

REGULATING CAPITAL FLOWS AT BOTH ENDS: DOES IT WORK?*

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OUTLINE

- Motivation
- Our Approach
- Regulating Flows at Both Ends (Source-Recipient Cooperation)
- Spillovers from Recipient Country Measures (Recipient-Recipient Cooperation)
- Key Takeaways

MOTIVATION

CALLS FOR GREATER INTERNATIONAL COOPERATION TO COPE WITH VOLATILE FLOWS

- Greater use of capital controls and FX-related prudential measures by EMs in face of volatile capital flows—but questions about effectiveness
- Greater recognition that cross border capital flows may complicate application of prudential measures in AEs
- Calls for a more **coordinated approach** to regulating flows by acting at both the source and recipient country ends (e.g., Ostry et al., 2012; IMF, 2012; Brunnermeier et al., 2012)
- Under Basel III “reciprocity”, the home country regulator is required (upon request) to impose the same counter-cyclical capital charge on international banks’ exposures in a foreign jurisdiction as is being imposed by host regulator on domestic banks (up to 2.5 percent; implemented 2016-19)

AN OLD IDEA...

“But such control will be more difficult to work...by unilateral action than if movements of capital can be controlled **at both ends.**”

John Maynard Keynes



“Almost every country at one time or another, exercises control over the inflow and outflow of investments, but **without the cooperation** of other countries such control is difficult, expensive, and subject to considerable evasion.” **Harry Dexter White**

...BUT SELDOM PUT INTO EFFECT

- Interwar period—1935-37
 - *Since such inflows complicate the problem of achieving and maintaining a prosperous stability, constitute a source of embarrassment to many countries from which the capital is flowing there appears to be a clear case for adopting measures designed to deter the growth of foreign capital holdings in our markets (Marriner Eccles, April 1937)*
- Postwar—1947-50
 - *The American taxpayer should not be obliged to provide the necessary funds for the [Marshall Plan] while...a small, bloated, selfish class of people [in Europe] continue to hold on to their private hidden investments in the US (American Veterans Committee; Henry Cabot Lodge, US Congress)*
- Breakdown of Bretton Woods—1972
 - US imposes IET 1963-72 to stem outflows; French and Japanese proposals for cooperative controls to sustain Smithsonian Agreement parities
 - *Attention should be directed to measures dealing with movements of liquid capital (Smithsonian communiqué)*
 - *The US is isolated in its opposition to controls...We have acknowledged that volatile capital flows are a problem. Unwillingness to cooperate in limiting them makes us appear irresponsible (Federal Reserve memo)*

CONDITIONS FOR GAINS FROM COOPERATION

- Government imposes capital control either for flow imbalances or balance sheet vulnerabilities
 - *Requires capital controls to have an effect on the volume of (at least the more risky) flows*
- When distortionary costs of capital controls are convex, a global social planner would impose both inflow and outflow controls, which are incentive compatible for both the source and recipient.
 - *Requires both source and recipient countries measures to be simultaneously effective*
- Coordination among borrowers is beneficial when there are distortionary costs of capital controls (not necessarily convex) because in the Nash equilibrium, each sets too high an inflow tax. (Gains from coordination are larger when countries are atomistic.)
 - *Requires measures to have spillovers between recipient countries*

LACK OF STRONG EVIDENCE...

- No significant instances of coordination of capital controls
 - In early 1970s, e.g., Japan and Western Europe suggested introducing cooperative controls to preserve the stable system of exchange rates. US did not, however, support the proposal (Helleiner, 1994)
- Unilateral evidence on capital controls is mixed
 - Level vs. composition (Magud et al., 2011; Ostry et al., 2012); “walls” vs. “gates” (Klein, 2012)
 - But note, if controls are ineffective, then no multilateral impact, and no (multilateral) reason to proscribe them
- Need for policy coordination in practice will depend on strength of spillovers
 - Emerging but mixed evidence on the extent of spillovers from recipient country policies (Forbes et al., 2011; IMF, 2011)
 - Stronger evidence of spillovers from source country policies—especially, monetary policies—to recipient countries (Calvo et al., 1993; Ghosh et al., 2014)

OUR APPROACH

WHAT DO WE DO...

- Use bilateral cross-border bank flows data to examine
 - Whether capital controls and prudential measures (that may act like capital controls) on outflows by source countries, and on inflows by recipient countries moderate large (and possibly) disruptive capital movements
 - The joint effect of restrictions on outflows by the source country, and on inflows by the recipient country, has not been examined before
 - In doing so, we not only establish the effect of outflow controls on the country implementing the control, but also that on the recipient countries
 - Spillovers from capital controls in recipient countries

FOCUS ON BANKING FLOWS HAS SEVERAL ADVANTAGES...

