Optimal central bank balance sheets

Egemen Eren
BIS

Timothy Jackson
University of Liverpool

Giovanni Lombardo
BIS (Visiting SNB)

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Motivation

- You all know the story... and the data
  - The **size of the balance sheet** of several central banks has increased manifolds since the **GFC** and further more in response to the **pandemic**
- **Past the crisis**, the debate has focused on the extent to which **balance sheets should be shrunk**
- Both phases rest on the belief that **the size of the balance sheet of central banks matters**
- Huge literature on CB-BS during crisis times (ZLB). Much less developed is the **analysis of CB-BS in "normal times"**.
- ... **our paper contributes to the latter strand of the literature**

Related Literature

- A few recent papers discuss the principles guiding the size of the CB-BS in normal times.
  - Reis et al. (2016) argues that "saturated" interbank market de-links the policy rate from the rate on reserves, thus endowing the CB of an extra policy tool.
  - Greenwood et al. (2019) argue that a large CB-BS will reduce the need for "runnable" private intermediaries to issue short-term liabilities.
  - Afonso et al. (2022) make an argument for a large balance sheet, based on the working on the market for reserves: reduce volatility of the interbank-market rate
  - Afonso et al. (2023) studies the optimal supply of reserves under uncertainty.

Related Literature cont'd

- Vissing-Jørgensen (2023) argues that the demand for reserves should be "satiated" – if feasible – in order to minimize the convenience yield. As reserves supply affects CB demand for Treasuries, an optimal "interior" solution should be found, resulting in a "larger" BS.
- Karadi and Nakov (2021), closer to our paper, compare QE under "normal times" and "crisis times" and point out that QE, by reducing banks' profitability, can lead to "addictiveness".

Our paper

- We have several elements discussed in the existing literature but focus especially on the **macroprudential** dimension of the **long-run balance sheet**
- Like Vissing-Jørgensen (2023) we highlight the two facets of BS policies: **A reserve policy implies a securities supply policy**
- In particular we focus on the **net-supply of duration risk**
  - The CB supplies reserves and purchases long-term government debt
  - Banks hold both long-term debt and reserves: they provide "convenience"
  - **The size and composition of CB's BS is reflected in the composition and size of banks' BS**

Our paper cont'd

- We use a canonical DSGE model with banks à la Gertler and Kiyotaki (2010)
- We introduce a fully specified CB BS
- Government debt is exogenously given (no active fiscal policy)
- The CB chooses optimally conventional MP and BS policy to maximize households welfare

What do we find

- The *long-run* size and composition of the CB BS has implications for the effectiveness of MP
- **Compare a two-instrument regime (MP+BSP), with conventional one-instrument (MP) regime: Both optimal**
    1. If the *long-run BS* is optimally chosen, dynamically resorting to MP only or to MP+BSP makes no material difference.
    2. If MP operates with a suboptimal *long-run* BS, it won't achieve the same outcomes as MP+BSP

Rationale

- By choosing an optimal long-run BS, the CB chooses the socially optimal duration-risk exposure by banks
  - **more duration risk implies more volatility of banks' BS and of prices and allocations.**
- Moreover, if banks don't see debt and reserves as perfect substitutes, the CB can aim at an **optimal mix**
- **In this case optimal MP suffices to maximize welfare.**
  - Optimal MP takes into account how BSs respond to shocks (inclusive of valuation effects)
- If the *long-run* BS is not optimal, MP even if optimally set cannot achieve the same outcome: **Taking into account BSs is necessary but not sufficient**

Outline of rest of presentation

1. Model
2. Calibration
3. Results
4. Conclusion

Model: Government

The Government issues a (quasi-)perpetuity: a fraction $1 - \delta_p$ is paid back to holders.
The period (quarter) return is

$$R_{B,t} = \frac{\delta_p P_{B,t} + (1 - \delta_p) + \bar{r}_p}{P_{B,t-1}}. \tag{1}$$

The total real stock of these perpetuities outstanding at the beginning of each period is

$$\mathcal{B}_t = \sum_{s=0}^{\infty} \frac{{\delta_p}^s}{\prod_{j=0}^{s-1} \pi_{t-j}} B_{N,t-s} = B_{N,t} + \frac{\delta_p}{\pi_t} \mathcal{B}_{t-1}, \tag{2}$$

Model: Government cont'd

Market-clearing

$$P_{B,t}\mathcal{B}_t = P_{B,t}\mathcal{B}_H + P_{B,t}\mathcal{B}_{CB,t} + P_{B,t}\mathcal{B}_{B,t}. \tag{3}$$

