Macroprudential Policy Coordination in Emerging Markets: A Multicountry Framework

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Prelude: Dissertation outline

Broad Topic of interest: **Design of Macroprudential Policies in Emerging Economies**

Possible related features:

- **Menu of policy tools** $\longrightarrow$ [Welfare] Effects (on the goal, spillovers)

  Analysis and comparison

- **What agents to target?**(borrowers, lenders, banks, households)

- **How to implement:**
  - Timing (prudential vs. crisis management)
  - Coordination issues (Cooperation vs. decentralized) **[this paper]**

Introduction

Macroprudential Policies (MaP): regulatory policies aimed at preserving the stability of the financial system.

Why are needed?:

- First Best: Financial Markets allow flow of resources to more productive destinations.

  Distortions may prevent productive countries from atracting capital flows: Gourinchas, Fahri, Caballero (2008, 2016)

- Problem: Countries are subject to the Global Financial Cycle and too volatile credit dynamics (H. Rey, 2013).

  K Flows don't matter as much as their timing or the sudden stops.
  Issues of excesive risk taking and overborrowing.
  } Imply strong externalities

What do we know about MaP policies?:

Forbes, 2019 AER P&P:

"*there is accumulating evidence that it can be effective on its direct targets,* ***albeit often with unintended leakages and spillovers****. There has been less progress in terms of understanding the ramifications of these leakages*".

How to "MacroPru"?:

If effective, should MaP be applied indiscriminately? ... Not necessarily:

- Trade-offs between other policy goals and Financial Stability (Rey and Coimbra, 2017)
- Aggresive limitations can curtail long term investment flows.
- Cost of regulation (e.g., subsidies, acquiring FX reserves, etc.)
- MaP interdependency may lead to regulatory wars: Race to the Bottom.

A call for coordination:

Both institutions (BIS, 2017) and academics (Obstfeld, 2015; Schoemaker, 2011; and Claessens et al, 2010) refer to a new *Financial Trilemma*:

· Financial Stability · International Integration · Independent Financial Regulation

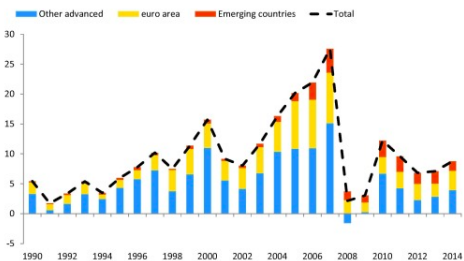
The three can't be achieved in isolated action due to the interdependence of the MaP.

Why to focus on Emerging Markets?

- EMEs are more vulnerable to risks (more frequent financial crises and shallow financial systems):

  Higher corporate debt (new sources of lending given less banking intermediation), currency risk (e.g., Argentina, Turkey, Brazil, Thailand), lower credit quality, loose regulation enforcement (China: Shadowbanking)

- AE: Connectedness has decreased since the GFC. In contrast, **the flows toward EMEs have gained traction.**



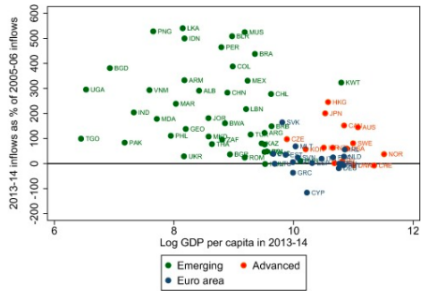


Figure: International Capital Flows (left), Capital Flows and GDP per Capita (right). (McQuade and Scmidht (JIMF, 2017))

Research Questions:

- Are there global gains from MaP policy coordination when interacting with EMEs?
- Under what conditions EMEs want to coordinate policy tools?
  - How are MaP tools set in each policy setup?
- Does EMEs coordination matter for a financial center?

Research Questions:

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- Does EMEs coordination matter for a financial center?

Context: Financially integrated peripheries, subject to international spillovers from financial centers.

[Def.] Emerging Market/periphery: Financially constrained economy that depends on the lending from a center.

Interbank lending is subject to agency costs $\longrightarrow$ reflective of their financial under-development.

Consequence: positive credit spread in equilibrium.

Aim: Assess welfare gains of different policy schemes in emerging markets

Key Features/Ingredients:

Multiple EMEs: My research questions concern peripheral interactions (feature not explored in MaP literature yet)

Banks

Intermediated Capital Accumulation

Center-Periphery structure

Agency frictions at the emerging bank level

Financial Regulation Tool

Macroprudential Tool used: tax on banking rates

literature

Where this paper stands in the literature?: the studies leading to my paper involve the following contributions

- **Financial Accelerator Channel:**

  Bernanke, Gertler and Gilchrist (1999), also: Gertler and Kiyotaki (1997), Bernanke and Gertler (1989)

- **Explicit banks modelling**:

  Gertler and Karadi (2011, JIE), Gertler and Kiyotaki (2010), Adrian and Shin (2010)

- **Macroprudential issues in EMEs:**

  Bianchi (2011, AER): Overborrowing and pecuniary collateral externalities.

  Nuguer (2016), Nuguer and Cuadra (2016, RED): Cross border balance sheet effects from AEs to EMEs.

  Benigno, Kiyotaki, Aoki (2018, wp): Optimal MaP pol. setting in a SoE with different types of debt risk.

  Cespedes, Chang and Velasco (2017, JIE): Unconventional policies for financially constrained economies and banks.

- **Coordination of policies involving MaP features.**

  Banerjee, Devereux and Lombardo (2015, JIMF), Fujiwara and Teranishi (2017, JIE): Monetary Pol. coordination in presence of financial frictions and MaP regulation.

  De Paoli and Paustian (2017, JMCB): Coordination between Central Bank and Financial Regulator.

▸ literature elements in model

literature (cont.)

- **Coordination of Macroprudential Policies:**

  Kara (2016, JIE): Coord. of K adequacy requirements in 2 country model.

  Agenor et al (2018, BIS wp 643.): Policy coordination of MaP.

  Deveraux and Davis (2019, NBER wp): Policy coordination of MaP taxes on capital flows on Large Open Economies.

  Jin and Shen (2020, RED): NFA accumulation policy coordination within Periphery block.

  Bengui (wp, R&R AEJ: Macro): Coordination of liquidity regulation with pecuniary externalities and ToT manipulation

  Korinek (2020, RES): Theory for First Welfare Theorem for Open Economies. Coordination of capital controls

Results:

DD2019, Bengui(2020): Coord. Gains due to Planners Internalizing ToT manipulation motive

JS2020: Gains from aggregating SoE decisions and Coord. planner internalizing $\sum SoE$ effect on global int. rates.

K2020: No Gains iff: planners price takers + Effective-flexible (costless) tools + Internat. Frictionless markets.

Kara(2016): Gains from coord. due to strong Free Riding Policy incentives under Nash eq.

literature (cont.)

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Differences with this study:

1. No banks	this paper: banks with frictions and regulation
2. Only Center-Periphery effects	this paper: P-C and P-P (with spillovers from center)
3. No role for center	this paper: Active policy-making by Center

This Paper:
Multi-country policy coordination + MaP targeted at banks and with focus on EMEs

Contribution to literature

My paper explores:

- Welfare spillovers between different types of countries (center-periphery, periphery-periphery)
- Whether the interactions within a peripheric block change structure of the MaP optimal policies
- Optimal taxes setup under different policy frameworks
- Study of features shaping [AE and EMEs] incentives for coordination
  when is the policy tool set differently between peripheries?

To do this, we consider the following cases:

Table: Cases to Analize

Case	Solutions
Nash	$RPP^i = \max \hat{W}^i, \quad \text{for } i = \{e_1, e_2, c\}$
Coalition 1 (Emergent Economies - EMEs)	$RPP^{e_1,e_2} = \max n_1 \hat{W}^{e_1} + n_2 \hat{W}^{e_2} \quad \text{vs} \quad RPP^c = \max \hat{W}^c$
Coalition 2 (Center and EME-1)	$RPP^{e_1,c} = \max n_1 \hat{W}^{e_1} + (1 - n_1 - n_2) \hat{W}^c \quad \text{vs} \quad RPP^{e_2} = \max \hat{W}^{e_2}$
Cooperation	$RPP = \max n_1 \hat{W}^{e_1} + n_2 \hat{W}^{e_2} + (1 - n_1 - n_2) \hat{W}^c$

Note: The world consists of 3 countries $i = \{e_1, e_2, c\}$ where the sizes are respectively $n_1, n_2, 1 - n_1 - n_2 > 0$ and $n_1 + n_2 \leq 1/2$.

