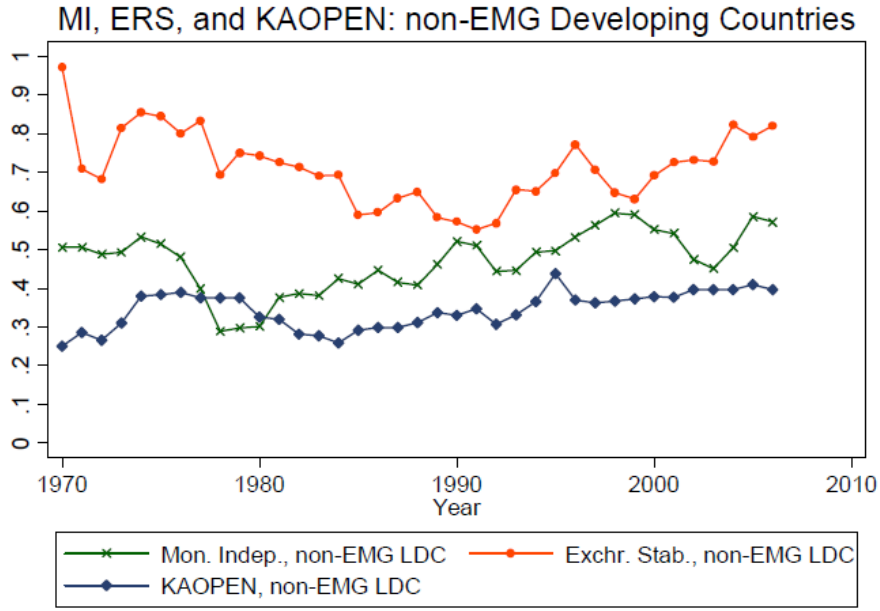


Source: Aizenman, Chinn and Ito (2010)

Trilemma trends 1970-2006

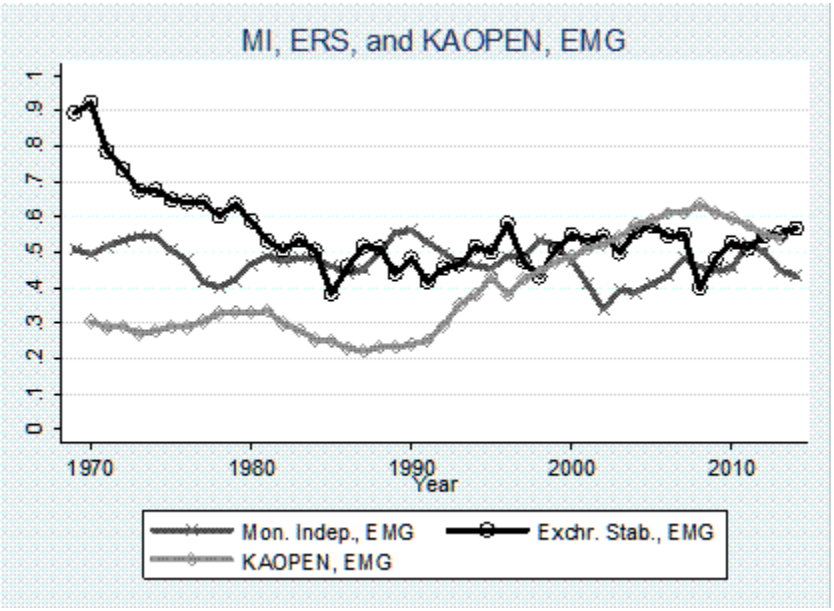


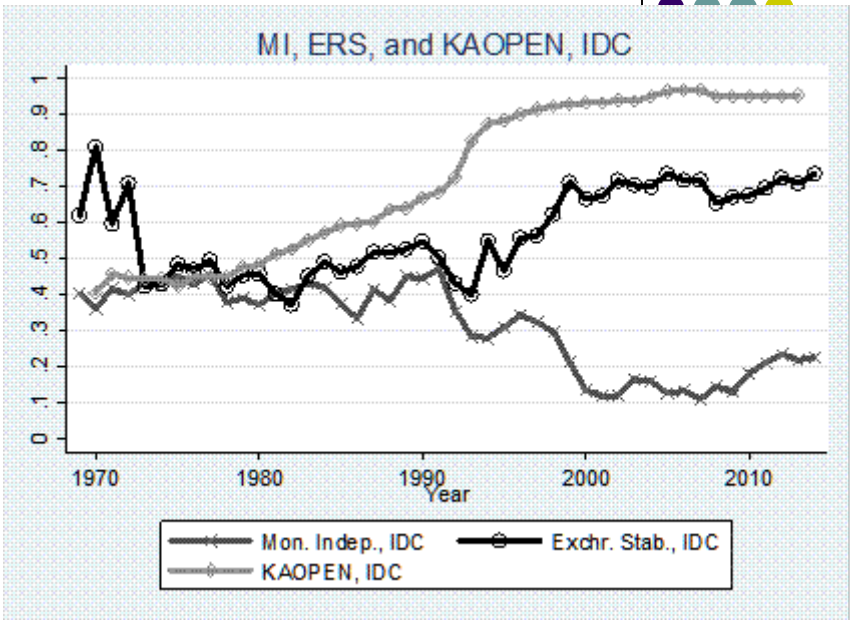


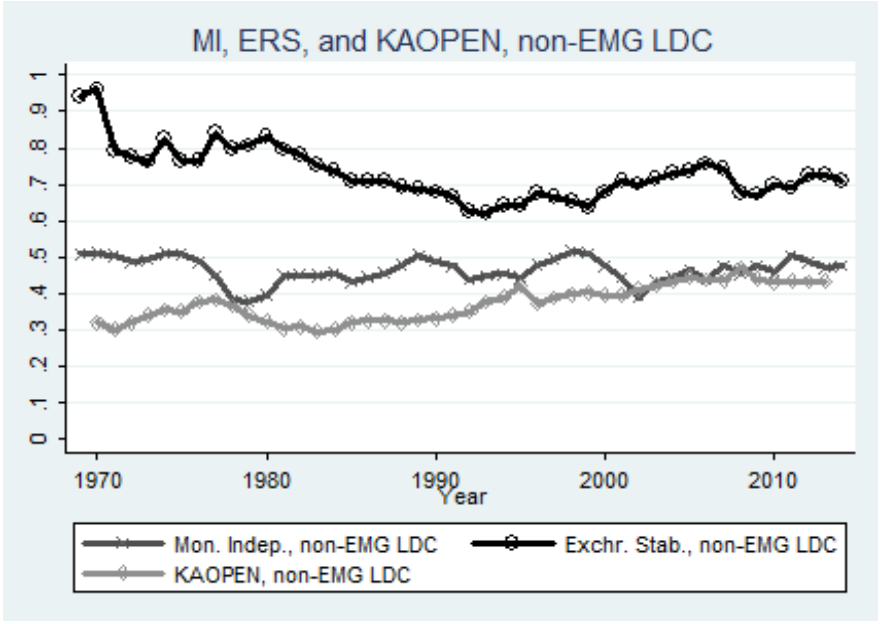


Source: "The emerging global financial architecture: Tracing and evaluating new patterns of the trilemma configuration," Aizenman, Chinn and Ito, JIMF 2010

