Fiscal regimes and the exchange rate*

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Exchange Rate: A Shock Absorber or a Shock Generator?

6 December 2021

*The views expressed in this paper are those of the authors and do not necessarily reflect those of the Bank for International Settlements and the Swiss National Bank.

Introduction

- Fiscal support has raised government debt to unprecedented levels
  - AEs: 104% of GDP (2019) $\rightarrow$ 122% of GDP (2021)
  - EMEs: 55% of GDP (2019) $\rightarrow$ 65% of GDP (2021)
- In the last few months, inflationary pressures have started to arise
  - supply bottlenecks, pent up demand, commodity prices
- EME central banks started raising rates. Since March 2021
  - Brazil +575bps (-225bps during pandemic)
  - Russia +325bps (-200bps during pandemic)
  - Mexico +75bps (-325bps during pandemic)

Introduction

- Brazil's Copom statements and minutes highlight fiscal risks
  - *[...] further extensions of fiscal policy responses to the pandemic that increase aggregate demand and deteriorate the fiscal path may pressure the country's risk premium. In spite of the improvement of debt sustainability indicators, the elevated fiscal risk creates an upward asymmetry in the balance of risks [...]*
  - *[...] the Committee assesses that recent questioning regarding the fiscal framework increased the risk of deanchoring inflation expectations, raising the upward asymmetry in the balance of risks.*
  - *[...] the inflation projections are slightly above the targets for 2022 and around the target for 2023. The Committee judged that the fiscal risks continue to imply an upward bias in the projections. This asymmetry in the balance of risks affects the appropriate degree of monetary stimulus thus justifying a path for monetary policy that is more restrictive than the path used in the baseline scenario.*

Introduction

- What do we know about the effects of monetary policy during (or when there is risk of) fiscal distress?
- Old idea (Blanchard (2004)): in a regime of fiscal distress higher interest rates increase sovereign risk $\Longrightarrow$ depreciates the domestic currency $\Longrightarrow$ increase inflation.
- This idea has survived despite lack of empirical or theoretical support
- Link between sovereign risk and exchange rate: Della Corte, Sarno, Schmeling, Wagner (2021)
  - there is no formal asset pricing theory that examines jointly the determination of sovereign risk and exchange rates

This paper

- Study BRL/USD daily movements around monetary (fiscal) policy announcements and find evidence of two regimes
- In response to a contractionary monetary (expansionary fiscal) shock, the domestic currency tends to
  - appreciate in normal times
  - depreciate during periods of fiscal distress
- To rationalize these findings, we propose a simple model of sovereign default with
  1. stochastic fiscal regimes
     - Ricardian: debt is fully backed by future fiscal surpluses
     - non-Ricardian: fiscal policy doesn't ensure solvency $\Longrightarrow$ default
  2. asymmetric recovery rates between domestic and foreign investors
     - sovereign risk drives currency excess return
     - endogenous default probability (non-strategic)

Empirical evidence

Empirical approach

- Empirical model

$$\Delta e_t = \alpha_t + \beta_t \xi_t + \boldsymbol{\gamma} \Delta \mathbf{X}_t^{>} + \varepsilon_t$$

  - Δe_t is the daily log change of the BRL/USD exchange rate
  - ξ_t is the (monetary/fiscal) policy surprise at policy announcement

- The object of interest is the sign of β_t and its evolution
  1. Identify fiscal regimes using narrative evidence:

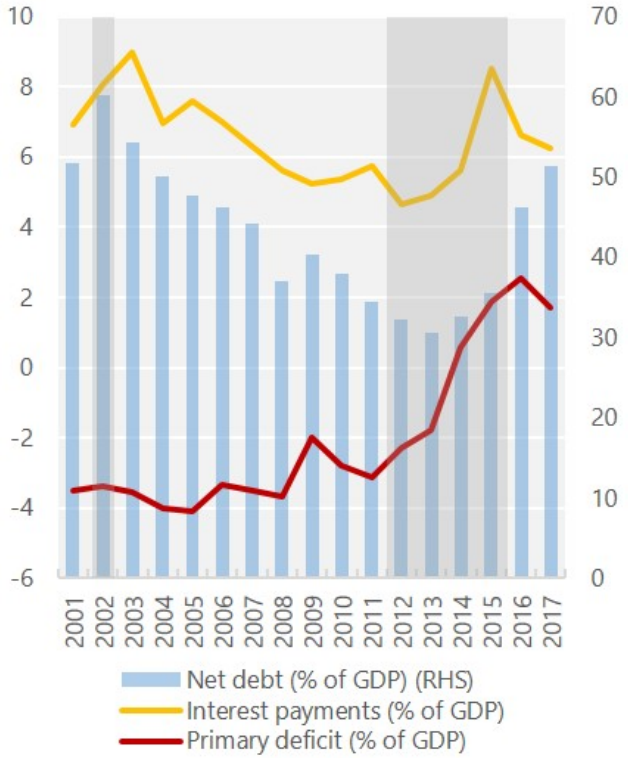
$$\beta_t = (1 - \mathbf{1}_t)\, \beta_R + \mathbf{1}_t \beta_N$$