$G_t \approx$, AR(1) process. Taxation, $\mathcal{T}$, is lumpsum so the government budget constraint is

$$\frac{(1-\delta_p)+r_p}{\pi_t}\mathcal{B}_{t-1} + G_t = P_{B,t}B_{N,t} + \mathcal{T}_t + \mathcal{T}_{CB,t} \tag{4}$$

where $\mathcal{T}_{CB,t}$ **transfer from the central bank** to the government

We assume the government maintains a **constant real stock of debt**,

$$B_{N,t} = \left(\mathcal{B}_t - \frac{\delta_p}{\pi_t}\mathcal{B}_{t-1}\right). \tag{5}$$

Model: Banks

- The representative bank i maximizes its franchising value $(J_{i,t})$

$$J_{i,t}\left(N_{i,t}\right) = \max E_t \Lambda_{t+1|t}\left[(1-\theta)N_{i,t+1} + \theta J_{i,t+1}\left(N_{i,t+1}\right)\right], \tag{6}$$

where $(1-\theta)$ is the probability of exiting the banking industry and bank net worth evolves according to

$$N_{i,t} = R_{K,t}Q_{t-1}K_{i,F,t-1} + \frac{R_{B,t}}{\pi_t}P_{B,t-1}\mathcal{B}_{i,B,t-1} + \frac{R_{F,t-1}}{\pi_t}B_{i,F,t-1} - \frac{R_{D,t-1}}{\pi_t}D_{i,t-1}, \tag{7}$$

subject to the balance sheet

$$N_{i,t} + D_{i,t} = Q_t K_{i,F,t} + P_{B,t}\mathcal{B}_{i,B,t} + B_{i,F,t}, \tag{8}$$

Model: Banks cont'd

- Different assets can be absconded to different extents (they have different recovery rates), i.e.

$$J_{i,t} \geq \kappa_K Q_t K_{i,t} + \kappa_{B,t} P_{B,t} \mathcal{B}_{i,B,t} + \kappa_F B_{i,F,t}. \tag{9}$$

  with κ_s positive parameters (measure riskiness, ie 1-recovery rate). $\kappa_{B,t}$ is assumed to be stochastic.
- The relative value of $\kappa_{B,t}$ and κ_F affects the extent to which an "operation twist" can have the desired effects.

Model: Central Bank

- The central bank issues money (M) and reserves (B_F)
- Together with its capital (N_{CB}) and net of transfers to the government (T_{CB}) it purchases government debt and capital (risky loans to firms)

$$P_{B,t}\mathcal{B}_{CB,t} + Q_t K_{CB,t} = M_t + B_{F,t} + N_{CB,t} - T_{CB,t} \tag{10}$$

where central bank net worth $N_{CB,t}$ evolves according to:

$$N_{CB,t} = R_{K,t} Q_{t-1} K_{CB,t-1} + \frac{R_{B,t}}{\pi_t} P_{B,t-1}\mathcal{B}_{CB,t-1} - \frac{R_{M,t-1}}{\pi_t} M_{t-1} - \frac{R_{F,t-1}}{\pi_t} B_{F,t-1}. \tag{11}$$

Model: Shocks

- Four shocks:
  1. TFP,
  2. government spending,
  3. net-worth (shock to θ_t),
  4. a shock to banks' demand for government debt (a shock to $\kappa_{B,t}$)
- The first two shocks can be seen as **real-economy shocks**, while the second two as **financial-sector shocks**.
- In the calibration we add a monetary policy shock.

Calibration

Description	Parameter	Value
Households		
Discount factor	β	0.99
Labor share	α	0.3
Labor utility weight	χ	0.5
Risk-aversion	σ	4
Inverse Frisch elasticity	ψ	1.5
Cash demand	A_m, B_m	$0.0111, 0.0752$
Firms		
Capital adjustment cost	η	1.0
Depreciation	δ	0.025
Demand elasticity	σ_p	6
Calvo probability	ς	0.75
Banks		
Survival probability	θ	0.94
Start-up transfer	δ_T	0.008
Risk-weight coefficients		
Lending	κ_K	0.48
Long-term bonds	κ_B	0.15
Reserves	κ_F	0.08
Government		
Spending (as share of SS output)	G/Y	0.16
Perpetuity expiry probability	δ_p	0.95
Perpetuity fixed return	$\bar{r}_p$	0.01
Central Bank		
Inflation objective (quarterly)	π	$2\% p.a.$
Central bank transfer	γ_{CB}	0.9
Bond adjustment cost (deviation of SS)	$\lambda_{\mathcal{B}_{CB}}$	0.01
Bond adjustment cost (change)	$\lambda_{\Delta\mathcal{B}_{CB}}$	0.0001
Long-run bond-holdings	$\tilde{\mathcal{B}}_{CB}/\mathcal{B}$	0.17