Latest trends, http://web.pdx.edu/~ito/trilemma_indexes.htm

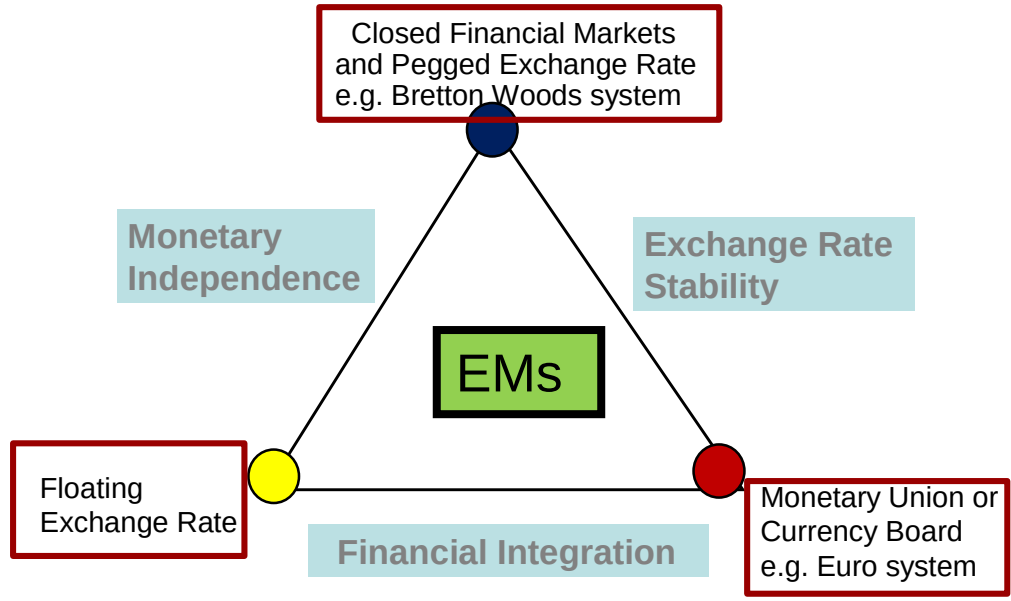






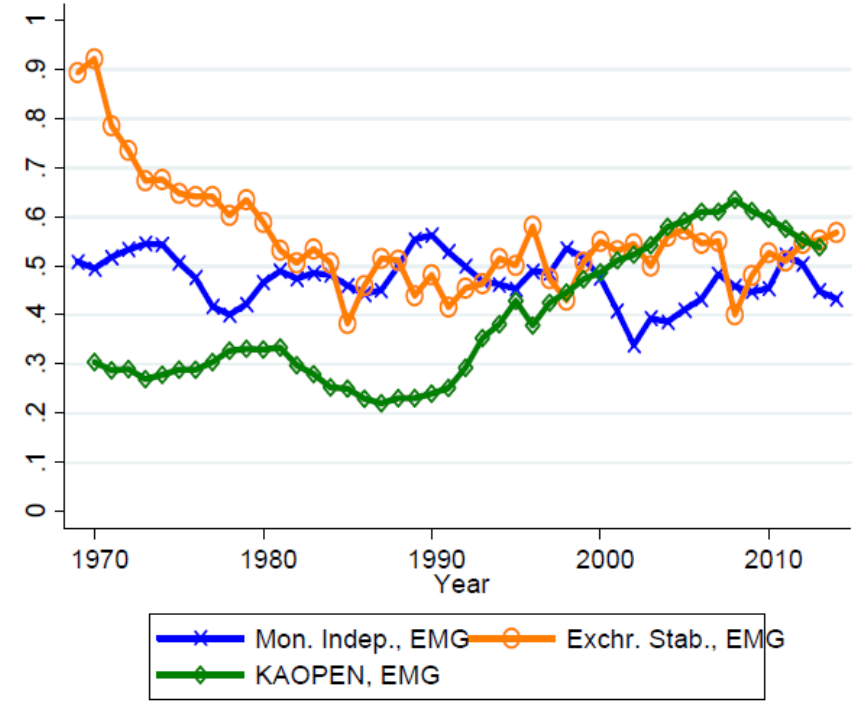
In practice, Aizenman, Chinn, Ito (2010, 1) found that countries do not choose 2 policy options out of the 3,

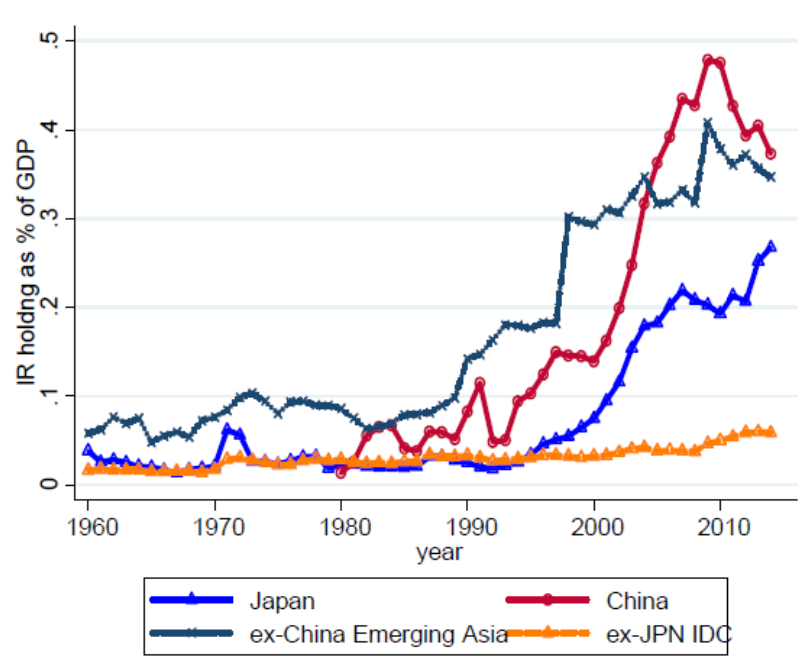
Instead, they choose all three with different weights on the 3 policy goals: managed E.R. flexibility, controlled financial integration, and limited financial autonomy.