- An increasingly important and volatile component of total flows—particularly important from a global financial stability perspective (Rey, 2013; Bruno and Shin, 2014)
- Bilateral data allows to determine simultaneously the association between capital flows and restrictions from both the outflow and inflow sides—while controlling for a range of source and recipient country characteristics (note: restrictions are never bilateral but apply to all recipient/source countries).
- Bilateral data helps to mitigate potential endogeneity concerns in econometric estimations (since such measures are generally adopted in response to the *aggregate*—and not bilateral—volume of flows)

DATA AND ESTIMATION

- Annual bilateral cross-border bank asset flows from 31 major source to 76 recipient (advanced/EM) countries over 1995-2012
- Capital controls and prudential measures are constructed using detailed information from the IMF's AREAER and the OECD Code of Liberalization of Capital Movements
- Estimate four types of equations:

$$F_{ijt} = X'_{it}\beta_i + X'_{jt}\beta_j + \gamma S_{it} + \mu_{ij} + \lambda_t + \varepsilon_{ijt} \left. \vphantom{F_{ijt}} \right\} \text{Source outflow restrictions}$$

$$F_{ijt} = X'_{it}\delta_i + X'_{jt}\delta_j + \chi R_{jt} + \mu_{ij} + \lambda_t + \eta_{ijt} \left. \vphantom{F_{ijt}} \right\} \text{Recipient inflow restrictions}$$

$$F_{ijt} = X'_{it}\theta_i + X'_{jt}\theta_j + \phi S_{it} + \phi R_{jt} + \mu_{ij} + \lambda_t + \xi_{ijt} \left. \vphantom{F_{ijt}} \right\} \text{Source/recipient restrictions}$$

$$F_{ijt} = X'_{it}\theta_i + X'_{jt}\theta_j + \phi S_{it} + \phi R_{jt} + \zeta R_{kt} + \mu_{ij} + \lambda_t + \xi_{ijt} \left. \vphantom{F_{ijt}} \right\} \text{Spillovers}$$

F_{ijt} — (log of) gross bank asset flows from source country i to recipient country j in year t

X_i/X_j — control variables for source and recipient countries

S_i/R_j — source and recipient country's outflow and inflow related restrictions

R_k — average inflow related restrictions in recipient country's neighbors

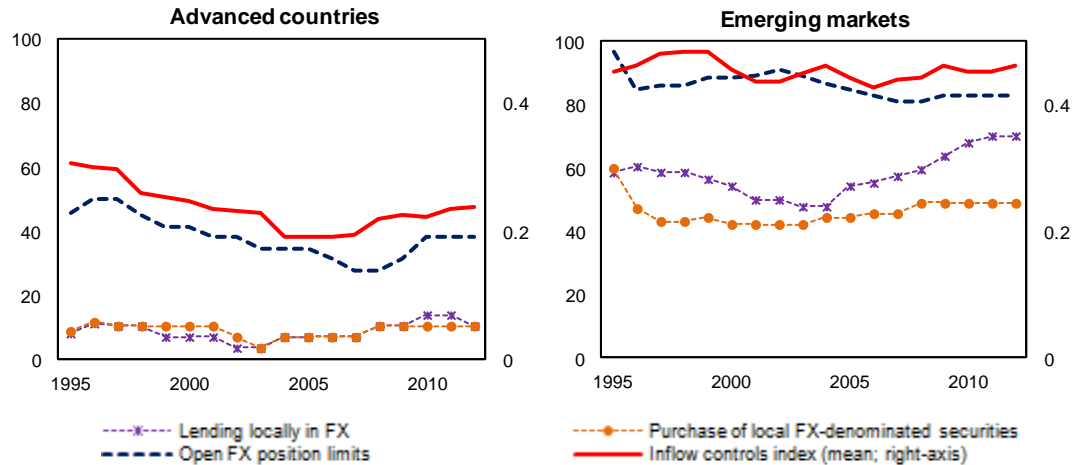
μ_{ij}/λ_t — source-recipient country specific, and year effects

WHAT ARE THE MEASURES?

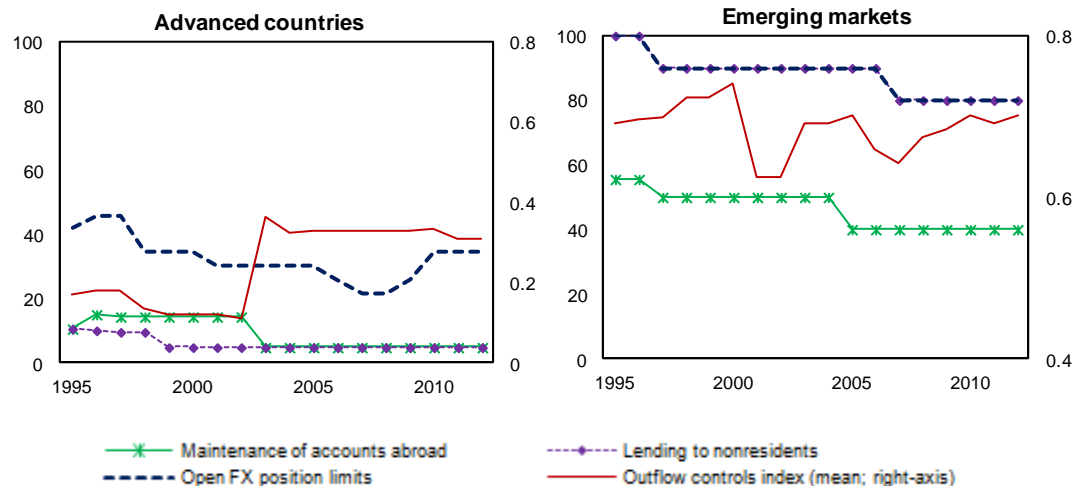
- Economy-wide capital controls on outflows and inflows
 - Disaggregated by asset class (bond, equity, direct investment, financial credit flows), and overall restrictiveness
 - Constructed following Schindler (2009)
- Prudential measures (specific to the financial sector)
 - Outflow-related: Restrictions on lending to nonresidents; restrictions on maintenance of accounts abroad; and open FX position limits
 - Inflow-related: restrictions on lending locally in FX; restrictions on purchase of locally issued securities denominated in FX; and open FX position limits
 - Proxied using binary variables on the existence of the measure

