# Risky Banks and MacroPrudential Policy for Emerging Economies

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[1] The views expressed herein are those of the authors and do not necessarily reflect those of Bank of Mexico.

# Motivation

Degree of interconnectedness among financial institutions $\uparrow \Rightarrow$ exposure of EMEs to AE financial shocks $\uparrow$, **global banks** played a key role

Portfolio capital flows and **cross-border banking flows** (non-core liabilities) create challenges for **EMEs financial stability**

- volatile, short-term, and pro-cyclical
- Hungarian case: banks borrowed from CH to finance mortgages
- important channel of international transmission of foreign shocks

What can **EMEs** do to mitigate the effects of volatile portfolio capital flows and cross-border banking flows, i.e. non-core liabilities? **Implement MacroPrudential measures**

# This paper

**What are the effects of the volatility of cross-border banking flows (non-core liabilities) in EMEs' credit?**

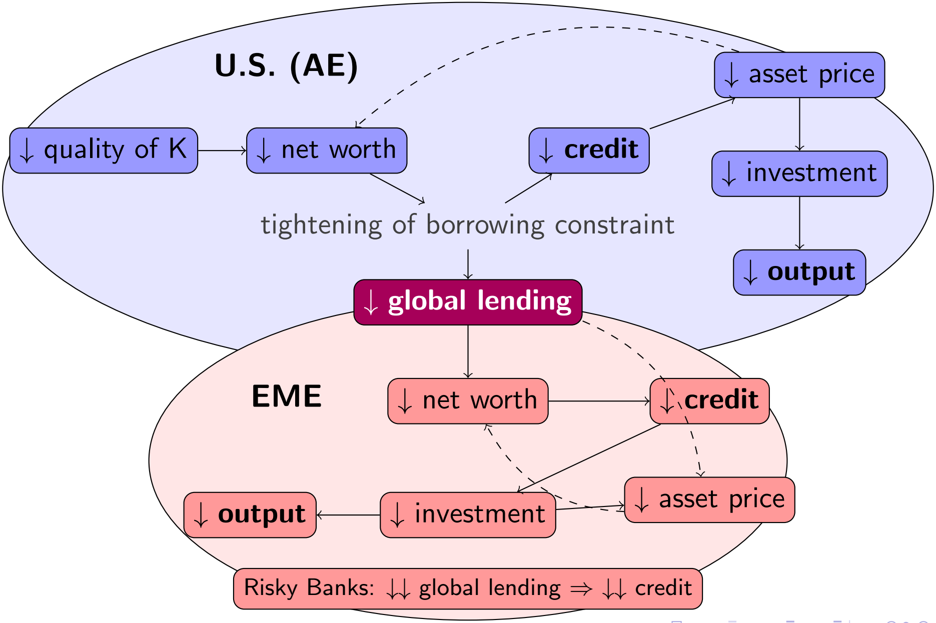
**What can EMEs do to mitigate these effects on credit?**

1. Empirical Evidence + VAR on the transmission of financial shocks from the U.S. to Mexico and Turkey (risky banks)
2. Two-country DSGE model
   - banks in the AE lend to banks in the EME
   - cross-border banking flows and risky EME banks
   - endogenous credit constraint faced by financial intermediaries (Gertler and Kiyotaki, 2010)
3. MacroPrudential policy in the EME to mitigate the effects of banks' non-core liabilities

# Results

1. VAR, a negative quality of capital shock in the U.S. prompts a negative impact in the EME
   - loans from U.S. banks to EME $\downarrow$
   - financial instability in the EME, credit $\downarrow$, GDP $\downarrow$
   - asset price co-movement across countries
   - when EME banks are risky for U.S. banks the crisis is deeper in the EME
2. Model replicates the facts from the VAR
3. MacroPrudential policy in the EME by $\downarrow$ the volatility of cross-border banking flows
   - $\downarrow$ sources of financial instability
   - EME consumers are better off

# Mechanism


U.S. (AE)
↓ quality of K
↓ net worth
↓ credit
↓ asset price
↓ investment
↓ output
tightening of borrowing constraint
↓ global lending
EME
↓ net worth
↓ credit
↓ asset price
↓ investment
↓ output
Risky Banks: ↓↓ global lending ⇒ ↓↓ credit

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# Empirical Evidence

In the last few years, cross-border banking flows have been very volatile

- financial crisis $\Rightarrow \downarrow$ of how much the U.S. lent to EMEs
- UMP, ZLB interest rate $\Rightarrow \uparrow$ of capital flows to EMEs
- normalization of MP $\Rightarrow$ a new reverse of the capital flows

Graph

Non-core liabilities have been financing the increase in credit with respect to deposits in EMEs (Lane and McQuade, 2013)

How much are cross-border banking flows with respect to households' deposits for Turkish and for Mexican commercial banks? Graph

- Turkey: 6.5%
- Mexico: 1.9%

$\Rightarrow$ not big numbers but they can create lots of noise in the EME

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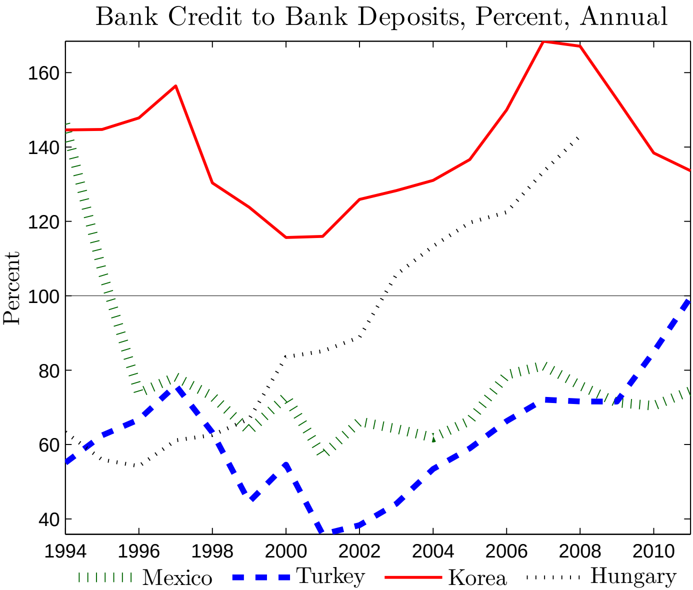
# Empirical Evidence: Credit to Deposits Ratio




Source: FRED, Federal Reserve Bank of St. Louis.

