Conducting Unconventional Monetary Policy with Foreign Exchange Reserves

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Q1. Can *sterilized asset purchase* be an effective policy tool in a sudden stop?
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Q2. If so, how to design this new tool? Which asset to purchase and how to sterilize?
  - I compare three different policy designs to find the most effective one

This paper

- proposes a small-open economy DSGE framework built on Gali-Monacelli (2005)
  - abstracting from nominal rigidity and assuming incomplete financial market
- with three key specifications:
  - (i) *Financial market imperfection*, (ii) *Liability dollarization*, and (iii) *Fear of losing reserves*

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- with three key specifications:
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- Results:

1. shows sterilized asset purchase is effective and it brings welfare gains
2. finds the optimal policy rule considering trade-offs: deep recession vs. slow recovery
3. provides the most effective design: purchasing corporate bonds sterilized with FX reserve

Related literature

- Financial frictions in open economies

  Krugman 1999, Aghion-Bacchetta-Banerjee 2004, Céspedes-Chang-Velasco 2004,
  Gertler-Gilchrist-Natalucci 2007, Aoki-Benigno-Kiyotaki 2016, Kitano-Takaku 2020, Akinci-Queralto 2022

  $\Rightarrow$ This paper: nonlinearities arising from the frictions imposed

- Unconventional monetary policies in open economies

  Jeanne-Korinek 2010, Bianchi 2011, Bianchi-Mendoza 2018
  Céspedes-Chang-Velasco 2017, Chang-Velasco 2017, Chang 2018
  Basu-Boz-Gopinath-Roch-Unsal 2020, Carrasco-Hoyle 2020
  Hofmann-Patel-Wu 2021, Mimir-Sunel 2021

  $\Rightarrow$ This paper: sterilized asset purchase as a policy response to sudden stops

- Motive for FX reserve hoarding

  Jeanne-Rancière 2011, Gopinath-Stein 2018, Bocola-Lorenzoni 2020, Céspedes-Chang 2020
  Das-Gopinath-Kim-Stein 2022

  $\Rightarrow$ This paper: FX reserve is a war chest to sterilize asset purchases

Outline

- Model
- Results
- Conclusion

Model

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- Consider a small-open economy with two tradable goods: home and foreign goods
  - inhabited by households, banks, non-financial firms, and the consolidated government

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  - *Liability dollarization*: borrow in foreign currency (i.e., in units of foreign goods)
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  - *Liability dollarization*: borrow in foreign currency (i.e., in units of foreign goods)
  - *Financial market imperfection*: operate under leverage constraint (à la Gertler-Kiyotaki-Karadi)
- The government conducts asset purchase programs with sterilization using FX reserves
  - *Fear of losing reserves*: the use of reserves is limited by a constraint

Banks

– The balance sheet is given as

$$\underbrace{q_{kt}s_{Bt} + q_{bt}b_{Bt}}_{\text{assets}} = \underbrace{n_t}_{\text{net worth}} + \underbrace{e_t d_t}_{\text{liabilities}}$$

where e_t is real exchange rate and $d_t \equiv d_{Ht} + d_{Ft}$

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– Banks are subject to the leverage constraint (Gertler-Karadi 2013) ▸ details

$$V_t(n_t) \geq \underbrace{\theta(q_{kt}s_{Bt} + \Delta q_{bt}b_{Bt})}_{\text{divertible assets}}$$

that is occasionally-binding, where $\Delta \in [0, 1)$

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- Consider corporate bond purchases sterilized with FX reserves

$$q_{kt}\underbrace{s_{Gt}}_{\uparrow} + e_t \underbrace{f_t}_{\downarrow} = q_{bt}\underbrace{b_t}_{\text{constant}}$$

Government

- **Policy rule**: sell Γ_t fraction of FX reserves

$$\Gamma_t \equiv \phi_\mu(\mu_t - \mu)$$

where $\phi_\mu > 0$ is the degree of intervention to ease financial stress measured by

$$\mu_t \equiv \mathbb{E}_t(R_{kt+1} - R_{t+1}\frac{e_{t+1}}{e_t})$$

the spread on corporate bond

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– Assume a constraint on the use of reserves

$$\Gamma_t \leq \bar{\Gamma}$$

that is occasionally-binding, where $\bar{\Gamma} \in (0, 1]$ due to *"fear of losing reserves"*

