The Liquidity Channel of Fiscal Policy

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1Disclaimer: The views expressed here reflect only the views of the authors and do not reflect the views of the German Federal Ministry of Finance.
Motivation

US public debt currently above 100% of GDP and projected to increase further
Research question

What are the effects of public debt on the US economy?

Concretely, we are interested in the following (positive) questions:

- How do interest rates respond?
- How much crowding out of capital?
- What is the fiscal burden?
- What are the distributional effects?
From evidence to model to policy

First, we document that fiscal expansions increase rates but decrease spreads

▶ Local Projections: Return difference between capital and government bonds, “Liquidity Premium”, falls after a fiscal shock increasing debt.

A HANK model features the same effect

▶ Estimating a 2-asset medium-scale HANK model, we show the same effect on the liquidity premium is present in the model and quantitatively of the same size.

Policy experiments and importance of the channel

▶ Consider the effects of higher debt-to-gdp ratio targets in our estimated model. We find the interest-rate effects of these policies to be important.
We contribute to three literatures

1) Importance of heterogeneity for business cycles and policy

2) Public debt and physical private capital
   - Aiyagari and McGrattan (1998), Challe and Ragot (2011), Heathcote (2005), and Woodford (1990) and a number of papers focusing on the optimal level of public debt.

3) Public debt and interest rates
Public Debt and Asset Returns

Evidence from Local Projections
Identification

Debt increases through spending shocks

- We want to look at exogenous variations in debt.
- Here through spending shocks.
- Identifying assumption – available for all data sets: government spending is predetermined (Blanchard and Perotti, 2002).
- Robust to alternatives for the US.
  - We can also use the military news series from Ramey (2011)
  - or tax shocks from Romer and Romer (2010).
Empirical Evidence: US quarterly, aggregates

- Standard response to fiscal shock.
- Normalize top peak debt response to 1%.
- Reached roughly 3 years after shock.
Empirical Evidence: US quarterly, premia

- Returns of public bonds increase.
- Relative returns of less liquid assets fall.
- Same finding employing international panel data
Empirical Evidence: Differences in financing fiscal shocks

- Not all countries finance fiscal expansion by deficits.
- Individual country regressions.

The equation is $y = 0.127 - 0.189 x$, with standard errors of $0.103$ and $0.106$.
Empirical Evidence: Differences in financing fiscal shocks

- Not all countries finance fiscal expansion by deficits.
- Individual country regressions.
- Plot relative housing return response against debt response (average years 4-6 after shock).
Empirical Evidence: Differences in financing fiscal shocks

- Not all countries finance fiscal expansion by deficits.
- Individual country regressions.
- Plot relative housing return response against debt response.
- **Finding:** 1% more debt response decreases the LP by 19bp.
Summary

Bond returns and returns on other assets do not move in lockstep

- The capital-bond spread falls after fiscal expansion.
- The more debt financed the expansion, the stronger the spread response.
Public Debt and Asset Returns

In a Two Asset HANK model
Heterogenous Agent New Keynesian (HANK) model with portfolio choice

**Evidence for the importance of portfolio adjustment costs**

- Households will require a compensation to hold their wealth in illiquid form.
- Known since Aiyagari and Gertler (1991): This has the potential to explain a large part of the equity premium.

**The total supply of liquidity matters**

- Government debt has a special role.
- Only source of external liquid wealth in these models.
- More government debt implies a lower premium.
- Compared to one-asset incomplete markets models: *less crowding out* of capital.
The Liquidity Channel of Fiscal Policy