Outline

- Model
- Welfare Effects of the Macroprudential Policies
  - Analysis of Social Planner Problem
  - Numerical effects
- Optimal Policy: Ramsey Planner Problems
  - Nash planners
  - Cooperative setups
- Baseline model results
- Model variants and experiments
- Conclusion

Results Preview:

- **Welfare Effects of MaP:** Present on the target and abroad.
- **Policy Spillovers:** Positive between countries.

  Center: *Weaker direct* effect. *Stronger cross-country*.
- **Effect grows with financial friction**

  Determinant of Effects: Asset positions, production distruption, profit (banking).
- **Cooperation Gains**: Not sizable in baseline model.
- **First Best**: mimicked by optimal policies.

  Welfare gains wrt No Policy
- Cooperation gains can arise: with inclusion of strong policy trade-offs.
- **Second Periphery:** Relevant if not replicate of first EME.

Roadmap of Talk

Model

Welfare Effects of Macroprudential Policies

Optimal Policy: Ramsey Planning Problem

Results

Conclusions

The Model: Simple two period economy with a banking sector

- General Equilibrium model with 3 economies: two emerging countries indexed by $\{a, b\}$ and a center (c)

  Population sizes: $n_j \geq 0$ with $n_c = 1 - n_a - n_b \leq \frac{1}{2}$

- 2 periods model (finite horizon): captures basics of intermediation by banks
- Symmetric preferences and the Law of one price holds $\longrightarrow$ PPP holds
- Agents: Households, Firms (final and investment goods), Banks and Goverment (regulator)
- **Key:** capital accumulation in EMEs $\longrightarrow$ funded with foreign lending
- EME banks subject to financial agency frictions

Environment

Financial Flows in the model

Households assets: international bonds and deposits (center).

Firms funded with banking loans.

Interbank lending between economies.

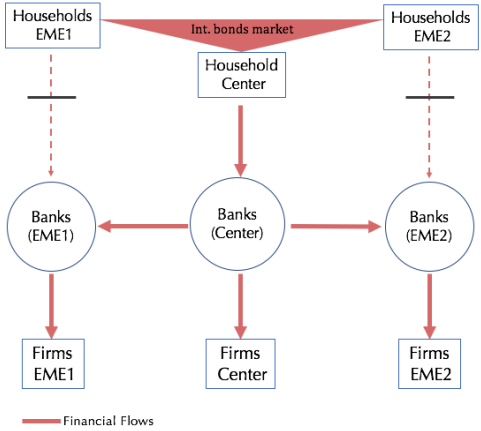

Figure: Financial flows in the model

Investors

Investment separated from the household decisions and subject to adjustment costs $\Rightarrow$ Capital Rel. Price is dynamic.

The investor solves:

$$\max_{I_1} \; Q_1 I_1 - I_1 \left(1 + \frac{\zeta}{2}\left(\frac{I_1}{\bar{I}} - 1\right)^2\right)$$

Where $\bar{I}$ is the reference level (we choose I_0).

the F.O.C is,

$$[I_1]: \qquad Q_1 = 1 + \frac{\zeta}{2}\left(\frac{I_1}{\bar{I}} - 1\right)^2 + \zeta\left(\frac{I_1}{\bar{I}} - 1\right)\frac{I_1}{\bar{I}}$$

Similarly, for period 2 (when investment is zero),

$$Q_2 = 1 + \frac{\zeta}{2}$$

Firms

Technology: The firm operates with a Cobb-Douglas technology that aggregates capital: $Y_t = A_t(\xi_t K_{t-1})^{\alpha}$

Capital:

- The capital dynamics for accumulation period: $K_1 = I_1 + (1-\delta)\xi_1 K_0$
- First period: given capital (K_0), rented directly to firms by households $\rightarrow$ Standard Firm PMP in $t = 1$
- Second period: **the EME relies on lending for funding capital accumulation** $\rightarrow$ firms fund K_1 with banks loans.

The problem of the firm in the second period is:

$$\max_{K_1} \ \pi_{f,2} = Y_2 + Q_2(1-\delta)\xi_2 K_1 \quad - \quad \underbrace{R_{k,2} Q_1 K_1}_{\text{Repayment to bank}} \qquad s.t. \quad Y_2 = A_2(\xi_2 K_1)^{\alpha}$$

Gross Intermediation Returns

Solving from F.O.C., we get $R_{k,2}$, the gross **return from intermediation for the bank**

This rate will be variable targeted by the policy tool:

$$R_{k,2} = \frac{(1-\tau)r_2 + (1-\delta)\xi_2 Q_2}{Q_1} \qquad \text{After tax rate}$$

With $r_2 = \frac{\partial Y_2}{\partial K_1}$ and τ is the macro-prudential policy tool: a tax/subsidy on the bankers revenue rate.

The tax is NOT paid by the firms but by the banks directly.

Government

Setting and enforcing the rate is the only role of the government which will have a balanced budget constraint:

$$T + \tau r_2 K_1 = 0$$

Banks

- Target sector of MaP Policies. Set up based in Gertler and Karadi (2011).
- Financial intermediation sector in $t = 1$ that facilitates funding

  At interbank and firms level.

Financial under-development of the EMEs will be reflected:

- EME creditors are subject to an Incentive Compatibility Constraint $\longrightarrow$ can divert a portion of assets intermediated.

  After realizing the return on capital holdings
- EME: limited capacity of intermediation

  will NOT have be able to hold local deposits from households

  will rely on foreign lending from the center bank in order to supply capital to the firms.

Agency problem: debtor bank can default and divert a portion κ of the assets.

The EME bank solves:

$$\max_{F_1, L_1} J_1 = \mathbb{E}_1 \Lambda_{1,2} \pi_{b,2} = \mathbb{E}_1 \Lambda_{1,2} (R_{k,2} L_1 - R_{B,1} F_1)$$

$$s.t. \quad L_1 = F_1 + \delta_B Q_1 K_0 \qquad \text{[Balance sheet]}$$

$$J_1 \geq \kappa \mathbb{E}_1 \Lambda_{1,2} R_{k,2} L_1 \qquad \text{[ICC]}$$

$L_1 = Q_1 K_1$: total lending intermediated, F_1: foreign borrowing and $\delta_B Q_1 K_0$: household bequest.

The F.O.C. implies a positive credit spread when the ICC binds:

$$[F_1]: \qquad \mathbb{E}_1 (R_{k,2} - R_{B,1}) = \mu \mathbb{E}_1 \left(\kappa R_{k,2} - (R_{k,2} - R_{B,1}) \right)$$

μ: Lagrange multiplier of the ICC.

The center economy bank is frictionless and solves:

$$\max_{F_1, L_1, D_1} \; J_1 = \mathbb{E}_1 \Lambda_{1,2} \pi^c_{b,2} = \mathbb{E}_1 \Lambda_{1,2} (R^a_{B,1} F^a_1 + R^b_{B,1} F^b_1 + R^c_{k,2} L^c_1 - R_{D,1} D_1)$$

$$s.t. \quad F^a_1 + F^b_1 + L^c_1 = D_1 + \delta_b Q^c_1 K^c_0$$

the associated F.O.C. are:

$$[F^a_1]: \quad \mathbb{E}_1 (R^a_{B,1} - R_{D,1}) = 0$$
$$[F^b_1]: \quad \mathbb{E}_1 (R^b_{B,1} - R_{D,1}) = 0$$
$$[L^c_1]: \quad \mathbb{E}_1 (R^c_{k,2} - R_{D,1}) = 0$$

In this case the problem and resulting conditions are simpler given I assume there is No agency problem in the Center economy.

Leverage and Credit Spread Implications from banking setup

Proposition 1: *If the ICC binds the credit spread is positive and increases in κ and μ*

From EME Banks F.O.C.:

$$R_{k,2} = \underbrace{\frac{1+\mu}{1+(1-\kappa)\mu}}_{\Phi>1} R_1$$

$\Phi > 1$ guarantees the credit spread is positive. The larger Φ the greater the spread ($R_{k,2} - R_1 \propto \Phi$).

$\mu > 0$ (def. of ICC). It follows that,

$$\frac{\partial \Phi}{\partial \kappa} = \frac{\mu(1+\mu)}{(1-(1-\kappa)\mu)^2} > 0$$

and,

$$\frac{\partial \Phi}{\partial \mu} = \frac{2(1-\kappa)\mu - \kappa}{(1-(1-\kappa)\mu)^2} > 0$$

These results are relevant to understand the role of the friction $\longrightarrow$ can exogenously increase the financial friction by $\uparrow \kappa$

Macroprudential policy tool

Several MaP policies available. We consider one of the general types, a tax targeted at the banks. This can encompass other types of policies (leverage constraints, capital controls, among others).

In addition, the planner compares whether to set the tax individually or cooperatively.