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- Turkey: 6.5%
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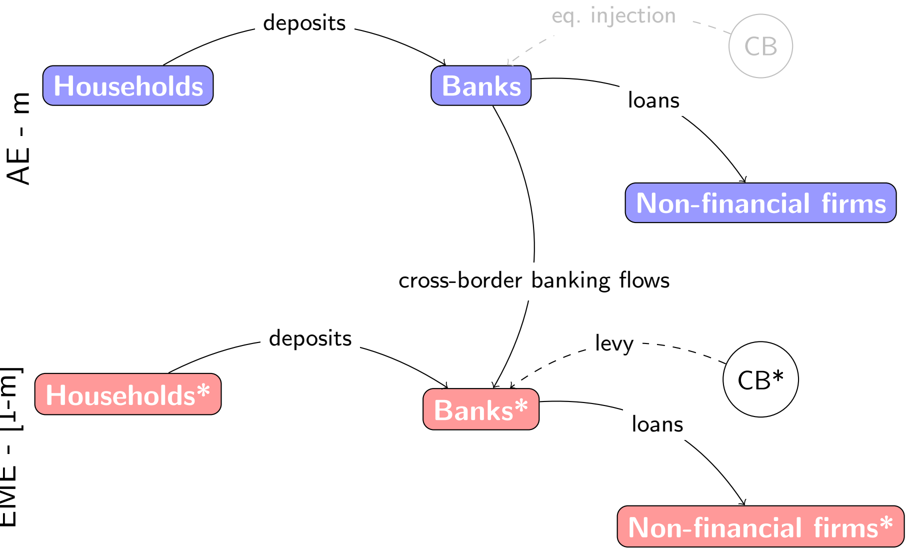
# Empirical Evidence: VAR for Mexico and Turkey


Note: VAR estimated for 2002Q1 to 2013Q4 for Mexico, and for 2001Q3 to 2013Q3 for Turkey.

# The Model

1. Two-country DSGE model
   - builds on Gertler and Kiyotaki (2010)
   - banking sector
   - endogenous credit constraint faced by financial intermediaries
   - U.S. (AE) banks invest (via EME banks) abroad $\Rightarrow$ external financing
     - U.S. is a relatively big economy with a big financial sector
     - EME is a relatively small open economy with a small financial sector
   - EME banks might run away with debt from AE banks - risky EME banks
2. Study the transmission of a shock to the quality of capital in the U.S.
3. Analysis of MacroPrudential policy in the EME
   - welfare evaluation

# General Setting



# Financial Frictions: AE Banks

Gertler and Kiyotaki with international flows

- raise deposits from AE households, $d_t$
- lend
  - to AE non-financial firms, $s_t$
  - to EME banks, $b_t$

| Assets | Liabilities |
|---|---|
| $Q_t s_t$ | $d_t$ |
| $Q_{bt} b_t$ | $n_t$ |

Incentive compatibility constraint

$$V_t(s_t, b_t, d_t) \geq \theta \left( Q_t s_t + Q_{bt} b_t \right)$$

Net worth of AE banks

$$N_t = (\xi + \sigma) \left\{ R_{k,t} Q_{t-1} S_{t-1} \Psi_t + R_{b,t} Q_{b,t-1} B_{t-1} \right\} - \sigma R_t D_{t-1}$$

At the end of the period $t-1$ the value of the banks satisfies

$$V(s_{t-1}, b_{t-1}, d_{t-1}) = E_{t-1} \Lambda_{t-1,t} \left\{ (1-\sigma) n_t + \sigma \left[ \max_{s_t, b_t, d_t} V(s_t, b_t, d_t) \right] \right\}$$

▸ Problem of AE banks

# Financial Frictions: EME Banks

- raise funds from
  - EME households, $d_t^*$
  - AE banks, $b_t^*$
- make loans to EME non-financial firms, $s_t^*$

| Assets | Liabilities |
| --- | --- |
| $Q_t^* s_t^*$ | $d_t^*$ |
| | $Q_{bt}^* b_t^*$ |
| | $n_t^*$ |

Incentive compatibility constraint

- $\omega = 1$, **safe** EME banks

$$V_t(s_t^*, b_t^*, d_t^*) \geq \theta^*(Q_t^* s_t^* - Q_{bt}^* b_t^*)$$

- $0 < \omega < 1$, **risky** EME banks

$$V_t(s_t^*, b_t^*, d_t^*) \geq \theta^*(Q_t^* s_t^* - \omega Q_{bt}^* b_t^*)$$

Net worth of EME banks

$$N_t^* = (\sigma^* + \xi^*)[Z_t^* + (1-\delta)Q_t^*]S_{t-1}^* - \sigma^*(R_t^* D_{t-1}^* + R_{bt}^* Q_{b,t-1}^* B_{t-1}^*)$$