Model overview

<table>
<thead>
<tr>
<th>Households</th>
<th>Production Sector</th>
<th>Government</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Obtain Income</strong></td>
<td><strong>Trade Assets</strong></td>
<td><strong>Produce and Differentiate Consumption Goods</strong></td>
</tr>
<tr>
<td><strong>Wages</strong></td>
<td>Bonds ((b &gt; B))</td>
<td>Intermediate goods producers</td>
</tr>
<tr>
<td>(\rightarrow) set by unions</td>
<td>(= ) claims on HH debt, + government debt, (nominal, liquid) and</td>
<td>Rent capital &amp; labor</td>
</tr>
<tr>
<td>(\rightarrow) s.t. adj. costs</td>
<td>Illiquid Assets, (k)</td>
<td>Competitive Market for Intermediate Goods</td>
</tr>
<tr>
<td>(\rightarrow) Idiosyncratic Risk</td>
<td>(=) capital (trading friction)</td>
<td>Entrepreneurs</td>
</tr>
<tr>
<td><strong>Interest</strong></td>
<td></td>
<td>Monopolistic resellers s.t. price adjustment costs</td>
</tr>
<tr>
<td>(\rightarrow) from bonds</td>
<td></td>
<td>Capital goods producers</td>
</tr>
<tr>
<td><strong>Dividends</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\rightarrow) from capital: MPK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\rightarrow) liquid rental market</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Profits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\rightarrow) as “entrepreneurs”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Estimate HANK-DSGE

**Two Step Estimation Procedure:**

- First, estimate or fix all parameters that affect the steady state (matching wealth, portfolio, and income distributions in the micro data).

- Second, estimate the parameters that only matter for dynamics via Bayesian methods. Same shocks and observables as in Smets and Wouters (2007).

**Solution Procedure:** We build on the algorithm suggested by Reiter (2009) to solve for aggregate dynamics, which treats the policy functions as controls and the distribution function as a state, representing the dynamic system as a function valued difference equation using the refinement of Bayer and Luetticke (2018).
The Short Run

Government Spending Shocks
The Liquidity Channel of Fiscal Policy

**G shocks**

IRFs to Government Spending Shock

Government spending $G_t$

Output $Y_t$

Consumption $C_t$

Investment $I_t$

Nominal rate $RB_t$

Liquidity premium $LP_t$

- Estimated HANK model
- IRFs normalized to 1% debt increase.
- matches the movements of the Liquidity Premium
- as well as aggregates.
Debt vs. Liquidity Premium: Model

In line with empirical finding:
- A 1% stronger debt response leads to a 16bp stronger LP response.
- (Empirical: 19bp)

Notes: Dots represent the response of government debt (x-axis) and liquidity premium (y-axis) at 12 horizons to a spending shock for alternative solutions of the model, where we let taxes react differently strong to the growth rate of government debt.
The Long Run

Public Debt and Interest Rates
Increasing the government debt target

- Increase government debt target by 10%.
- Almost permanent increase ($\rho_B = 0.9999$).
- 10 year transition period.
- Let (non-distortionary) taxes adjust, constant expenditures.
Response to an increase in the debt target

Transfer (% of $\tilde{Y}$)

Public debt $B_t$

Capital $K_t$

Output $Y_t$

Nominal rate $RB_t$

Liquidity premium $LP_t$
Distributional consequence of an increase in the debt target
Fiscal Implications of Public Debt

- Fiscal burden of public debt: \( \mathcal{R}(B)B \), where \( \mathcal{R} = \frac{R^b_t}{\pi_t} - \log(Y_{t+1}/Y_t) \)

- Our log-linearized solution yields constant semi-elasticity of interest-growth differential:

\[
\mathcal{R}(B) \approx \mathcal{R}(\bar{B}) + \eta_B \ln\left(\frac{B}{\bar{B}}\right)
\]

- Marginal fiscal burden of additional debt starting from steady state:

\[
\frac{\partial (R(B)B)}{\partial B} = \mathcal{R}(B) + \eta_B
\]

- Our estimate: \( \eta_B = 2.5\% \) ⇒ despite the fact that the marginal real rate on government bonds is zero, there is an important fiscal burden from higher public debt.
Fiscal Implications of Public Debt

![Graph showing Debt burden and Interest rate over time.](image)
Conclusion
Concluding Remarks

- Return differentials between public debt and physical capital respond to fiscal expansions
- Overshooting of bond yields:
  +25 basis points on impact vs. +2.5 basis points in the long run (after +1% debt)
- A HANK model with liquid and illiquid assets can explain this effect.
Concluding Remarks

How much debt is fiscally optimal?