     where $\mathbf{1}_t = 1$ during non-Ricardian regimes
  2. Unobserved fiscal regimes:

$$\beta_t = \beta\,(s_t)$$

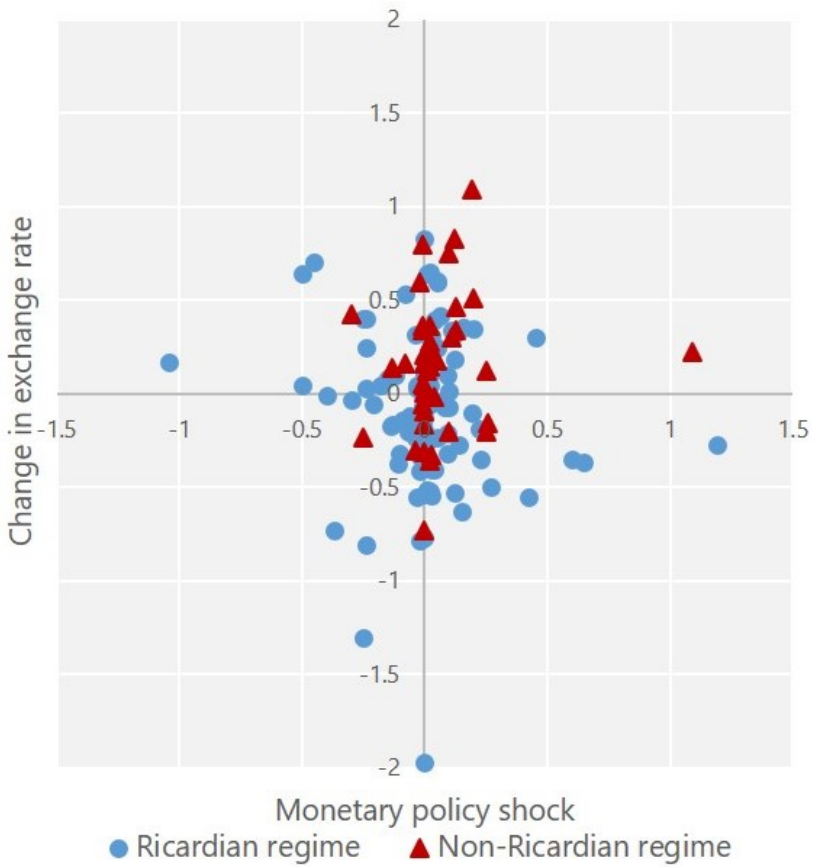
     where s_t is a hidden state that follows a two-state Markov chain

Non-Ricardian fiscal regimes



- Two episodes (exact dates using CDS spread dynamics):
  1. runoff to Lula election: Mar-Oct 2002
  2. uncontrolled fiscal expansion: Jan 2012-Dec 2015

Monetary policy shocks



- Announced minus avg expected (BCB survey) Selic target rate
- 147 interest rate decisions, from Nov 2001 to Dec 2017
  - decision distribution: 42 $\uparrow$, 50 $=$, 55 $\downarrow$
  - shock distribution: 71 $>$, 17 $=$, 59 $<$