Rest of the model

– The economy is subject to debt-elastic interest rates (Schmitt-Grohé and Uribe 2003)

$$R_t = R_t^* + \psi \left[\exp\left(\frac{e_t(d_{Ft} - f_t)}{y_t} - \frac{e(d_F - f)}{y} \right) - 1 \right] + \xi_t$$

where ξ_t is a risk premium following AR(1) that generates sudden stops

Results

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1. Sudden stop episodes with and without sterilized asset purchase
2. Design of sterilized asset purchase

Sudden stop without policy

- In the steady state where banks are not constrained
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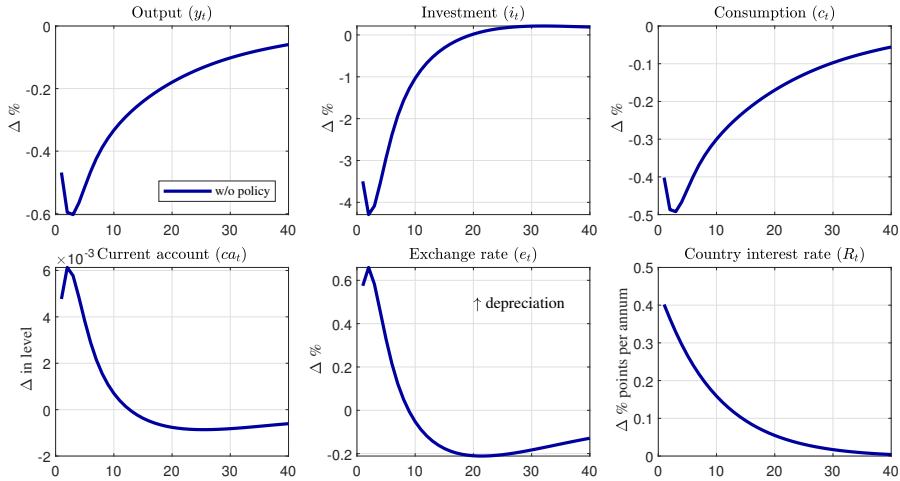

Sudden stop without policy

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- To see in more detail, banks' net worth is

$$\underbrace{n_t}_{\downarrow\downarrow} = \underbrace{(z_t + (1-\delta)q_{kt})s_{Bt-1}}_{\downarrow} + \underbrace{(\Xi + \varrho\, q_{bt})b_{Bt-1}}_{\downarrow} - \underbrace{e_t R_t d_{t-1}}_{\uparrow}$$

- As banks get constrained, their asset demand decreases
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- As banks get constrained, their asset demand decreases
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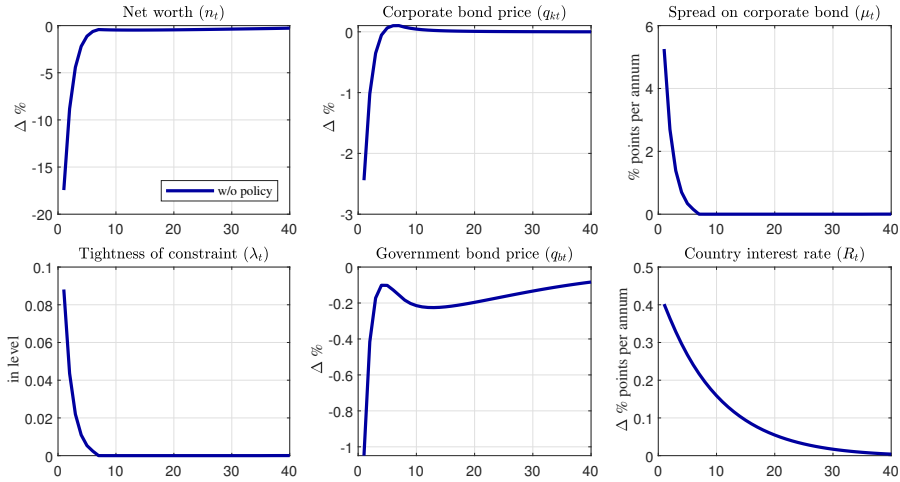
- This negative feedback loop is balance sheet effect that amplifies the sudden stop ▸ details

