International Reserves and Central Bank Independence

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  - international reserves
  - public debt

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$\Longrightarrow$ independent central banks $\uparrow$ reserves to offset government borrowing

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- **Quantify:** welfare gains of having an independent central bank

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- <u>Main contribution:</u> novel motive for reserve accumulation

Motives for Reserve Accumulation

1. **Fx Interventions:** CB $\uparrow$ reserves to intervene in the exchange market
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Tractable model of sovereign default and reserve accumulation in an environment with lack of coordination between policymakers

Outline

1. Introduction
2. Motivation
3. Model
4. Example
5. Quantitative Analysis
6. Appendix

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2. **independence allows central banks to manage their reserves without interference from the government**

- **De jure central bank independence index for Latin America**

International Reserves and Central Bank Independence

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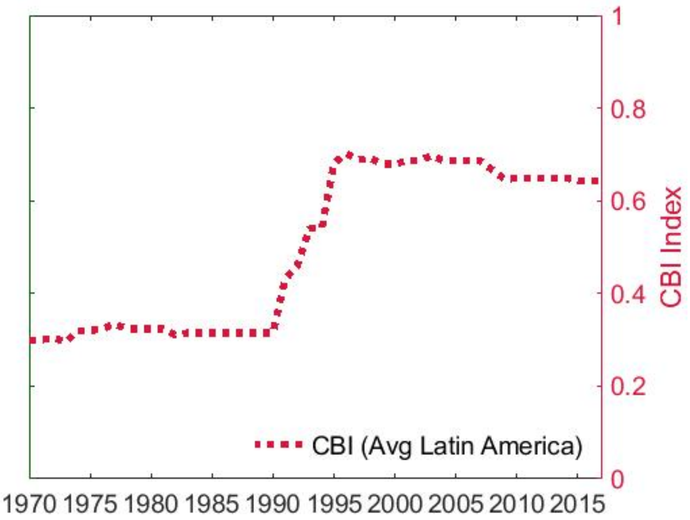

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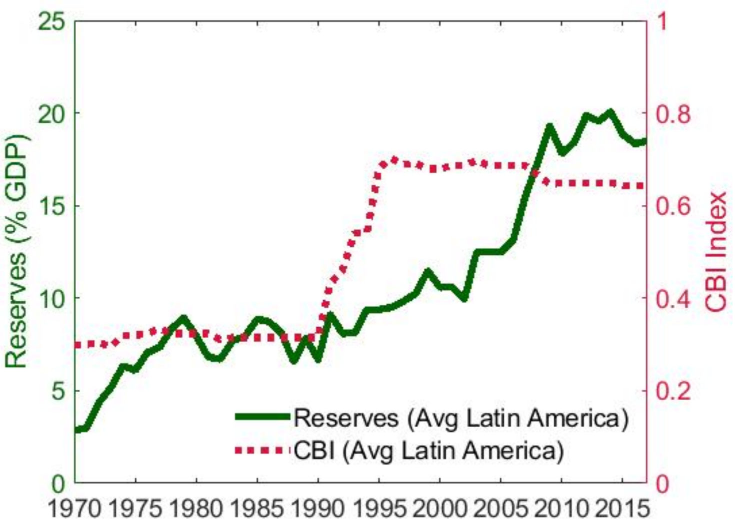

Regression Analysis: Equation

$$\mathbf{log(A/y)_{i,t}=\beta_1(CBI)_{i,t\text{-}1}} + \beta_2 log(y)_{i,t-1} + \beta_3 log(B/y)_{i,t-1} + \alpha_i + \gamma_t + \epsilon_{i,t}$$

where:

- $(A/y)_{i,t}$ denotes reserves normalized by GDP for country i at time t
- $(CBI)_{i,t-1}$ represents the CBI index for country i at time $t-1$
- $(y)_{i,t-1}$ is the cyclical component of GDP for country i at time $t-1$
- $(B/y)_{i,t-1}$ is debt normalized by GDP for country i at time $t-1$
- α_i denotes time invariant country fixed effects
- γ_t represents country invariant time fixed effects
- $\epsilon_{i,t}$ denotes the regression residuals

Regression Analysis: Main Result

Dependent variable: $log(A/y)$	(1)
CBI index	**2.36****
	(0.96)
$log(\hat{y})$	−0.95
	(0.64)
$log(B/y)$	−0.24
	(0.30)
inflation	
fx regime	
spreads	
Number of countries	11
Observations	359
R^2	0.47

Regression Analysis: Main Result

Dependent variable: $log(A/y)$	(1)	(2)	(3)	(4)
CBI index	**2.36****	**2.38****	**2.37****	**3.45****
	(0.96)	**(0.92)**	**(0.90)**	**(0.94)**
$log(\hat{y})$	−0.95	−1.41**	−1.42**	−0.65**
	(0.64)	(0.59)	(0.58)	(0.23)
$log(B/y)$	−0.24	−0.18	−0.17	0.21
	(0.30)	(0.28)	(0.27)	(0.17)
inflation		−0.20**	−0.20**	−0.13**
		(0.08)	(0.09)	(0.05)
fx regime			0.05	0.35*
			(0.15)	(0.19)
spreads				−0.47**
				(0.16)
Number of countries	11	11	11	9
Observations	359	359	359	148
R^2	0.47	0.51	0.51	0.61

The Case of Argentina in 2015

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- In 2015, the Argentinian central bank won the reversal of a U.S. court ruling that had allowed bondholders to move forward with a lawsuit targeting the assets of the central bank for the debt defaulted in 2002