We can map the leverage with the MaP Tax:

Proposition 2: *An increase in the tax lowers the leverage ratio of banks*

$$L_1 = \underbrace{\frac{R^e_{b,1}}{R^e_{b_1} - (1-\kappa^e)R_{k,2}}}_{\phi_L\text{: leverage ratio}} \delta_B Q^e_1 K^e_0$$

We can substitute $R^e_{k,2} = [(1-\tau^e)r^e_2 = (1-\delta)\xi^e_2 Q_2]/Q_1$ and differentiate with respect to τ^e:

$$\frac{\partial \phi_L}{\partial \tau^e} = -\frac{(1-\kappa^e)R^e_{b,1}(r^e_2)}{(R^e_{b,1} - (1-\kappa^e)R^e_{k,2})^2 Q^e_1} < 0$$

Households

The household lifetime utility is given by $U = u(c_1) + \beta u(c_2)$ with $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$.

The budget constraints for emergent markets in each period are the following:

Emerging markets:

$$C_1^s + \frac{B_1^s}{R_1^s} = r_1^s K_0^s + \pi_{f,1}^s + \pi_{inv,1}^s - \delta_B Q_1^s K_0^s$$
$$C_2^s = \pi_{f,2}^s + \pi_{b,2}^s + B_1^s - T^s, \quad for\ s = \{a, b\}$$

Advanced Economy:

$$C_1^c + \frac{B_1^c}{R_1^c} + \boldsymbol{D_1} = r_1^c K_0^c + \pi_{f,1}^c + \pi_{inv,1}^c - \delta_B Q_1^c K_0^c$$
$$C_2^c = \pi_{f,2}^c + \boldsymbol{\pi_{b,2}^c} + B_1^c + R_{D,1} D_1 - T^c$$

▸ HH (F.O.C.)

Market Clearing

- Int. Bonds: given at zero-net-supply

$$n_a B_1^a + n_b B_1^b + n_c B_1^c = 0$$

- Goods:

$$n_a \left(C_1^a + C(I_1^a)\right) + n_b \left(C_1^b + C(I_1^b)\right) + n_c \left(C_1^c + C(I_1^c)\right) = n_a Y_2^a + n_b Y_2^b + n_c Y_2^c$$

$$n_a C_2^a + n_b C_2^b + n_c C_2^c = n_a Y_2^a + n_b Y_2^b + n_c Y_2^c$$

where $C(I_1) = I_1(1 + (I_1/\bar{I} - 1)^2)$

Finally, given that there is only one final good and the law of one price holds ($RER = 1$), we have by an UIP argument:

$$R_1^a = R_1^b = R_1^c = R_1$$

where R denotes the world interest rate on bonds.

Equilibrium

The analysis is deterministic for now. The model is being set more generally, allowing for exogenous shocks in: Productivity, Capital quality, Financial Distortion:

$$A_t^j = \rho_A A_{t-1}^j + \sigma_A \epsilon_{A,t}^j \qquad \xi_t^j = \rho_\xi \xi_{t-1}^j + \sigma_\xi \epsilon_{\xi,t}^j \qquad \kappa_t^s = \rho_\kappa \kappa_{t-1}^s + \sigma_\kappa \epsilon_{\kappa,t}^s$$
$$\epsilon_{A,t}^j \sim N(0,1) \qquad \epsilon_{\xi,t}^j \sim N(0,1) \qquad \epsilon_{\kappa,t}^s \sim N(0,1)$$

tax-distorted competitive equilibrium: The solution will be a function of the parameters and the MaP taxes.

The original system of variables is simplified to a system with 24 variables, 16 for the first period, 8 for the second.

I use the dependency on taxes to perform a welfare analysis from policy making.

Simplified Equations used for solving the model (summary)

Common to all countries:

$$Q_1 = 1 + \frac{\zeta}{2}\left(\frac{I_1}{\bar{I}} - 1\right)^2 + \zeta\left(\frac{I_1}{\bar{I}} - 1\right)\frac{I_1}{\bar{I}} \qquad \text{[Price of Capital]}$$

$$K_1 = I_1 + (1-\delta)K_0 \qquad \text{[Capital Dynamics]}$$

$$R_{k,2} = \frac{(1-\tau)\alpha A_2 K_1^{\alpha-1} + (1-\delta)Q_2}{Q_1} \qquad \text{[Banks rate of return]}$$

$$C_1^{-\sigma} = \beta R_1 C_2^{-\sigma} \qquad \text{[Euler Equation w.r.t. Bonds]}$$

for EMEs:

$$R_{k,2}Q_1K_1 - R_1Q_1K_1 + R_1\delta_B Q_1K_0 = \kappa R_{k,2}Q_1K_1 \qquad \text{[ICC]}$$

$$R_{k,2} - R_1 = \mu\left(\kappa R_{k,2} - (R_{k,2} - R_1)\right) \qquad \text{[Credit Spread]}$$

$$C_1 + \frac{B_1}{R_1} = A_1K_0^{\alpha} + Q_1I_1 - C(I_1) - \delta_b Q_1K_0 \qquad \text{[BC for t=1]}$$

$$C_2 = (1-\alpha)A_2K_1^{\alpha} + R_{k,2}Q_1K_1 - R_1Q_1K_1 + R_1\delta_B Q_1K_0 + B_1 + \tau r_2K_1 \qquad \text{[BC for t=2]}$$

for the Center:

$$Q_1^aK_1^a - \delta_B Q_1^aK_0^a + Q_1^bK_1^b - \delta_B Q_1^bK_0^b + Q_1^cK_1^c = D_1 + \delta_B Q_1^cK_0^c \qquad \text{[Bal. Sheet of Banks]}$$

$$C_1 + \frac{B_1}{R_1} + D_1 = A_1K_0^{\alpha} + Q_1I_1 - C(I_1) - \delta_B Q_1K_0 \qquad \text{[BC for t=1]}$$

$$C_2^c = (1-\alpha)A_2^cK_1^{c\ \alpha} + R_1Q_1^aK_1^a - R_1\delta_B Q_1^aK_0^a + R_1Q_1^bK_1^b - R_1\delta_B Q_1^bK_0^b + R_1Q_1^cK_1^c + B_1^c + \tau^c r_2^cK_1^c \qquad \text{[BC for t=2]}$$

International Links:

$$n_aB_1^a + n_bB_1^b + n_cB_1^c = 0 \qquad \text{[Zero Net Supply of Bonds]}$$

Roadmap of Talk

Model

Welfare Effects of Macroprudential Policies

Optimal Policy: Ramsey Planning Problem

Results

Conclusions

Analytical Welfare Analysis

We set a social planner problem and analyze the welfare expressions following Davis and Deveraux (2019):

The welfare of a country is set as $W = U + \lambda_1 BC_1 + \beta\lambda_2 BC_2$:

$$W^s = U^s + \lambda_1^s \left(r_1^s K_0^s + \pi_{f,1}^s + \pi_{inv,1}^s - \delta_B Q_1^s K_0^s - C_1^s - \frac{B_1^s}{R_1^s} \right) \quad \text{(For EMEs)}$$
$$+ \beta\lambda_2^s \left(\pi_{f,2}^s + \pi_{b,2}^s + B_1^s - T^s - C_2^s \right) \quad \text{for } s = \{a, b\}$$

$$W^c = U^c + \lambda_1^c \left(r_1^c K_0^c + \pi_{f,1}^c + \pi_{inv,1}^c - \delta_B Q_1^c K_0^c - C_1^c - \frac{B_1^c}{R_1^c} - D_1 \right)$$
$$+ \beta\lambda_2^c \left(\pi_{f,2}^c + \pi_{b,2}^c + B_1^c + R_{D,1} D_1 - T^c - C_2^c \right) \quad \text{(For the Center)}$$

A non-cooperative planner will maximize the welfare of her country W^j.

In contrast, a global planner (the one acting under cooperation) will maximize: $W = n_a W^a + n_b W^b + n_c W^c$

▸ Welfare Analysis Method steps

We substitute the profits for banks and firms from the Competitive Equilibrium equations (ICCs included) and the tax rebates:

$$W^s = u(C_1^s) + \beta u(C_2^s) + \lambda_1^s \left(A_1^s {K_0^s}^{\alpha} + Q_1^s I_1^s - C(I_1^s) - C_1^s - \frac{B_1^s}{R_1^w} \right) \qquad \text{EMEs}$$
$$+ \beta \lambda_2^s \left(\phi(\tau^s) A_2^s {K_1^s}^{\alpha} + \kappa^s (1-\delta) Q_2^s K_1^s + B_1^s - C_2^s \right) \quad \text{for } s = \{a, b\}$$

$$W^c = u(C_1^c) + \beta u(C_2^c) + \lambda_1^c \left(A_1^c {K_0^c}^{\alpha} + Q_1^c I_1^c - C(I_1^c) - C_1^c - D_1^c - \frac{B_1^c}{R_1^w} \right)$$
$$+ \beta \lambda_2^c \left(A_2^c K_1^{\alpha} + R_{b,1}^a F_1^a + R_{b,1}^b F_1^b + (1-\delta) Q_2^c K_1^c + B_1^c - C_2^c \right) \qquad \text{Center}$$

with $\phi(\tau) = 1 - \alpha(1-\kappa)(1-\tau)$

From this welfare expressions we will obtain the effects of taxes via implicit differentiation and will simplify with the FOCs of the Competitive Equilibrium.