▸ Problem of EME banks

# IRF to a Neg. Quality of $K$ Shock in the AE

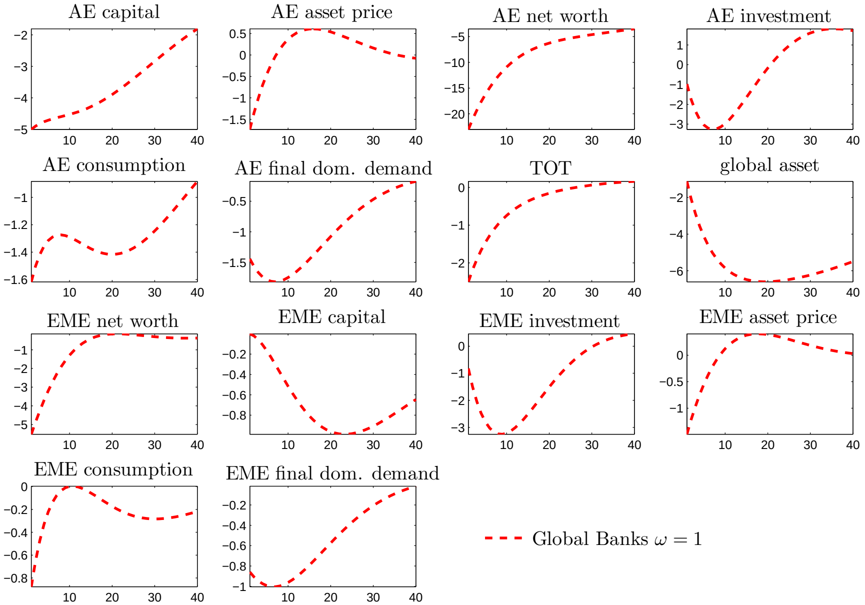
1. Model with safe global banks (GB)
   - transmission across countries with asset price co-movement
   - cross-border banking flows fall
   - collapse of EME's credit, financial instability
   - global financial crisis
2. Safe vs. risky EME banks
   - cross-border banking flows fall more
   - deeper transmission of the financial crisis
3. MacroPrudential policy by the EME CB

Calibration

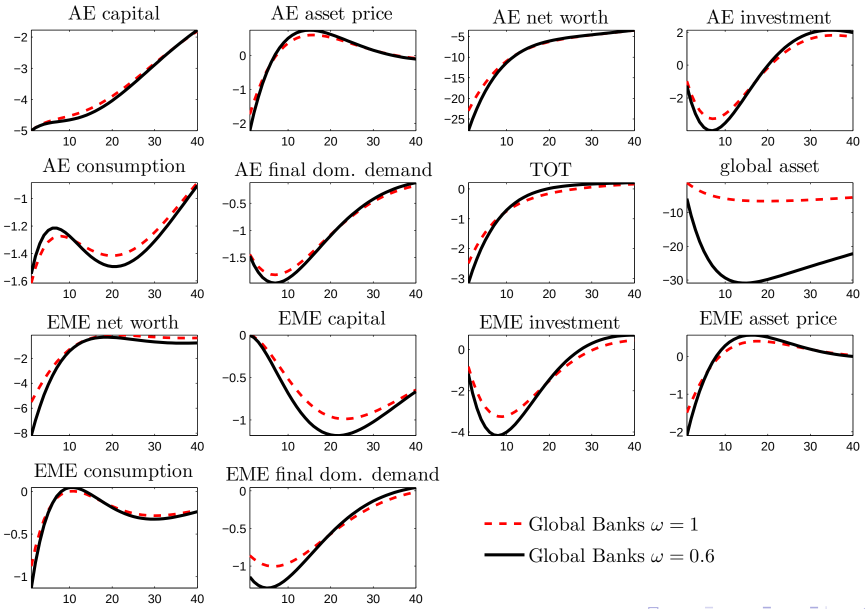
- real sector: previous literature and Mexican data
- banking sector: previous literature and Mexican data on cross-border banking flows

▸ Calibration

# IRF to a Neg. Quality of $K$ Shock - Global Banks



# IRF to a Neg. Quality of $K$ Shock - Risky Banks



# MacroPrudential Policy (MPP) in the EME

The Korean Experience

- August 2011, the Bank of Korea put a **levy on non-core liabilities**
- Purpose: non-core liabilities can generate systemic risk (procyclical and global interconnection of financial institutions)
- Result: share of short-tem in total foreing borrowing by banks dropped from 64% as of end-June 2010 to 47% at end-December 2012

In the Model

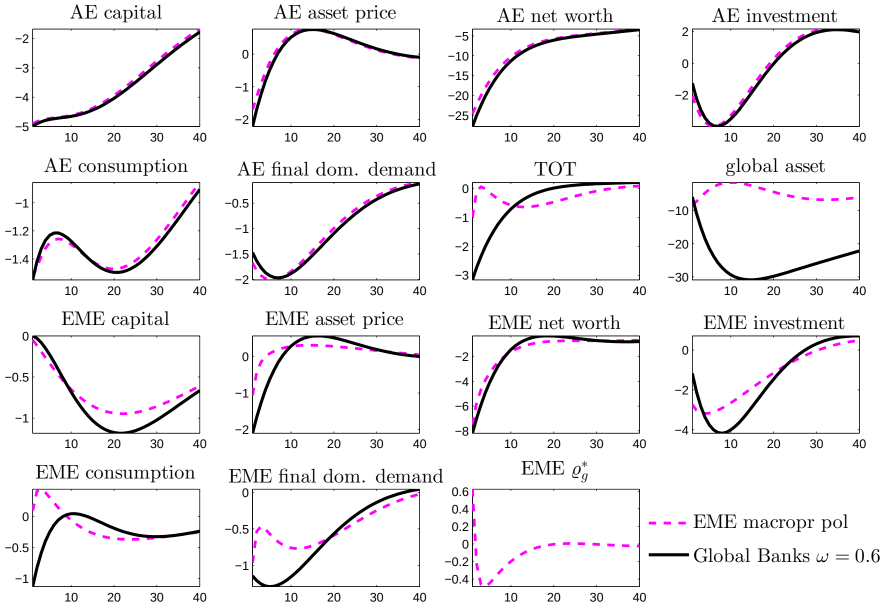
- There is a cost (tax) when assets grow faster than deposits

$$\varrho_{gt}^{*} = \left( \frac{\frac{S_{t+1}^{*} - S_{t}^{*}}{S_{t}^{*}}}{\frac{D_{t}^{*} - D_{t-1}^{*}}{D_{t-1}^{*}}} \right)^{\tau_{g}^{*}}$$

- Total net worth of EME banks

$$N_t^* = (\sigma^* + \xi^*) R_{kt}^* Q_{t-1}^* S_{t-1}^* - \sigma^* \left[ R_t^* D_{t-1}^* + \varrho_{gt}^* R_{bt}^* Q_{b,t-1}^* B_{t-1}^* \right]$$