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- In 2015, the Argentinian central bank won the reversal of a U.S. court ruling that had allowed bondholders to move forward with a lawsuit targeting the assets of the central bank for the debt defaulted in 2002
- This case sets an international precedent and guarantees that lenders will not be allowed to seize the reserves held by the central bank

In Summary

1. CB may be more prudent than the govt about the use of reserves
2. Independence allows CB to manage reserves without govt interference
3. International law protects central bank´s reserves in case of default

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- **these three ingredients together $\implies \uparrow$ reserves**

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  + independent central bank that accumulates international reserves

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     independent central banks can be isolated from political pressures
  3. lenders cannot seize the reserves held by the central bank

- Small open economy, with a stochastic endowment y_t, populated by
  - Households: $c_t = (1 - \tau^{\pi})y_t + T_t$
  - Central Bank: $q^* A_{t+1} + \Omega_t = \tau^{\pi} y_t + A_t$
  - Government: $T_t + B_t = q_t B_{t+1} + \Omega_t$

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Endowment Shocks | Preferences

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3. Households consume, c_t

Recursive Problems

Government's Problem Central Bank's Problem

- Households simply consume their endowment after taxes and transfers
- Lenders provide the amount of debt demanded by the government
- Policymakers are the only two strategic agents in the model

$\Longrightarrow$ simultaneous game:

  - Govt chooses $\{D_t, B_{t+1}\}$ taking as given CB´s strategy
  - CB chooses $\{A_{t+1}\}$ taking as given Govt´s strategy

- **I focus on Markov perfect equilibria**
  - strategies depend only on payoff-relevant state variables

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Deterministic Economy

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  2. **Independent Central Bank:** $\beta^F < \beta^M = \beta$

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Proposition

Let $\bar{B}$ *denotes the borrowing limit. If* $\beta^M = \beta = q^*$ *then* $\bar{B} = \frac{\gamma}{1-q*}$.

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$\iff$ (by definition)

$$\frac{u(1 + (1 - q^*)(A - \bar{B}))}{1 - \beta^F} = \frac{u(1 - \gamma + (1 - q^*)A)}{1 - \beta^F},$$

Characterization of the Borrowing Limit

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Let $\bar{B}$ denotes the borrowing limit. If $\beta^M = \beta = q^*$ then $\bar{B} = \frac{\gamma}{1-q*}$.

Sketch of proof:

Claim 1: If $B = \bar{B}$ then $B' = \bar{B}$

Claim 2: If $\beta^M = q^*$ then $\hat{A}_d(1, A) = A$ and $\hat{A}_r(1, \bar{B}, A) = A$

The rest of the proof follows from the definition of borrowing limit:

$$V_r^F(1, \bar{B}, A) = V_d^F(1, A),$$

$\iff$ (by definition)

$$\frac{u(1 + (1 - q^*)(A - \bar{B}))}{1 - \beta^F} = \frac{u(1 - \gamma + (1 - q^*)A)}{1 - \beta^F},$$

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$\iff$

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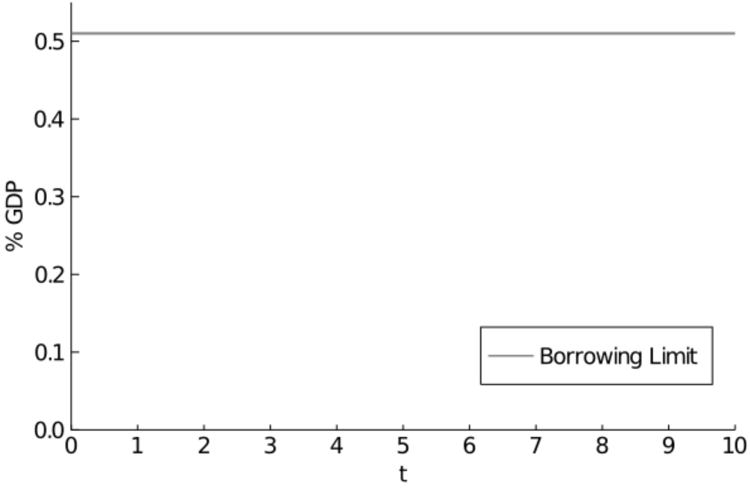
Consolidated Government ($\beta^F = \beta^M < \beta = q^*$)



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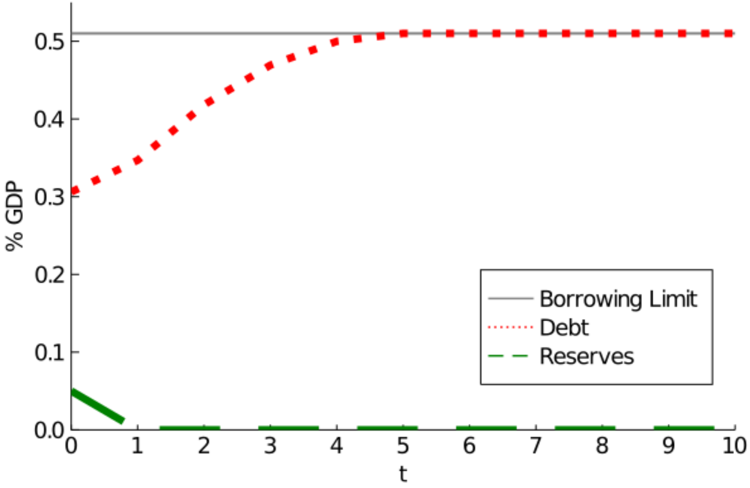

