Local Government Debt Valuation

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This Paper

Local Governments are Important Economic Entities:

- Local governments account for $\$1.6$ trn.—7.8% of GDP—in public expenditures (CoG 2017) and 10.0% of employment (BLS OES 05/2019).
- Despite its economic importance little is know about its financial position.
- In 2020 COVID-19 highlighted immediate financial fragility of local governments.
- CARES Act, FFCRA, RRA and ARPA provided substantial financial relief to state ($423bn) and local government, ($415bn), total of $838bn (Clemens, Hoxie, Veuger 2022)

Questions: What is the financial situation of local governments?

1. **Approach**: Use the financial disclosures (ACFRs) for book values $\Rightarrow$ Disadvantage: Book values are *backward-looking*.
2. **Approach**: Estimate market values of local governments equity position $\Rightarrow$ Advantage: Market values are *forward-looking*.

Summary

Document Financial Health of Local Governments across U.S.

- In 2018 15.20% of cities in a nationwide sample operate with negative net position (60.95% with negative unrestricted net position).
- Obligations predominantly related to legacy commitments, e.g. pension + other post employment benefits (OPEB).

Examine the market valuation of the equity position

- Positive correlation between book and market valuation of equity.
- Market valuation—similarly to book valuations—are negative for sizable fraction of local governments.

Literature

Local Finances: Adelino et al. (2017), Anzia (2019), Chernick et al. (2021), Clemens and Veuger (2021), Chava et al. (2021a), Chava et al. (2021b), Gao et al. (2019), Giesecke and Mateen (2021), Green and Loualiche (2020), Haughwout et al. (2021), Myers (2017), Spiotto (2014), Yi (2021)

$\Rightarrow$ *Document state and trajectory of local governments' financial position.*

Dynamic Asset Pricing: Alvarez and Jermann (2005), Ang and Piazzesi (2003), Backus et al. (2018), Campbell (1991, 1993, 1996), Dai and Singleton (2000), Duffie and Kan (1996), Hansen and Sargent (1980), Hansen et al. (1991), Hansen and Scheinkman (2009), Jiang et al. (2019), Lustig et al. (2013)

$\Rightarrow$ *Price large cross-section of non-traded claims.*

Roadmap

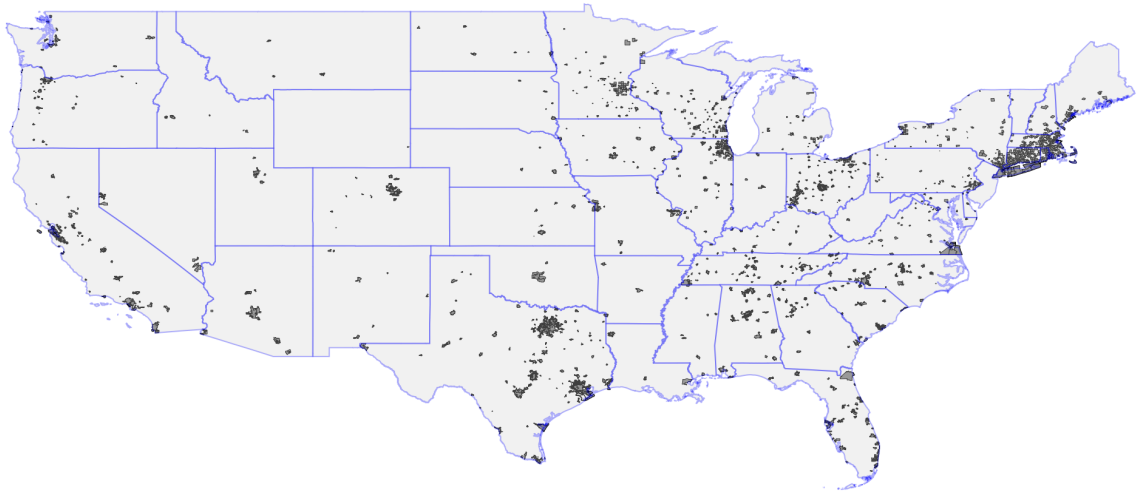
Data Sources

- **Annual Comprehensive Financial Reports** (ACFRs) from Moody's Investor Services for a nationwide sample of local governments + manually collected ACFRs for Census certainty sample.
- **Annual Survey of State and Local Governments Finances (ASSLGF)** for government expenditure and receipt claims for Census certainty sample.
- **Municipal bond yields** in the primary and secondary market from Mergent Municipal Bond Database and MSRB EMMA, respectively.
- **Debt securities disclosures** from MSRB continued disclosure statements collected under U.S. Security and Exchange Commission Rule 15c2-12 to link debt securities to issuers.
- **Demographic characteristics** from the decennial population census.