Exchange rate response to MP shocks

	Unconditional		Fiscal regimes			
	(1)	(2)	(3)		(4)	
			R	N	R	N
Constant	-0.02	0.01	-0.09**	0.14**	-0.05	0.16***
	(0.03)	(0.03)	(0.04)	(0.06)	(0.04)	(0.06)
$i - \mathbb{E}[i]$	**0.14**	**0.14**	**-0.22**	**0.25*****	**-0.25****	**0.27*****
	(0.12)	**(0.12)**	**(0.13)**	**(0.04)**	**(0.12)**	**(0.04)**
Δ VIX		0.06*			0.06*	
		(0.03)			(0.03)	
Δ Comm. Prices		-0.07***			-0.07***	
		(0.03)			(0.03)	
Δ 2 year T-note		0.18			0.08	
		(0.68)			(0.64)	
Constant (diff.)			0.23***		0.21***	
			(0.07)		(0.07)	
$i - \mathbb{E}[i]$ **(diff.)**			**0.46*****		**0.52*****	
			(0.14)		**(0.12)**	
R^2	0.01	0.11	0.11		0.21	
No. of observations	147	147	147		147	

Note: Robust standard errors in parenthesis. Statistical significance at the 10%, 5% and 1% levels is denoted by *, **, and ***.

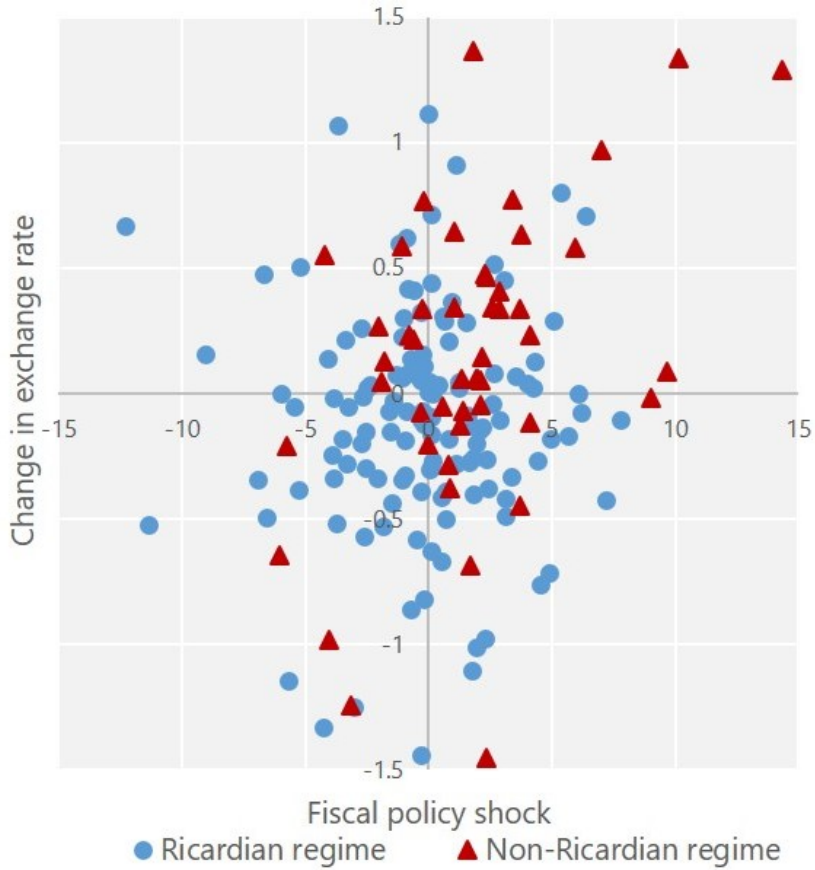
Robustness

- Capital controls: check announcement dates (2009-2014) and add capital controls indexes
  1. Pasricha et al. (2017): quarterly NKI, inflow, outflow indexes
  2. Cantú (2019): monthly NKI, inflow, outflow indexes

- Informational effect of MP decisions: add path surprises
  - Residual from orthogonalizing 1-year interbank swap rate with MP surprises (Gürkaynak et al. (2005))

- Proxy MP surprises with market interest rate variations
  - Use 1-day changes in 30-day interbank swap rate

Fiscal policy shocks



- Announced minus avg expected (Bloomberg survey) primary deficit
  - 10 units of shock roughly equivalent to 0.26% of GDP
- 177 announcements, from Apr 2003 to Dec 2017
  - shock distribution: 95 $>$ and 79 $<$