HOW PREVALENT ARE THE MEASURES?

a. Inflow-related measures (recipient countries)



b. Outflow-related measures (source countries)



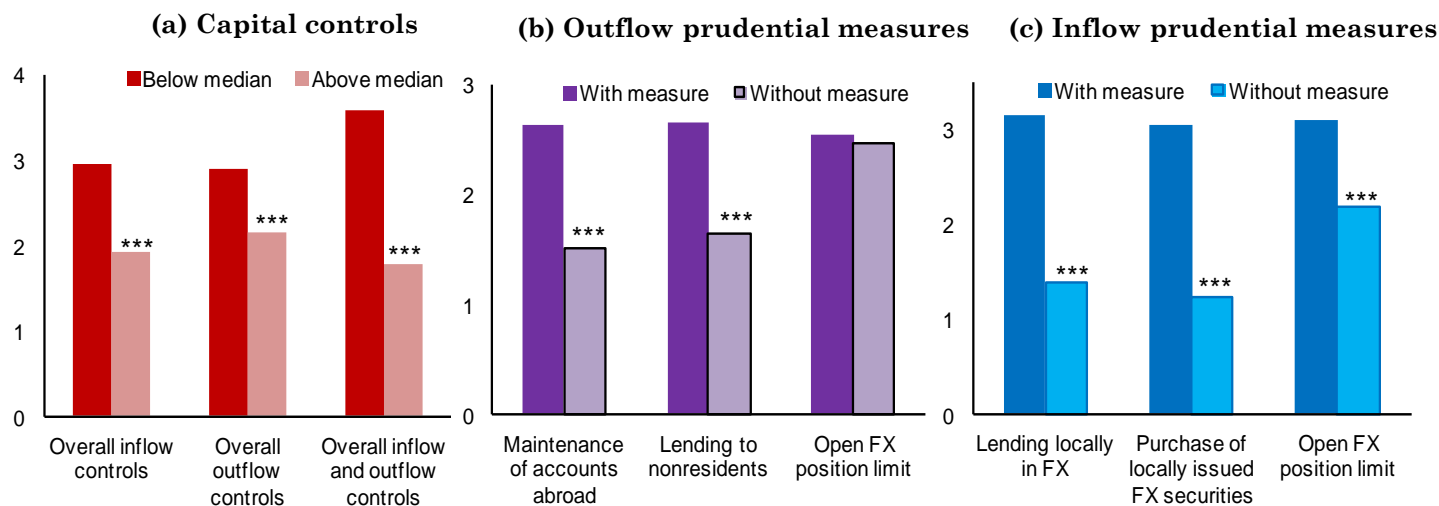
Source: Based on IMF's AREAER.

Note: Statistics on prudential measures reflect the proportion of countries in the sample with the specific measure in place. Controls indices reflect the average of the overall (outflow and inflow) restrictiveness indices. The jump in the outflow controls index for advanced countries in 2003 in panel [b] is mainly because of measures introduced by some EU countries on the purchase of securities abroad by insurance companies and pension funds, as reported by the OECD and AREAER.

REGULATING FLOWS AT BOTH ENDS (SOURCE-RECIPIENT COOPERATION)

SOME STYLIZED FACTS

Figure. Cross-Border Bank Flows, Capital Controls, and Prudential Measures, 1995–2012



Note: Banking flows measured as log of exchange rate adjusted changes in the total stock (amounts outstanding) of assets (all instruments). *** indicates statistically significant different means between the two groups at the 1 percent level.

DO CAPITAL ACCOUNT RESTRICTIONS MATTER?