Nationwide Sample

Sample:

- Restrict to observations with non-missing financial information for 2007 and 2018 $\Rightarrow$ avoid composition effect in temporal change.
- Final sample contains 1,803 local governments – 107 million residents in 2010.
- The sample is tilted towards bond issuers. (median population: 21,187; mean population: 59,787)



Nationwide Sample

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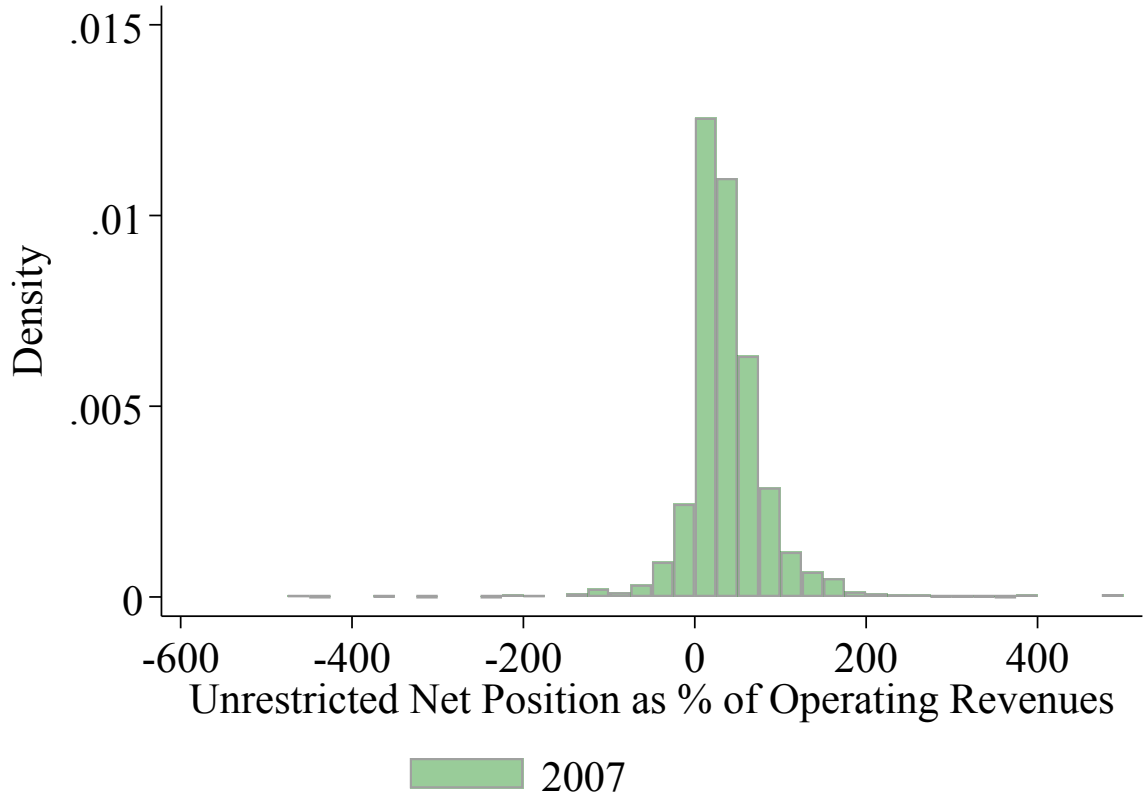
Financial Indicators:

1. Unrestricted net position as % of operating revenues,
2. Total liabilities as % of market value of taxable property (full value).