Exchange rate response to FP shocks

	Unconditional		Fiscal regimes			
	(1)	(2)	(3)		(4)	
			R	N	R	N
Constant	-0.05	-0.04	-0.10***	0.03	-0.10***	0.03
	(0.04)	(0.04)	(0.04)	(0.08)	(0.04)	(0.08)
pd − 𝔼 [pd]	**0.03****	**0.02**	**0.00**	**0.07*****	**-0.01**	**0.05****
	(0.01)	**(0.01)**	**(0.01)**	**(0.02)**	**(0.01)**	**(0.02)**
Δ VIX		0.12***			0.12***	
		(0.03)			(0.03)	
Δ Comm. Prices		-0.04			-0.04	
		(0.02)			(0.02)	
Δ 2 year T-note		1.20			1.24*	
		(0.73)			(0.70)	
Constant (diff.)			0.14		0.13	
			(0.09)		(0.08)	
pd − 𝔼 [pd] (diff.)			**0.07*****		**0.06****	
			(0.02)		**(0.02)**	
R^2	0.05	0.22	0.13		0.29	
No. of observations	177	177	177		177	

Note: Robust standard errors in parenthesis. Statistical significance at the 10%, 5% and 1% levels is denoted by *, **, and ***, respectively.

Markov-switching regression

- Empirical model

$$\Delta e_t = \alpha_t + \beta_t \xi_t + \boldsymbol{\gamma} \Delta \mathbf{X}_t^{\top} + \varepsilon_t$$

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  2. Unobserved fiscal regimes:

$$\beta_t = \beta\,(s_t)$$

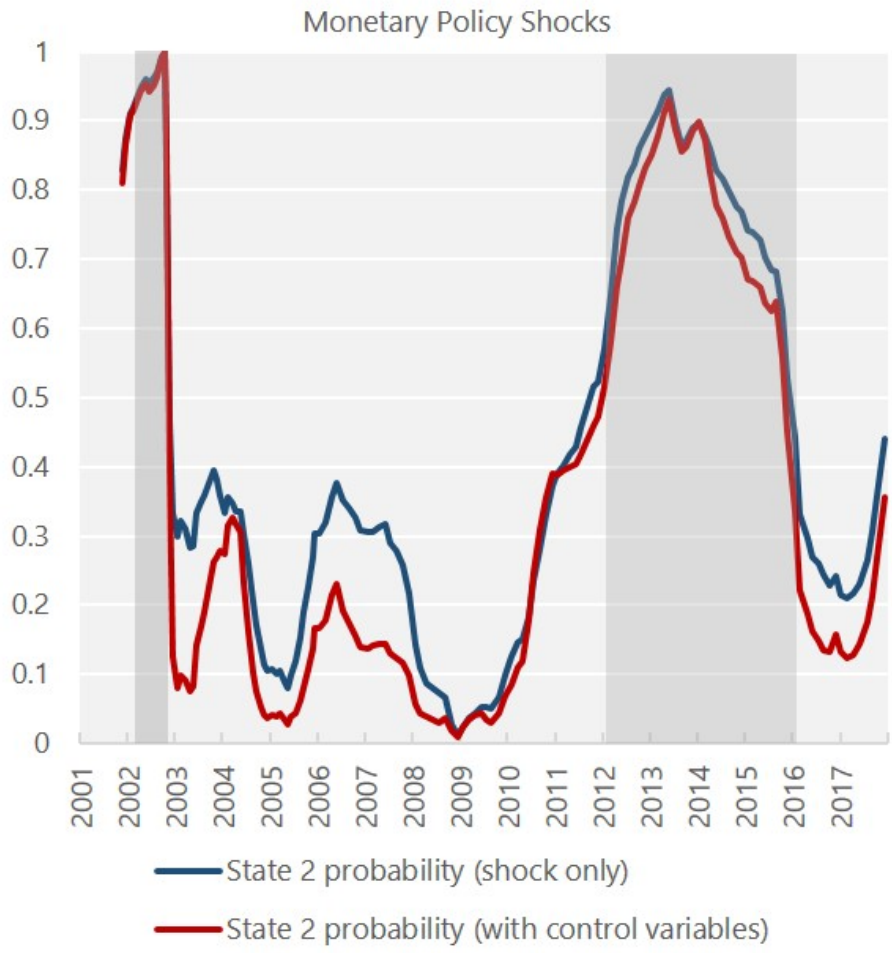
     where s_t is a hidden state that follows a two-state Markov chain