- Formal analysis confirms that capital controls and prudential measures at either end can significantly lower volume of cross-border bank flows

| | Source country (outflow) measures | | | | | | | | | Recipient country (inflow) measures | | | | | | | | | |
|------------------------------------|-----------------------------------|-----------------------------|---------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------|------------------|-------------------------------------|----------------------------|-----------------------------|-------------------|------------------|-------------------|----------------|---------------------------|-----------------------------|-------------------|
| | OLS (1) | CPFE/TE (2) | CPFE/TE (3) | CPFE/TE (4) | CPFE/TE (5) | CPFE/TE (6) | CPFE/TE (7) | CPFE/TE (8) | CPFE/TE (9) | OLS (1) | CPFE/TE (2) | CPFE/TE (3) | CPFE/TE (4) | CPFE/TE (5) | CPFE/TE (6) | CPFE/TE (7) | CPFE/TE (8) | CPFE/TE (9) | |
| Overall controls | -2.442*** (0.518) | -2.978*** (1.020) | | | | | | | | 0.083 (0.466) | -1.998** (0.989) | | | | | | | | |
| Bond controls | | | -1.446* (0.837) | | | | | | | | | -2.023*** (0.658) | | | | | | | |
| Equity controls | | | | -2.316*** (0.863) | | | | | | | | | -0.092 (0.749) | | | | | | |
| Direct investment controls | | | | | -4.019*** (0.992) | | | | | | | | | 0.674 (0.784) | | | | | |
| Financial credit controls | | | | | | -1.438*** (0.527) | | | | | | | | | -0.863 (0.534) | | | | |
| Lending to nonresidents | | | | | | | -5.505*** (1.167) | | | | | | | | | | | | |
| Maintenance of acc. abroad | | | | | | | | -1.459 (1.144) | | | | | | | | | | | |
| Open FX position limits | | | | | | | | | 0.419 (0.626) | | | | | | | | -1.110* (0.653) | | |
| Lending locally in FX | | | | | | | | | | | | | | | | | | -1.792*** (0.666) | |
| Purchase of locally issued FX sec. | | | | | | | | | | | | | | | | | | | -0.494 (0.757) |
| Country-pair effects | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year effects | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 |
| R2 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Country-pairs | 1,943 | 1,943 | 1,943 | 1,943 | 1,943 | 1,943 | 1,943 | 1,943 | 1,943 | 1,943 | 1,943 | 1,943 | 1,943 | 1,943 | 1,943 | 1,943 | 1,943 | 1,943 | 1,943 |

Note: Dependent variable is (log of) bank asset flows from country i to j. Control variables include (log of) real GDP and real GDP per capita, real interest rates, and real GDP growth rates in both source and recipient countries, and exchange rate regime and current account balance (to GDP) in recipient countries in all specifications. The OLS specification also includes time-invariant geographical, political characteristics of the pair, and VIX and commodity prices. All domestic variables are lagged one period. Constant is included in all specifications. R2 reported for CPFE estimations is the within-R2. Clustered standard errors (by country-pair) are reported in parentheses. ***, ** and * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

DO CAPITAL ACCOUNT RESTRICTIONS MATTER?

- On the source side, moving from the lower to the upper quartile on overall, bond, equity, direct investment or financial credit outflow controls, and prudential measures is associated with about 50-100 percent lower flows
- On the recipient side, moving from the lower to the upper quartile on overall and bond inflow controls, and on the existence of foreign currency (FX) related prudential measures is associated with some 50-80 percent lower inflows
- Among other factors, global risk aversion and the interest rate in source countries matter strongly—highlighting the procyclical nature of bank flows—as do the domestic interest rate and exchange rate regime of the recipient countries
- **Controlling simultaneously for both source and recipient country restrictions, the estimated effects remain largely unchanged**

REGULATING CAPITAL FLOWS AT BOTH ENDS

- Individual measures are, however, associated with a larger reduction in flows when the other side is financially more open....though not necessarily *fully* open

| | More open recipient countries | | | | | | | | Less open recipient countries | | | | | | | | |
|---|-------------------------------|-------------------|--------------------|---------------------|---------------------|----------------------|-------------------|------------------|-------------------------------|-------|-------------------|-------------------|-------------------|-------------------|--------------------|-------------------|-------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | |
| Outflow controls _i | -2.966** (1.182) | | | | | | | | -2.297 (2.469) | | | | | | | | |
| Bond outflow controls _i | | -0.705 (0.963) | | | | | | | | | -2.694 (2.064) | | | | | | |
| Equity outflow controls _i | | | -1.814* (0.997) | | | | | | | | | -2.529 (2.159) | | | | | |
| Direct investment outflow controls _i | | | | -4.717** (1.103) | | | | | | | | | -1.513 (2.301) | | | | |
| Financial credit outflow controls _i | | | | | -1.586** (0.611) | | | | | | | | | -0.853 (1.258) | | | |
| Lending to nonresidents | | | | | | -4.664*** (1.359) | | | | | | | | | -4.167* (2.357) | | |
| Maintenance of acc. abroad _i | | | | | | | -1.156 (1.258) | | | | | | | | | -0.977 (2.831) | |
| Open FX position limits _i | | | | | | | | 0.653 (0.737) | | | | | | | | | -1.478 (1.305) |
| CPFE/TE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | |
| Observations | 16,934 | 16,934 | 16,934 | 16,934 | 16,934 | 16,934 | 16,934 | 16,934 | 16,934 | 5,323 | 5,323 | 5,323 | 5,323 | 5,323 | 5,323 | 5,323 | |
| R2 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | |

| | More open source countries | | | | | | | | Less open source countries | | | | | | | | |
|--|----------------------------|---------------------|-------------------|------------------|--------------------|----------------------|-------------------|-------------------|----------------------------|-------|------------------|-------------------|------------------|------------------|------------------|------------------|-------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | |
| Inflow controls _i | -2.478** (1.027) | | | | | | | | 2.863 (4.348) | | | | | | | | |
| Bond inflow controls _i | | -2.383** (0.675) | | | | | | | | | 2.162 (3.519) | | | | | | |
| Equity inflow controls _i | | | -0.219 (0.796) | | | | | | | | | -1.942 (2.831) | | | | | |
| Direct investment inflow controls _i | | | | 0.712 (0.842) | | | | | | | | | 2.605 (2.649) | | | | |
| Financial credit inflow controls _i | | | | | -1.029* (0.562) | | | | | | | | | 0.089 (1.926) | | | |
| Lending locally in FX _i | | | | | | -2.154*** (0.707) | | | | | | | | | 0.709 (2.051) | | |
| Purchase of local FX sec. _i | | | | | | | -0.777 (0.775) | | | | | | | | | 3.897 (3.179) | |
| Open FX position limits _i | | | | | | | | -1.065 (0.716) | | | | | | | | | -2.208 (1.843) |
| CPFE/TE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | |
| Observations | 19,374 | 19,374 | 19,374 | 19,374 | 19,374 | 19,374 | 19,374 | 19,374 | 19,374 | 2,883 | 2,883 | 2,883 | 2,883 | 2,883 | 2,883 | 2,883 | |
| R2 | 0.06 | 0.06 | 0.05 | 0.05 | 0.06 | 0.06 | 0.05 | 0.06 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | |

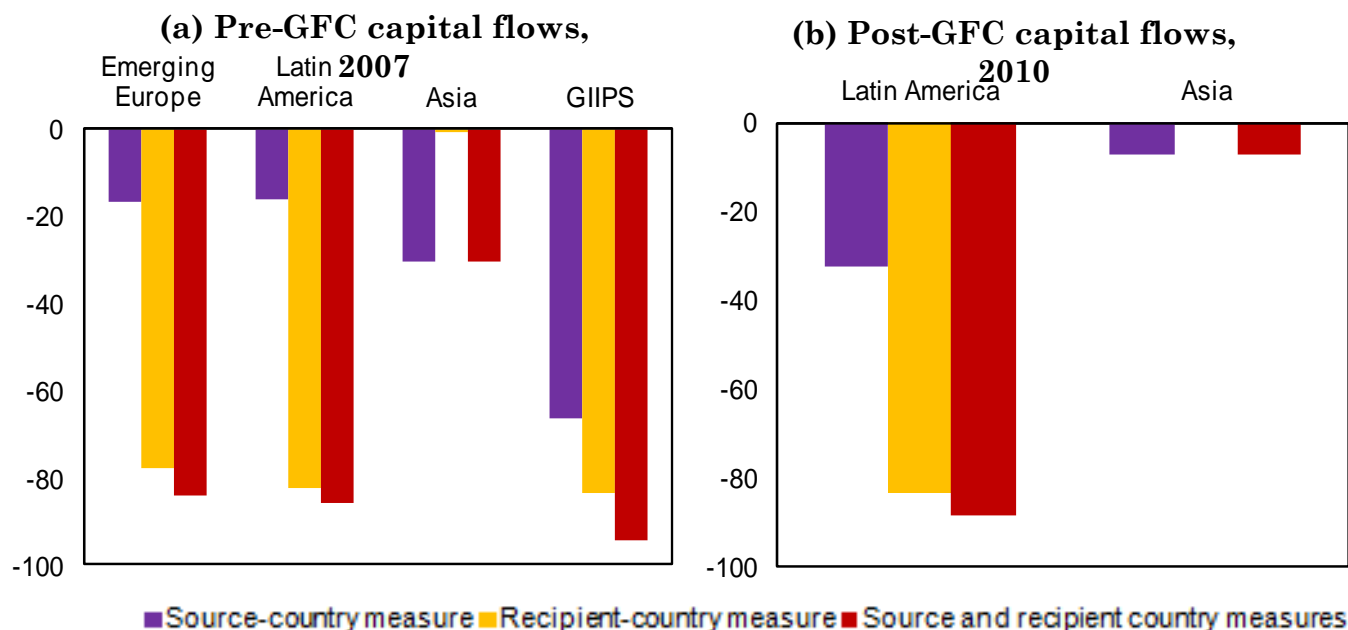
REGULATING CAPITAL FLOWS AT BOTH ENDS

- Inasmuch as capital controls are effective, this result makes sense:
 - when one side is already restricting flows, the incremental effect of restrictions on the other side will be smaller
- Estimated effects of source and recipient country restrictions are thus partially (but not fully) additive, making it possible to impose measures at both ends
 - achieving either a larger reduction in flows, or the same reduction with less intensive—and therefore perhaps less distortive—measures at either end
- Results survive a battery of robustness tests including
 - Addressing potential endogeneity concerns through the use of IV approach—(lack of) monetary/central bank freedom and presence of a democratic left-wing government taken as instruments for the existence of restrictions; using alternate samples; defining the dependent variable in alternate ways