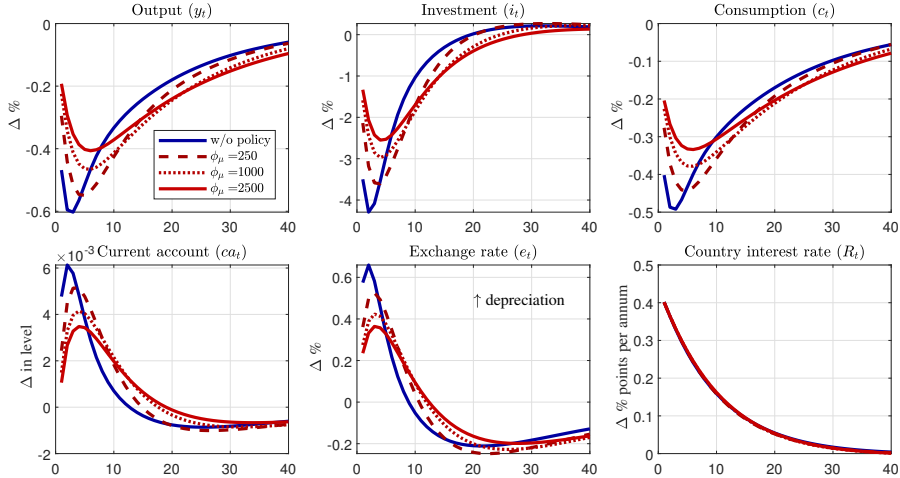
Sudden stop without policy



– The spike in spread indicates a tight credit condition, inducing investment decline

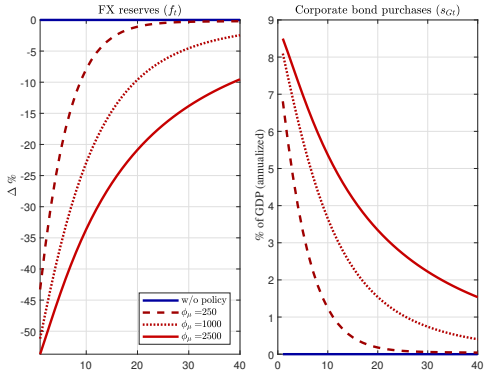
Sudden stop with sterilized asset purchase

Sudden stop with sterilized asset purchase

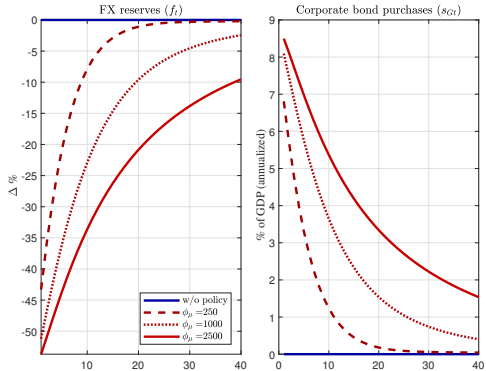


- The impact of sudden stop is significantly diminished under policy
  - More aggressive policy (higher ϕ_μ) brings greater buffer effects