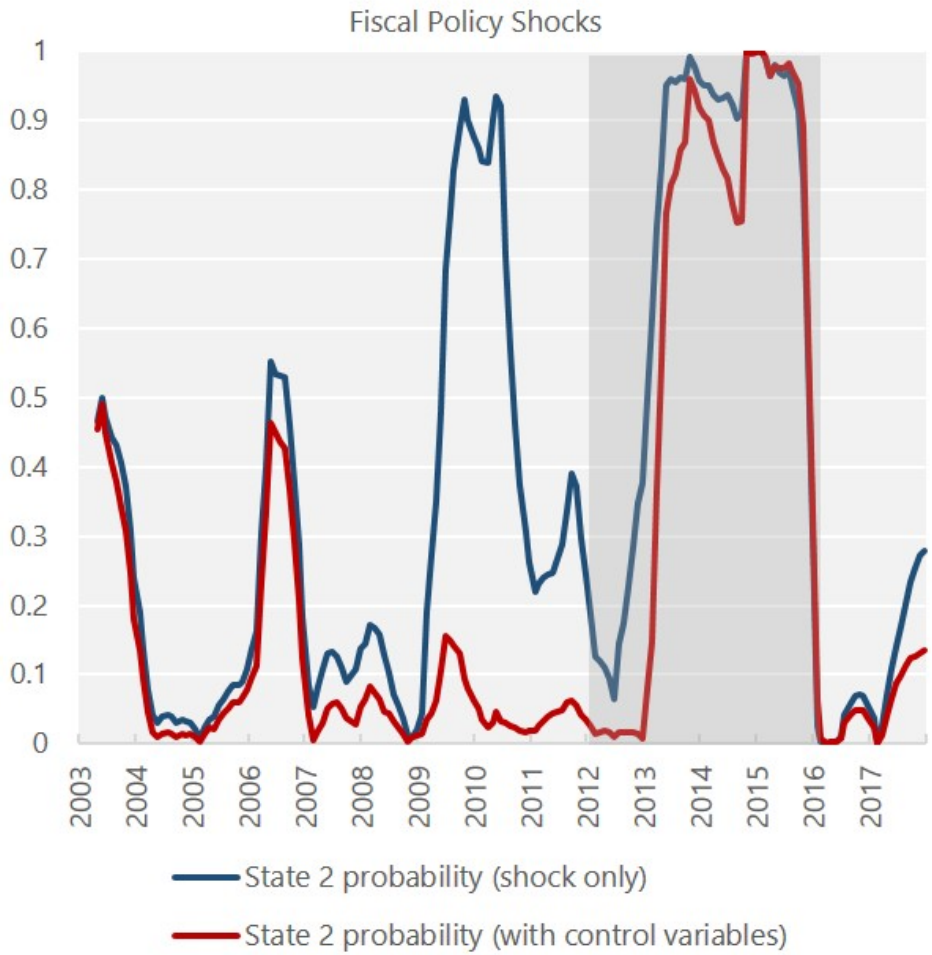
Exchange rate response in the two regimes

		Monetary policy				Fiscal policy			
		(1)		(2)		(3)		(4)	
		State 1	State 2	State 1	State 2	State 1	State 2	State 1	State 2
Transition	State 1	0.95	0.05	0.96	0.04	0.95	0.05	0.97	0.03
matrix	State 2	0.06	0.94	0.06	0.94	0.07	0.93	0.08	0.92
Constant		-0.11	0.09	-0.06	0.14**	-0.12**	0.01	-0.07	-0.01
		(0.18)	(0.17)	(0.05)	(0.06)	(0.05)	(0.07)	(0.05)	(0.08)
policy shock		**-0.14**	**0.19**	**-0.21***	**0.23****	**-0.02**	**0.08*****	**-0.01**	**0.09*****
		(0.43)	**(0.39)**	**(0.13)**	**(0.09)**	**(0.02)**	**(0.02)**	**(0.02)**	**(0.02)**
Δ VIX				0.06*				0.13***	
				(0.03)				(0.03)	
Δ Comm. Prices				-0.07***				-0.04	
				(0.03)				(0.03)	
Δ 2 year T-note				0.02				1.37**	
				(0.72)				(0.70)	
Volatility		0.40		0.37		0.44		0.40	
		(0.05)		(0.03)		(0.03)		(0.03)	
Obs.		147				177			

Note: Robust standard errors in parenthesis. Statistical significance at the 10%, 5% and 1% levels is denoted by *, **, and ***, respectively.