IMPLICATIONS

- Estimates suggest that pre-GFC flows to emerging Europe and the Eurozone peripheral countries would have been substantially lower in the presence of capital account restrictions at either end
- Similarly for Latin America and Asia in the post-crisis surge in inflows

Figure: Potential Impact of CARs on Cross-Border Bank Flows (in percent)



Note: Left and right hand panels show the change in predicted flows (in percent) if all source countries imposed a financial credit outflow control; if all recipient countries imposed restriction on FX lending; and if all source and recipient countries imposed these measures together in 2007 and 2010, respectively.

**SPIILLOVERS ACROSS RECIPIENT
MEASURES
(RECIPIENT-RECIPIENT COOPERATION)**

SPILLOVERS ACROSS RECIPIENT COUNTRIES

- If recipient country restrictions are effective in reducing the volume of cross-border bank inflows, do they deflect flows to other countries?
 - Evidence suggests that the volume of bank flows received by the recipient country is significantly larger when its neighbors (defined in terms of regional or economic similarity) are financially relatively closed
 - Note though that neighbor controls comingle both “walls” and “gates”

SPILLOVERS ACROSS RECIPIENT COUNTRIES

| | Regional neighbors | | | | | | | Economic neighbors | | | | | | |
|---|----------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| Inflow controls in neighbors _j | 3.840** (1.843) | 3.609** (1.831) | 4.272** (1.835) | 4.261** (1.840) | 4.000** (1.843) | 4.038** (1.821) | 4.488** (1.833) | 5.790*** (1.721) | 5.631*** (1.723) | 6.050*** (1.712) | 6.007*** (1.727) | 5.854*** (1.718) | 6.028*** (1.719) | 5.992*** (1.716) |
| Capital outflow controls index _i | -2.992*** (1.016) | | | | | | | -2.942*** (1.020) | | | | | | |
| Capital inflow controls index _j | -1.751* (0.999) | | | | | | | -1.727* (0.991) | | | | | | |
| Bond outflow controls index _i | -1.470* (0.830) | | | | | | | -1.425* (0.834) | | | | | | |
| Bond inflow controls index _j | -1.857*** (0.667) | | | | | | | -1.717** (0.668) | | | | | | |
| Equity outflow controls index _i | -2.311*** (0.860) | | | | | | | -2.279*** (0.864) | | | | | | |
| Equity inflow controls index _j | 0.031 (0.749) | | | | | | | 0.052 (0.745) | | | | | | |
| Direct investment outflow controls index _i | -4.013*** (0.995) | | | | | | | -4.011*** (0.992) | | | | | | |
| Direct investment inflow controls index _j | 0.685 (0.786) | | | | | | | 0.532 (0.787) | | | | | | |
| Financial credit outflow controls index _i | -1.438*** (0.526) | | | | | | | -1.411*** (0.527) | | | | | | |
| Financial credit inflow controls index _j | -0.756 (0.534) | | | | | | | -0.777 (0.530) | | | | | | |
| Lending to nonresidents _i | -5.489*** (1.168) | | | | | | | -5.548*** (1.177) | | | | | | |
| Lending locally in FX _j | -1.720*** (0.664) | | | | | | | -1.748*** (0.660) | | | | | | |
| Open FX position limits _i | 0.397 (0.628) | | | | | | | 0.449 (0.632) | | | | | | |
| Open FX position limits _j | -1.192* (0.658) | | | | | | | -1.063 (0.653) | | | | | | |
| Country-pair/year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,257 | 22,007 | 22,007 | 22,007 | 22,007 | 22,007 | 22,007 | 22,007 |
| No. of source (recip.) countries | 31 (76) | 31 (76) | 31 (76) | 31 (76) | 31 (76) | 31 (76) | 31 (76) | 31 (74) | 31 (74) | 31 (74) | 31 (74) | 31 (74) | 31 (74) | 31 (74) |

CONCLUSIONS

KEY TAKEAWAYS

- Valid macro and financial stability reasons to impose capital controls
- Controls may give rise to spillovers but spillovers do not per se give rise to case for coordination
- Coordination, however, may be desirable if
 - Controls are distortionary/costly \Rightarrow coordination among borrowers
 - When costs are convex \Rightarrow both inflow and outflow controls, which are incentive compatible for both the borrower and lender
- Empirical evidence suggests that there is scope for greater international cooperation in managing large and volatile cross-border flows. Thus,
 - Where administrative capacity and treaty obligations permit, tackling flows at both the source and receiving ends can result in globally more efficient outcomes if the cost of imposing restrictions is convex (as seems plausible)
 - Coordination among recipient countries could help prevent costly “capital control wars” in the presence of cross-border spillovers from measures in recipient countries