Sudden stop with sterilized asset purchase

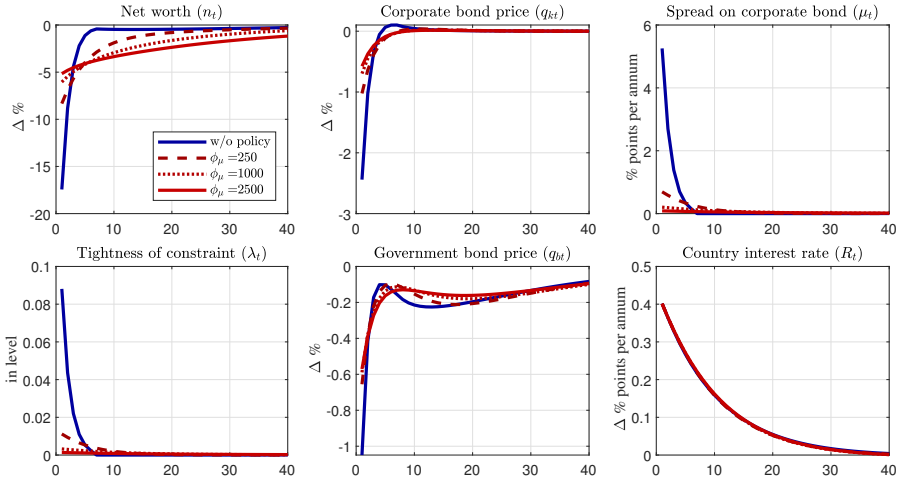


Sudden stop with sterilized asset purchase



- In addition to direct liquidity provision, the policy supports asset prices and exchange rates
- Thus, the policy enchances the value of banks' net worth, relaxing the leverage constraint

Sudden stop with sterilized asset purchase



Policy trade-offs

- Trade-offs: deep recession vs. slow recovery
  - Eliminating spreads decreases banks' profits, slowing down the growth of net worth

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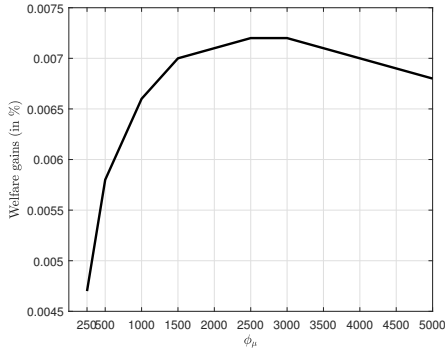
  - Eliminating spreads decreases banks' profits, slowing down the growth of net worth
- The growth of net worth can be written as

$$\underbrace{\frac{n_t}{n_{t-1}}}_{\downarrow} = \underbrace{\left(R_{kt} - R_t \frac{e_t}{e_{t-1}}\right)}_{\downarrow} \frac{q_{kt-1} s_{Bt-1}}{n_{t-1}} + \underbrace{\left(R_{bt} - R_t \frac{e_t}{e_{t-1}}\right)}_{\downarrow} \frac{q_{bt-1} b_{Bt-1}}{n_{t-1}} + R_t \frac{e_t}{e_{t-1}}$$

  showing that net worth recovers in a slower pace with low spreads

Welfare analysis

- The consumption-equivalent welfare measure is given below



- The policy brings welfare gains whose concave shape describes trade-offs
  - The optimal level of intervention is $\phi_\mu = 2500$ under which the welfare is maximized

Design of sterilized asset purchase program

- Consider a discretionary asset purchase in the steady state where banks are constrained

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1. Purchasing corporate bonds is more effective than government bond (re)purchases ▸ figure

$$q_{kt}\underbrace{s_{Gt}}_{\text{constant}} + e_t \underbrace{f_t}_{\downarrow} = q_{bt}\underbrace{b_t}_{\downarrow}$$

   – Intuition: since gov. bond is safer, it is less effective in making banks' portfolio less riskier

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2. Selling FX reserve is a better sterilization than issuing government bonds ▸ figure

$$q_{kt}\underbrace{s_{Gt}}_{\uparrow}+e_t\underbrace{f_t}_{\text{constant}}=q_{bt}\underbrace{b_t}_{\uparrow}$$

   – Intuition: the effect gets partially offset, since banks must absorb these additional bonds