Estimated probabilities





Theory

The model

- Continuous-time small open economy New Keynesian model
- Central bank fully committed to stabilize inflation $(\phi > 0)$

$$i(t) = [\rho + (1 + \phi_\pi)\,\pi_H(t)] + \varepsilon_i(t)$$

- Fiscal authority finances spending issuing debt and taxing

$$T(t) - \bar{T} = \psi^x \left(B(t) - \bar{B}\right)$$

where $B(t)$ is total real debt and x denotes the fiscal regime

- Tax policy is stochastic
  1. $\psi^R >> 0 \implies$ Ricardian regime (passive FP)
  2. $\psi^N \approx 0 \implies$ non-Ricardian regime (active FP)

Sovereign bonds and default

- The government issues two short-term (instantaneous) bonds:
  - Home-currency bond, pays the interest rate $i_H(t)$
  - Foreign-currency bond, pays the interest rate $i_F(t)$
- Complete financial markets integration
  - Home and Foreign investors can buy both bonds
- The government can default on its (total) debt
  - default is a stochastic event with endogenous probability $\eta(t)$
  - $\eta(t)$ is determined in equilibrium by the government budget constraint
- Upon default foreign investors are subject to higher haircuts
  - Domestic creditors recover a fraction χ of credits
  - Foreign creditors recover $\chi^* < \chi$

Exchange rate and default risk

- No arbitrage yields the modified Uncovered Interest Parity condition

$$\mathsf{E}\left[\frac{d\mathcal{E}(t)}{\mathcal{E}(t)}\right] = i(t) - i\ (t) - (\chi - \chi\ )\,\eta(t)$$

- Default risk drives the currency excess return
  - an increase in $\eta(t)$ depreciates the exchange rate
- An increase in $\eta(t)$ raises sovereign bonds spreads
  - increase in $i_H(t)$ too low for foreign investors
  - increase in $i_F(t)$ too high for domestic investors
- Empirical evidence
  - Della Corte et al (2021): an increase in a country's CDS spread is accompanied by a depreciation of its currency [...] mainly driven by default expectations (rather than distress risk premia)
  - Broner et al (2014), Converse and Mallucci (2019): when default risk rises international investors reallocate away

Equilibrium default probability

- The intertemporal budget constraint of the government is

$$B(t) = \mathsf{E} \int_t^1 e^{\int_t^k (i(z) \quad \pi_H(z) \quad \xi(z)(\chi \quad \chi^*)\eta(z) + \ldots) dz} (T(k) - G(k)) \, dk$$

- Assume $B(t)$ is not sustainable. Then, either
  1. $T(k) - G(k)$ rises for $k \geq t$
  2. $e^{\int_t^k (i(z) \quad \pi_H(z)) dz}$ rises for $k \geq t$
  3. $B(t)$ fall (instantaneous default)
  4. $e^{\int_t^k \xi(z)(\chi \quad \chi^*)\eta(z) dz}$ rises for $k \geq t$

- To solve, assume that default risk is proportional to debt:

$$\eta(t) = \max \left\{ 0, \eta^x \frac{B(t) - \bar{B}}{\bar{B}} \right\}$$

Constant fiscal regimes

Proposition

The log-linearized model has up to two equilibria:

- *a* **Ricardian equilibrium**, *denoted with* R, *in which*

$$\psi_b^R > \rho \quad \textit{and} \quad \tilde{\eta}^R = 0$$

- *a* **non-Ricardian equilibrium**, *denoted with* N, *in which*

$$\psi_b^N < \rho \quad \textit{and} \quad \tilde{\eta}^N = \frac{\rho - \psi_b^N}{\xi - \alpha\left(1 - \psi_\pi^N\right)}$$

provided $\phi_\pi > \tilde{\eta}^N \left(1 - \psi_\pi^N\right) \frac{\rho\alpha}{\kappa\omega}$ *and* $\xi > \frac{\alpha}{\rho}\left(1 - \psi_\pi^N\right)\left(2\rho - \psi_b^N\right)$.