- We constructed & confirmed a continuous version of the Trilemma: policy makers face a tradeoff, wherein increasing one variable induces a drop in the weighted average of the other two variables. Example: greater financial integration lowers exchange rate stability or lower monetary autonomy, or weighted average of both.

Emerging Market Economies' lesson from sudden stop crises of the 1990s - aim at the middle ground of the trilemma (managed ER flexibility, controlled financial integration, active IR & monetary policy).





Emerging market economies' trilemma trends

IR/GDP trends

Source: http://web.pdx.edu/~ito/trilemma_indexes.htm

Testing the modern trilemma

Hypothesis: the weighted sum of the 3 trilemma policy variables adds up to a constant, with positive weights:

$$1 = a_j MI_{i,t} + b_j ERS_{i,t} + c_j KAOPEN_{i,t} + \varepsilon_t; \quad a, b, c > 0,$$

where j can be either Industrial Countries, Emerging markets [EMs], or developing countries.

We tested this specification, and validated it -- in line with the conjecture that countries face the trade-off, where higher policy goal is traded of with a drop in the weighted average of the other two policy goals.

Key findings for EMEs

1. Greater MI can dampen output volatility while greater ERS implies greater output volatility, which can be mitigated by managing a buffer stock of reserves.

Key findings

- The regressions were run for the full sample period as well as the subsample periods that are divided by major economic event and crises [i.e., the collapse of the BW system in 1973, the Mexican debt crisis of 1982, and the Asian crisis of 1997-1998].
- If the goodness of fit is high, a linear specification is rich enough to explain the trade-off among the 3 policy goals dimensions.
- Adjusted R-squared for the full sample is ~ 95%.
- Across different time periods, the estimated coefficients vary, possibly due changes in the governments' objective functions, or the structure and the shocks impacting the economies.

- We also tested the linear specification by verifying that adding quadratic terms is redundant.

Key Findings for EMs

1. Greater monetary independence can dampen output volatility, while greater ERS is associated with greater output volatility, which can be mitigated by managing a buffer of international reserves.

2. Greater monetary autonomy is associated with higher inflation while greater exchange rate stability and greater financial openness could lower the inflation level;

3. A policy pursuit of stable exchange rate while financial development is at the medium level can increase output volatility.

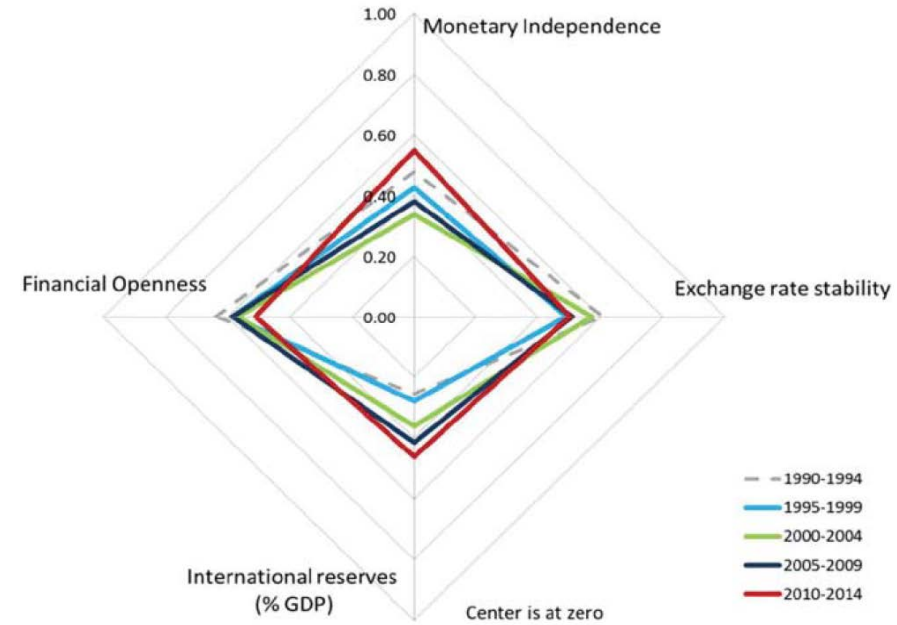
4. Greater financial openness with a high level of financial development can reduce output volatility, though greater financial openness with a low level of financial development can be volatility-increasing.

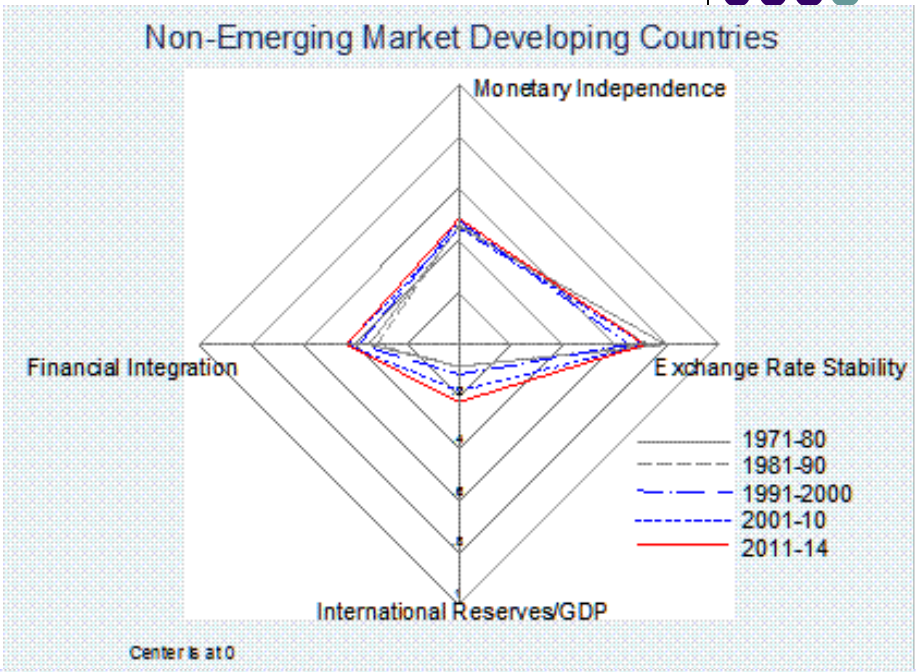
5. Emerging market economies have adopted a policy combination of the three trilemma policies and active management of international reserves, which allow these economies to lessen output volatility through reduced REER volatility.