Each economy's planner will take W^j as their welfare function. In contrast, the cooperative welfare would be a sum of the individual welfare expressions.

Direct Effects

Welfare effect of the tax for EMEs:

$$\frac{dW^a}{d\tau^a} = \underbrace{\lambda_1^a I_1^a \frac{dQ_1^a}{d\tau^a}}_{\substack{\text{Changes in inv.profits} \\ ①}} + \underbrace{\beta\lambda_2^a \frac{B_1^a}{R_1^w}\frac{dR_1^w}{d\tau^a}}_{\substack{\text{Changes in bonds rate} \\ ②}} + \underbrace{\beta\lambda_2^a\left(\phi(\tau^a)\alpha A_2^a {K_1^a}^{\alpha-1} + \kappa^a(1-\delta)Q_2^a\right)\frac{dK_1^a}{d\tau^a}}_{\substack{\downarrow \text{ in welfare by hindering K accumulation} \\ ③}} + \underbrace{\beta\lambda_2^a\alpha(1-\kappa^a)A_2^a {K_1^a}^{\alpha}}_{\text{Direct effect of } \tau}$$

①: sign depends on whether investing above/below reference level

②: proportional to Foreign Assets Position. Sign changes for borrower/lender.

③: proportional profit sources from K (MPK and resale value). Effect grows in τ, κ.

Welfare Effects

Nash Case (Cont.)

Direct effect for Center:

$$\frac{dW^c}{d\tau^c} = \lambda_1^c I_1^c \frac{dQ_1^c}{d\tau^c} + \beta\lambda_2^c \frac{B_1^c}{R_1^w}\frac{dR_1^w}{d\tau^c} + \beta\lambda_2^c \left(\alpha A_2^c {K_1^c}^{\alpha-1} + (1-\delta)Q_2^c\right)\frac{dK_1^c}{d\tau^c}$$
$$+ \underbrace{\beta\lambda_2 \left[R_{b,1}^{eme}\left(\frac{dF_1^a}{d\tau^c} + \frac{dF_1^b}{d\tau^c}\right) + \frac{dR_{b,1}^{eme}}{d\tau^c}\left(F_1^a + F_1^b\right)\right]}_{\substack{\text{welfare effect of changes} \\ \text{in intermediation profits} \\ \textcircled{4}}}$$

④: interbank lending quantities and rates effects from $\uparrow \tau^c$

Cross-country effects: will have a similar structure, but without direct effects for peripheries.

▸ Cross-country Effects

Optimal tax

For obtaining the optimal tax: set $\frac{dW^a}{d\tau^b} = 0$ and solve for τ^a:

$$\tau^{a\,*} = -\frac{1}{\alpha(1-\boldsymbol{\kappa^a})}\left\{\frac{1}{\alpha A_2^a \xi_2^a\, {}^{\alpha} K_1^{a\;\alpha-1}}\left[\left(R_1 I_1^a \frac{dQ_1^a}{dK_1^a} + \frac{B_1^a}{R_1}\frac{dR_1}{dK_1^a}\right) + \boldsymbol{\kappa^a}(1-\delta)\xi_2^a Q_2\right] + 1 + \alpha(\boldsymbol{\kappa^a}-1)\right\}$$

Relevant features:

- Effects driving the tax are **amplified with the friction** (κ)
  - But sign of $(\cdot)$ term tends to be negative $\Rightarrow$ sign of optimal tax is hard to determine $\longrightarrow$ Depends on reference point for derivatives
- Decreases with Marginal Productivity of K
- Investment $\lessgtr \bar{I}$
- country being a saver of borrower and change in int. bonds rate

We follow a similar process for obtaining an expression for the optimal tax in the center.

Optimal tax (cont.)

For c:

$$\tau^{c\,*} = \frac{Q_1^c}{\alpha A_2^c \xi_2^{c\,\alpha} K_1^{c\,\alpha-1}} \left\{ R_1 I_1^c \frac{dQ_1^c}{dF_1^S} + \frac{B_1^c}{R_1} \frac{dR_1}{dF_1^S} + (\alpha A_2^c \xi_2^{c\,\alpha} K_1^{c\,\alpha-1} + (1-\delta)\xi_2^c Q_2) \frac{dK_1^c}{dF_1^S} \right.$$
$$\left. + (F_1^a + F_1^b) \frac{dR_{b,1}^{eme}}{dF_1^S} + (1-\delta)\xi_2^c \frac{Q_2}{Q_1^c} \right\} + 1$$

with $dF_1^S = dF_1^a + dF_1^b$

- prevalent role for cross-border lending variables.
- Quantities role is analogous to physical capital effects on EMEs.

In both expressions: Inside brackets sign may not coincide: policy trade-off.

Cooperative cases

The welfare for the cooperative setups can be obtained as weighted averages from Nash results:

Table: Welfare spillovers in the model

	Planners	Obj. Function	Effect of taxes
Case: Cooperation (all countries)			
	World	$W = n_a W^a + n_b W^b + n_c W^c$	$\frac{dW}{d\tau^j} = n_a \frac{dW^a}{d\tau^j} + n_b \frac{dW^b}{d\tau^j} + n_c \frac{dW^c}{d\tau^j}$
Case: Semi-Cooperation (EMEs vs. Center)			
	Periphery block A+B	$W^{ab} = n_a W^a + n_b W^b$	$\frac{dW^{ab}}{d\tau^j} = n_a \frac{dW^a}{d\tau^j} + n_b \frac{dW^b}{d\tau^j}$
	Center	W^c	$\frac{dW^c}{d\tau^j}$
Case: Semi-Cooperation (EME-A + C vs. EME-B)			
	Cooperative A+C	$W^{ac} = n_a W^a + n_c W^c$	$\frac{dW^{ac}}{d\tau^j} = n_a \frac{dW^a}{d\tau^j} + n_c \frac{dW^c}{d\tau^j}$
	EME-B	W^b	$\frac{dW^b}{d\tau^j}$

Note: $j = a, b, c$

Simulation results

Simulation choices

The model is solved using non-linear methods. For the private model we must provide the taxes as a parameter.

Parameter choices

Parameter		Value	Comment/Source
Adjustment costs of investment	ζ	4.65	Cespedes, Chang and Velasco (2017)
Start-up transfer rate to banks	δ_b	0.005	Gertler and Karadi (2011), Gertler and Kiyotaki (2010)
Fraction of capital that can be diverted	$\kappa^a = \kappa^b$	0.399	Aoki, Benigno and Kiyotaki (2019)
Discount factor	β	0.99	
Risk Aversion parameter	σ	2	
Country size	$n_a = n_b$	0.25	
Depreciation rate	δ	0.6	Targets a longer than quarterly period duration $\sim$ 5 years
Capital share	α	0.333	

Predetermined variables: $K_0^a,\ K_0^b,\ K_0^c,\ \bar{I}^a,\ \bar{I}^b,\ \bar{I}^c$

We use literature values for the parameters. Given the model simplicity, most of them won't change drastically relative to quarterly calibration counterparts.

Welfare Effects

Table: Welfare effect of 1% increase in taxes

Direct Effects	
$\tau_a \to W^a$	-1.560
$\tau_b \to W^b$	-1.560
$\tau_c \to W^c$	-0.847

Cross-country Effects	
$\tau_a \to W^b$	-0.078
$\tau_a \to W^c$	-0.039
$\tau_b \to W^a$	-0.078
$\tau_b \to W^c$	-0.039
$\tau_c \to W^a$	-0.308
$\tau_c \to W^b$	-0.308

- Stronger Direct effect

The welfare gain is approximated, based on the numerical results, as: $\frac{\partial W^j}{\partial \tau^k} \approx \frac{\Delta W^j}{\Delta \tau^k} = \frac{W^j_{\tau^k=0.01} - W^j_{\tau=0}}{\tau^k - 0}$

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- Stronger Direct effect

- Positive MaP Policy Spillovers.

A welfare increasing policy is *prosper-thy-neighbor*

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$\tau_c \to W^b$	-0.308

- Stronger Direct effect

- Positive MaP Policy Spillovers.

A welfare increasing policy is *prosper-thy-neighbor*

- Policy free riding incentives.