- The non-Ricardian equilibrium always exists if $\psi_\pi^N = 1$

Monetary policy shocks

Proposition

The elasticity of the exchange rate to the shock $\varepsilon_i(0) = \varrho\bar{\varepsilon}_i > 0$ *is*

- *in the Ricardian equilibrium*

$$\frac{e^R(0)}{\bar{\varepsilon}_i} = -1 + \frac{\kappa\omega\phi_\pi}{\kappa\omega\phi_\pi + \varrho(\rho+\varrho)}$$

- *in the non-Ricardian equilibrium*

$$\frac{e^N(0)}{\bar{\varepsilon}_i} = \frac{e^R(0)}{\bar{\varepsilon}_i} + \underbrace{\frac{\varrho(\rho+\varrho)\left(\rho-\psi_b^N\right)}{\kappa\omega\phi_\pi + \varrho(\rho+\varrho)} \frac{1-\iota+\frac{\kappa\omega\phi_\pi\frac{1-\alpha}{\rho+\varrho}\quad\rho}{\kappa\omega\phi_\pi(1\quad\alpha)+\alpha\rho^2}\frac{\kappa\omega\phi_\pi}{\rho+\varrho}}{\frac{\rho\xi\kappa\omega\phi_\pi}{\kappa\omega\phi_\pi(1\quad\alpha)+\alpha\rho^2}-\iota\left(\rho-\psi_b^N\right)}}_{\text{debt channel}>0}$$

- Foreign-currency debt (ι) tends to amplify the response of the exchange rate in the non-Ricardian equilibrium

Fiscal policy shocks

Proposition

The elasticity of the exchange rate to the shock $\varepsilon_g(0) = \varrho\bar{\varepsilon}_g > 0$ *is*

- *in the Ricardian equilibrium*

$$\frac{e^R(0)}{\bar{\varepsilon}_g} = -\frac{\varrho\kappa\varphi\phi_\pi}{\kappa\omega\phi_\pi + \varrho(\rho+\varrho)}$$

- *in the non-Ricardian equilibrium*

$$\frac{e^N(0)}{\bar{\varepsilon}_g} = \frac{e^R(0)}{\bar{\varepsilon}_g} + \underbrace{\frac{\varrho\kappa\varphi\phi_\pi\left(\rho-\psi_b^N\right)}{\kappa\omega\phi_\pi+\varrho(\rho+\varrho)}\frac{\beta\frac{\rho+\varrho}{\kappa\varphi\phi_\pi}-\iota+\frac{\kappa\omega\phi_\pi\frac{1-\alpha}{\rho+\varrho}\rho}{\kappa\omega\phi_\pi(1-\alpha)+\alpha\rho^2}\frac{1+\varphi}{\varphi}\beta}{\frac{\rho\xi\kappa\omega\phi_\pi}{\kappa\omega\phi_\pi(1-\alpha)+\alpha\rho^2}-\iota\left(\rho-\psi_b^N\right)}}_{\text{debt channel}>0}$$

Markov-switching fiscal regimes

Proposition

Assume that the model switches stochastically between the Ricardian and the non-Ricardian regime according to the transition matrix

$$\Sigma = \begin{bmatrix} -\sigma^N & \sigma^N \\ \sigma^R & -\sigma^R \end{bmatrix} \tag{1}$$

and $\psi_\pi^R = \psi_\pi^N = 1$. *Then, the equilibrium of the model is mean-square stable if*

$$\tilde{\eta}^N = \frac{\rho - \psi_b^N}{\xi} - \frac{\sigma^R}{\xi} \frac{\psi_b^R - \rho}{2\left(\psi_b^R - \rho\right) + \sigma^N} \tag{2}$$

- With $\psi_\pi^R = \psi_\pi^N = 1$ the elasticity of default wrt to debt is smaller
- In more general case, it can be higher due to inflation

Monetary policy shocks

Proposition

Let $\psi_\pi^R = \psi_\pi^N = 1$, $\psi_b^N = 0$, $\psi_b^R \downarrow \rho$, *and* $\iota = 0$. *Then the elasticity of the exchange rate to the shock* $\varepsilon_i(0) = \varrho\bar{\varepsilon}_i > 0$ *in the MS model is*

$$\frac{e^R(0)}{\bar{\varepsilon}_i} = \left.\frac{e^R(0)}{\bar{\varepsilon}_i}\right|_{\sigma^N=0} + \sigma^N \Xi$$

and

$$\frac{e^N(0)}{\bar{\varepsilon}_i} = \left.\frac{e^N(0)}{\bar{\varepsilon}_i}\right|_{\sigma^R=0} - \sigma^R \Xi$$

where $e^x(0)/\bar{\varepsilon}_i|_{\sigma^{-x}=0}$ *is the response of the exchange rate in regime* $x \in \{R, N\}$ *in the deterministic model.*