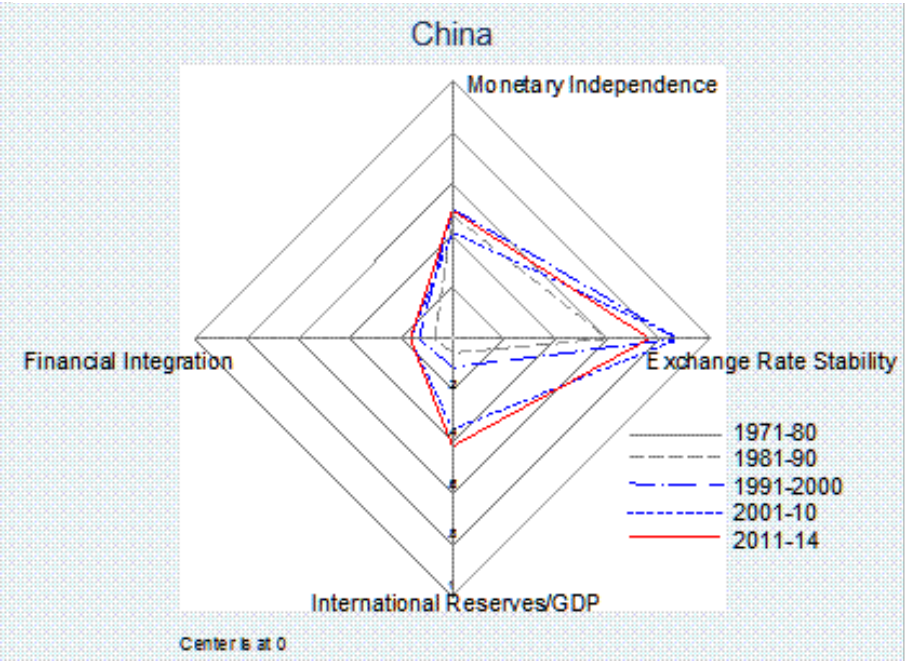
- Thus, it is not surprising for EMEs economies to have become active in accumulating international reserves in the 1990s-2000s.

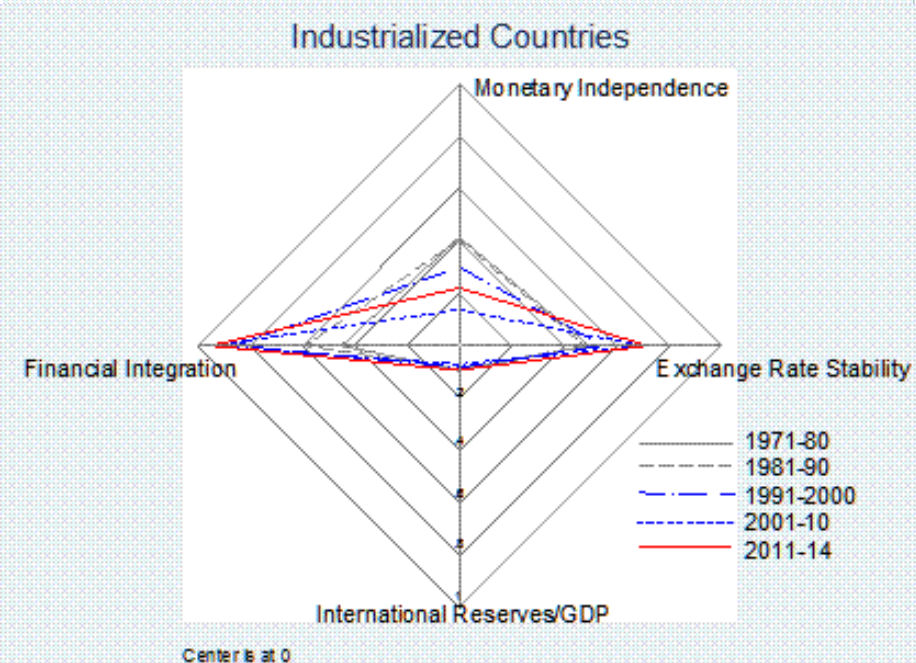
- The methodology outlined above has been applied and the main results were corroborate and extended in several follow up studies, including Hutchison, Sengupta, Singh (2012), Çörtük, Singh (2013), Popper, Mandilaras, and Bird (2013).