- Stronger cross-country effects from the center.

Together with weaker direct effect $\Rightarrow$ Strong Spillovers

- EME tax effects are stronger between peripheries

The welfare gain is approximated, based on the numerical results, as: $\frac{\partial W^j}{\partial \tau^k} \approx \frac{\Delta W^j}{\Delta \tau^k} = \frac{W^j_{\tau^k=0.01} - W^j_{\vec{\tau}=0}}{\tau^k - 0}$

Results are robust to parameter changes

Table: Welfare effect of 1% increase in taxes - parameter changes

	Baseline	Symmetric Country size	Smaller periphery	Lower financial friction (-20%)	Higher financial friction (+20%)
Direct Effects					
$\tau_a \to W^a$	-1.560	-1.637	-1.498	-1.375	-1.763
$\tau_b \to W^b$	-1.560	-1.637	-1.498	-1.375	-1.763
$\tau_c \to W^c$	-0.847	-0.877	-0.811	-0.819	-0.870
Cross-country Effects					
$\tau_a \to W^b$	-0.078	-0.045	-0.089	-0.092	-0.062
$\tau_a \to W^c$	-0.039	-0.012	-0.056	-0.056	-0.025
$\tau_b \to W^a$	-0.078	-0.045	-0.089	-0.092	-0.062
$\tau_b \to W^c$	-0.039	-0.012	-0.056	-0.056	-0.025
$\tau_c \to W^a$	-0.308	-0.221	-0.308	-0.254	-0.374
$\tau_c \to W^b$	-0.308	-0.221	-0.308	-0.254	-0.374

Note: Smaller periphery: Center country's size increase to 2/3 of world population.

Results are robust to parameter changes

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$\tau_c \rightarrow W^b$	-0.308	-0.221	-0.308	-0.254	-0.374

Note: Smaller periphery: Center country's size increase to 2/3 of world population.

Disclaimer

These results depend on the taxes (set exogenously) $\longrightarrow$ e.g. I used $\vec{\tau} = (0, 0, 0)$ as benchmark

To determine optimal taxes and actual equilibria: Cannot use the Private Equilibrium or SPP.

Need to go a step beyond and formulate the **Ramsey Policy Problem** $\longrightarrow$ Endogenize τ

Still, the previous welfare analysis allows to better understand the results from the Ramsey Planner setup.

Particularly:

- τ^c having a weaker direct effect but stronger spillover effect $\rightarrow$ implies more active policy stance
- The sources of welfare effects.

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Ramsey Planner Problem

Policy problem that allows us to recover the optimal tool levels.

The Ramsey planner maximizes an objective function subject to the private decisions of agents.

Generally:

$$\begin{aligned} \max_{\mathbf{x_t}, \tilde{\tau}_t} \quad & W_t^{objective} = f(\alpha^j, W_t^j) \\ s.t. \quad & \mathbb{E}_t F(\mathbf{x_{t-1}}, \mathbf{x_t}, \mathbf{x_{t+1}}, \tau_t, \theta) \end{aligned}$$

with $\tilde{\tau} \subseteq \tau$ and welfare weights $\alpha^j \geq 0 \quad \forall j$.

$F(\cdot)$: System of equations that characterize private equilibrium (e.g., FOC, BC and MC Conds)

$\mathbf{x_t}$: Endogenous (decision) variables to agents. θ: Other parameters.

We set 4 possible setups: Nash and 3 types of cooperation.

Nash

In each country a planner solves:

$$\max_{\mathbf{x_t^j}, \tau_t^j} \quad W^j_{Nash,t} = W^j_t$$
$$s.t. \qquad \mathbb{E}_t F(\mathbf{x_{t-1}}, \mathbf{x_t}, \mathbf{x_{t+1}}, \tau_t, \theta)$$

for $t = 1$.

In this case we compute an *Open Loop Nash Equilibrium*: Each planner j will only take the tools of the other players (τ^{-j}) as given and decide on optimal actions ($\mathbf{x_t^j}, \tau_t^j$) at the start of the game.

Result:

F.O.C. wrt λ^j, $F(\cdot)$: 24 Eqs

F.O.C. wrt $\mathbf{x_t}$: 24 Eqs

F.O.C. wrt τ^j: 1 Eq.

} 25 New Eqs $\times$ 3 Players

99 Eqs for 99 Unknowns: 24 economic variables ($\mathbf{x_1}$), 72 lagrange multipliers ($\vec{\lambda}^a, \vec{\lambda}^b, \vec{\lambda}^c$) and **3 taxes** ($\vec{\tau}$)

Cooperative cases

Table: Cooperative Cases

	Planners/Players	Obj. Function	Decision variables
Cooperation (all countries)	World	$W_{Coop,t} = n_a W_t^a + n_b W_t^b + n_c W_t^c$	$\mathbf{x_t}, \tau_t$
Semi-Cooperation (EMEs vs. Center)	Periphery block A+B	$W^{ab} = n_a W^a + n_b W^b$	$\mathbf{x_t}, \tau_t^a, \tau_t^b$
	Center	W^c	$\mathbf{x_t}, \tau_t^c$
Semi-Cooperation (EME-A + C vs. EME-B)	Cooperative A+C	$W^{ac} = n_a W^a + n_c W^c$	$\mathbf{x_t}, \tau_t^a, \tau_t^c$
	EME-B	W^b	$\mathbf{x_t}, \tau_t^b$

Note: $j = a, b, c$

In all cases the constraints are the same: $\mathbb{E}_t F(\mathbf{x_{t-1}}, \mathbf{x_t}, \mathbf{x_{t+1}}, \tau_t, \theta)$

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Results: baseline model

Table: Welfare comparison across policy schemes with respect to the Nash Equilibrium

	Policy Scheme		
Country	Cooperation (All)	Cooperation (EMEs)	Cooperation (Center and EME-A)
C (Center)	1.00	1.00	1.00
A	1.00	1.00	1.00
B	1.00	1.00	1.00
World	1.00	1.00	1.00
EME Block	1.00	1.00	1.00

Units: Proportional steady state consumption increase in the baseline (Nash) model

- No Gains from Cooperative setups relative to Nash Equilibrium
- Including semi-cooperative frameworks

Baseline results (cont)

Optimal Taxes

Table: Ramsey-Optimal taxes under each policy setup

	Policy Scheme			
Country tool	Nash	Cooperation (All)	Cooperation (EMEs)	Cooperation (Center and EME-A)
τ^a	0.38	-0.11	0.15	0.30
τ^b	0.38	-0.11	0.15	0.34
τ^c	1.19	0.96	1.11	1.14

Units: proportional tax on banking rate of return

- Frequent Policy: set a Tax to undo the friction (↓ Credit Spread)

Policy trade-off:
Increasing Production vs. Undoing Friction

Baseline results (cont)

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- Frequent Policy: set a Tax to undo the friction (↓ Credit Spread)
- Taxes are lower under cooperation.
- Only Cooperation (world) gives scope for some subsidizing

Policy trade-off:
Increasing Production vs. Undoing Friction

Baseline results (cont)

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τ^c	1.19	0.96	1.11	1.14

Units: proportional tax on banking rate of return

- Frequent Policy: set a Tax to undo the friction (↓ Credit Spread)
- Taxes are lower under cooperation.
- Only Cooperation (world) gives scope for some subsidizing
- Taxes by Center: much larger ($\approx 3 \times \tau^{eme}$)
- Center tax is set with different aim: to foster trade of assets(↓ price of bonds)

Policy trade-off:
Increasing Production vs. Undoing Friction

may worsen the friction $\Rightarrow \tau^c_{coop} < \tau^c_{Nash}$

No policy setup and First Best

Country	Policy Scheme			
	Nash	Coop (All)	Coop (EMEs)	Coop (Center and EME-A)
C (Center)	1.01	1.01	1.01	1.01
A	0.99	0.99	0.99	0.99
B	0.99	0.99	0.99	0.99
World	1.00	1.00	1.00	1.00
EME Block	0.99	0.99	0.99	0.99

Units: Proportional steady state consumption increase in the baseline (First Best) model

Country	Policy Scheme				
	First Best	Nash	Coop (All)	Coop (EMEs)	Coop (Center and EME-A)
C (Center)	1.05	1.06	1.06	1.06	1.06
A	1.03	1.02	1.03	1.02	1.02
B	1.03	1.02	1.03	1.02	1.02
World	1.04	1.04	1.04	1.04	1.04
EME Block	1.03	1.02	1.03	1.02	1.02

Units: Proportional steady state consumption increase in the baseline (No Policy) model

- World level: friction mitigated, FB mimicked by all Ramsey Equilibria
- Country level: Distributional issues (against EMEs)