- Debt is fiscally more expensive than R-g suggests.
- Low debt levels below can nonetheless be (fiscally) inefficient.
- Under the currently high demand for liquidity, this critical level has moved to around 60%.
- Much higher debt rates needed to “normalize” \( R > g \) interest rates.
Bibliography I


S Rao Aiyagari and Mark Gertler. “Asset returns with transactions costs and uninsured individual risk”. In: Journal of Monetary Economics 27.3 (1991), pp. 311–331.


Bibliography II


Bibliography III


Bibliography V


Bibliography VI


Bibliography VII


Local projection

Letting $x_{t+h}$ denote the variable of interest in period $t + h$, we estimate how it responds to fiscal shocks in period $t$:

$$x_{t+h} = \psi_h \log g_t + \beta_0 + \beta_1 t + \beta_2 t^2 + \Gamma(L)Z_{t-1} + u_{t+h}.$$  \hspace{1cm} (1)

$\psi_h$ provides a direct estimate of the impulse response at horizon $h$ to the government spending shock in period $t$.

$Z_{t-1}$ is a vector of control variables that always includes four (annual one) lags of government spending, output, and debt, plus the real interest rate and lags of the respective dependent variable.
Data

**US and international data**

- Annual data from 16 advanced economies 1947-2015. Aggregates and in particular housing returns (Jordà et al., 2019).

**Liquidity Premium**

- Return to capital (incl. housing and private capital) from Gomme et al. (2011)
- Housing return (Jordà et al., 2019)
- AAA corporate bond yield (Krishnamurthy and Vissing-Jorgensen, 2012)
- To compute the premium, we subtract a long-term government bond rate.
Empirical Evidence: International pooled, premia

- Returns of bonds increase.
- Relative returns of housing as an asset falls.
- Government debt response peaks around year 4.
Households

- Productivity $h$ (idiosyncratic and risky)
- Labor/Leisure Choice
- Consume
- Cannot trade state-contingent claims
- Two Assets: Liquid nominal bond, illiquid capital
Households

- Households face productivity risk

\[ \log h_{it} = \rho_h \log h_{it-1} + \epsilon_{it}^h, \quad \epsilon_{it}^h \sim N(0, \sigma_h) \]
Households

- Households face productivity risk
- Union differentiates labor, driving a wedge between MPL and wages paid to workers. It distributes related profits among workers
Households

- Households face productivity risk
- Union differentiates labor, driving a wedge between MPL and wages paid to workers.
- A random fraction $\lambda$ of households participates in the market for illiquid capital
Households

- Households face productivity risk
- Union differentiates labor, driving a wedge between MPL and wages paid to workers.
- A random fraction $\lambda$ of households participates in the market for illiquid capital
- A fraction of households becomes “entrepreneurs” and earns all other pure rents. Stochastic transition into and out of this state
Household Planning Problem

- GHH preferences with constant Frisch elasticity:
  - representative labor supply $N_t$.  

- Budget equation:

$$c_{it} + b_{it+1} + q_t k_{it+1} = b_{it} \frac{R(b_{it}, R^b_t)}{\pi_t} + (q_t + r_t) k_{it}$$

$$+ (1 - \tau_t) [h_{it} w_t N_t + \mathbb{I}_{h_{it} \neq 0} \Pi^U_t + \mathbb{I}_{h_{it} = 0} \Pi^F_t] ,$$

$$k_{it+1} \geq 0, \quad b_{it+1} \geq B.$$
Household Planning Problem

- GHH preferences with constant Frisch elasticity:
  \[ \Rightarrow \text{representative labor supply } N_t. \]

- Budget equation:

- Bellman equation:

\[
V^a_t(b, k, h) = \max_{k', b'_a} u[x(b, b'_a, k, k', h)] + \beta \mathbb{E}_t V_{t+1}(b'_a, k', h')
\]

\[
V^n_t(b, k, h) = \max_{b'_n} u[x(b, b'_n, k, k, h)] + \beta \mathbb{E}_t V_{t+1}(b'_n, k, h')
\]

\[
\mathbb{E}_t V_{t+1}(b', k', h') = \mathbb{E}_t \left[ \lambda V^a_{t+1}(b', k', h') \right] + \mathbb{E}_t \left[ (1 - \lambda) V^n_{t+1}(b', k, h') \right]
\]
The Liquidity Channel of Fiscal Policy