Calibration

Standard deviation in the data and in the model

	Stdev	Data (Quartiles) 25%	50%	75%	Model
Targeted	π_{yoy}	0.141	0.170	0.201	0.163
	R_d	0.310	0.415	0.439	0.133
	C/Y	0.764	0.855	1.33	1.19
	$spread$	0.281	0.364	0.432	0.392
	$spread_B$	0.301	0.319	0.34	0.273
	G/Y	7.54	8.43	10.5	4.88
Not-targeted	ΔY	0.509	0.549	0.687	0.513
	I/Y	6.18	8.61	11.7	5.73
	Δvel	1.11	1.15	1.44	0.217
	B_f/Y	44.4	66.6	191	1.01
	$\Delta B_{cb}/Y$	1.02	7.79	8.15	0.577

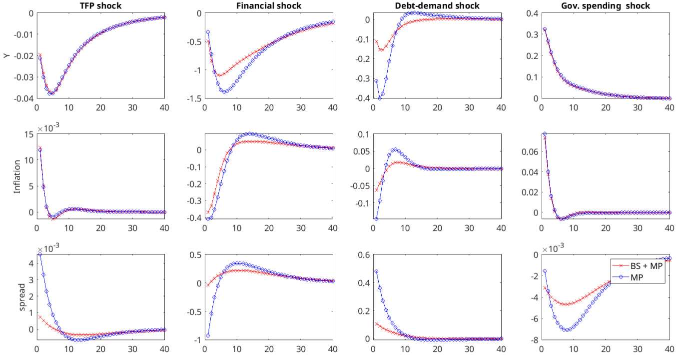
Note: Percentages. Sample 1987Q1-2019Q4. Interquartile range of 40 quarters rolling standard deviations.

Results

Effectiveness of reserves supply in normal times: MP=Taylor rule

simple feed-back rule for reserves, i.e.

$$B_{F,t} - B_{F,ss} = 0.96\left(B_{F,t} - B_{F,ss}\right) + 40\left(spread_t - spread_{ss}\right) \quad (12)$$

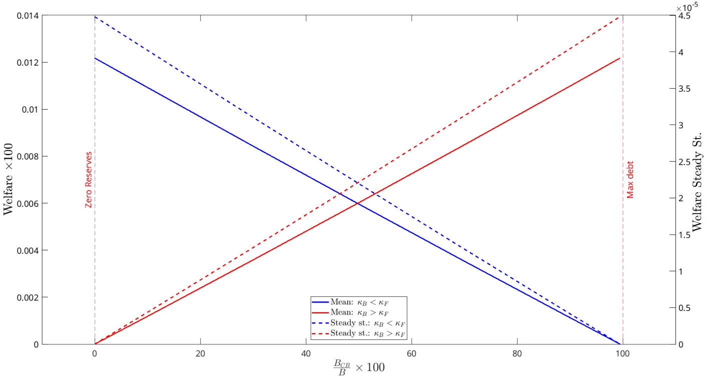


What drives the optimal CB decision?

1. No Monetary and nominal frictions

No Duration Risk

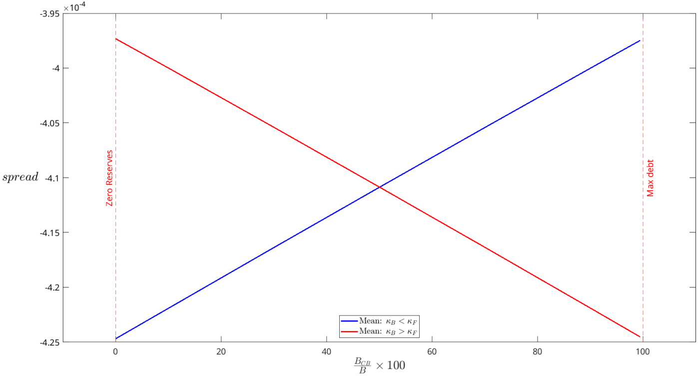
Welfare and central bank debt holding: $\delta_p = 0$



- **CB should go to the corner**

No Duration Risk cont'd

Spread and central bank debt holding: $\delta_p = 0$



- **... and thus minimize spreads**

Duration risk ($\delta_p = .95$)

- Essentially the same (only asymmetric due to a term premium)

2. With Monetary and nominal frictions

CB Challenges

- The CB must now deal with **inflation**:
  - It distorts the **allocation of goods**
  - It affects the costs of holding **real monetary balances**
  - It generates inflation risk of **long-duration assets**