Trilemma and IR overtime

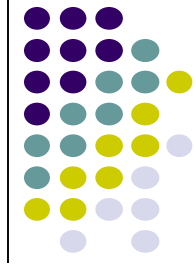




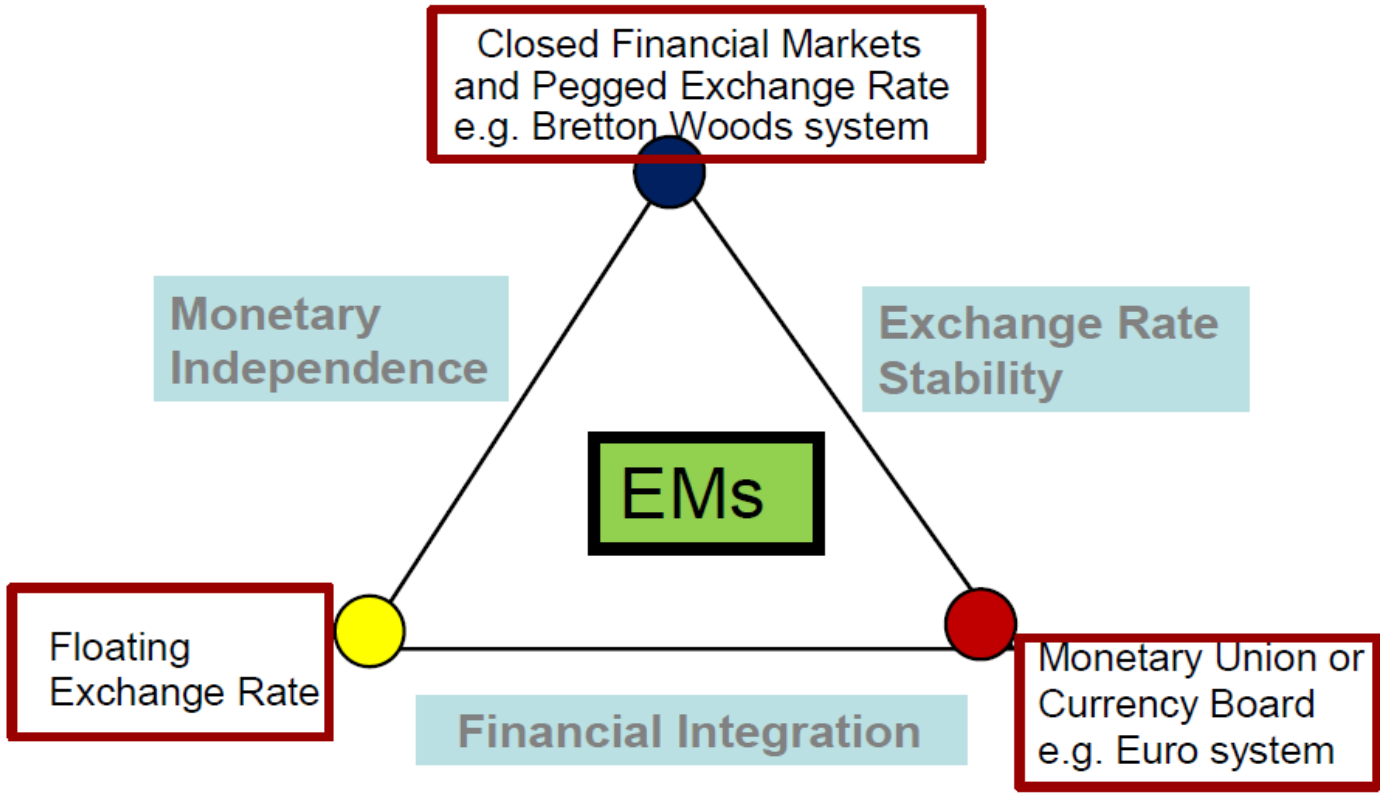




Rey (2015) - alternative take on the trilemma



- The economic centre's [i.e. US] monetary policy influences other countries' national monetary policy.
- That happens mostly through capital flows, credit growth, and bank leverages, making the types of exchange rate regime of the non-centres irrelevant.
- **The countries in the periphery are all sensitive to a 'global financial cycle' irrespective of their exchange rate regimes.** Thereby, the 'trilemma' reduces to an 'irreconcilable duo' of monetary independence and capital mobility – **"Dilemma not Trilemma."** Consequently, restricting capital mobility maybe the only way for non-centre countries to retain monetary autonomy. Rey's concluded that whenever capital is freely mobile, the global financial cycle constrains national monetary policies regardless of the exchange rate regime.

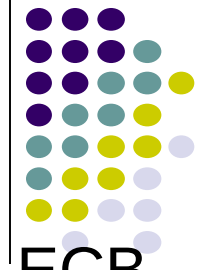


Rey (2013)

Capital Mobility ⟷ Monetary Independence

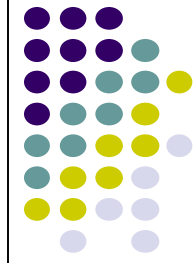
"irreconcilable duo"

The follow up literature propagated by Rey's "Dilemma not Trilemma" hypothesis painted mixed & nuanced views of Rey's conjecture.



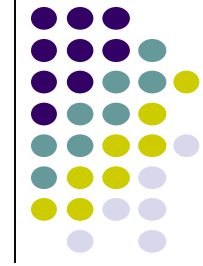
- Taking the 'irreconcilable duo' hypothesis literally, the ECB & UK's monetary policy stance are irrelevant, as the EZ and the UK have been financially integrated with the global economy…
- Mundell's Trilemma does not argue that countries can insulate themselves from global shocks propagated by large countries: the Trilemma is about trade-offs and mitigations.
- Size matters, as among n currencies, at most only n – 1 are independent. USA's size matters especially as the financial size of the US well exceeds its global GDP share.
- A possible avenue to test the viability of the trilemma is to verify the degree to which exchange rate regimes impact significantly the transmissions of shocks from financial center economies.

Trilemma empirical literature is bounded by the historical data – no easy ways to control for the counter factual



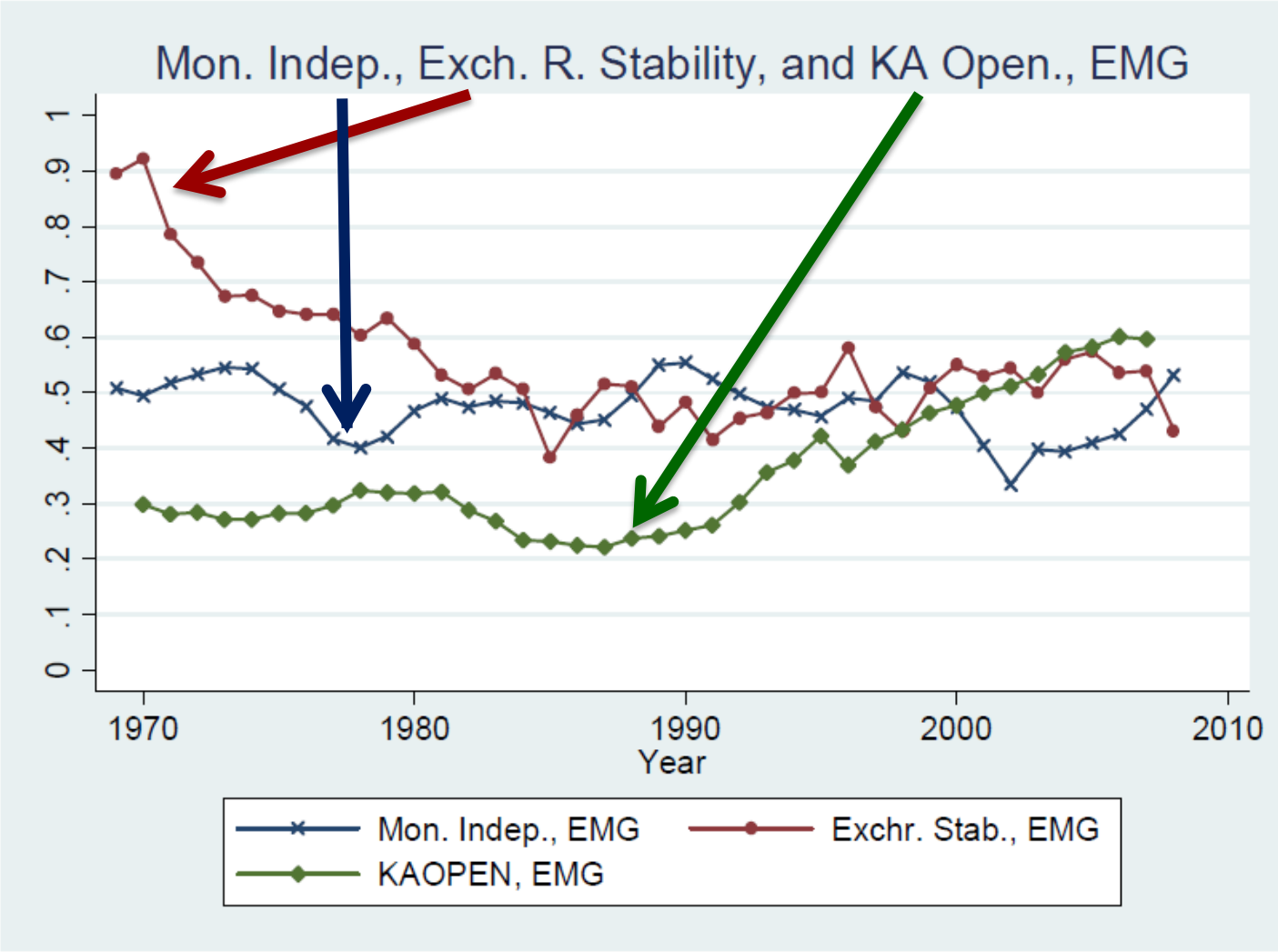
- Closeness to ZLB accounts for the growing sensitivity to the Center.
- Had Brazil been under a fixed exchange rate regime in 2010s, it would have gone by now a balance of payment and banking crises, aka collapsing exchange rate (Reinhart and Rogoff (2004), Ghosh, Ostry, and Qureshi (2015)).
- Without controlling for this counterfactual, inference about the relevance of the exchange rate regime is limited, and should be taken with a grain of salt.
- These views are in line with Bernanke (2017)'s Mundell-Fleming 2015 lecture at the International Monetary Fund, putting Rey's conjecture in the context of the evolving debate on the global financial structure.