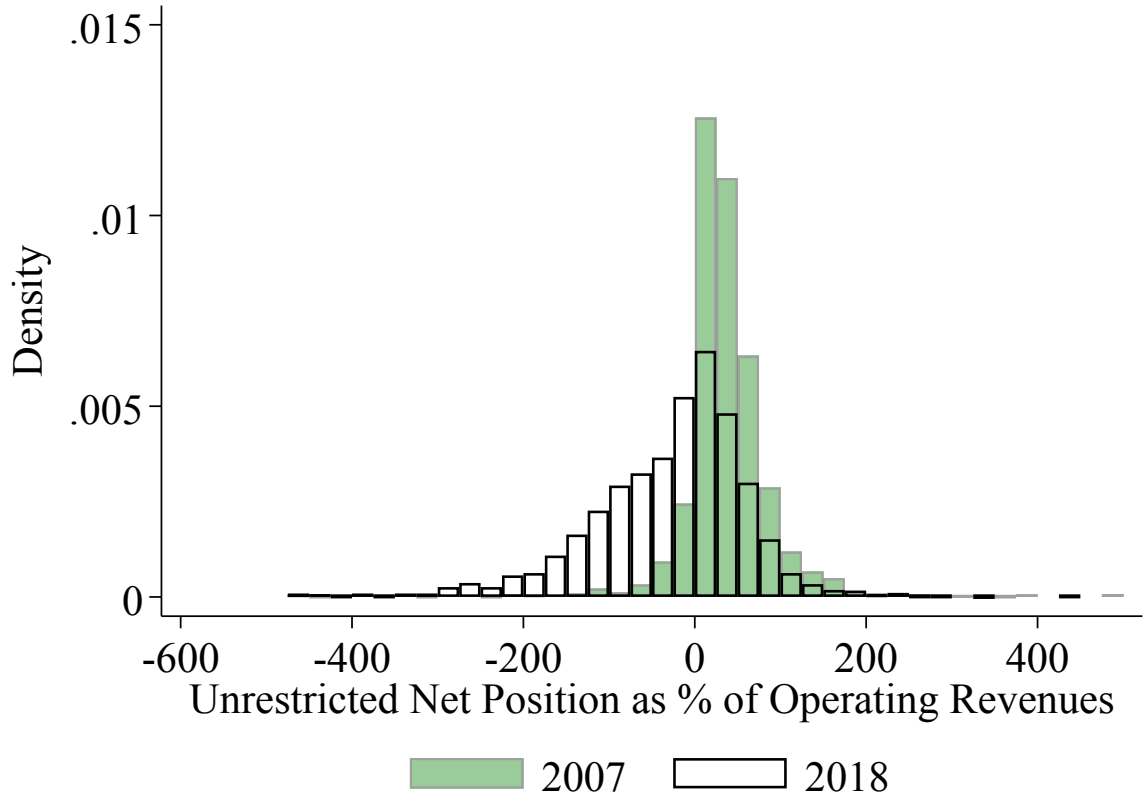
Summary Statistics

Financial Conditions of Local Governments



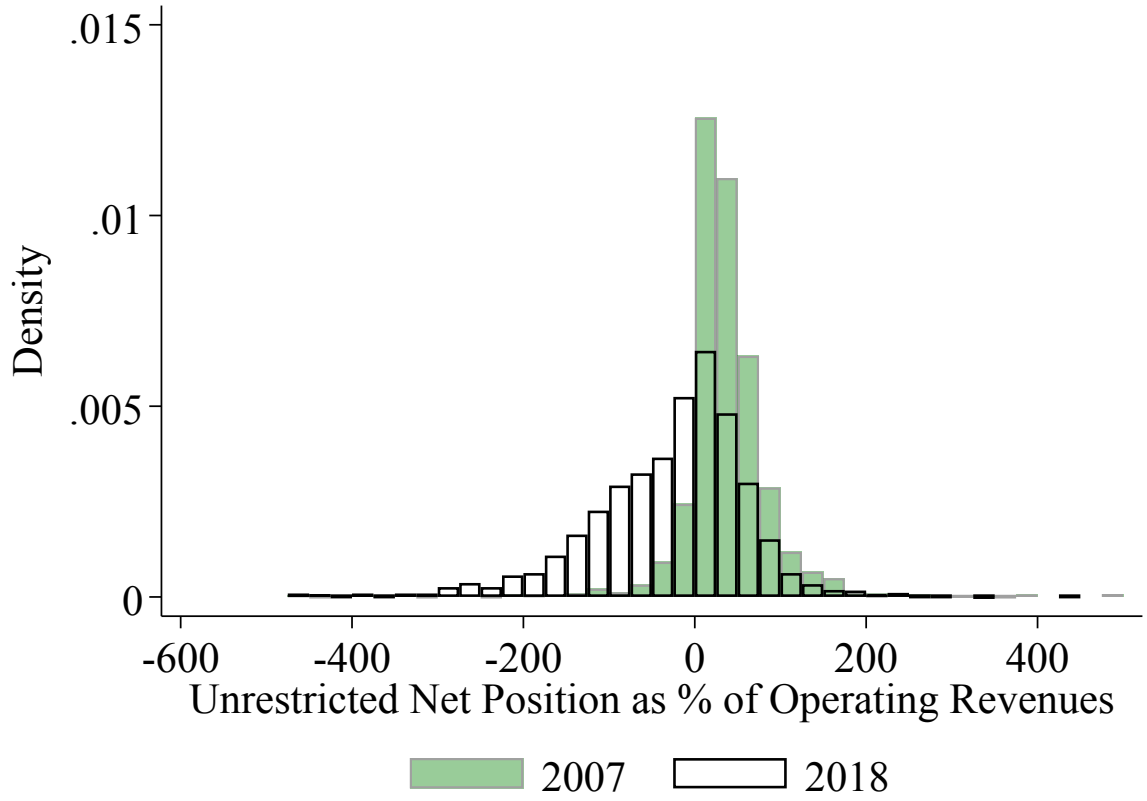
Composition BS TS