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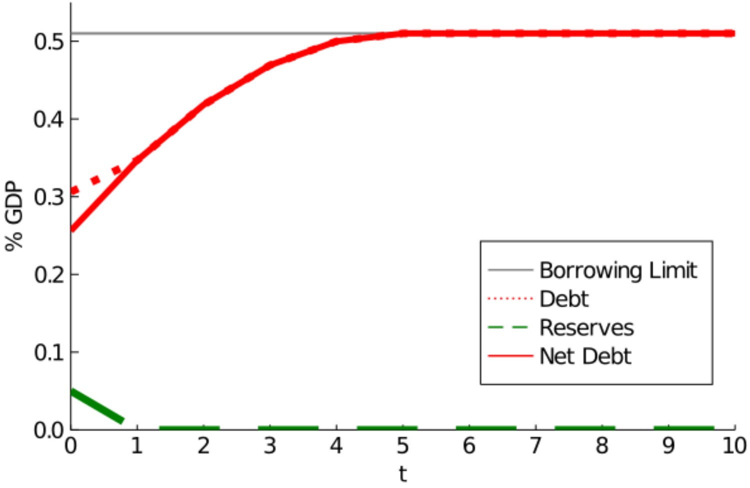
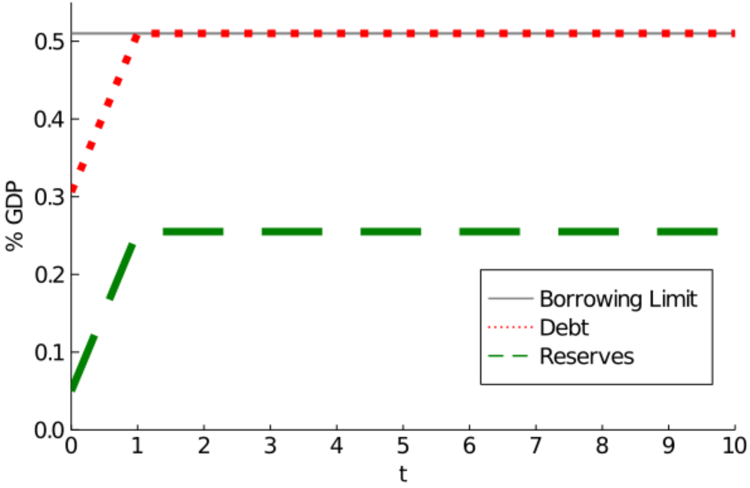


Independent Central Bank ($\beta^F < \beta^M = \beta = q^*$)



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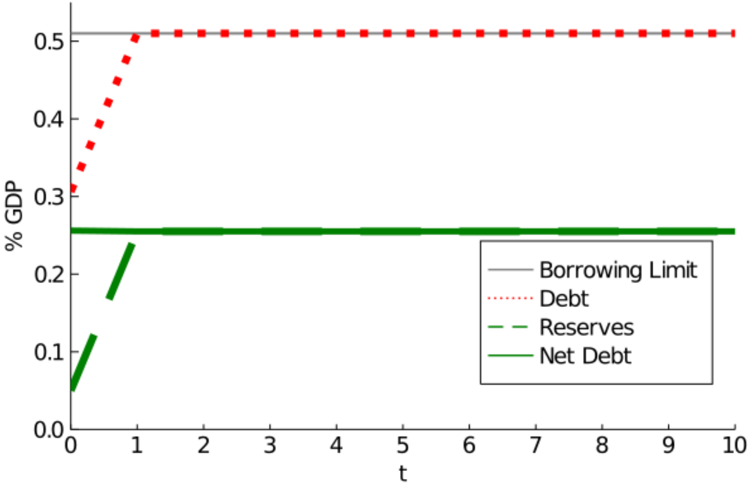
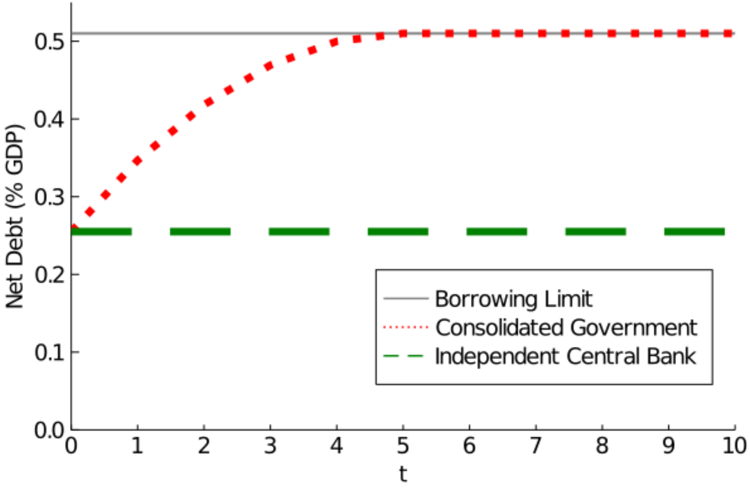