Alternative take, supported by ACI (2016, 7) research, “Balance Sheet Effects on Monetary and Financial Spillovers.”



- An economy that pursues greater exchange rate stability and financial openness faces a stronger link with the center economies. Managed ER flexibility seems to mitigate the exposure to external shocks.
- **The extended Trilemma is about trade-offs and mitigations. EMs found in the hard way that the Trilemmas’ “constrained optimal solution” is at the middle ground.**

EMs Trilemma configurations
1970- Convergence to the middle ground

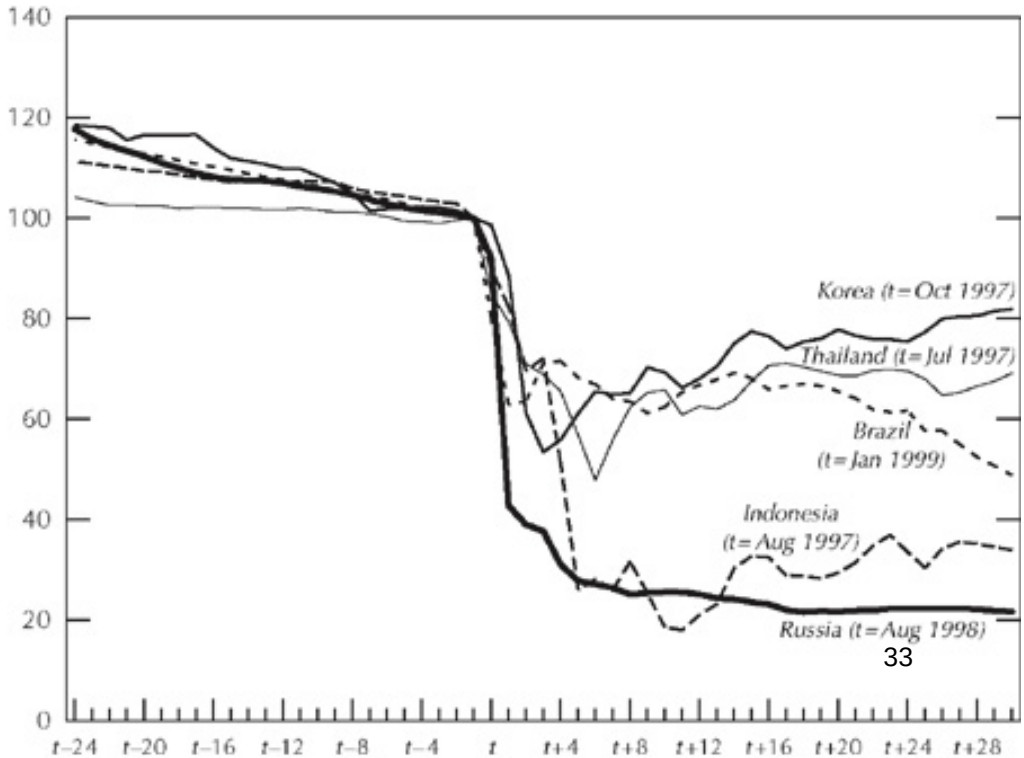


Latest update, see
http://web.pdx.edu/~ito/trilemma_indexes.htm

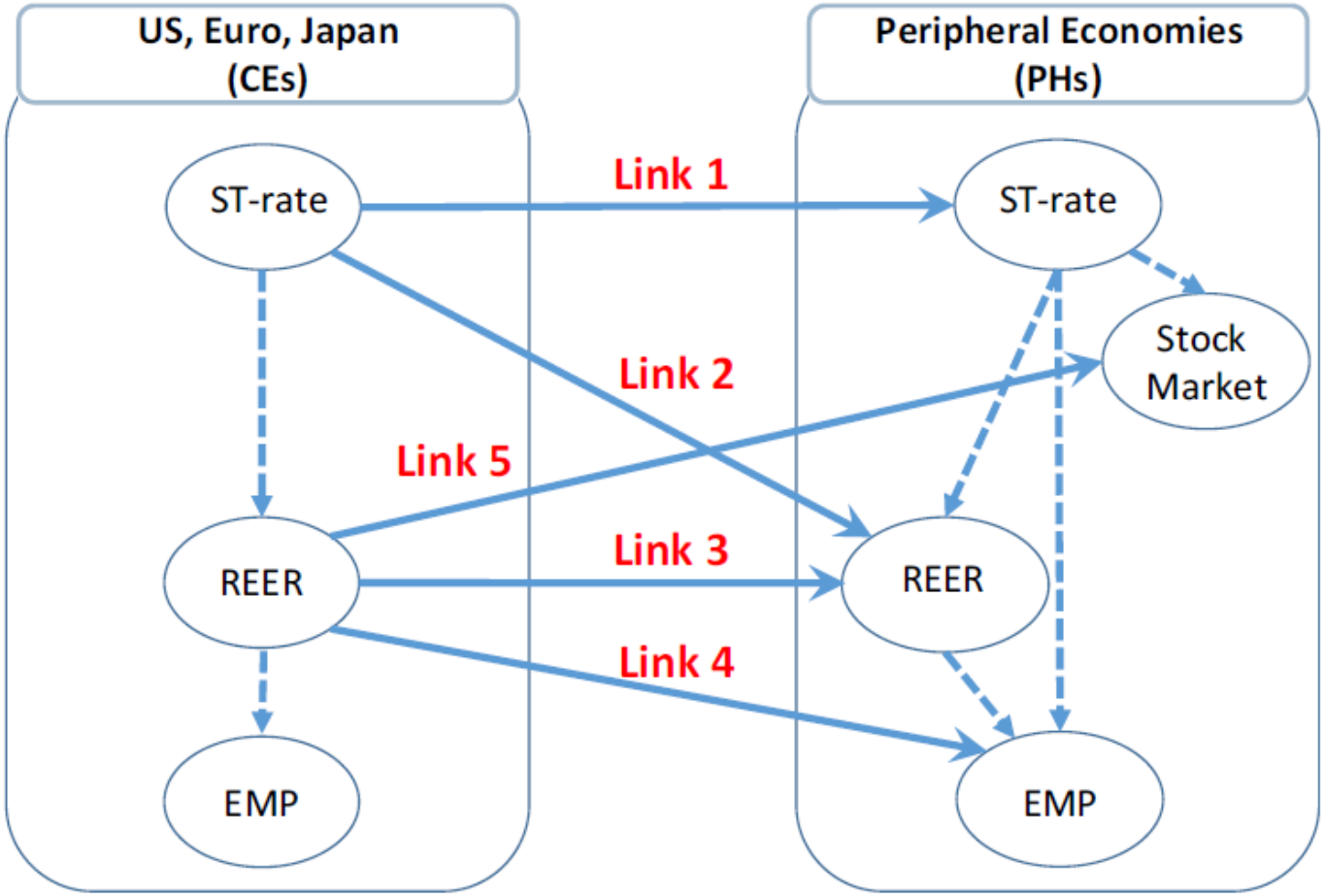
The counter factual of fixed exchange rate is not flexible ER, but collapsing exchange rate, and skyrocketing interest rates.