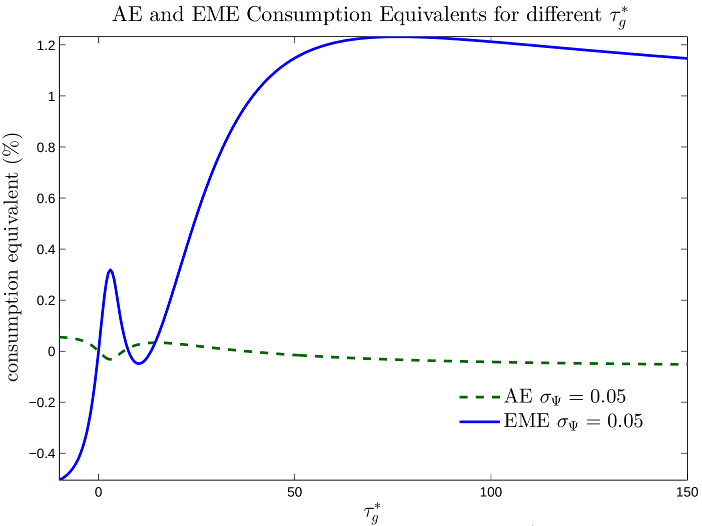
# IRF to a Neg. Quality of $K$ Shock - MPP



# Welfare Analysis

- Moments of the second order approximation of the model
- $Welf_t = U(C_t, L_t) + \beta E_t Welf_{t+1}$
- **Consumption Equivalent**: fraction of households consumption that would be needed to equate the welfare under no policy to the welfare under policy

# Consumption Equivalent




$$\varrho_{gt}^* = \left( \frac{\text{asset growth}}{\text{deposits growth}} \right)^{\tau_g^*}$$

# Conclusions

**What are the effects of the volatility of cross-border banking flows (non-core liabilities) in EMEs' credit?**

- prompt instability for the EME
- specially when EME banks are risky for the AE
- model matches qualitative evidence from the VAR

**What can EMEs do to mitigate these effects on credit?**

- Macroprudential Policy: levy on non-core liabilities, i.e. foreign debt, cross-border banking flows
- EME shows a smoother reaction with the intervention
- EME households are better off with the policy

# Related Literature

## Empirical Evidence

- Cross-border banking flows channel
  Cetorelli and Goldberg (2011) and Morais, Peydró, and Ruiz (2014)
- Large capital inflows increase the probability of credit booms
  Mendoza and Terrones (2008), Avdjiev, McCauley, and McGuire (2012), and Magud, Reinhart, and Vesperoni (2014)
- Credit growth associated with banks' net debt flows
  Lane and McQuade (2013)

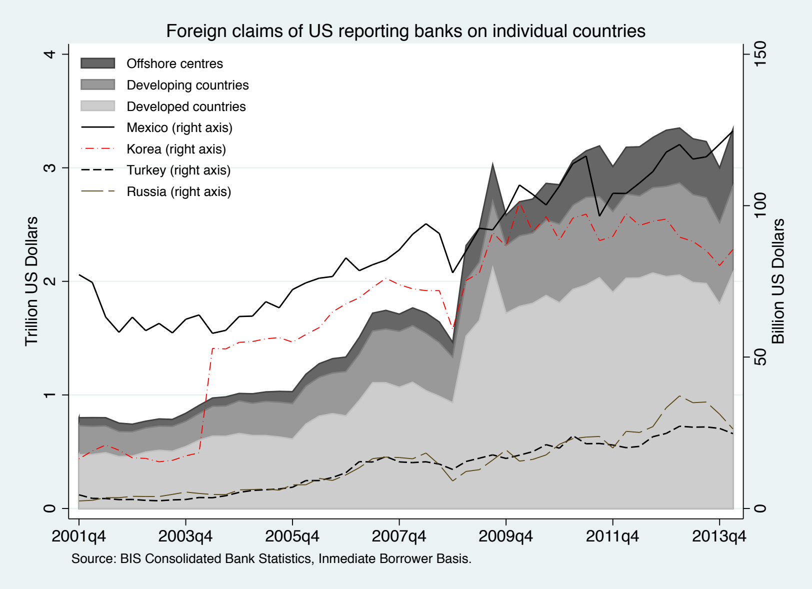
## Theoretical Analysis

- Relevance of non-core liabilities
  Shin (2010), Shin and Shin (2010)
- 2-country model with global banks
  Dedola, Karadi, and Lombardo (2013) and Nuguer (2015)

## This Paper's Contribution

- VAR for different EME with a US net charge-off banks shock (risky banks)
- Theoretical model with global banks with cross-border banking flow channel for EMEs and MPP

# Empirical Evidence

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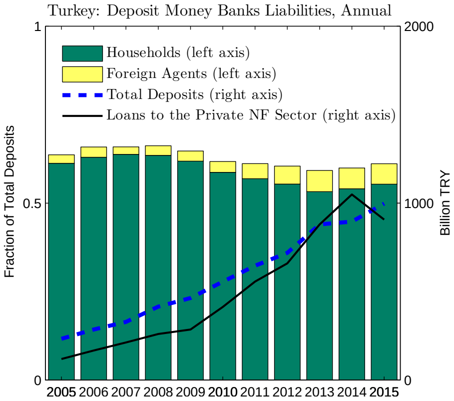
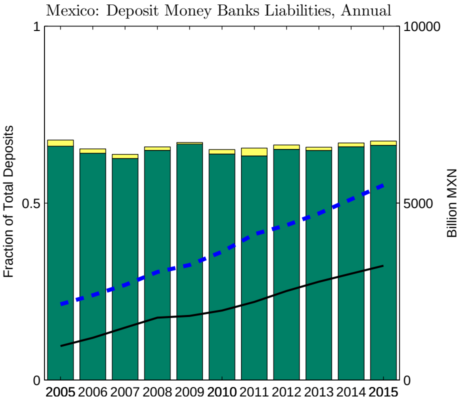
# Empirical Evidence: Funding of Commercial Banks




Source: Turkish Central Bank and Bank of Mexico.