  No scope for Pareto improvements

▸ Results with $\sigma = 1.5$

No policy setup and First Best

Country	Policy Scheme: Nash	Coop (All)	Coop (EMEs)	Coop (Center and EME-A)
C (Center)	1.01	1.01	1.01	1.01
A	0.99	0.99	0.99	0.99
B	0.99	0.99	0.99	0.99
World	1.00	1.00	1.00	1.00
EME Block	0.99	0.99	0.99	0.99

Units: Proportional steady state consumption increase in the baseline (First Best) model

Country	Policy Scheme: First Best	Nash	Coop (All)	Coop (EMEs)	Coop (Center and EME-A)
C (Center)	1.05	1.06	1.06	1.06	1.06
A	1.03	1.02	1.03	1.02	1.02
B	1.03	1.02	1.03	1.02	1.02
World	1.04	1.04	1.04	1.04	1.04
EME Block	1.03	1.02	1.03	1.02	1.02

Units: Proportional steady state consumption increase in the baseline (No Policy) model

- World level: friction mitigated, FB mimicked by all Ramsey Equilibria
- Country level: Distributional issues (against EMEs)

  No scope for Pareto improvements
- Substantial Welfare Improvement wrt No Policy setup
- Equivalent to 4% Consumption increase

▸ Results with $\sigma = 1.5$

Experiments: changes in baseline model

We explore whether the results change with variations in a number of parameters.

In particular we wonder:

How important is the friction in shaping the results? Does the population size structure matters?

Cases:

- Changes in Financial Friction
  - Stronger Friction (both EMEs)
  - Stronger Friction in one EME

- Changes in population size
  - Larger Center
  - Asymmetric EMEs: Smaller EME2

Experiment 1: higher financial friction in both EMEs ($\kappa^a = \kappa^b = \frac{1}{2}$)

Table: Welfare comparison

Country	Bechmark: Nash			Bechmark: First Best			
	Coop (All)	Coop (EMEs)	Coop (C+EME-A)	Nash	Coop (All)	Coop (EMEs)	Coop (C+EME-A)
C (Center)	1.00	1.00	1.00	1.01	1.01	1.01	1.01
A	1.00	1.00	1.00	0.99	0.99	0.99	0.99
B	1.00	1.00	1.00	0.99	0.99	0.99	0.99
World	1.00	1.00	1.00	1.00	1.00	1.00	1.00
EME Block	1.00	1.00	1.00	0.99	0.99	0.99	0.99

Units: Proportional steady state consumption increase in the benchmark model

Table: Ramsey-Optimal taxes

Country	Policy Scheme			
	Nash	Cooperation (All)	Cooperation (EMEs)	Cooperation (Center+EME-A)
τ^a	0.20	-0.30	-0.04	0.15
τ^b	0.20	-0.30	-0.04	0.16
τ^c	1.29	1.09	1.23	1.25

Units: proportional tax on banking rate of return

- No gains from Cooperation
- Larger gain wrt No Policy (expected)
- Consistent w increased Welfare Effects given $\uparrow \kappa$:

  Stronger taxes in Center

Experiment 2: higher financial friction in EME-A ($\kappa^a = \frac{1}{2}$, $\kappa^b = 0.399$)

Table: Welfare comparison

Country	Bechmark: Nash				Bechmark: First Best				
	Coop (All)	Coop (EMEs)	Coop (C+EME-A)	Coop (C+EME-B)	Nash	Coop (All)	Coop (EMEs)	Coop (C+EME-A)	Coop (C+EME-B)
C (Center)	1.00	1.00	1.00	1.00	1.01	1.01	1.01	1.01	1.01
A	1.01	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.99
B	1.01	1.01	1.01	1.01	0.98	0.99	0.99	0.99	0.99
World	1.01	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00
EME Block	1.01	1.01	1.01	1.01	0.98	0.99	0.99	0.99	0.99

Units: Proportional steady state consumption increase in the benchmark model

Table: Ramsey-Optimal taxes

Country	Policy Scheme				
	Nash	Coop (All)	Coop (EMEs)	Coop (Center+EME-A)	Coop (Center+EME-B)
τ^a	-0.05	-0.28	-0.08	0.08	0.11
τ^b	0.09	-0.12	0.18	0.40	0.37
τ^c	1.19	1.03	1.17	1.20	1.20

Units: proportional tax on banking rate of return

- Small gains from World Cooperation
- EME with lower distortion is benefited from cooperation.
- Cooperative Planners match the FB
- Country with larger distortion: Sets Subsidy or lower tax when cooperating
- Consistent w increased Welfare Effects given $\uparrow \kappa$:

  EMEs: Less aggressive policy setting ($\tau^{eme} < \tau^{eme}_{base}$)

▸ Results with $\sigma = 1.5$

Experiment 3: Larger financial center $(n_a, n_b, n_c) = (\frac{1}{6}, \frac{1}{6}, \frac{2}{3})$

Table: Welfare comparison

Country	Bechmark: Nash			Bechmark: First Best			
	Coop (All)	Coop (EMEs)	Coop (C+EME-A)	Nash	Coop (All)	Coop (EMEs)	Coop (C+EME-A)
C (Center)	1.00	1.00	1.00	0.98	0.98	0.98	0.98
A	1.00	0.99	1.00	0.99	1.00	0.99	1.00
B	1.00	0.99	1.01	0.99	1.00	0.99	1.00
World	1.00	1.00	1.00	0.98	0.99	0.98	0.99
EME Block	1.00	0.99	1.01	0.99	1.00	0.99	1.00

Units: Proportional steady state consumption increase in the benchmark model

Table: Ramsey-Optimal taxes

Country	Policy Scheme			
	Nash	Cooperation (All)	Cooperation (EMEs)	Cooperation (Center and EME-A)
τ^a	-0.71	-0.90	-0.44	-1.14
τ^b	-0.71	-0.91	-0.44	-0.92
τ^c	0.09	-0.05	0.30	-0.11

Units: proportional tax on banking rate of return

- No Gains from Cooperation
- Larger welfare (expected)
- Planners no longer can match FB

  Guess: lower effect of τ^{eme} $\rightarrow$ less effective tools
- Smallest departure from FB: World Cooperation

Experiment 4: Smaller periphery $(n_a, n_b, n_c) = (\frac{1}{3}, \frac{1}{6}, \frac{1}{2})$

Table: Welfare comparison

Country	Bechmark: Nash				Bechmark: First Best				
	Coop (All)	Coop (EMEs)	Coop (C+EME-A)	Coop (C+EME-B)	Nash	Coop (All)	Coop (EMEs)	Coop (C+EME-A)	Coop (C+EME-B)
C (Center)	1.00	1.00	1.00	1.00	1.00	1.01	1.01	1.01	1.01
A	1.00	1.01	1.00	1.00	0.99	0.99	1.00	0.99	0.99
B	1.01	1.01	1.01	1.01	0.97	0.99	0.99	0.99	0.99
World	1.00	1.01	1.00	1.00	0.99	1.00	1.00	1.00	1.00
EME Block	1.01	1.01	1.00	1.00	0.98	0.99	0.99	0.99	0.99

Units: Proportional steady state consumption increase in the benchmark model

Table: Ramsey-Optimal taxes

Country	Policy Scheme				
	Nash	Coop (All)	Coop (EMEs)	Coop (Center + EME-A)	Coop (Center + EME-B)
τ^a	0.30	0.25	0.13	0.32	0.35
τ^b	-0.16	0.11	-0.67	0.33	0.27
τ^c	1.12	1.06	0.97	1.14	1.15

Units: proportional tax on banking rate of return

- Small gains from Cooperation for smaller EME
- For both EMEs in Regional Cooperation
- CoopEMEs: Better-off EMEs $\Rightarrow$ Small gains from Cooperation (World)
- Smaller EME wants to subsidize in more setups

▸ Results with $\sigma = 1.5$

Explained results

- Baseline model shows No gains from cooperation.

- Experiments show at best small gains for subcollections of countries.

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We can rationalize this based on Korinek 2020, RES:

Cooperation Gains exist only if Nash Eq. is Pareto Inefficient and fails to achieve FB (context: Two countries, K Controls)

First Welfare Theorem of Open Economies: The Nash Eq. is Pareto Efficient conditions 1-3 hold.

1. *Competition:* Policy makers act as price takers by not exerting market power over international assets prices.
2. *Sufficient Instruments:* The policy tool is flexible and effective enough.
3. *Frictionless International Markets:* International market for assets is free of imperfections and frictions.

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In our model conditions 1-3 hold. Hence Risk Sharing across country is not impaired in any Policy setup. We try a number of alternative models to **achieve gains from cooperation**.

Generating gains from cooperation

First modification: Every country suffers from Agency frictions.

Before, a Center without frictions implied important simplifications in equilibrium (equalization of rates).