For EMs, the transitions from fixed to flexible exchange rate have been the outcome of sudden stop crises -- depleted IR forced twin or triplet crises – collapsing exchange rate, banking, and sovereign debt. During this transition, the CB policy rate skyrockets.

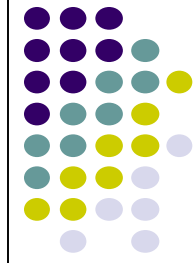
Figure 1.1. Nominal Exchange Rates
(US$ per unit of local currency; t–1=100)



We study how the financial conditions in the Center Economies (CE --U.S., Japan, Euro and China) impact other non center countries (PHs), over 1986 – 2015.

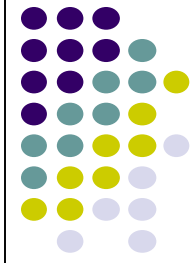


- For each of the five linkages, we first regress a financial variable of the PHs on financial variables of the CEs while controlling for global factors.



- Next, we examine the determinants of sensitivity to the CEs as a function of country-specific macroeconomic conditions and policies, **including the exchange rate regime, currency weights, monetary, trade and financial linkages with the CEs, the levels of institutional development, and international reserves.**
- We study the impact of currency weights in the implicit currency basket, balance sheet exposure, and currency composition of external debt.

Examining the determinants of sensitivity to the CEs as a function of country-specific macroeconomic conditions and policies, **including**



- exchange rate regime, currency weights in the implicit currency basket, international reserves.
- balance sheet exposure, currency composition of external debt.
- monetary, trade and financial linkages with the CEs,
- the levels of institutional development,

For both policy interest rates and the real exchange rate (REER), the link with the CEs has been pervasive for developing and EMs in the last two decades.

Movements of policy interest rates are found to be more sensitive to global financial shocks around the time of the EMs' crises in the late 1990s and early 2000s, and since 2008.

- Country specific weights of major currencies, external debt, and currency compositions of debt are significant factors.
- Having a higher weight on the dollar (or the euro) makes the response of financial variable like the REER and exchange market pressure in the PHs more sensitive to a change in key variables in the U.S. (or the euro area), such as policy interest rates, the REER, etc.
- Economies more reliant on dollar-denominated debt issuance tend to be more vulnerable to shocks emanating from the U.S.
- China does not exert (yet) substantial influence in financial markets
- The greater exchange rate stability or less of financial openness a country pursues, the more **financial development** makes its economy's **EMP** more sensitive to changes in the center economies' **REER**

- If a non-center economy runs a **current account *deficit***, its **EMP** sensitivity to the **REER** of the CEs rises especially when it pursues greater exchange rate stability.
- Having greater **trade linkages** with the CE contributes to more positive **EMP-EMP** linkages if a country pursues greater financial openness.
- Greater import demand for a developing country increases policy interest rate or stock market price correlations at higher levels of exchange rate stability.
- Greater exchange rate stability also amplifies the impact of gross debt on the REER link.

- Holding higher levels of foreign reserves tend to help non-CEs to shield the impact of changes in the CEs' policy interest rates, i.e., to retain greater monetary autonomy.
- The above results validate EMs benefits from being in the Trilemma middle ground, buffered by international reserves and policies aiming at reducing balance sheet exposures.

Related studies with similar findings include:

Klein and Shambaugh (2015)

Find that partial capital controls do not generally allow for greater monetary control than with open capital accounts, unless capital controls are quite extensive, but **a moderate amount of exchange rate flexibility does allow for some degree of monetary autonomy, especially in emerging and developing economies.**

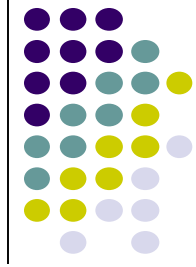
Some countries having long-standing, pervasive capital controls, but also a substantial subset of countries that use limited controls on an episodic basis. Their results are in line with Klein (2012), who classified capital control these regimes into “walls” and “gates,” respectively, and shows that walls are more effective than gates in limiting asset price booms and swings in the value of the real exchange rate. **In any given year, there is a wide range of scope with which capital controls are employed, generating an extensive middle ground between open and closed capital markets.**

Obstfeld, Ostry and Qureshi (2017)

find that countries with fixed exchange rate regimes are more likely to experience financial vulnerabilities—faster domestic credit and house price growth, and increases in bank leverage—than those with relatively flexible regimes.

The transmission of global financial shocks is magnified under fixed exchange rate regimes relative to more flexible (though not necessarily fully flexible) regimes. They attribute this to both reduced monetary policy autonomy and a greater sensitivity of capital flows to changes in global conditions under fixed rate regimes.

Bekaert and Mehl (2017) propose a measure



of de facto financial market integration based on a factor model of monthly equity returns.
They find evidence consistent with the trilemma and inconsistent with the dilemma hypothesis, both throughout history and for the recent decades; non-US central banks still exert more control over domestic interest rates when exchange rates are flexible in economies open to global finance.