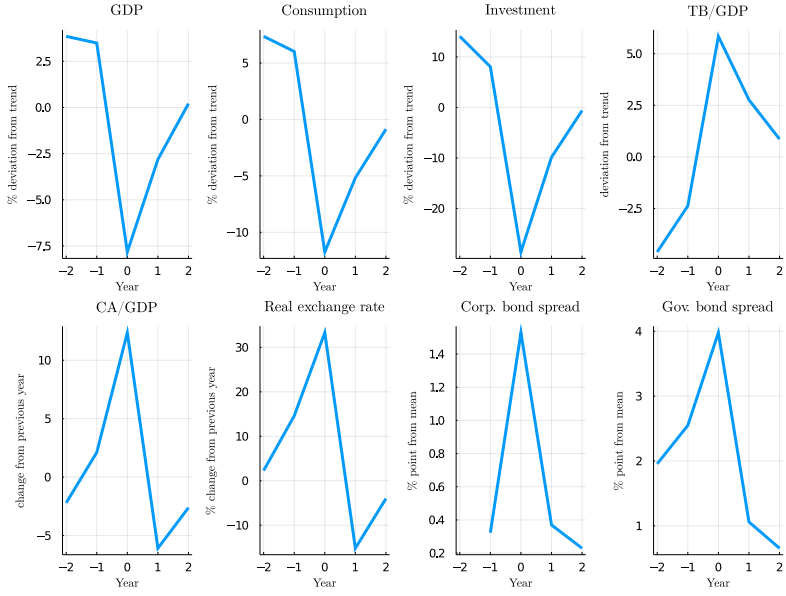
Conclusion

- This paper analyzes the effectiveness and design of sterilized asset purchase programs
- Policy implications:
  - Conduct sterilized asset purchase programs in a sudden stop if banks are constrained
  - Purchasing private assets sterilized with FX reserves is most effective
  - Too much asset purchases may slow down the recovery
  - Hoard enough FX reserves in advance ▸ details

Appendix

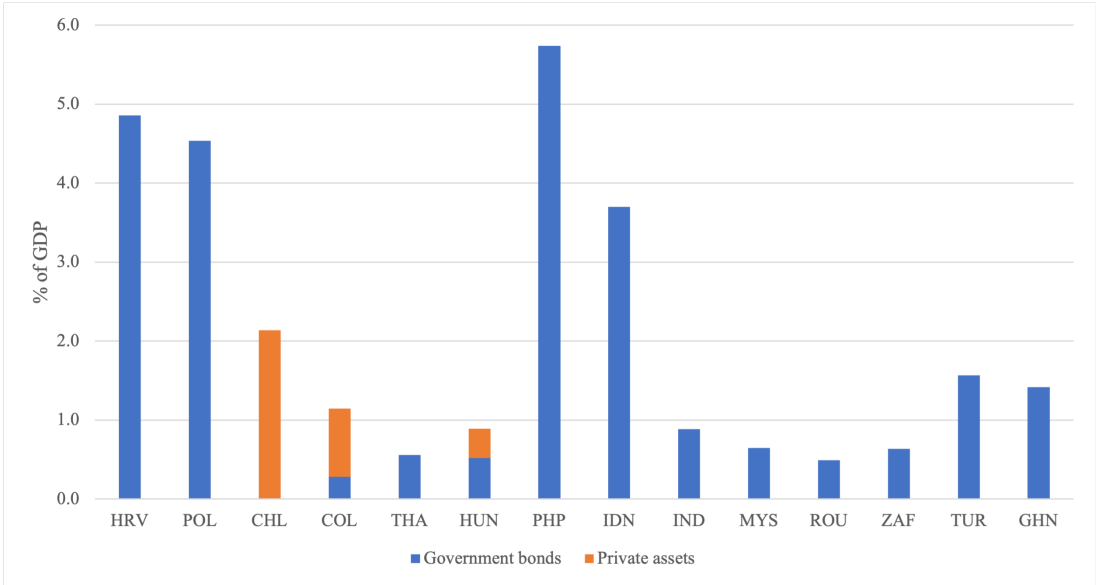
Sudden stop episode (South Korea 1998)

Back



Asset purchases (March - August 2020)

Back



Leverage constraint

Back

– The given constraint can be rewritten in terms of the leverage ratio defined as

$$l_t = \frac{q_{kt} s_{Bt} + \Delta q_{bt} b_{Bt}}{n_t} \leq \bar{l}_t$$

where the maximum value is

$$\bar{l}_t \equiv \frac{\mathbb{E}_t \Lambda_{t,t+1} \Omega_{t+1} R_{t+1} e_{t+1} / e_t}{\theta - \mathbb{E}_t \Lambda_{t,t+1} \Omega_{t+1} (R_{kt+1} - R_{t+1} e_{t+1} / e_t)}$$

Calibration

Back

- The following parameters are targeting
  - Banks' leverage, government bond spread, and corporate bond spread in the steady state

Parameter	Value	Description	Source/Target
Δ	0.37	Relative divertible fraction of gov. bond	Gov. bond spread
χ	0.92	Banks' surviving probability	Mimir-Sunel (2021)
θ	$\{0.1587, 006116\}$	Divertible fraction of total assets	Leverage & lending-deposit rate spread
ι	$\{0.0112, 0.0019\}$	Transfer rate for new banks	Small positive number