Embedded in an otherwise almost standard NK model

- Factor prices equal marginal products

\[ w_t^F = \alpha m c_t Z_t \left( \frac{u_t K_t}{N_t} \right)^{1-\alpha}, \]

\[ r_t + q_t \delta(u_t) = u_t (1 - \alpha) m c_t Z_t \left( \frac{N_t}{u_t K_t} \right)^\alpha \]
Embedded in an otherwise almost standard NK model

- Factor prices equal marginal products
- Capital price equals cost of production of capital

\[ 1 = q_t \left[ 1 - \frac{\phi}{2} \left( \frac{l_t}{l_{t-1}} - 1 \right)^2 - \phi \left( \frac{l_t}{l_{t-1}} - 1 \right) \frac{l_t}{l_{t-1}} \right] + \beta q_t+1 \phi \left( \frac{l_{t+1}}{l_t} - 1 \right) \left( \frac{l_{t+1}}{l_t} \right)^2 \]
Embedded in an otherwise standard NK model

- **Phillips Curve under quadratic price adjustment costs**
  \[
  \log \left( \frac{\pi_t}{\bar{\pi}} \right) = \beta E_t \log \left( \frac{\pi_{t+1}}{\bar{\pi}} \right) + \kappa_Y \left( m c_t - \frac{1}{\mu_Y} \right),
  \]

- **Wage Phillips Curve under quadratic price adjustment costs**
  \[
  \log \left( \frac{\pi^W_t}{\bar{\pi}^W} \right) = \beta E_t \log \left( \frac{\pi^W_{t+1}}{\bar{\pi}^W} \right) + \kappa_W \left( w_t - \frac{1}{\mu^W_t} \right),
  \]
Government

Monetary Policy

- Monetary policy follows Taylor rule

\[
\frac{R_{t+1}^b}{\bar{R}^b} = \left( \frac{R_t^b}{\bar{R}^b} \right)^{\rho_R} \left( \frac{\pi_t}{\bar{\pi}} \right)^{(1-\rho_R)\theta_{\pi}} \left( \frac{Y_t}{Y_{t-1}} \right)^{(1-\rho_R)\theta_{Y}} \epsilon_t^R.
\]
We assume that the government follows an expenditure rule

$$\frac{G_t}{G} = \left( \frac{G_{t-1}}{G} \right)^{\rho_G} \left( \frac{Y_t}{Y_{t-1}} \right)^{(1-\rho_G)\gamma_Y} \left( \frac{B_t}{B_t} \right)^{(1-\rho_G)\gamma_B} D_t,$$

where $D_t = \epsilon_t^G \left( \epsilon_{t-1}^G \right)^{\gamma_e}$
Government

Budget Constraint

- Total taxes $T_t$ are then

$$T_t = \tau \left( w_t n_{it} h_{it} + \mathbb{I}_{h_{it} \neq 0} \Pi_t^U + \mathbb{I}_{h_{it} = 0} \Pi_t^F \right),$$

with constant tax rate $\tau$

- The government budget constraint determines government bonds residually:

$$B_{t+1} = G_t - T_t + R_t^b / \pi_t B_t.$$
Equilibrium

Equilibrium is characterized by the same system of equations as in a standard NK Model except for

- Bonds-Market Equilibrium

\[ B_{t+1} = B^d(R^b_t, A_t, r_t, q_t, \Pi^F_t, \Pi^U_t, w_t, \lambda_t, \Theta_t, V_{t+1}) \]

\[ := \mathbb{E}_t [\lambda_t b_{a,t}^* + (1 - \lambda_t) b_{n,t}^*], \]

instead of simple Consumption-Euler Equation

- Capital-Market Equilibrium

\[ K_{t+1} = K^d(R^b_t, A_t, r_t, q_t, \Pi^F_t, \Pi^U_t, w_t, \lambda_t, \Theta_t, V_{t+1}) \]

\[ := \mathbb{E}_t [\lambda_t k_{t}^* + (1 - \lambda_t) k] \]

instead of an arbitrage condition between bonds and capital (using the stochastic discount factor)
Steady State