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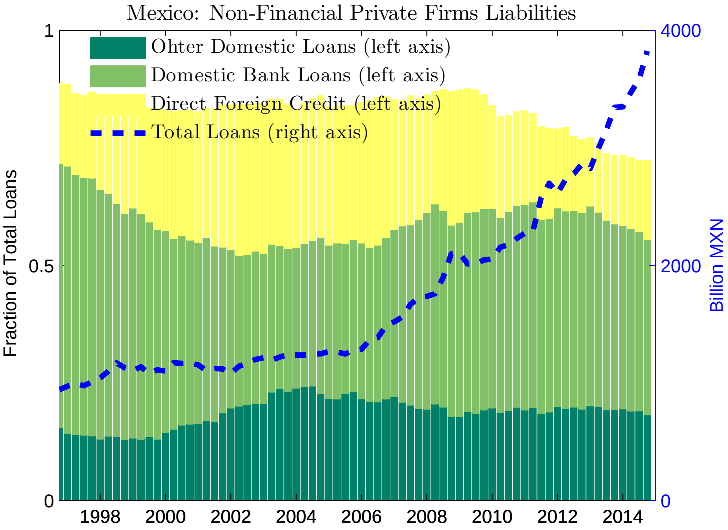
# Empirical Evidence: Funding of Non-Financial Firms




Source: Bank of Mexico.

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# Benchmark: The RBC Model in Financial Autarky

**Advanced Economy (AE)**

$$
\begin{aligned}
E_0 \quad \textstyle\sum_{t=0}^{\infty} \quad & \beta^t \left[ \ln C_t - \frac{\chi}{1+\gamma} L_t^{1+\gamma} \right] \\
X_t \quad = \quad & A_t K_t^{\alpha} L_t^{1-\alpha} = X_t^H + X_t^{*H} \frac{1-m}{m} \\
Y_t \quad = \quad & \left[ \nu^{\frac{1}{\eta}} X_t^{H\,\frac{\eta-1}{\eta}} + (1-\nu)^{\frac{1}{\eta}} X_t^{F\,\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} \\
Y_t \quad = \quad & C_t + \left[ 1 + f\left( \frac{I_t}{I_{t-1}} \right) \right] I_t + G_t \\
S_t \quad = \quad & I_t + (1-\delta) K_t \\
K_{t+1} \quad = \quad & S_t \underbrace{\Psi_{t+1}}_{\text{quality of capital shock}} \\
\text{Financial autarky case: } CA_t \quad = \quad & \frac{1-m}{m} X_t^{H*} - X_t^F \tau_t = 0
\end{aligned}
$$

EME is similar with variables with *.

$\Psi_t$ and $\Psi_t^*$ are i.i.d. and mutually independent. We study a shock in $\Psi_t$.

# Financial Frictions: Households

Each household consists of a continuum of members

1. Worker
   - supplies labor
2. Banker
   - with prob. $\sigma$ continues being a banker
   - with prob. $1 - \sigma$ exits the banking business

Perfect consumption insurance within the household.
Problem

$$\max_{C_t, L_t, D_t} E_0 \sum_{t=0}^{\infty} \beta^t \left[ \ln C_t - \frac{\chi}{1+\gamma} L_t^{1+\gamma} \right]$$
$$\text{s.t. } C_t + D_t = W_t L_t + \Pi_t + R_t D_{t-1} + T_t$$

# Financial Frictions: Non Financial Firms

1. Good producers
   Profit per unit of capital

$$Z_t = \frac{X_t - W_t L_t}{K_t} = \alpha A_t \left( \frac{L_t}{K_t} \right)^{1-\alpha}$$

   In order to finance new investment, they sell state-contingent claims, $S_t$, to banks.

   ▸ Firms

2. Capital good producers
   They choose investment to maximize profit

$$Q_t = 1 + f\left(\frac{I_t}{I_{t-1}}\right) + \frac{I_t}{I_{t-1}} f'\left(\frac{I_t}{I_{t-1}}\right) - E_t \Lambda_{t,t+1} \left[\frac{I_{t+1}}{I_t}\right]^2 f'\left(\frac{I_{t+1}}{I_t}\right)$$

   with $\Lambda_{t,t+1} = \beta \frac{C_t}{C_{t+1}}$

   ▸ Adj Costs

# Non-financial firms

No-cost technology for the final good production, problem:

$$\max_{X_t^H, X_t^F} Y_t = \left[ \nu^{\frac{1}{\eta}} X_t^{H\,\frac{\eta-1}{\eta}} + (1-\nu)^{\frac{1}{\eta}} X_t^{F\,\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}$$

$$\text{s.t. } P_t Y_t \equiv Z_t = P_t^H X_t^H + P_t^F X_t^F$$

The optimization problem yields

$$P_t = \left[ \nu (P_t^H)^{1-\eta} + (1-\nu)(P_t^F)^{1-\eta} \right]^{\frac{1}{1-\eta}} .$$

We can define everything in terms of TOT ($\tau = \frac{P^F}{P^H}$),

$$\frac{P_t}{P_t^H} = \left[ \nu + (1-\nu)\tau_t^{1-\eta} \right]^{\frac{1}{1-\eta}} .$$

The demands are defined by

$$X_t^H = \nu Y_t \left[ \frac{P_t^H}{P_t} \right]^{-\eta} \text{ and } X_t^F = (1-\nu) Y_t \left[ \frac{P_t^F}{P_t} \right]^{-\eta}$$

Law of one price + home bias, the real exchange rate is

$$\varepsilon_t = \frac{S_t P_t^*}{P_t} = \left[ \frac{\nu^* + (1-\nu^*)\tau_t^{1-\eta}}{\nu + (1-\nu)\tau_t^{1-\eta}} \right]^{\frac{1}{1-\eta}}$$