- The persistence of risk premium is estimated from Emerging Markets Bond Spread (EMBI+)

Other parameters

Back

Parameter	Value	Description	Source/Target
β	0.99	Discount factor	Standard
σ	2	Inverse of intertemporal elasticity of subst.	Standard
α	0.33	Income share for capital	Standard
δ	0.025	Depreciation rate	Standard
κ_i	1	Adjustment cost in capital production	Standard
κ_h	2.2434	Utility weight on labor	Labor hours of 1/3
φ	1/3	Inverse of Frisch elasticity	Gertler-Kiyotaki (2010)
η	1.5	Trade elasticity	Kitano-Takaku (2020)
γ	0.29	Trade openness	Export-GDP ratio

– External debt, FX reserves, gov. spending to GDP ratios are from the data

Other parameters

Back

Parameter	Value	Description	Source/Target
Ξ	0.0275	Coupon payment for gov. bond	Spread on gov. bond
ϱ	0.9848	Decaying rate for gov bond	10 years duration
g	0.13	Government public spending	Gov. expenditure to GDP ratio
f	0.64	FX reserves	Reserve to GDP ratio (annual)
ϕ_μ	{250,1000,2500}	Responsiveness to spreads in policy rule	
$\bar{\Gamma}$	{1,0.3}	Limit on the use of FX reserves	
ρ_ξ	0.91	Persistence in risk premium	AR(1) estimation
ψ	0.001	Elasticity of debt in interest rate	Small positive number
R^*	1.0101	Foreign interest rate	Implied from model
y^*	1	Foreign output	Normalization
γ^*	0.344	Foreign trade openness	Implied from model

Untargeted moments

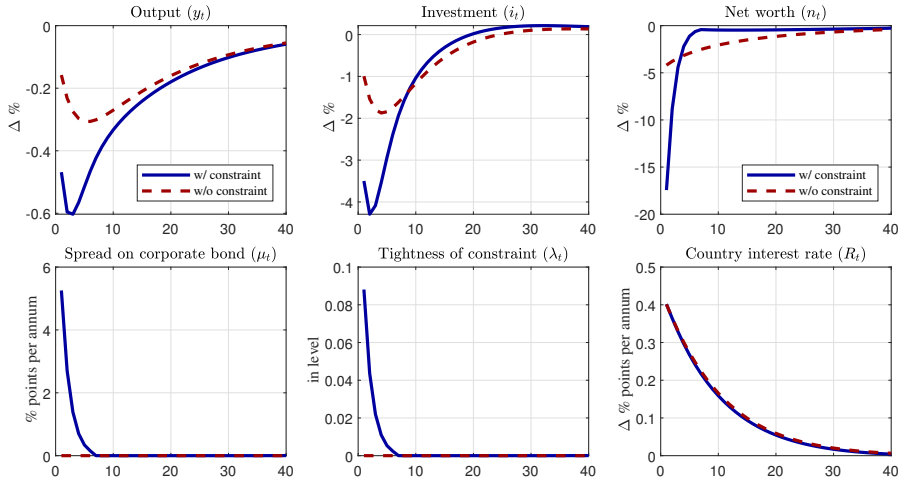
Back

Moments	Model		Data		
			Average	Minimum	Maximum
$\rho(c, y)$	1.00	0.99	0.71	0.22	0.94
$\rho(i, y)$	0.85	0.79	0.49	0.34	0.75
$\rho(tb, y)$	-0.68	-0.61	-0.46	-0.66	-0.27
$\rho(ca, y)$	-0.66	-0.55	-0.41	-0.73	-0.22
$\rho(e, y)$	-0.3	-0.15	-0.15	-0.48	0.51
$\rho(l, y)$	-0.47	-0.53	-0.06	-0.17	0.11
$\rho(\mu, y)$	-0.51	-0.61	-0.16	-0.7	0.36
$\sigma(c)/\sigma(y)$	0.87	0.92	1.04	0.24	1.63
$\sigma(i)/\sigma(y)$	5.41	6.19	4.07	2.28	7.72