Table: Calibration Targets

<table>
<thead>
<tr>
<th>Targets</th>
<th>Model</th>
<th>Data</th>
<th>Source</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean illiquid assets (K/Y)</td>
<td>2.87</td>
<td>2.87</td>
<td>NIPA</td>
<td>Discount factor</td>
</tr>
<tr>
<td>Mean liquidity (B/Y)</td>
<td>0.59</td>
<td>0.59</td>
<td>FRED</td>
<td>Port. adj. probability</td>
</tr>
<tr>
<td>Private liquidity (IOUs/Y)</td>
<td>0.14</td>
<td>0.14</td>
<td>FRED</td>
<td>Borrowing penalty</td>
</tr>
<tr>
<td>Top10 wealth share</td>
<td>0.68</td>
<td>0.68</td>
<td>WID</td>
<td>Fraction of entrepreneurs</td>
</tr>
</tbody>
</table>
## More...

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Households</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.983</td>
<td>Discount factor</td>
<td>K/Y=2.88</td>
</tr>
<tr>
<td>$\zeta$</td>
<td>4</td>
<td>Relative risk aversion</td>
<td>Kaplan et al. (2018)</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>2</td>
<td>Inverse of Frisch elasticity</td>
<td>Chetty et al. (2011)</td>
</tr>
<tr>
<td>$\nu$</td>
<td>6.4%</td>
<td>Prob. of capital holding adjustment</td>
<td>B/Y=0.59</td>
</tr>
<tr>
<td>$\rho_h$</td>
<td>0.98</td>
<td>Persistence labor income</td>
<td>Storesletten et al. (2004)</td>
</tr>
<tr>
<td>$\sigma_h$</td>
<td>0.12</td>
<td>STD labor income</td>
<td>Storesletten et al. (2004)</td>
</tr>
<tr>
<td>$\bar{R}$</td>
<td>1.0%</td>
<td>Interest wedge</td>
<td>IOUs/Y=0.14</td>
</tr>
<tr>
<td>$\tau$</td>
<td>0.29</td>
<td>Tax rate</td>
<td>G/Y=0.2</td>
</tr>
<tr>
<td><strong>Intermediate Goods</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\alpha$</td>
<td>0.68</td>
<td>Share of labor</td>
<td>Income share of labor of 62%</td>
</tr>
<tr>
<td>$\delta_0$</td>
<td>1.75%</td>
<td>Depreciation rate</td>
<td>NIPA: Fixed assets</td>
</tr>
<tr>
<td><strong>Final Goods</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$\mu^Y$</td>
<td>11</td>
<td>Price markup</td>
<td>10% markup</td>
</tr>
<tr>
<td>$\mu^W$</td>
<td>11</td>
<td>Wage markup</td>
<td>10% markup</td>
</tr>
</tbody>
</table>
Estimate HANK-DSGE

We consider the following shocks (as in Smets-Wouters)

- total factor and investment-specific productivity
- price and wage markup
- intermediation cost (a.k.a. “government bond spread”, “risk premium”)
- monetary policy
- government spending

Estimate on the same time series as in Smets-Wouters.
Observables

Quarterly US data from 1947Q1 – 2019Q4

In first-differences

- GDP, Consumption, Investment
- the real wage

In log-levels

- GDP deflator based inflation rates
- Hours worked per capita
- the (shadow) federal funds rate

All demeaned and without measurement error.
The Liquidity Channel of Fiscal Policy

Observables

Quarterly US data from 1947Q1 – 2015Q4

In log-levels

- Liquidity premium based on Gomme et al. (2011)’s capital return
- Demeaned and with measurement error.
### Prior and Posterior