The Center bank now solves:

$$\max_{F_1,L_1,D_1} J_1 = \mathbb{E}_1 \Lambda_{1,2} \pi^c_{b,2} = \mathbb{E}_1 \left[\Lambda_{1,2} (R^a_{b,1} F^a_1 + R^b_{b,1} F^b_1 + R^c_{k,2} L^c_1 - R_{D,1} D_1) \right]$$

$$s.t. \quad F^a_1 + F^b_1 + L^c_1 = D_1 + \delta_b Q^c_1 K^c_0$$

$$J_1 \geq k^c \mathbb{E}_1 \Lambda^c_{1,2} \left[R^a_{a,1} F^a_1 + R^b_{b,1} F^b_1 + R^c_{k,2} L^c_1 \right]$$

F.O.C.:

$$[F^a_1]: \quad \mathbb{E}_1 (R^a_{b,1} - R_{D,1}) = \mu^c_1 \left[\kappa^c R^a_{b,1} - (R^a_{b,1} - R_{D,1}) \right]$$

$$[F^b_1]: \quad \mathbb{E}_1 (R^b_{b,1} - R_{D,1}) = \mu^c_1 \left[\kappa^c R^b_{b,1} - (R^b_{b,1} - R_{D,1}) \right]$$

$$[L^c_1]: \quad \mathbb{E}_1 (R^c_{k,2} - R_{D,1}) = \mu^c_1 \left[\kappa^c R^c_{k,2} - (R^c_{k,2} - R_{D,1}) \right]$$

Thus, the credit spread is > 0 for the center as well.

Generating gains from coordination

model with frictions in every economy ($\kappa^a = \kappa^b = 0.399$ and $\kappa^c = 0.1$)

Table: Welfare comparison

Country	Bechmark: Nash			Bechmark: First Best			
	Coop (All)	Coop (EMEs)	Coop (C+EME-A)	Nash	Coop (All)	Coop (EMEs)	Coop (C+EME-A)
C (Center)	1.00	1.00	1.00	1.03	1.04	1.03	1.03
A	1.00	1.00	1.00	0.97	0.98	0.98	0.97
B	1.00	1.00	1.00	0.97	0.98	0.98	0.98
World	1.00	1.00	1.00	1.00	1.00	1.00	1.00
EME Block	1.00	1.00	1.00	0.97	0.98	0.98	0.98

Units: Proportional steady state consumption increase in the benchmark model

Table: Ramsey-Optimal taxes

Country	Policy Scheme			
	Nash	Cooperation (All)	Cooperation (EMEs)	Cooperation (Center and EME-A)
τ^a	-0.11	-0.68	-0.19	-0.47
τ^b	-0.11	-0.68	-0.19	-0.22
τ^c	0.68	0.34	0.65	0.55

Units: proportional tax on banking rate of return

- No Gains from Cooperation
- FB achieved at world level. Same distributional issues as baseline
- **Lower Gains wrt No Policy**

  with $\kappa^c > 0$ the Cr.Spread in EMEs will be lower by default
- Smaller tax in Center wrt baseline
- Now EMEs subsidize in all cases

  Offsetting frictions (between countries) already mitigate distortion $\Rightarrow$ they can subsidize

Now we break the flexibility of the policy tool. They can no longer be set without costs:

The welfare for the planner now is:

$$\max_{\mathbf{x_t}, \tilde{\tau}_t} \quad W_t^{objective} = f(\alpha^j, W_t^j) - \Gamma(\tau^j)$$
$$s.t. \qquad \mathbb{E}_t F(\mathbf{x_{t-1}}, \mathbf{x_t}, \mathbf{x_{t+1}}, \tau_t, \theta)$$

with: $\boldsymbol{\Gamma(\tau^j) = \psi(\tau^j)^2}$

$\tilde{\tau} \subseteq \tau$ and welfare weights $\alpha^j \geq 0 \quad \forall j$

Generating gains from coordination (cont.)

Policy Implementation Costs: $\kappa^a = \kappa^b = 0.399$ and $\kappa^c = 0.1$ and $\psi = 1$

Table: Welfare comparison

Country	Bechmark: Nash			Bechmark: First Best			
	Coop (All)	Coop (EMEs)	Coop (C+EME-A)	Nash	Coop (All)	Coop (EMEs)	Coop (C+EME-A)
C (Center)	1.02	1.02	1.02	1.00	1.02	1.02	1.02
A	1.01	1.01	1.01	0.97	0.98	0.98	0.98
B	1.01	1.01	1.01	0.97	0.98	0.98	0.98
World	1.01	1.01	1.01	0.99	1.00	1.00	1.00
EME Block	1.01	1.01	1.01	0.97	0.98	0.98	0.98

Units: Proportional steady state consumption increase in the benchmark model

Table: Ramsey-Optimal taxes

Country	Policy Scheme			
	Nash	Cooperation (All)	Cooperation (EMEs)	Cooperation (Center and EME-A)
τ^a	0.20	-0.30	-0.04	0.15
τ^b	0.20	-0.30	-0.04	0.16
τ^c	1.29	1.09	1.23	1.25

Units: proportional tax on banking rate of return

- Large Cost $\Rightarrow$ Significantly lower taxes by all countries
- Gains from Coordination for all countries and at the world level
- Subsidies in Cooperation by EMEs
- FB at world level is achieved by all policies but Nash

Results with $\sigma = 1.02$

Roadmap of Talk

Model

Welfare Effects of Macroprudential Policies

Optimal Policy: Ramsey Planning Problem

Results

Conclusions

Conclusions

- We study the presence of gains from international coordination of Macroprudential policies (MaP) aimed at a banking sector with agency frictions.
- Questions of interest:
  - (i) Can EMEs benefit from coordination in an environment of strong Center-Periphery spillovers?
  - (ii) Is the Center affected by cooperative arrangements?
- Approach: 3 country model with banking frictions and center-periphery features
- An additional periphery is included to determine value of modelling regional interactions
- Policy tool: taxes on banking sector revenues
- Cross-country policy spillovers are verified $\Rightarrow$ we look for Coordination Gains
- Given the 2nd EME we can verify: Cooperation and Semi-Cooperative Policy frameworks
- Baseline result: Cooperative frameworks do not deliver sizable welfare gains

Conclusions (cont.)

- Still, bulk of small gains are concentrated on cooperative parties
- Optimal policy [usually] consists on setting taxes to undo financial distortion
- Some frameworks favor facilitating intermediation instead
- Center planner sets more aggressive (higher) taxes.

  Intuition: Necessary since she has weaker policy welfare effects on her own economy
- Absence of gains can be explained by omission of policy costs and frictions in international markets
- We explore these features to generate gains from coordination. They appear when large costs are assumed.

Finally,

- Considering a second periphery:
  - Delivers similar results to 2 country model if new EME is a replicate of EME-1 [Scale Effect]
  - Different [qualitative] outcomes when EME-2 has idiosyncratic features [Interaction Effect]

Conclusions (cont.)

Further research Still Needed in a number of directions:

- Stochastic analysis: idiosyncratic shocks transmission
- Timing of policies: Prudential vs. Crisis Management
- Trade-offs with other policies

Thank you for your attention!

EXTRA-MATERIAL

References followed for the model setup

Article	**Feature used in the model**
Gertler and Karadi (2011, JME), *A model of unconventional monetary policy*	framework for modelling the balance sheet of banks and financial constraint.
Banerjee, Deveraux and Lombardo (2016, JIMF) *Self-oriented monetary policy, global financial markets and excess volatility of international capital flows*	General equilibrium model structure for center and periphery.
Cespedes, Chang and Velasco (2017, JIE): *Financial Intermediation, Real Exchange Rates, and Unconventional Policies in an Open Economy*	Modelling of banks in finite horizon
Davis and Deveraux (2019, NBER wp): *Capital Controls as Macro-prudential Policy in a Large Open Economy*	Analytical welfare analysis method (and coordination gains framework)

Back to Literature

Welfare Analysis Methodology Description

The welfare analysis method is borrowed from Davis and Deveraux (2019, NBER wp)

0. Characterize Competitive Equilibrium Conditions.
1. Set a Social Planner Problem: individual welfare is $W^j = U^j + \lambda_1^j BC_1^j + \beta\lambda_2^j BC_2^j$ or jointly as the weighted sum.
2. Substitute from CEq conditions variables/equations characterizing optimal behaviour of non-household decision variables (profits of bankers and constraints, production, taxes rebate, etc.)
3. Obtain welfare effects via implicit differentiation: here we recognize that the CEq-derived variables are a function of the taxes (taken as exogenous by agents). -> *Tax distorted equilibrium*
4. Based on numerical/calibrated estimation of CEq, obtain approximated values of welfare effects and optimal taxes.