Net Debt Position



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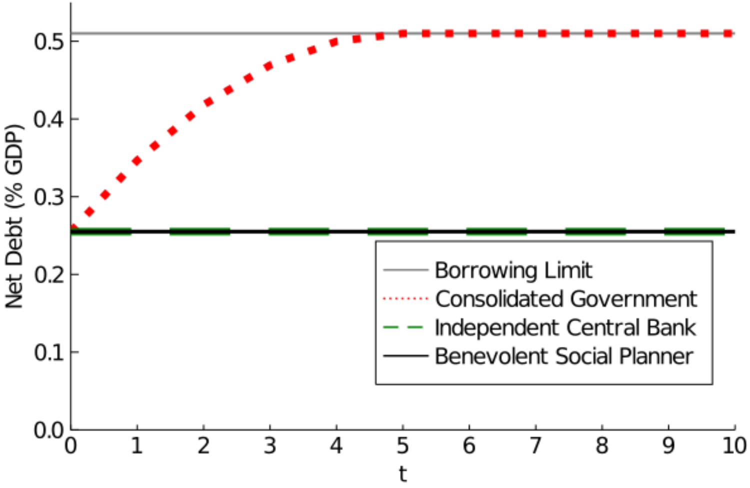

Outline

1. Introduction
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6. Appendix

Calibration

Functional Forms · Discount Factors

I calibrate the model using data for Mexico from 1994 to 2017

Parameter	Description	Value	Source/Target
σ	Risk aversion	2	Alfaro and Kanczuk (2009)
r^*	Risk-free interest rate	0.011	US Treasury Bills Rate $= 1.1\%$
π_{LH}	Prob of transiting to H	0.15	Global EMBI +
π_{HL}	Prob of transiting to L	0.80	Global EMBI +
ρ	Auto-correlation of y	0.66	Mexico's GDP
η	Variance of y	0.034	Mexico's GDP
θ	Reentry probability	0.11	9 years in default (1982-1990)
β^{M}	**CB's discount factor**	0.966	**MX Money Market**$=3.5\%$
β^{F}	**Govt's discount factor**	0.946	**Avg. B/GDP** $= 44.4$
d_0	Default cost	-0.81	Avg. spreads $= 273bp$
d_1	Default cost	0.902	Increase in spread $= 300bp$
κ_H	Pricing kernel parameter	0.17	$corr(r_s, B/y) = -0.1$

Key Statistics

The following table reports long-run moments in model simulations

	Data	Model
Targeted		
mean B/y (%)	44.4	43.3
mean r_s (%)	2.7	2.7
Δ (r_s) for $\kappa = \kappa_H$ (%)	3.0	2.9
corr $(B/y, y)$	0.1	0.0
Non-targeted		
mean (A/y) (%)	**8.7**	**7.2**
cor $(A/y, B/y)$	0.6	0.8
cor $(A/y, y)$	0.7	0.3
cor (c, y)	0.8	0.9
default prob (%)	3.0	0.9

Independent Central Bank vs Consolidated Government

	Data	Independent Central Bank	Consolidated Government
mean B/y (%)	44.4	43.3	39.4
mean r_s (%)	2.7	2.7	2.7
Δ (r_s) for $\kappa = \kappa_H$ (%)	3.0	2.9	2.9
corr $(B/y, y)$	0.1	0.0	-0.7
mean (A/y) (%)	**8.7**	**7.2**	**0.0**
cor $(A/y, B/y)$	0.6	0.8	0.0
cor $(A/y, y)$	0.7	0.3	0.0
cor (c, y)	0.8	0.9	0.9
default prob (%)	3.0	0.9	0.3

Inspecting the Mechanism

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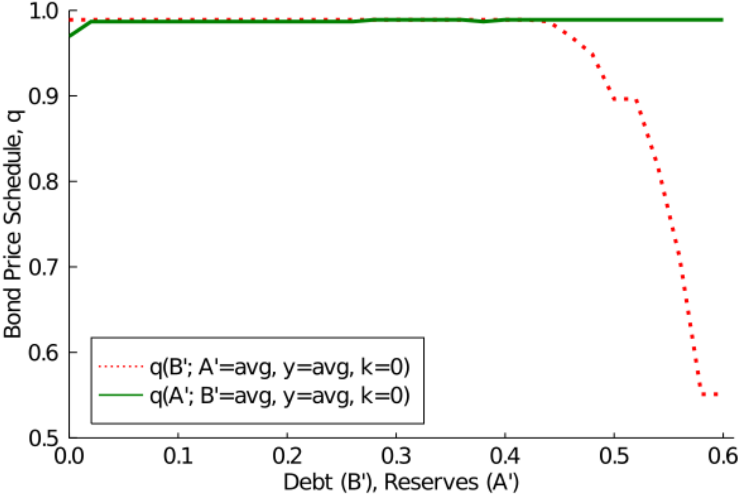
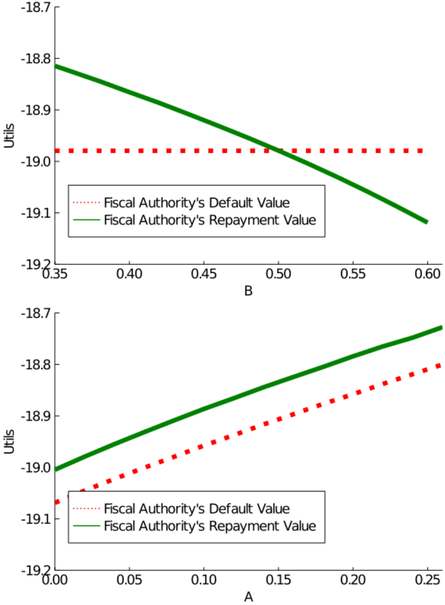
  - It is essential for my results that the economy is debt-constrained:
    either by a endogenous borrowing limit
    or implicitly by the bond price schedule, $q(s, B', A')$
  - Otherwise, the government can undo the effect of central bank's choice on the net debt position by issuing more debt