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Frictions</th>
<th>Monetary policy rule</th>
<th>Spending rule</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distribution</strong></td>
<td><strong>Prior</strong></td>
<td><strong>Posterior</strong></td>
<td><strong>Prior</strong></td>
</tr>
<tr>
<td>Frictions</td>
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</tr>
<tr>
<td></td>
<td><strong>Mean</strong></td>
<td><strong>Std. Dev.</strong></td>
<td><strong>Mean</strong></td>
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<tr>
<td>$\delta_s$</td>
<td>Gamma</td>
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<tr>
<td>$\phi$</td>
<td>Gamma</td>
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<td>$\kappa$</td>
<td>Gamma</td>
<td>0.10</td>
<td>0.01</td>
</tr>
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<td>$\kappa_w$</td>
<td>Gamma</td>
<td>0.10</td>
<td>0.01</td>
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<tr>
<td>Monopoly policy rule</td>
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</tr>
<tr>
<td>$\rho_R$</td>
<td>Beta</td>
<td>0.50</td>
<td>0.20</td>
</tr>
<tr>
<td>$\sigma_R$</td>
<td>Inv.-Gamma</td>
<td>0.10</td>
<td>2.00</td>
</tr>
<tr>
<td>$\theta_\pi$</td>
<td>Normal</td>
<td>1.70</td>
<td>0.30</td>
</tr>
<tr>
<td>$\theta_Y$</td>
<td>Normal</td>
<td>0.13</td>
<td>0.05</td>
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<tr>
<td>Spending rule</td>
<td></td>
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<tr>
<td></td>
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</tr>
<tr>
<td>$\gamma_B$</td>
<td>Normal</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>$\gamma_Y$</td>
<td>Normal</td>
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<td>1.00</td>
</tr>
<tr>
<td>$\rho_G$</td>
<td>Beta</td>
<td>0.50</td>
<td>0.20</td>
</tr>
<tr>
<td>$\gamma_c$</td>
<td>Beta</td>
<td>0.50</td>
<td>0.20</td>
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<tr>
<td>$\sigma_G$</td>
<td>Inv.-Gamma</td>
<td>0.10</td>
<td>2.00</td>
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</table>
## Prior and Posterior

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Distribution</th>
<th>Prior Mean</th>
<th>Prior Std. Dev.</th>
<th>Posterior Mean</th>
<th>Posterior Std. Dev.</th>
<th>5 %</th>
<th>95 %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structural shocks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\rho_A$</td>
<td>Beta</td>
<td>0.50</td>
<td>0.20</td>
<td>0.976</td>
<td>0.008</td>
<td>0.961</td>
<td>0.989</td>
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<tr>
<td>$\sigma_A$</td>
<td>Inv.-Gamma</td>
<td>0.10</td>
<td>2.00</td>
<td>0.177</td>
<td>0.018</td>
<td>0.148</td>
<td>0.207</td>
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<tr>
<td>$\rho_Z$</td>
<td>Beta</td>
<td>0.50</td>
<td>0.20</td>
<td>0.972</td>
<td>0.006</td>
<td>0.963</td>
<td>0.981</td>
</tr>
<tr>
<td>$\sigma_Z$</td>
<td>Inv.-Gamma</td>
<td>0.10</td>
<td>2.00</td>
<td>0.803</td>
<td>0.035</td>
<td>0.749</td>
<td>0.862</td>
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<tr>
<td>$\rho_\psi$</td>
<td>Beta</td>
<td>0.50</td>
<td>0.20</td>
<td>0.936</td>
<td>0.008</td>
<td>0.922</td>
<td>0.950</td>
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<td>$\sigma_\psi$</td>
<td>Inv.-Gamma</td>
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<td>2.00</td>
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<td>0.112</td>
<td>1.692</td>
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<td>$\rho_\mu$</td>
<td>Beta</td>
<td>0.50</td>
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<td>0.018</td>
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<td>0.882</td>
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<td>$\sigma_\mu$</td>
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<td>2.00</td>
<td>1.938</td>
<td>0.138</td>
<td>1.723</td>
<td>2.174</td>
</tr>
<tr>
<td>$\rho_\mu w$</td>
<td>Beta</td>
<td>0.50</td>
<td>0.20</td>
<td>0.786</td>
<td>0.026</td>
<td>0.742</td>
<td>0.828</td>
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<tr>
<td>$\sigma_\mu w$</td>
<td>Inv.-Gamma</td>
<td>0.10</td>
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<tr>
<td><strong>Measurement error</strong></td>
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<tr>
<td>$\sigma_{meLP}$</td>
<td>Inv.-Gamma</td>
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<td>0.01</td>
<td>1.885</td>
<td>0.091</td>
<td>1.741</td>
<td>2.040</td>
</tr>
</tbody>
</table>
Robustness