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# Non-financial firms - Adjustment Costs

CEE (2005)

$$F(i_t, i_{t-1}) = \left[1 - S\left(\frac{i_t}{i_{t-1}}\right)\right] i_t,$$

$$\text{with } S(1) = S'(1) = 0,\ \varphi \equiv S''(1) > 0.$$

GK (2010) problem

$$\max_{I_t} E_t \sum_{\tau=t}^{\infty} \Lambda_{t,\tau} \left\{ Q_\tau I_\tau - \left[1 + f\left(\tfrac{I_\tau}{I_{\tau-1}}\right)\right] I_\tau \right\}$$

$$\text{with } f\left(\tfrac{I_\tau}{I_{\tau-1}}\right) = \left[\varrho \tfrac{I_\tau}{I_{\tau-1}} - \varrho\right]^2$$

$$f(1) = 0,\ \ f'\left(\tfrac{I_t}{I_{t-1}}\right) = 2\varrho\left[\varrho \tfrac{I_\tau}{I_{\tau-1}} - \varrho\right],\ \ f'(1) = 0,\ \ f''\left(\tfrac{I_t}{I_{t-1}}\right) = 2\varrho^2 \equiv \varphi > 0.$$

The optimization problem yields

$$\begin{aligned} Q_t &= 1 + f\left(\frac{I_t}{I_{t-1}}\right) + \frac{I_t}{I_{t-1}} f'\left(\frac{I_t}{I_{t-1}}\right) - E_t \Lambda_{t,t+1} \left(\frac{I_{t+1}}{I_t}\right)^2 f'\left(\frac{I_{t+1}}{I_t}\right) \\ &= 1 + \left[\varrho \frac{I_t}{I_{t-1}} - \varrho\right]^2 + \frac{I_t}{I_{t-1}} 2\varrho \left[\varrho \frac{I_t}{I_{t-1}} - \varrho\right] - E_t \Lambda_{t,t+1} \left(\frac{I_{t+1}}{I_t}\right)^2 \left[\varrho \frac{I_{t+1}}{I_t} - \varrho\right] \end{aligned}$$

Go back

# AE Banks Optimization

Bellman equation

$$\begin{aligned} V(s_t, b_t, d_t) &= \nu_{st} s_t + \nu_{bt} b_t - \nu_t d_t \\ &= E_t \Lambda_{t,t+1} \left\{ (1-\sigma)\, n_{t+1} + \sigma \left[ \max_{d_{t+1}, s_{t+1}, b_{t+1}} V\left(s_{t+1}, b_{t+1}, d_{t+1}\right) \right] \right\} \end{aligned}$$

The optimization implies

$$\begin{aligned} \nu_t &= E_t[\Lambda_{t,t+1} \Omega_{t+1} R_{t+1}] \\ \mu_t &= E_t[\Lambda_{t,t+1} \Omega_{t+1} (R_{kt+1} - R_{t+1})] \\ \phi_t &= \frac{\nu_t}{\theta - \mu_t} \\ \mu_t &= \frac{\nu_{st}}{Q_t} - \nu_t \\ \frac{\nu_{st}}{Q_t} &= \frac{\nu_{bt}}{Q_{bt}} \Rightarrow E_t \Lambda_{t,t+1} \Omega_{t+1} R_{kt+1} = E_t \Lambda_{t,t+1} \Omega_{t+1} R_{bt+1} \end{aligned}$$

where

$$\begin{aligned} \Omega_{t+1} &= 1 - \sigma + \sigma(\nu_{t+1} + \mu_{t+1} \phi_{t+1}) \\ R_{kt+1} &= \Psi_{t+1} \frac{Z_{t+1} + (1-\delta) Q_{t+1}}{Q_t} \end{aligned}$$

▸ Go back

# EME Banks Optimization

Bellman equation

$$
\begin{aligned}
V(s_t^*, b_t^*, d_t^*) &= \nu_{st}^* s_t^* - \nu_{bt}^* b_t^* - \nu_t^* d_t^* \\
&= E_t \Lambda_{t,t+1}^* \left\{ (1-\sigma^*) n_{t+1}^* + \sigma^* \left[ \max_{d_{t+1}^*, s_{t+1}^*, b_{t+1}^*} V(s_{t+1}^*, b_{t+1}^*, d_{t+1}^*) \right] \right\}
\end{aligned}
$$

The optimization implies

$$
\begin{aligned}
\nu_t^* &= E_t[\Lambda_{t,t+1}^* \Omega_{t+1}^* R_{t+1}^*] \\
\mu_t^* &= E_t[\Lambda_{t,t+1}^* \Omega_{t+1}^* (R_{kt+1}^* - R_{t+1}^*)] = \frac{\nu_{st}^*}{Q_t^*} - \nu_t^* \\
\phi_t^* &= \frac{\nu_t^*}{\theta^* - \mu_t^*} \\
\mu_{bt}^* &= E_t[\Lambda_{t,t+1}^* \Omega_{t+1}^* (R_{bt+1}^* - R_{t+1}^*)] = \frac{\nu_{bt}^*}{Q_t^*} - \nu_t^* \\
\phi_{bt}^* &= \frac{\nu_t^*}{\theta^* \omega - \mu_{bt}^*} \\
\omega = 1 \quad \frac{\nu_{st}^*}{Q_t^*} &= \frac{\nu_{bt}^*}{Q_{bt}^*} \Rightarrow E_t \Lambda_{t,t+1}^* \Omega_{t+1}^* R_{kt+1}^* = E_t \Lambda_{t,t+1}^* \Omega_{t+1}^* R_{bt+1}^* \\
\omega < 1 \quad \frac{\nu_{st}^*}{Q_t^*} &= \left[ \frac{\nu_{bt}^*}{Q_{bt}^*} - (1-\omega)\nu_t \right] \frac{1}{\omega} \Rightarrow \mu_{bt}^* = \omega \mu_t^*
\end{aligned}
$$

where

$$
\begin{aligned}
\Omega_{t+1}^* &= 1 - \sigma^* + \sigma^* (\nu_{t+1}^* + \mu_{t+1}^* \phi_{t+1}^*) \\
R_{kt+1}^* &= \Psi_{t+1}^* \frac{Z_{t+1}^* + (1-\delta^*) Q_{t+1}^*}{Q_t^*}
\end{aligned}
$$