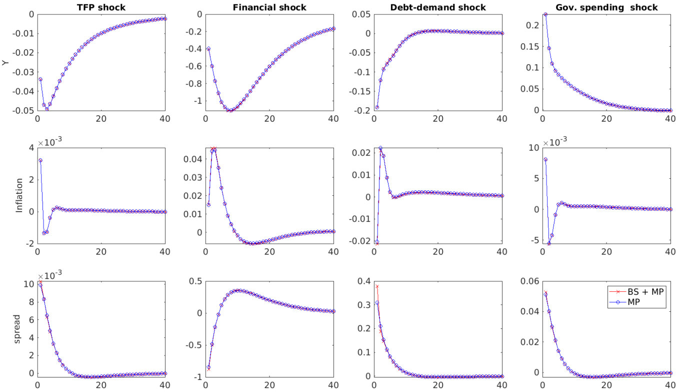
IRFs and Moments

Experiments

- Optimal MP only vs dual instrument MP+BSP
- MP with optimal long-run BS and without

IRFs: Optimal Long-Run BS

Response to shocks when the (deterministic) long run supply of reserves is the same under MP and BSP+MP regimes



Moments: Optimal Long-Run BS

Table: Mean and standard deviation under the two alternative policy regimes: Equal steady-state BS size

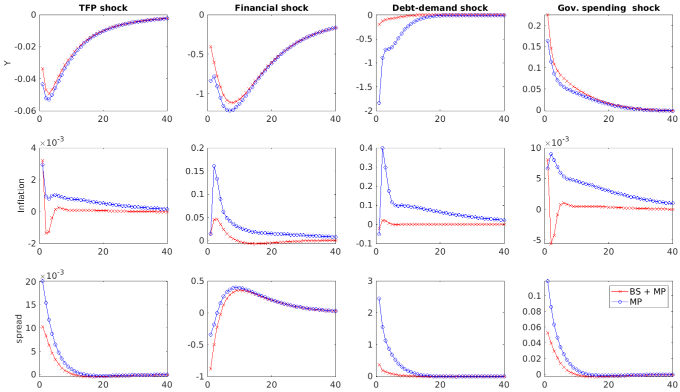
	MP+BSP			MP		
Variable	Det. ss	Mean	Stdev[§]	Det. ss	Mean	Stdev[§]
π	1	0.9994	0.0927	1	0.9995	0.0909
Y	1.913	1.958	4.312	1.913	1.958	4.3
$spread$	1.008	1.006	1.679	1.008	1.006	1.641
P_B	0.9816	0.9473	5.172	0.9816	0.9478	5.151
N_{cb}	1	1.008	2.018	1	1.009	2.019
R_d	1.009	1.007	1.66	1.009	1.007	1.649

[†] The steady-state balance sheet of the central bank under MP is 100% of that under MP+BSP.

[§] In percent.

IRFs: Sub-optimal Long-Run BS

Response to shocks when the (deterministic) long run supply of reserves under MP is 10% of that under the BSP+MP



Moments: Sub-optimal Long-Run BS

Table: Mean and standard deviation under the two alternative policy regimes: Small BS under MP

	MP+BSP			MP[†]		
Variable	Det. ss	Mean	Stdev[§]	Det. ss	Mean	Stdev[§]
π	1	0.9994	0.0927	0.9998	0.994	0.7147
Y	1.913	1.958	4.312	1.913	2.029	5.314
$spread$	1.008	1.006	1.679	1.008	1.009	3.679
$P_B B_{cb}$	2.295	2.165	4.03	0.657	0.7952	35.21
P_B	0.9816	0.9473	5.172	0.9861	0.7237	10.93
N_{cb}	1	1.008	2.018	1	1.002	2.821
R_d	1.009	1.007	1.66	1.008	1.001	7.236

[†] The steady-state balance sheet of the central bank under MP is 10% of that under MP+BSP.

[§] In percent.

Summing up

1. When reserves and debt are valued differently by banks, the **CB should supply as much reserves as needed to reduce the cost of capital**
   - When financial frictions are the only market imperfection, the CB would pick the corner
2. **Duration risk** —highest in the presence of inflation volatility— worsens the **MP trade off**
   - The CB would want to address this by **changing the degree of duration risk**: supply more reserves
   - When the BS problem is addressed, **little help from cyclical adjustments** of the CB BS (away from the ZLB)
   - Constraints on the optimal implementation of MP would make BS policies desirable also in normal times

Conclusion

Conclusion

- The GFC and the pandemic have seen CB-BS swelling
- Should BS go back to pre crisis times?
- Our paper contributes to the literature arguing for larger BS
  - Conventional MP would benefit from regulated duration risk in the economy
  - This could be achieved with **other macroprudential tools or tailored public debt management**
  - **In their absence the CB BS can act as macroprudential instrument**
- Obviously our argument must be weighted against other concerns discussed in the literature.