Back to Welfare Analysis

Cross-country Effects

The welfare effect between emergent countries is,

$$\frac{dW^a}{d\tau^b} = \lambda_1^a I_1^a \frac{dQ_1^a}{d\tau^b} + \beta\lambda_2^a \frac{B_1^a}{R_1^w}\frac{dR_1^w}{d\tau^b} + \beta\lambda_2^a \left(\phi(\tau^a)\alpha A_2^a {K_1^a}^{\alpha-1} + \kappa^a(1-\delta)Q_2^a\right)\frac{dK_1^a}{d\tau^b}$$

and the emerging country welfare effect of a change in the center country tax is,

$$\frac{dW^a}{d\tau^c} = \lambda_1^a I_1^a \frac{dQ_1^a}{d\tau^c} + \beta\lambda_2^a \frac{B_1^a}{R_1^w}\frac{dR_1^w}{d\tau^c} + \beta\lambda_2^a \left(\phi(\tau^a)\alpha A_2^a {K_1^a}^{\alpha-1} + \kappa^a(1-\delta)Q_2^a\right)\frac{dK_1^a}{d\tau^c}$$

On the other hand the emerging economy welfare effect of a change in the center economy tax is,

$$\frac{dW^c}{d\tau^a} = \lambda_1^c I_1^c \frac{dQ_1^c}{d\tau^a} + \beta\lambda_2^c \frac{B_1^c}{R_1^w}\frac{dR_1^w}{d\tau^a} + \beta\lambda_2^c \left(\alpha A_2^c {K_1^c}^{\alpha-1} + (1-\delta)Q_2^c\right)\frac{dK_1^c}{d\tau^b} + \beta\lambda_2^c \left[R_{b,1}^{eme}\left(\frac{dF_1^a}{d\tau^a} + \frac{dF_1^b}{d\tau^a}\right) + \frac{dR_{b,1}^{eme}}{d\tau^a}\left(F_1^a + F_1^b\right)\right]$$

Back to Welfare Effects

Welfare gains computation

I compute the welfare gains as a proportional change in the consumption stream of the agents.

Thus, if I want to compare the welfare gains of a policy that leads to 'welfare 1' given by $W_1 = u(c_{1,1}) + \beta u(c_{1,2})$ relative to a benchmark $W_0 = u(c_{0,1}) + \beta u(c_{0,2})$ we just find the proportional change in average consumption ϕ such that:

$$W_0 = u(\boldsymbol{\phi}\bar{c}_0) + \beta u(\boldsymbol{\phi}\bar{c}_0) = W_1$$

Where $\bar{c}_0$ would be the equivalent constant stream of consumption that would yield the welfare (W_0) delivered by the baseline model.

For the CRRA we get ϕ as:

$$\begin{aligned} \frac{(\phi\bar{c}_0)^{1-\sigma}}{1-\sigma} + \beta\frac{(\phi\bar{c}_0)^{1-\sigma}}{1-\sigma} &= W_1 \\ \phi^{1-\sigma}W_0 &= W_1 \\ \phi &= \left(\frac{W_1}{W_0}\right)^{\frac{1}{1-\sigma}} \end{aligned}$$

Back to policy comparison

Households (cont.)

In the first period each household will maximize the present value of its life-time utility subject to the budget constraints for the first and second period.

The associated F.O.C.s for the three types of households are:

$$u'(C_1) = \beta R_1 u'(C_2)$$
$$u'(C_1^c) = \beta R_{D,1} u'(C_2^c)$$

The first three are the Euler Equations for bonds and the last one, applying only for country c, is the Euler Equation for local deposits.

Back to HH-UMP

Alternative microfoundation for policy cost

Change Government structure

Current: balanced budget $T + \tau r_2 K_1 = 0$

Alternative: MaP Subsidy funded by other sectors: $\tau_w W_2 L_2 + \tau_r r_2 K_1 = 0$

In that way a subsidy to the banks imply taxing the workers sector.

In the case of a Ramsey tax, wages will be pushed upwards increasing production which may be inefficient.

back

Baseline model with $\sigma = 1.5$

Table: Welfare comparison

Country	Bechmark: Nash			Bechmark: First Best			
	Coop (All)	Coop (EMEs)	Coop (C+EME-A)	Nash	Coop (All)	Coop (EMEs)	Coop (C+EME-A)
C (Center)	1.00	1.00	1.00	1.02	1.02	1.02	1.02
A	1.00	1.00	1.00	0.99	0.99	0.99	0.99
B	1.00	1.00	1.00	0.99	0.99	0.99	0.99
World	1.00	1.00	1.00	1.00	1.00	1.00	1.00
EME Block	1.00	1.00	1.00	0.99	0.99	0.99	0.99

Units: Proportional steady state consumption increase in the benchmark model

Table: Ramsey-Optimal taxes

Country	Policy Scheme			
	Nash	Coop (All)	Coop (EMEs)	Coop (Center+EME-A)
τ^a	0.86	0.37	0.75	0.83
τ^b	0.86	0.37	0.75	0.84
τ^c	1.71	1.55	1.69	1.68

Units: proportional tax on banking rate of return

back

Higher financial friction in one emerging economy ($\kappa^a = 0.399$, $\kappa^b = \frac{1}{2}$)

$\sigma = 1.5$

Table: Welfare comparison

Country	Bechmark: Nash			Bechmark: First Best			
	Coop (All)	Coop (EMEs)	Coop (C+EME-A)	Nash	Coop (All)	Coop (EMEs)	Coop (C+EME-A)
C (Center)	1.00	1.00	1.00	1.01	1.02	1.02	1.02
A	1.00	1.02	1.02	0.96	0.97	0.99	0.99
B	1.02	1.02	1.02	0.96	0.98	0.99	0.99
World	1.01	1.01	1.01	0.99	1.00	1.00	1.00
EME Block	1.01	1.02	1.02	0.96	0.98	0.99	0.99

Units: Proportional steady state consumption increase in the benchmark model

Table: Ramsey-Optimal taxes

Country	Policy Scheme			
	Nash	Coop (All)	Coop (EMEs)	Coop (Center+EME-A)
τ^a	0.68	0.49	0.60	0.83
τ^b	0.37	0.09	0.28	0.57
τ^c	1.72	1.57	1.66	1.68

Units: proportional tax on banking rate of return

back

Smaller periphery $(n_a, n_b, n_c) = (\frac{1}{3}, \frac{1}{6}, \frac{1}{2})$

$\sigma = 1.5$

Table: Welfare comparison

Country	Bechmark: Nash			Bechmark: First Best			
	Coop (All)	Coop (EMEs)	Coop (C+EME-A)	Nash	Coop (All)	Coop (EMEs)	Coop (C+EME-A)
C (Center)	1.00	1.00	1.00	1.02	1.02	1.02	1.02
A	0.99	1.01	1.00	0.99	0.97	0.99	0.99
B	1.02	1.02	1.02	0.97	0.98	0.98	0.99
World	1.00	1.01	1.00	1.00	1.00	1.00	1.00
EME Block	1.00	1.01	1.01	0.98	0.98	0.99	0.99

Units: Proportional steady state consumption increase in the benchmark model

Table: Ramsey-Optimal taxes

Country	Policy Scheme			
	Nash	Coop (All)	Coop (EMEs)	Coop (Center + EME-A)
τ^a	0.84	0.58	0.72	0.84
τ^b	0.65	0.24	0.09	0.83
τ^c	1.70	1.55	1.61	1.68

Units: proportional tax on banking rate of return

back

Policy Implementation Costs: $\kappa^a = \kappa^b = 0.399$ and $\kappa^c = 0.1$ and $\psi = 1$ $\sigma = 1.02$

Table: Welfare comparison

Country	Bechmark: Nash			Bechmark: First Best			
	Coop (All)	Coop (EMEs)	Coop (C+EME-A)	Nash	Coop (All)	Coop (EMEs)	Coop (C+EME-A)
C (Center)	0.96	0.94	1.00	1.05	1.01	0.99	1.04
A	1.09	1.08	1.07	0.91	0.99	0.99	0.98
B	1.09	1.08	1.06	0.91	0.99	0.99	0.96
World	1.02	1.01	1.03	0.98	1.00	0.99	1.01
EME Block	1.09	1.08	1.06	0.91	0.99	0.99	0.97

Units: Proportional steady state consumption increase in the benchmark model

Table: Ramsey-Optimal taxes

Country	Policy Scheme			
	Nash	Cooperation (All)	Cooperation (EMEs)	Cooperation (Center and EME-A)
τ^a	0.01	-0.01	1.20	1.25
τ^b	0.01	-0.01	1.20	-0.01
τ^c	2.00	0.02	0.02	1.98

Units: proportional tax on banking rate of return

back