Table: Post-2010 Scenarios for the Interest Rate Elasticity

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Capital (K/Y)</th>
<th>Private liquidity (IOUs/Y)</th>
<th>Top 10% wealth share</th>
<th>Interest Rate semi-elasticity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>2.87</td>
<td>0.14</td>
<td>0.68</td>
<td>2.50</td>
</tr>
<tr>
<td>Data (1947-2019)</td>
<td>2.87</td>
<td>0.14</td>
<td>0.68</td>
<td></td>
</tr>
<tr>
<td>Data (2010-2019)</td>
<td>2.95</td>
<td>0.18</td>
<td>0.72</td>
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</tr>
<tr>
<td>A) Post-2010 public-debt-to-GDP ratio of 110%</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Discount factor</td>
<td>3.11</td>
<td>0.08</td>
<td>0.63</td>
<td>2.36</td>
</tr>
<tr>
<td>Risk premium</td>
<td>2.79</td>
<td>0.12</td>
<td>0.66</td>
<td>1.68</td>
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<tr>
<td>Income risk</td>
<td>3.00</td>
<td>0.08</td>
<td>0.56</td>
<td>3.06</td>
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<tr>
<td>Price markup</td>
<td>2.92</td>
<td>0.14</td>
<td>0.76</td>
<td>2.79</td>
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<tr>
<td>Portfolio liquidity</td>
<td>2.77</td>
<td>0.15</td>
<td>0.66</td>
<td>3.13</td>
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<tr>
<td>Borrowing limit</td>
<td>2.85</td>
<td>0.01</td>
<td>0.62</td>
<td>5.70</td>
</tr>
</tbody>
</table>
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</tr>
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<td>0.18</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td>B) Post-2010 real interest rate of −1%</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Discount factor</td>
<td>3.05</td>
<td>0.14</td>
<td>0.67</td>
<td>2.60</td>
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<tr>
<td>Risk premium</td>
<td>2.88</td>
<td>0.12</td>
<td>0.67</td>
<td>2.47</td>
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<tr>
<td>Income risk</td>
<td>2.96</td>
<td>0.14</td>
<td>0.63</td>
<td>2.61</td>
</tr>
<tr>
<td>Price markup</td>
<td>2.93</td>
<td>0.19</td>
<td>0.77</td>
<td>2.68</td>
</tr>
<tr>
<td>Portfolio liquidity</td>
<td>2.83</td>
<td>0.19</td>
<td>0.70</td>
<td>2.55</td>
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<tr>
<td>Borrowing limit</td>
<td>2.88</td>
<td>0.07</td>
<td>0.67</td>
<td>3.95</td>
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</table>
Debt-financed Sovereign Wealth Fund

- Idea: Government exploits liquidity premium when issuing debt in order to buy marketable capital goods
- Our calibration: return difference of 1.5% p.a.
- However: marginal fiscal burden equal to our semi-elasticity of 2.5% (as st. st. interest rate is zero) $\gg\gg$ liquidity premium
- Wealth fund remains fiscal burden as long as
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  $\rightarrow$ would require either lower spending or higher taxes in long run
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- Would debt-financed build-up of government-owned capital (financed by taxes in long run) increase or decrease the economy’s capital stock?
Debt-financed build-up of government-owned capital

![Graphs showing LP, Consumption $C_t$, Capital $K_t$, Consumption Gini, Top 10% Wealth Share, Transfer (% of $\bar{Y}$)]

The Liquidity Channel of Fiscal Policy
Sovereign Wealth Fund