Financial Conditions of Local Governments



Composition BS TS

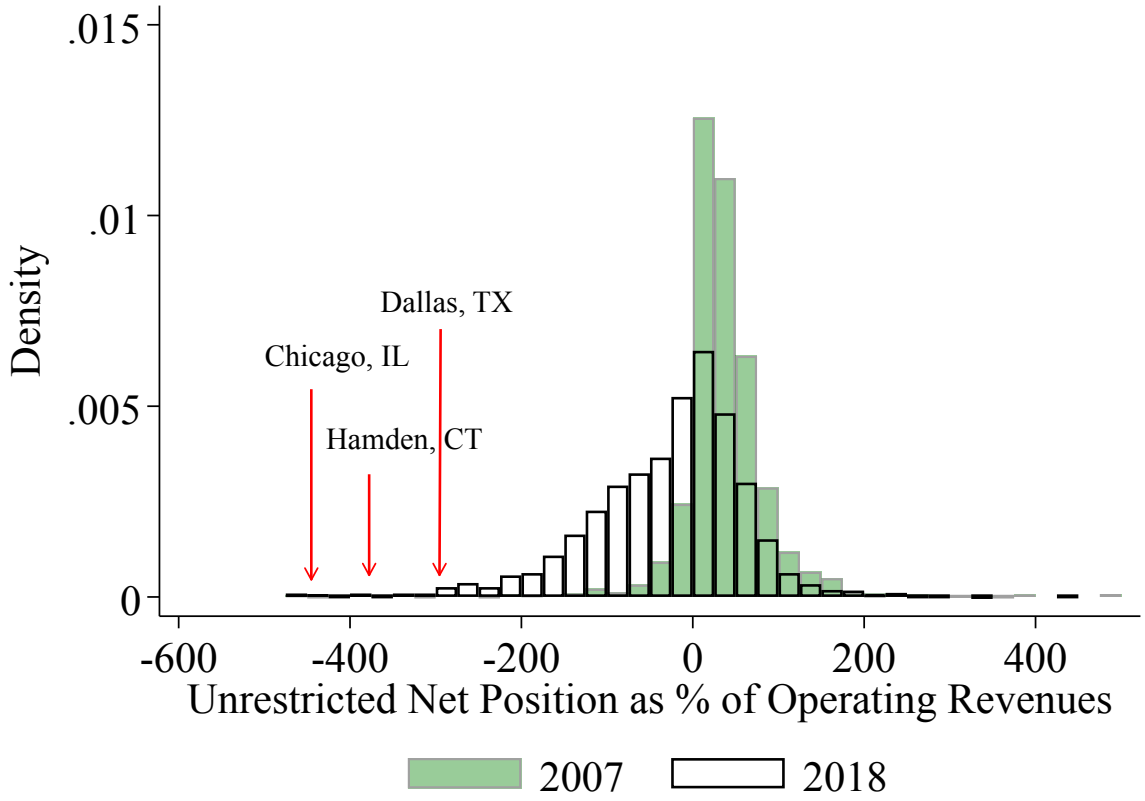
Financial Conditions of Local Governments