Thank you



A SIMPLE FRAMEWORK

The representative agent lives for two periods, maximizing lifetime utility:

$$V(p, I) = \text{Max } u(c_1) + \beta u(c_2)$$

$$c_1 = y_1 + b \quad c_2 = y_2 - pb + T - \xi(b) - \delta(\tau)$$

$$\xi(b), \xi' > 0, \xi(0) = 0, \xi'(0) = 0 \quad \text{financial-stability externality}$$

$$\delta(\tau), \delta' > 0, \delta(0) = 0, \delta'(0) = 0 \quad \text{distortionary cost of capital control}$$

$$p = (1 + r); p = \hat{p} + \tau; I = py_1 + y_2 + \tau b - \xi b - \delta(\tau)$$

Consumer's first-order condition: $u_c(c_1) = \beta p u_c(c_2)$

which implies: $b = b(\hat{p}, \tau); b_{\hat{p}} < 0, b_{\tau} < 0$

Government's problem: $\text{Max}_{\tau} V(p, I)$

subject to resource constraints and $u_c(c_1) = \beta(\hat{p} + \tau)u_c(c_2)$

$$\frac{dV}{d\tau} = \frac{dV}{dI} \left\{ b \left(1 - \frac{dp}{d\tau} \right) + (\tau - \xi) \frac{db}{d\tau} - \delta'(\tau) \right\} = 0 \Rightarrow \tau = \left(\frac{b(d\hat{p}/d\tau)}{(db/d\tau)} \right) + \xi - \left(\frac{\delta'(\tau)}{-(db/d\tau)} \right)$$

A SIMPLE FRAMEWORK—NASH EQUILIBRIUM

$$\tau = \underbrace{\left(\frac{b(d\hat{p} / d\tau)}{(db / d\tau)} \right)}_{\text{terms of trade}} + \underbrace{\xi}_{\text{externality}} - \underbrace{\left(\frac{\delta'(\tau)}{-(db / d\tau)} \right)}_{\text{distortion vs. reduced borrowing}}$$

Assume there are n identical borrowing countries each with mass $(1/n)$

Credit supply is $\hat{p} = \hat{p}(\sum_{i=1}^n (b_i / n))$, $\hat{p}'(\cdot) > 0$

$$d\hat{p} = \frac{\hat{p}_b \left(\sum_{i=1}^n (b_\tau^i / n) d\tau^i \right)}{\left(1 - \hat{p}_b \sum_{i=1}^n (b_{\hat{p}}^i / n) \right)}$$

Under Nash: $\partial \tau_j / \partial \tau_i = 0 \forall j \neq i$.

$$(d\hat{p} / d\tau)^N = \frac{\hat{p}_b (b_\tau / n)}{(1 - b_{\hat{p}})} \leq 0;$$

$$(db / d\tau)^N = b_{\hat{p}} \left(1 + \frac{\hat{p}_b (b_\tau / n)}{(1 - b_{\hat{p}})} \right) < 0$$

$$\lim_{n \rightarrow \infty} (d\hat{p} / d\tau)^N = 0$$

$$\lim_{n \rightarrow \infty} (db / d\tau)^N = b_{\hat{p}}$$

A SIMPLE FRAMEWORK—COOPERATIVE EQUILIBRIUM

$$\tau = \underbrace{\left(\frac{b(d\hat{p} / d\tau)}{(db / d\tau)} \right)}_{\text{terms of trade}} + \underbrace{\xi}_{\text{externality}} - \underbrace{\left(\frac{\delta'(\tau)}{-(db / d\tau)} \right)}_{\text{distortion vs. reduced borrowing}}$$

$$d\hat{p} = \frac{\hat{p}_b \left(\sum_{i=1}^n (b_\tau^i / n) d\tau^i \right)}{\left(1 - \hat{p}_b \sum_{i=1}^n (b_{\hat{p}}^i / n) \right)}$$

Under cooperation: $\partial\tau_j / \partial\tau_i = 1 \forall j \neq i$.

$$(d\hat{p} / d\tau)^c = \frac{\hat{p}_b b_\tau}{(1 - b_{\hat{p}})} \leq 0 \quad (db / d\tau)^c = b_{\hat{p}} \left(1 + \frac{\hat{p}_b b_\tau}{(1 - b_{\hat{p}})} \right) < 0$$

$$\lim_{n \rightarrow \infty} (d\hat{p} / d\tau)^c = \frac{\hat{p}_b b_\tau}{(1 - b_{\hat{p}})} \leq 0 \quad \lim_{n \rightarrow \infty} (db / d\tau)^c = b_{\hat{p}} \underbrace{\left(1 + \frac{\hat{p}_b b_\tau}{(1 - b_{\hat{p}})} \right)}_{< 1} < 0$$