Bond Price Schedule



Government's Repayment and Default Values



Welfare Analysis

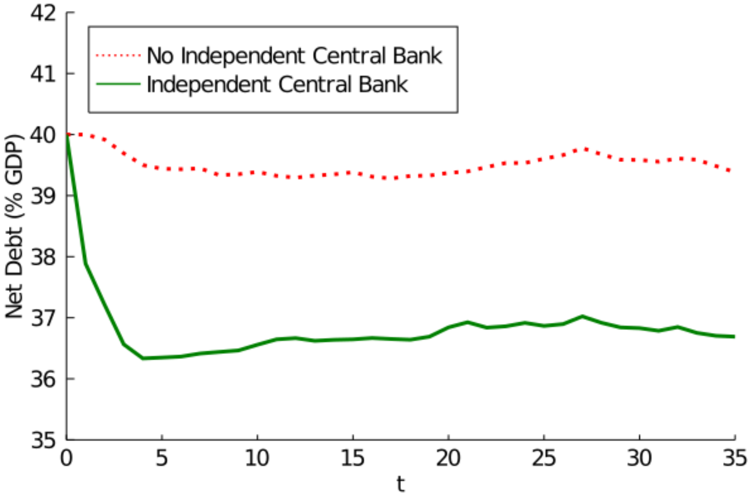
What is the welfare effect of accumulating reserves?

1. Ergodic distribution for the consolidated government economy
2. Introduce an independent central bank and compute welfare gains

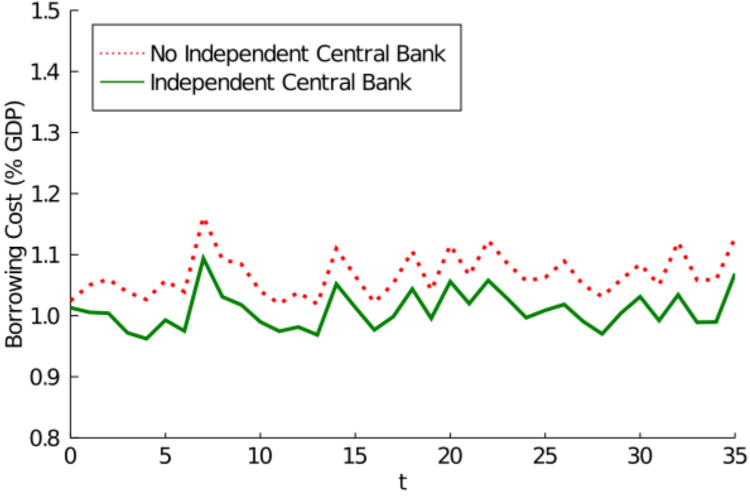
By accumulating reserves social welfare increases by 0.1%

	Independent Central Bank	Consolidated Government
mean (B/y) (%)	43.3	39.4
mean (A/y) (%)	7.2	0.0
net debt position (%)	36.1	39.4
% Social Welfare	0.1	0.0

Net Debt Position



Borrowing Cost



Final Remarks Extensions

- This paper emphasizes the role of CBI on reserve accumulation

  1. CB may be more prudent than the govt about the use of reserves
  2. CBI allows CB to manage reserves without govt interference
  3. International law protects CB´s reserves in case of default

Final Remarks Extensions

- This paper emphasizes the role of CBI on reserve accumulation
  1. CB may be more prudent than the govt about the use of reserves
  2. CBI allows CB to manage reserves without govt interference
  3. International law protects CB´s reserves in case of default
- Central Bank Independence channel accounts for 83% of the average level of international reserves observed in Mexico from 1994 to 2017
  - **By accumulating reserves, an independent central bank is able to shift resources towards the future in a way that cannot be undone by a govt that lacks fiscal discipline.**

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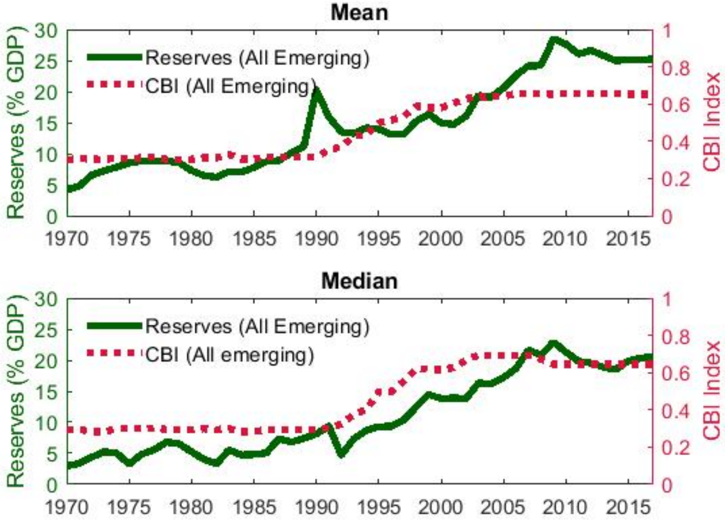
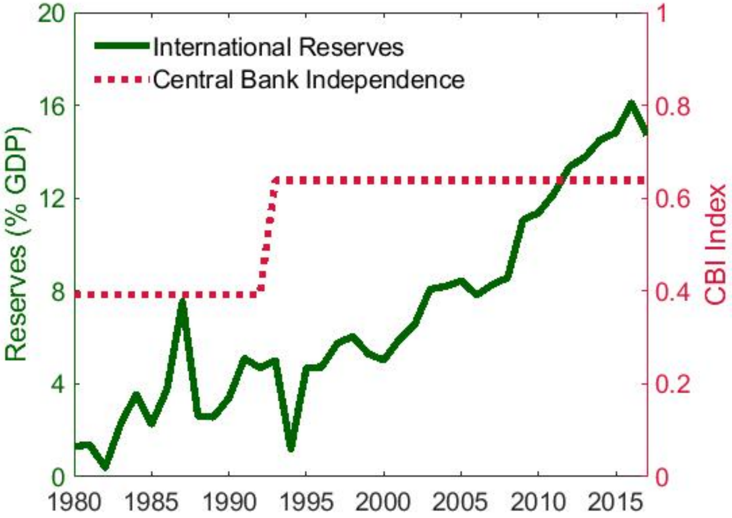
International Reserves and Central Bank Independence