⇒ Median: 28.40% ↘ -18.97% and 5% percentile: -25.02% ↘ -190.62%

Composition BS TS

Financial Conditions of Local Governments

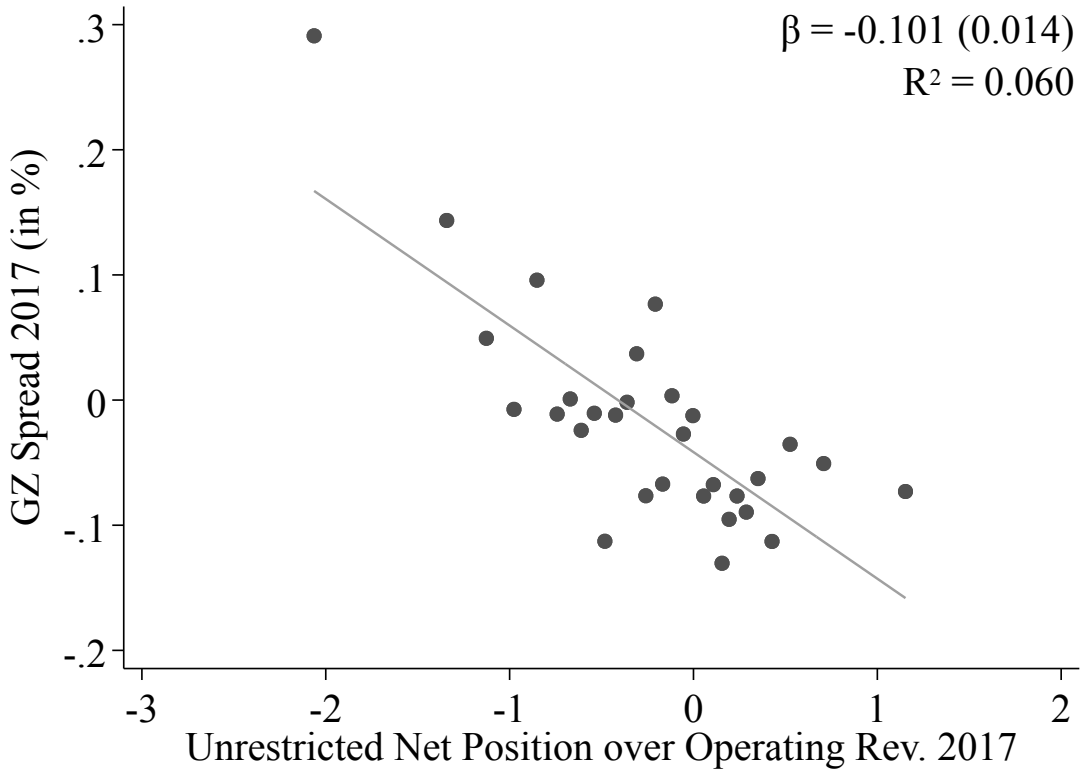


⇒ Median: 28.40% ↘ -18.97% and 5% percentile: -25.02% ↘ -190.62%

Composition BS TS

Financial Conditions of Local Governments

Balance sheet financial indicators show strong association with duration matched yield spread over treasuries ("GZ spread").



Full Value Share 1st-diff '07-'18 MMA Spread TS Spread

Roadmap

Market Value of Equity

We start with the simple **balance sheet identity**:

$$Equity = Assets - Liabilities$$

And express assets and liabilities by its components:

$$\begin{aligned} Assets =& PV(Revenues) + Cash \\ Liabilities =& PV(Expenditures) + PV(Pension\ Obligations) \\ &+ PV(OPEB) + PV(Debt) \end{aligned}$$

The **market value of equity** is:

$$\begin{aligned} Equity =& PV(Revenues) + Cash - PV(OPEB) - PV(Debt) \\ &- PV(Expenditures) - PV(Pension\ Obligations) \end{aligned} \quad (1)$$

- Valuations of pensions and OPEBs follows Novy-Marx and Rauh (2011); Brown and Wilcox (2009); Lucas and Zeldes (2006).
- Debt obligations are valued using credit spread of bond portfolio.