A SIMPLE FRAMEWORK—NASH VS. COOPERATIVE

$$\tau = \underbrace{\left(\frac{b(d\hat{p} / d\tau)}{(db / d\tau)} \right)}_{\text{terms of trade}} + \underbrace{\xi}_{\text{externality}} - \underbrace{\left(\frac{\delta'(\tau)}{-(db / d\tau)} \right)}_{\text{distortion vs. reduced borrowing}}$$

$$\lim_{n \rightarrow \infty} \tau^N = \xi - \left(\frac{\delta'(\tau)}{-b_{\hat{p}}} \right) \quad \tau^C = b \left(\frac{\frac{\hat{p}_b b_\tau}{(1 - b_{\hat{p}})}}{b_{\hat{p}} \left(1 + \frac{\hat{p}_b b_\tau}{(1 - b_{\hat{p}})} \right)} \right) + \xi - \left(\frac{\delta'(\tau)}{-b_{\hat{p}} \left(1 + \frac{\hat{p}_b b_\tau}{(1 - b_{\hat{p}})} \right)} \right)$$

Ignoring terms of trade manipulation, necessarily $\tau^N \geq \tau^C$
because Nash overestimates effect of tax on reducing borrowing

Hence, gains from coordination among borrowers (unless distortionary cost of capital controls is zero):

$$\delta' = 0 \Rightarrow \tau^N = \tau^C$$

A SIMPLE FRAMEWORK—BORROWER-CREDITOR COOPERATION

Borrower: $V(P, I) = \text{Max } u(c_1) + \beta u(c_2)$

$$c_1 = y_1 + b$$

$$c_2 = y_2 - (\hat{p} + \tau)b + \bar{z} = y_2 - (\hat{p} + \tau)b + \tau b - \xi(b) - \delta(\tau)$$

Creditor: $V^*(P^*, I^*) = \text{Max } u(c_1^*) + \beta^* u(c_2^*)$

$$c_1^* = y_1^* - b$$

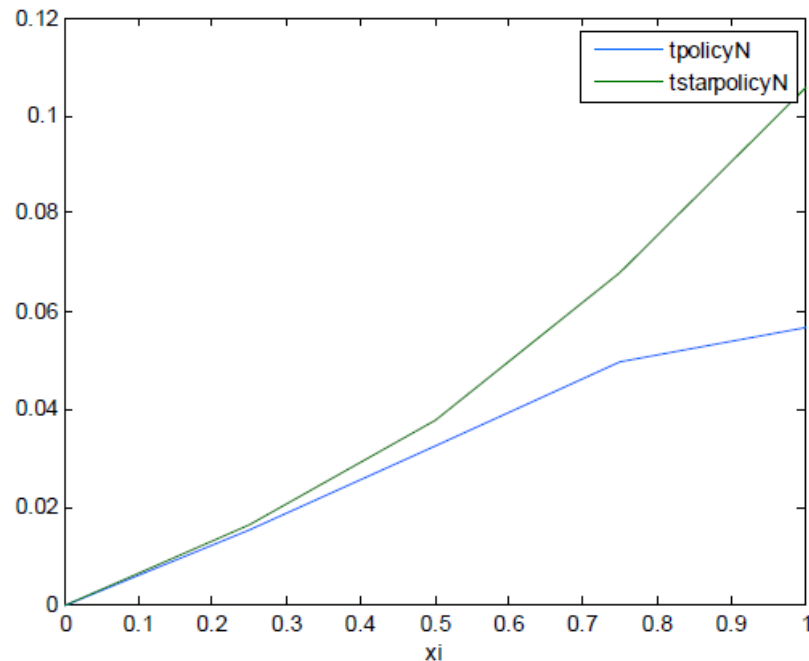
$$c_2^* = y_2^* + (\hat{p} - \tau^*)b + \bar{z}^* = y_2^* + (\hat{p} - \tau^*)b + \tau^* b - \delta^*(\tau^*)$$

Global planner:

$$W = \left\{ \omega V(P, I) + (1 - \omega) V^*(P^*, I^*) \right\} \quad \omega / (1 - \omega) = (dV^* / dI^*) / (dV / dI)$$

$$\tau + \tau^* = \xi - \frac{[\delta'(\tau) + \delta^{*'}(\tau^*)]}{-(db / d\tau)}$$

A SIMPLE FRAMEWORK—BORROWER AND CREDITOR GLOBAL PLANNER—INCENTIVE COMPATIBLE



With convex costs, the global planner splits the tax between borrower and creditor. This is incentive compatible for the borrower because of the lower financial-stability risk; and for the creditor because of the terms of trade gain.

A SIMPLE FRAMEWORK—SUMMARY

- Decentralized economy—too much borrowing because atomistic agents do not take account of externalities (Korinek)
- Coordination among borrowers is beneficial if controls are distortionary/costly because in the Nash equilibrium, each sets too high an inflow tax
- The gains from coordination are larger when countries are atomistic
- When costs are convex, a global social planner would impose both inflow and outflow controls, which are incentive compatible for both the borrower and lender