Back

The positive correlation between reserves and CBI holds across all EMEs



Reserves and CBI: Mexico back



Regression Analysis: All Emerging back

	Dependent variable: $log(A/y)$			
	Latin America		All Emerging	
	(1)	(2)	(3)	(4)
CBI	2.36^{**}	3.24^{**}	0.14	0.78
	(0.96)	(1.26)	(0.46)	(0.74)
$log(y)$	-0.95	-0.39	-0.84^{**}	-0.38
	(0.64)	(0.27)	(0.32)	(0.26)
$log(B/y)$	-0.24	0.09	-0.25	0.16
	(0.30)	(0.21)	(0.17)	(0.14)
$log(spreads)$		-0.50^{**}		-0.24^{*}
		(0.19)		(0.13)
# of Countries	11	9	30	22
Observations	359	148	965	361
R^2	0.47	0.52	0.50	0.28

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

Regression Analysis: Exchange Rate Regime back

	Latin America		All Emerging	
	(5)	(6)	(7)	(8)
CBI	2.35**	3.07**	0.03	0.72
	(0.95)	(1.14)	(0.43)	(0.73)
$log(y)$	−0.96	−0.39*	−0.89**	−0.41
	(0.64)	(0.20)	(0.33)	(0.25)
$log(B/y)$	−0.23	0.25	−0.24	0.20
	(0.29)	(0.17)	(0.16)	(0.15)
$log(spreads)$		−0.51**		−0.28**
		(0.18)		(0.11)
dummy	0.07	0.36	0.22**	0.29**
fixed	(0.14)	(0.20)	(0.10)	(0.13)
# of Countries	11	9	30	22
Observations	359	148	962	361
R^2	0.47	0.57	0.51	0.33

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

Regression Analysis: Inflation back

	Latin America		All Emerging	
	(9)	(10)	(11)	(12)
CBI	2.38**	3.62***	−0.12	0.84
	(0.92)	(1.06)	(0.41)	(0.72)
log(y)	−1.41**	−0.65*	−0.82**	−0.37
	(0.59)	(0.31)	(0.35)	(0.29)
log(B/y)	−0.18	0.05	−0.22	0.18
	(0.28)	(0.18)	(0.18)	(0.14)
log(spreads)		−0.45**		−0.24*
		(0.17)		(0.14)
log(inflation)	−0.20**	−0.13*	−0.08	−0.03
	(0.08)	(0.06)	(0.06)	(0.05)
# of Countries	11	9	30	22
Observations	359	148	914	343
R^2	0.51	0.57	0.51	0.28

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

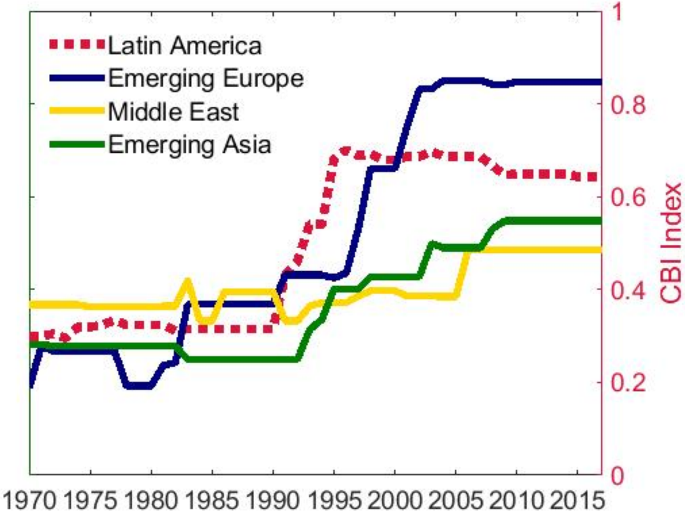
Regression Analysis: By Region

CBI · Fiscal Discipline · back

	Dependent variable: $log(A/y)$			
	Latin America	Emerging Europe	Middle East	Emerging Asia
	(1)	(13)	(14)	(15)
CBI	2.36^{**}	0.69	0.33	-1.19^{*}
	(0.96)	(0.98)	(0.45)	(0.47)
$log(y)$	-0.95	-1.19^{**}	-1.68^{*}	-0.65
	(0.64)	(0.37)	(0.74)	(0.72)
$log(B/y)$	-0.24	-0.40^{**}	-0.77^{***}	0.26
	(0.30)	(0.12)	(0.13)	(0.15)
# of Countries	11	8	5	6
Observations	359	195	172	239
R^2	0.47	0.65	0.73	0.82