Fiscal policy shocks

Proposition

Let $\psi_\pi^R = \psi_\pi^N = 1$, $\psi_b^N = 0$, $\psi_b^R \downarrow \rho$, *and* $\iota = 0$. *Then the elasticity of the exchange rate to the shock* $\varepsilon_g(0) = \varrho\bar{\varepsilon}_g > 0$ *in the MS model is*

$$\frac{e^R(0)}{\bar{\varepsilon}_g} = \left.\frac{e^R(0)}{\bar{\varepsilon}_g}\right|_{\sigma^N=0} + \sigma^N \beta \Xi$$

and

$$\frac{e^N(0)}{\bar{\varepsilon}_g} = \left.\frac{e^N(0)}{\bar{\varepsilon}_g}\right|_{\sigma^R=0} - \sigma^R \beta \Xi$$

where $e^x(0)/\bar{\varepsilon}_g|_{\sigma^{-x}=0}$ *is the response of the exchange rate in regime* $x \in \{R, N\}$ *in the deterministic model.*

Conclusion

- Study BRL/USD daily movements around monetary (fiscal) policy announcements and find evidence of two regimes
- In response to a contractionary monetary (expansionary fiscal) shock, the domestic currency tends to
  - appreciate in normal times
  - depreciate during periods of fiscal distress
- We rationalize these fact with a sovereign default model featuring
  - stochastic fiscal regimes
  - asymmetric recovery rates between domestic and foreign investors
- Sovereign risk drives the currency excess return.
  $\Longrightarrow$ domestic policies affect the exrate through debt sustainability

Appendix

Direct evidence of unequal treatment

- Ukraine (1998): domestic-law, domestic-currency treasury bills
  - residents and nonresidents were offered different exchange options
  - Sturzenegger and Zettelmeyer (2008) haircuts: 7% res vs 56% nonres
- Russia (1998): domestic-law, domestic-currency bonds
  - same offer but nonresidents had to deposit in restricted accounts (capital controls). SZ estimates: 46% res vs 59% nonres
  - some banks were secretly allowed to exchange frozen GKOs/OFZs for central bank and dollar-denominated bonds.
- Argentina (2001): exchange of foreign-law, foreign-currency bonds
  - exchange with domestic-law, dollar loans, but domestic banks and pension funds (50%) could value them at par. Later "pesified".
  - nonresidents refused and tendered in 2005 for different instruments. SZ estimated haircuts: 66% res vs 73% nonres

Passive monetary policy

Proposition

Assume $\phi_\pi^N < 0$. Then $\tilde{\eta}^N = 0$ and the elasticity of the exchange rate in the non-Ricardian equilibrium (with $\psi_\pi^N = 0$) is

$$\frac{e^N(0)}{\bar{\varepsilon}_i} = \frac{\frac{\varrho(\rho+\varrho)\left(\rho \quad \psi_b^N\right)}{(\mu+\rho+\varrho)\left(\varrho+\rho \quad \psi_b^N\right)}}{(1-\iota)\,\mu - \iota\left(\rho - \psi_b^N\right)}$$

$$\frac{e^N(0)}{\bar{\varepsilon}_g} = \frac{\varrho\frac{\beta\omega(\mu+\rho+\varrho)\left(\mu+\rho \quad \psi_b^N\right) \quad \varphi\mu(\mu+\rho)\left(\rho \quad \psi_b^N\right)}{\omega(\mu+\rho+\varrho)\left(\varrho+\rho \quad \psi_b^N\right)}}{(1-\iota)\,\mu - \iota\left(\rho - \psi_b^N\right)}$$

where $\mu \equiv \left(\sqrt{\rho^2 - 4\kappa\omega\phi_\pi^N} - \rho\right)/2 > 0.$

- The sign is ambiguous. It is negative if
  1. the share of foreign-currency debt is high and/or
  2. monetary policy is not too passive, ie $\left|\phi_\pi^N\right|$ is small