Go back

# Risky EME Banks

The parameter $\omega$ introduces a level of riskiness in the EME' cross-border banking flows. EME banks can run away with a fraction $\theta^*(1-\omega)$ of international flows. $\Rightarrow$ **risky EME banks**

For $0 < \omega < 1$

$$E_t \Lambda^*_{t,t+1} \Omega^*_{t+1} R^*_{kt+1} > E_t \Lambda^*_{t,t+1} \Omega^*_{t+1} R^*_{bt+1} > E_t \Lambda^*_{t,t+1} \Omega^*_{t+1} R^*_{t+1}$$

vs. $\omega = 1$ $\quad E_t \Lambda^*_{t,t+1} \Omega^*_{t+1} R^*_{kt+1} = E_t \Lambda^*_{t,t+1} \Omega^*_{t+1} R^*_{bt+1} > E_t \Lambda^*_{t,t+1} \Omega^*_{t+1} R^*_{t+1}$

When EME banks can run away with a fraction of cross-border banking flows, EME banks borrow more from AE banks and they are more exposed to events in the AE. Go back

# IRF to a Neg. Quality of $K$ Shock in the AE

1. Benchmark (no financial frictions and in financial autarky) vs. banks in financial autarky ▸ IRF
   - amplification of the shock
   - transmission across countries very small
2. Model with banks and in financial autarky vs. model with global banks (GB) ▸ IRF
   - transmission across countries with asset price co-movement
   - cross-border banking flows work as an insurance
   - global financial crisis
3. Model with GB and safe vs. risky EME banks
   - cross-border banking flows fall more
   - deeper transmission of the financial crisis
4. MacroPrudential policy by the EME CB

▸ Calibration

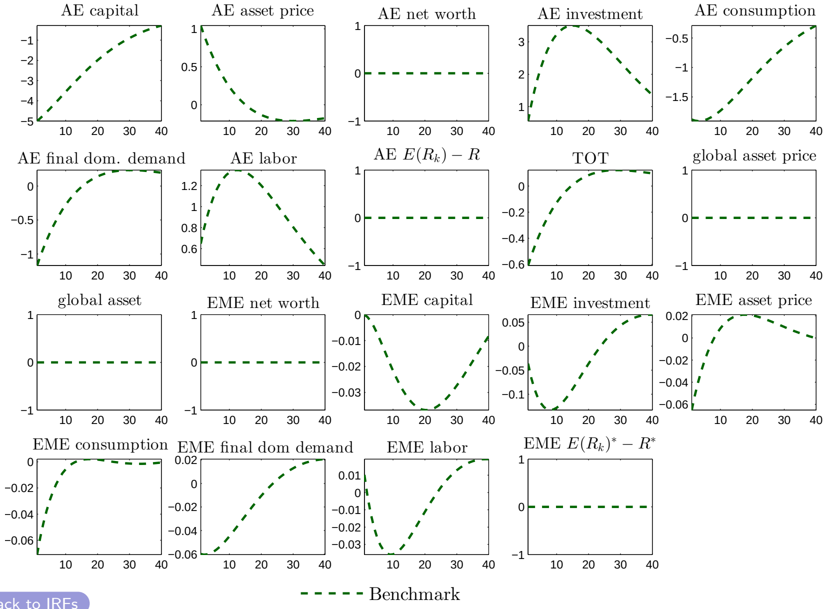
# Calibration

| | | AE | EME |
|---|---|---|---|
| $\beta$ | discount factor | 0.9900 | 0.9900 |
| $\gamma$ | inverse elasticity of labor supply | 0.1000 | 0.1000 |
| $\chi$ | relative utility weight of labor | 5.0130 | 5.0130 |
| $\alpha$ | effective capital share | 0.3330 | 0.3330 |
| $\delta$ | depreciation | 0.0250 | 0.0250 |
| $\nu$ | home bias | 0.8500 | 0.9625 |
| $\eta$ | elasticity of substitution | 1.5000 | 1.5000 |
| $m$ | islands | 0.9600 | 0.0400 |
| $\bar{g}$ | steady state gov expenditure | 0.2000 | 0.2670 |
| $\xi$ | start-up | 0.0018 | 0.0018 |
| $\theta$ | fraction of div assets | 0.4067 | 0.4074 |
| $\sigma$ | survival rate | 0.9720 | 0.9710 |
| $\Phi$ | country-specific int rate premium | | 0.1000 |
| $\omega$ | riskiness of EME banks | | 0.6000 |
| $\Psi$ | | -0.0500 | |

$\Rightarrow \theta$ matches $R_k - R = 110$ basis point per year and $\theta^*$, $R_k^* - R^* = 115$