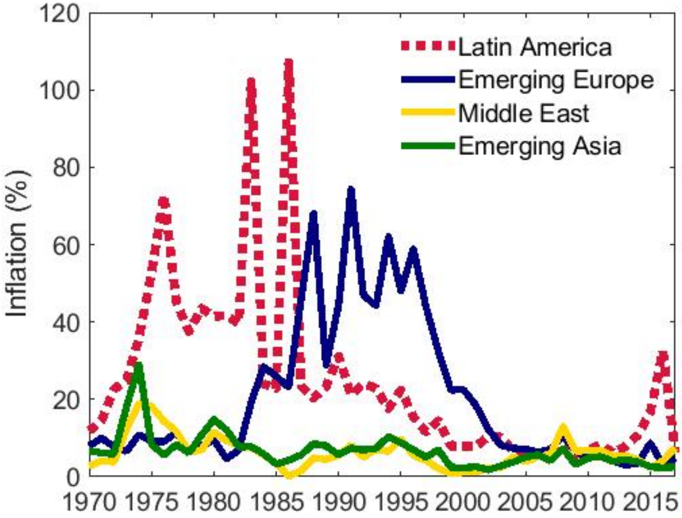
$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

Central Bank Independence by Region back



Inflation by Region

back



Regression Analysis: Event Study back

	Dependent variable: $log(A/y)$			
	Latin America		All Emerging	
	(16)	(17)	(18)	(19)
CBI dummy	0.55		-0.13	0.18
	(0.58)		(0.19)	(0.17)
$log(y)$	-0.95	-0.25	-0.84^{**}	-0.36
	(0.60)	(0.37)	(0.33)	(0.27)
$log(B/y)$	-0.27	0.27	-0.25	0.20
	(0.30)	(0.18)	(0.17)	(0.14)
$log(spreads)$		-0.68^{*}		-0.24^{*}
		(0.30)		(0.13)
# of Countries	11	9	30	22
Observations	370	148	977	361
R^2	0.41	0.37	0.49	0.26

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Endowment Shocks back

Households receive a stochastic endowment, $y_t \epsilon Y$, given by

$$log(y_t) = \rho log(y_{t-1}) + \varepsilon_t, \quad where \mid \rho \mid < 1 \, and \, \varepsilon_t \sim N(0, \eta^2)$$

Preferences back

Households have preferences over consumption given by

$$E_0 \left\{ \sum_{t=0}^{\infty} \beta^t u(c_t) \right\}$$

where β is the hhs discount factor, and $u(\,)$ is inc. and str. concave

Government entities, $j \epsilon \{M, F\}$, maximize:

$$E_0 \left\{ \sum_{t=0}^{\infty} (\beta^{\mathrm{j}})^t u(c_t) \right\}$$

where $\beta^{\mathrm{M}} = \beta$ represents the monetary authority's discount factor, and $\beta^{\mathrm{F}} < \beta$ denotes the fiscal authority's discount factor

Risk Premium Shocks back

Risk premium shocks as Bianchi, Hatchondo, and Martinez (2018):

$$m_{t,t+1} = e^{-r^* - (\kappa_t \varepsilon_{t+1} + 0.5\kappa_t^2 \eta^2)}$$

where $m_{t,t+1}$ denotes the lender's stochastic discount factor and κ_t is the parameter governing the risk premium shock

- $\kappa_t = 0 \Rightarrow$ lenders are risk neutral
- $\kappa_t > 0 \Rightarrow$ lenders are risk averse
- κ_t plays an important role to account for spread levels

Government's Problem back

The government's recursive problem is given by

$$V^F(s,B,A) = \max_{D} \left\{ (1-D)V_r^F(s,B,A) + (D)V_d^F(s,A) \right\}$$

where

$$V_r^F(s,B,A) = \max_{B'} \left\{ u(c) + \beta^F E[V^F(s',B',A')|s] \right\}$$

s.t.

$$c = y + A - B - q^* A' + q(s,B',A')B'$$

$$A' = \hat{A}_r(s,B,A)$$

and

$$V_d^F(s,A) = u(c) + \beta^F (\theta E[V^F(s',0,A')|s] + (1-\theta)E[V_d^F(s',A')|s])$$

s.t.

$$c = y^{def} + A - q^* A'$$

$$A' = \hat{A}_d(s,A)$$

Solution: policy functions for default and debt, $\hat{D}(s,B,A)$ and $\hat{B}(s,B,A)$

Central Bank's Problem back

The central bank's recursive problem in repayment states is given by

$$V_r^M(s, B, A) = \max_{A' \geq 0} \left\{ u(c) + \beta^M E[(1 - D')V_r^M(s', B', A') + (D')V_d^M(s', A')|s] \right\}$$

s.t.

$$c = y + A - B - q^* A' + q(s, B', A')B'$$

$$B' = \hat{B}(s, B, A)$$

$$D' = \hat{D}(s', B', A')$$

and in default states the central bank's value function is given by

$$V_d^M(s, A) = \max_{A' \geq 0} \left\{ u(c) + \beta^M(\theta E[V_r^M(s', 0, A')|s] + (1 - \theta)E[V_d^M(s', A')|s]) \right.$$

s.t.

$$c = y^{def} + A - q^* A'$$

Solution: policy functions reserves in repayment and default, $\hat{A}_r(s, B, A)$ and $\hat{A}_d(s, A)$