- Although the magnitude is larger, the model delivers the correct cyclicality
- It also delivers relative volatilities close to the ones from data

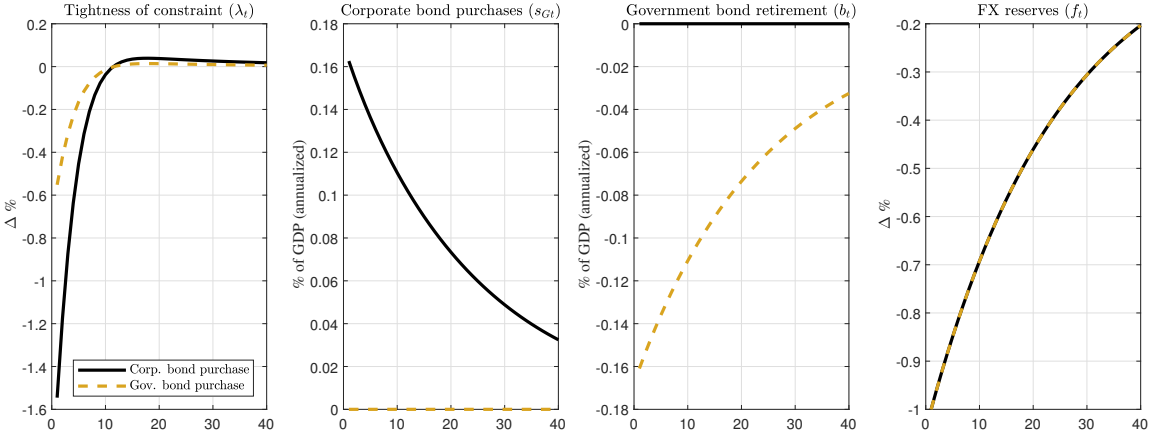
Sudden stop is amplified through balance sheet effect

Back



Corp. bond purchase vs. Gov. bond purchase

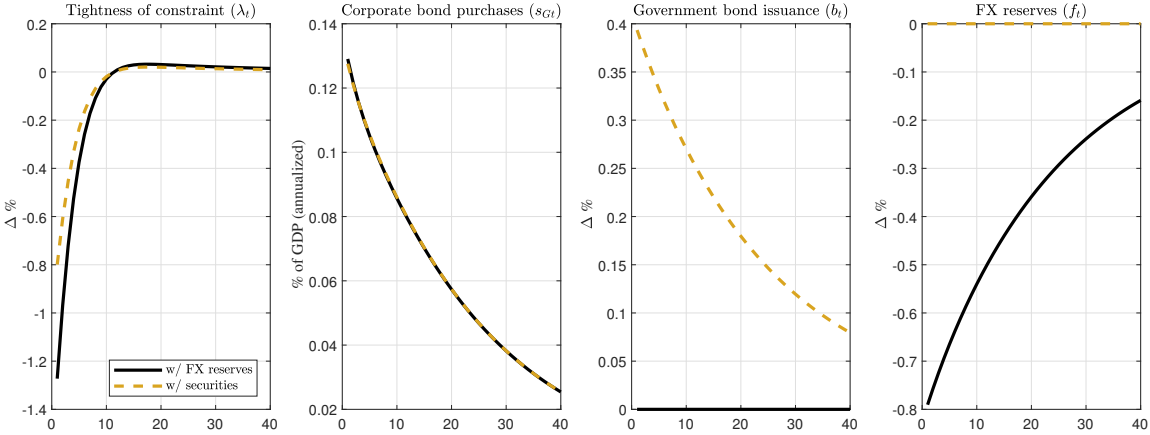
Back



– Same amount of FX reserves used but the effect is greater when purchasing corporate bonds

Sterilization with FX reserves vs. Other securities

Back



– Same amount of corporate bond purchase but the effect is greater when sterilized with FX reserves