ACI work in progress

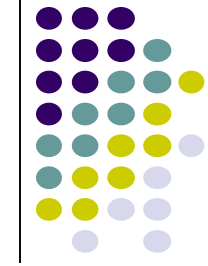
Measuring Monetary Policy Spillovers using Aggregate Data: Bank Lending, Capital Controls, Macroprudential

- Lower bank lending means weaker link between core and non-core REERs
- The greater the presence of macroprudential measures, the weaker the correlation between policy rates
- The latter is driven by borrower-based macroprudential measures

Concluding remarks

- The GFC, and the Eurozone crisis validated that no country is immune from exposure to financial instability, and from the modern quadrilemma.
  Countries with more mature institutions & fiscal space may substitute the reliance on costly precautionary buffers with bilateral swaps lines coordinated among their central banks, and macroprudential regulations.
- The benefits of these arrangements hinge on the presence and the credibility of their fiscal backstop mechanism, and curbing the moral hazard associated with insurance.
- Time will test their credibility, and the degree to which risk pooling arrangements can be extended to cover growing share of emerging markets and developing countries.
- Future volatility and crises will keep us moving on the learning curve of properly implementing macroprudential policies.

Thanks for your attention!



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Step 1 – estimate γ's

$$R_{it}^{F} = \alpha_{Fit} + \sum_{g=1}^{G} \beta_{Fit}^{G} Z_{it}^{G} + \sum_{c=1}^{C} \gamma_{Fit}^{C} X_{it}^{C} + \phi_{Fit} Y_{it} + \varepsilon_{it}. \qquad (1)$$

- R^F : real return

  Policy ST interest rates, sovereign bond term spread, changes in stock market price indexes, and changes in the REER
- X^c : a vector of corresponding returns of the "center economies"
- Z^G : global factors
  - **Real**: PC of the U.S., ECB, and BOJ policy rates, oil, commodity
  - **Financial**: VIX, Ted-spread
- Y : local factor (y/y IP growth)
- Rolling estimation w/ 36-month windows, each of 100 countries
- Model w/ and w/out China as one of the CEs
- Model w/ and w/out China as one of the CEs

Step 2 – Relate γ's to Policies, Conditions, Institutions

$$\hat{\gamma}_{Fit}^{C} = \theta_0 + \theta_1 OMP_{Fit} + \theta_2 MC_{Fit} + \theta_3 LINK_{Fit} + \theta_4 INST_{Fit} + \theta_5 CRISIS_{Fit} + u_{Fit}. \quad (2)$$

- **OMP**: Open Macro Policies – Exchange rate stability, financial openness (Chinn-Ito), Int'l reserve accumulation
- **MC**: Macro conditions – infl. volatility, CA balances, public finances (budget balance or gov't gross debt)
- **LINK**: Import Demand by CEs, bank lending by CEs, FDI provided by CEs, degree of trade competition w/r/t CEs
- **INST**: LEGAL (PC of BQ, LAO, Anti-corrupt), Fin. Dev.
- **CRISIS**: currency and banking
- 1986-2012, 3-yr panels, non-overlapping, about 60 countries

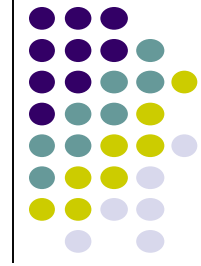
Technical Notes on the two steps

- Endogeneity can be an issue for this type of estimation. As a robustness check, we re-estimated the first-step model by lagging the right-hand-side variables. However, it did not change the characteristics of the results (not reported). Hence, we keep the estimation method as it is.
- Once we estimate γ_{Fit}^{C} for each of the dependent variables, we regress $\hat{\gamma}_{Fit}^{C}$ on a number of country-specific variables. To account for potential outliers on the dependent variable, we apply the robust regression estimation technique to the following estimation model.
- The second step estimation method keeps recursively down-weighting the outliers until it obtains converged estimates.

Frankel and Wei (1996)

- Using the widely-used method developed by Haldane and Hall (1991) and popularized by Frankel and Wei (1996), we estimate the weights of the dollar, the euro (or the German deutsche mark and the French franc before the introduction of the euro in 1999), the yen, and the British sterling with a rolling window of 36 months.
- With the estimated weights, we can test whether and to what extent the weights of currencies in the basket affect the extent of connectivity between the CEs and the PHs (i.e., $\hat{\gamma}$'s).

Frankel and Wei (1996), cont.



The basic assumption of this exercise is that monetary authorities use an implicit or hypothetical basket of currencies as the portfolio of official foreign exchange reserves, but that the extent of response to the change in the value of the entire basket should vary over time and across countries. If the authorities want to maintain a certain level of exchange rate stability, whether against a single currency or a basket of several currencies, they should allow the currency value to adjust only in accordance with the change in the *entire* value of the basket of major currencies. The examples of the application of this method can be found in Frankel and Wei (1996) among many others.

Currency weights (CZW) – First, we run the estimation model:

$$\Delta e_{it}^{USD} = \alpha_i + \beta_{iJYt}\Delta e_{it}^{JY} + \beta_{iBPt}\Delta e_{it}^{UKP} + \beta_{iDMt}\Delta e_{it}^{DM} + \beta_{iFFt}\Delta e_{it}^{FF} + \varepsilon_{it}$$

Here, e_{it} is the nominal exchange rate of home currency i, against the dollar (USD), yen (JP), pound (UKP), Deutsche mark (DM), and French franc (FF). The major currencies in the right-hand side of the estimation equation can be thought of comprising an implicit currency basket in the mind of the home economy's policymaker. Therefore, $\hat{\beta}_{ih}$, the estimated coefficient on the rate of change in the exchange rate of major currency *h* vis-à-vis the U.S. dollar, represents the weight of currency *h* in the implicit basket. The weight of the dollar can be calculated as $\hat{\beta}_{iUSt} = 1 - \left(\hat{\beta}_{iJYt} + \hat{\beta}_{iBPt} + \hat{\beta}_{iDMt} + \hat{\beta}_{iFFt}\right)$. We apply the estimation model to each of our sample currencies, estimating it over rolling windows of 36 months. Thus, the $\hat{\beta}_{ih}$'s are time-varying in monthly frequency [assuming that policymakers keep updating their information sets and, thus, currency weights].

Exchange market pressure (EMP) index –a weighted average of monthly changes in the nominal exchange rate, the international reserve loss in percentage, and the nominal interest rate. The nominal exchange rate is calculated against the base country that we use to construct the trilemma indexes. The weights are inversely related to each country's standard deviations of each of the changes in the three components over the sample countries:

$EMP_{i,t} = \alpha(\%\Delta e_{i,t}) + \beta[\Delta(i_{i,t} - i_{b,t}) - \gamma(\%\Delta r_{i,t} - \%\Delta r_b)]$, *b* stands for the "base country," defined as the country that a home country's monetary policy is most closely linked with as in Shambaugh (2004) and Aizenman, et al. (2013). The base countries are Australia, Belgium, France, Germany, India, Malaysia, South Africa, the U.K., and the U.S. The base country can change as it has happened to Ireland, for example. Its base country was the U.K. until the mid-1970s, and changed to Germany since Ireland joined the European Monetary System (EMS).