Functional Forms back

The utility function $u(\,)$ is given by

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}$$

Default cost as in Chatterjee and Eyigungor (2012)

$$\phi(y) = max\{0, d_0 y + d_1 y^2\}$$

The risk premium shock, κ, follows a two-state Markov process

- values: $\kappa_L = 0$ and $\kappa_H > 0$
- transition probabilities: $\pi_{LH} = 0$ and $\pi_{HL} > 0$

Discount Factors back

- Sovereign default models usually assume a high degree of impatience to account for political economy aspects in emerging economies
  - This is a reasonable assumption for the fiscal authority, which depends on the current government and faces short-term political pressures
  - But it may not be accurate for an independent central bank
  - Moreover, a high degree of impatience implies a domestic interest rate that is not consistent with the data
- I choose:
  - β^M by matching the domestic interest rate
  - β^F by targeting public debt levels

Alternative Calibration back

I calibrate the model using data for Mexico from 1994 to 2017

Parameter	Description	Value	Source/Target
σ	Risk aversion	2	Alfaro and Kanczuk (2009)
r^*	Risk-free interest rate	0.011	US Treasury Bills Rate $= 1.1\%$
π_{LH}	Prob of transiting to H	0.15	Global EMBI +
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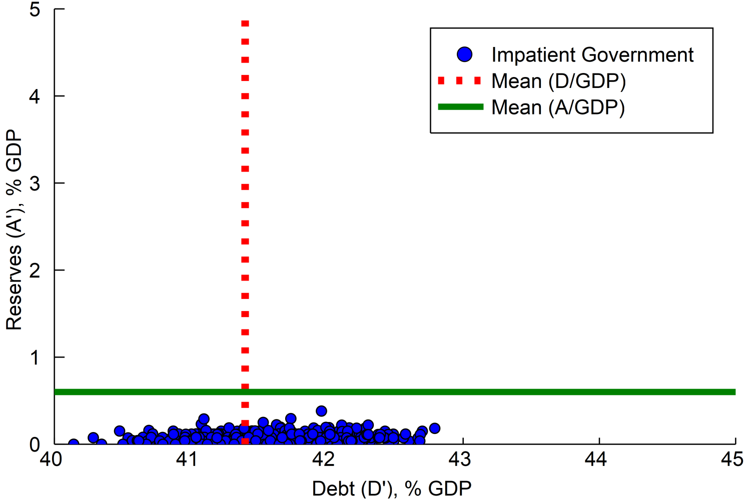
θ	Reentry probability	0.11	9 years in default (1982-1990)
β^{M}	**MA's discount factor**	0.966	**MX Money Market=**3.5%
β^{F}	**FA's discount factor**	0.946	**Avg. B/GDP =** 44.4
d_0	Default cost	-0.81	Avg. spreads $= 273bp$
d_1	Default cost	0.894	Std. spreads $= 140bp$
κ_H	Pricing kernel parameter	5.1	$cor(B/y, y) = -0.1$

Key Statistics back

The following table reports long-run moments in model simulations

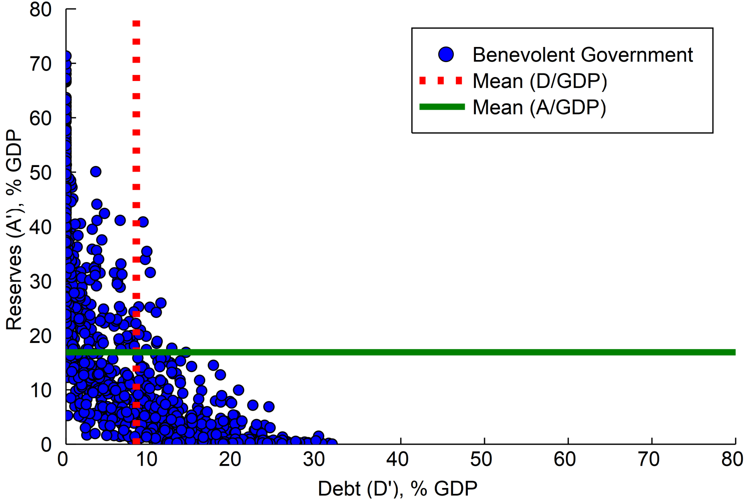
	Data	Two-Gov-Entities
Targeted		
mean (B/y)	44.4	43.3
mean (r_s)	2.7	2.5
std. (r_s)	1.4	1.4
cor $(B/y, y)$	-0.1	0.1
Non-targeted		
mean (A/y)	**8.7**	**37.2**
cor $(A/y, B/y)$	0.6	0.9
cor $(A/y, y)$	0.7	0.2
cor (r_s, y)	-0.6	0.0
cor $(r_s, A/y)$	-0.4	-0.1
cor $(r_s, B/y)$	0.1	-0.1

Alfaro and Kanczuk back



Benevolent Social Planner

back



Welfare Analysis back

1. Ergodic distribution for the Alfaro and Kanczuk economy
2. Introduce a benevolent social planner and compute welfare gains

	Alfaro and Kanczuk	Two Government Entities	Benevolent Social Planner
mean (B/y)	42.4	43.6	4.6
mean (A/y)	0.0	5.1	22.0
Net Debt Position	42.4	38.5	-17.4
% Social Welfare	0.0	1.0	4.2

Future Research back

1. Add long-term debt as in Bianchi, Hatchondo, and Martinez (2018)
   - two-gov-entities + rollover risk
   - variance decomposition

2. Add money in the utility function
   - monetary policy implications
   - rationalize negative correlation between reserves and inflation