The role of FX reserves

Back

1. Suppose that use of reserves is limited to 30%: $\bar{\Gamma} = 0.3$

The role of FX reserves

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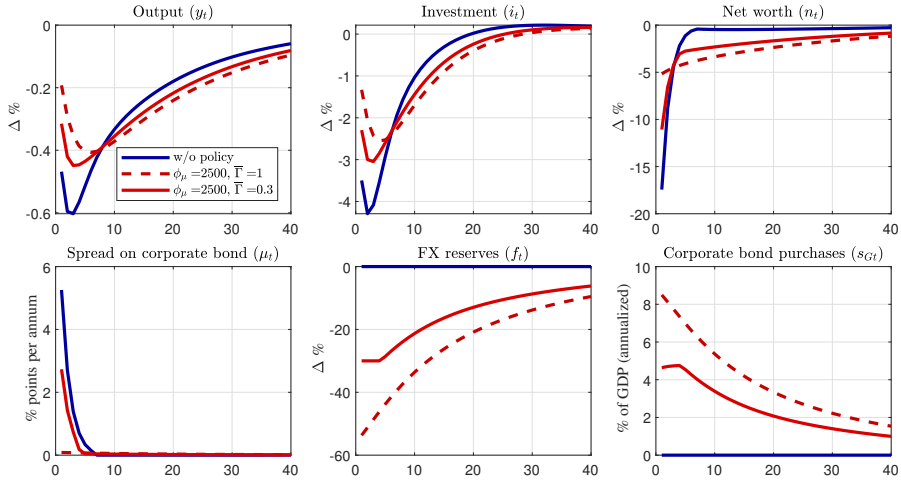

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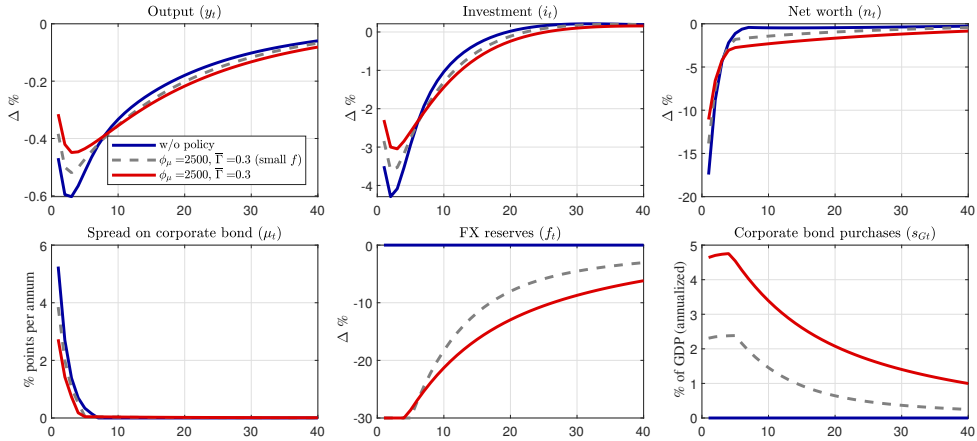

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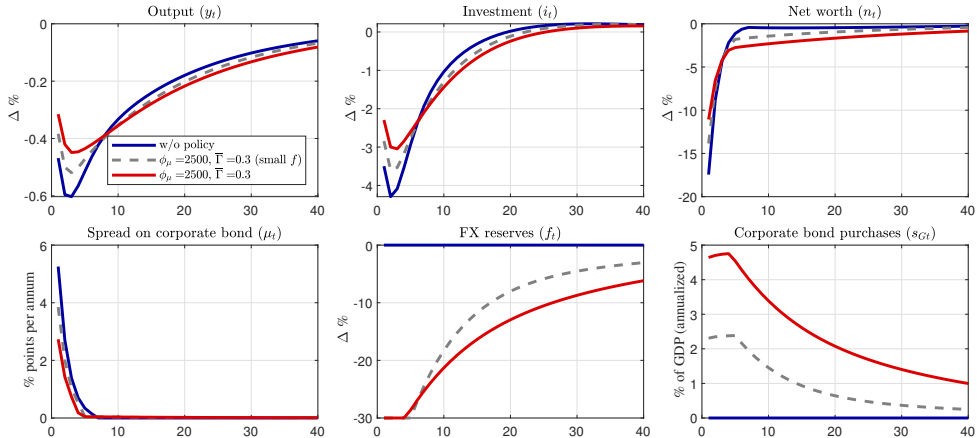

– Both analyses emphasize the role of FX reserve as a war chest