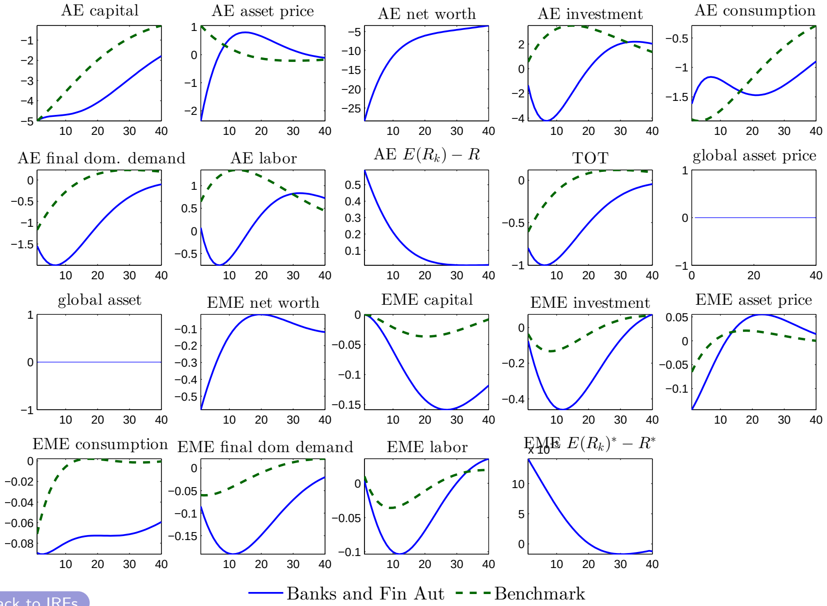
Back to IRFs

# IRF to a Neg. Quality of $K$ Shock - Benchmark



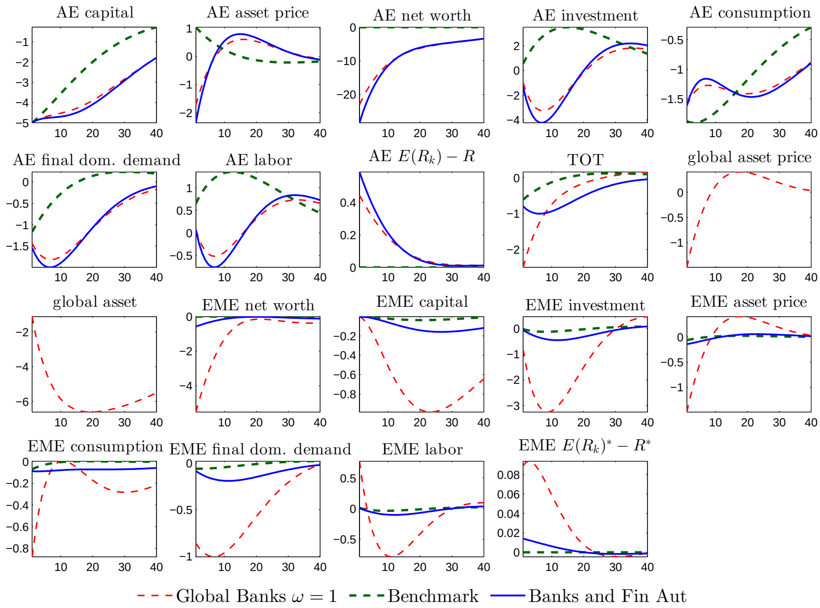

▸ Back to IRFs

# IRF to a Neg. Quality of $K$ Shock - No global banks

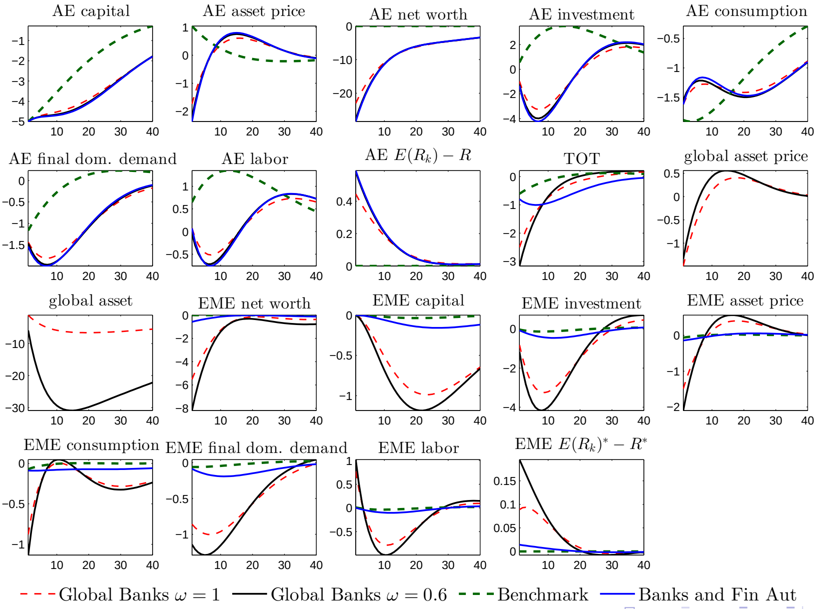



Back to IRFs

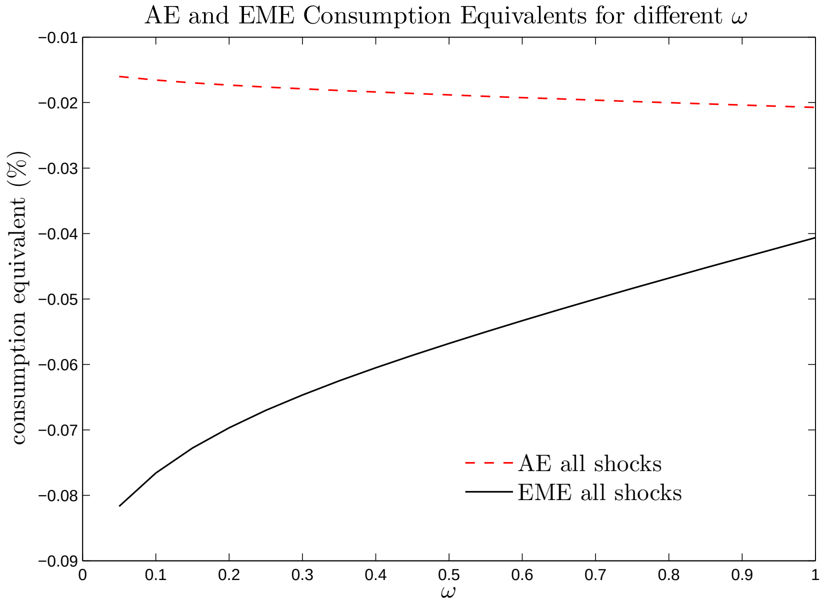
# IRF to a Neg. Quality of $K$ Shock - Global Banks



# IRF to a Neg. Quality of $K$ Shock - Risky Banks



# Consumption Equivalent



# IRF to a Neg. Quality of $K$ Shock - MPP+UMP