Asset Pricing Model

Evolution of state variables There is a $N \times 1$ vector $\mathbf{z}$ of state variables that follows a first order VAR with Gaussian error:

$$\mathbf{z}_{t+1} = \mathbf{\Psi}\mathbf{z}_t + \mathbf{u}_{t+1} = \mathbf{\Psi}\mathbf{z}_t + \Sigma^{\frac{1}{2}}\varepsilon_{\mathbf{t+1}} \tag{2}$$

where $\mathbf{\Psi}$ is a $N \times N$ companion matrix, $\mathbf{u}_t$ is a Gaussian error $\mathbf{u}_t \sim i.i.d.\ \mathcal{N}(0, \Sigma)$. And $\Sigma^{\frac{1}{2}}$ is a lower triangular matrix of a Cholesky decomposition and $\varepsilon_{\mathbf{t+1}} \sim i.i.d.\ \mathcal{N}(0, I)$.

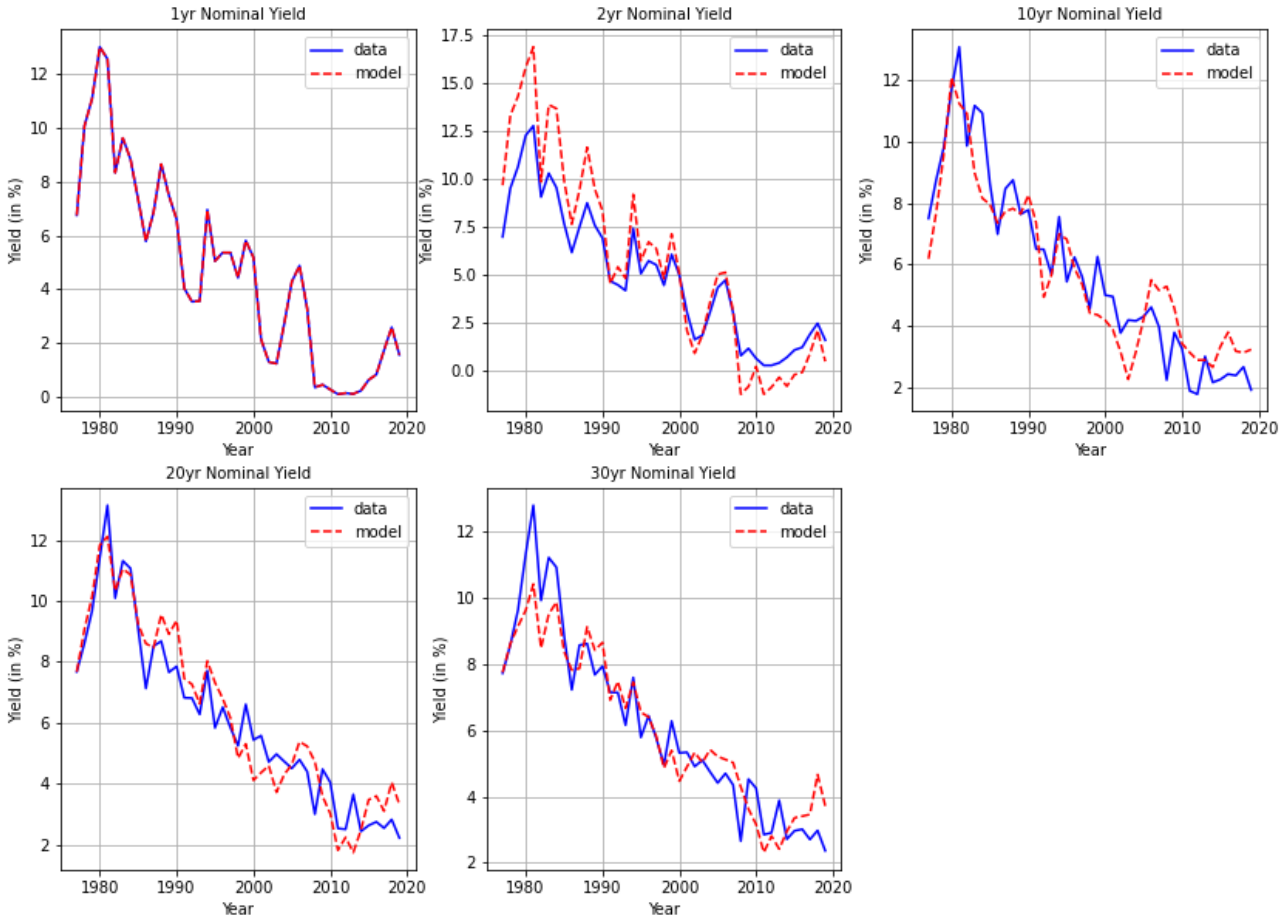
Asset Pricing We postulate an exponentially affine stochastic discount factor (Duffie and Kan (1996)). The nominal SDF is conditionally log-normal:

$$m^{\$}_{t+1} = -y^{\$}_t(1) - \frac{1}{2}\mathbf{\Lambda_t}'\mathbf{\Lambda_t} - \mathbf{\Lambda_t}'\varepsilon_{t+1} \tag{3}$$

where $m^{\$}_{t+1} = \log(M^{\$}_{t+1})$ the short rate is $y^{\$}_t(1)$ and the $\mathbf{\Lambda_t} = \mathbf{\Lambda_0} + \mathbf{\Lambda_1}\mathbf{z}_t$ vector prices the sources of risk in the structural innovations $\varepsilon_{\mathbf{t+1}}$.

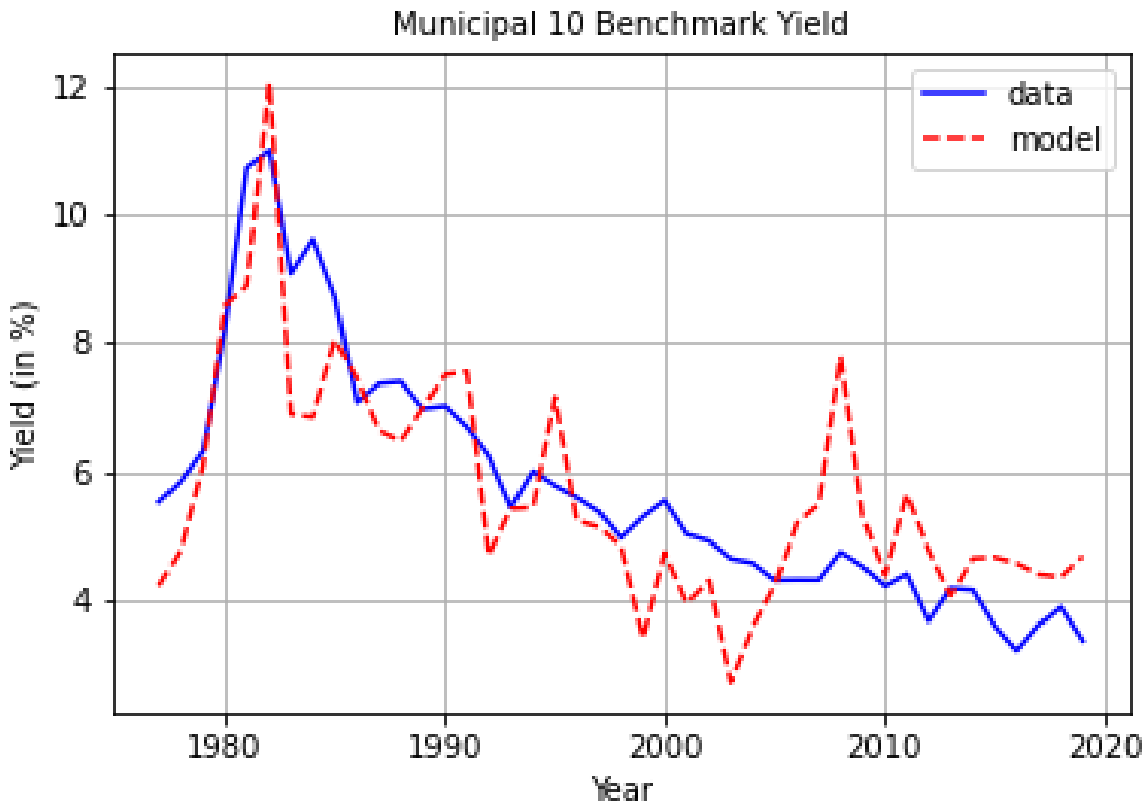
More

Asset Pricing - Nominal Yields



Real Yields

Asset Pricing - Municipal Index

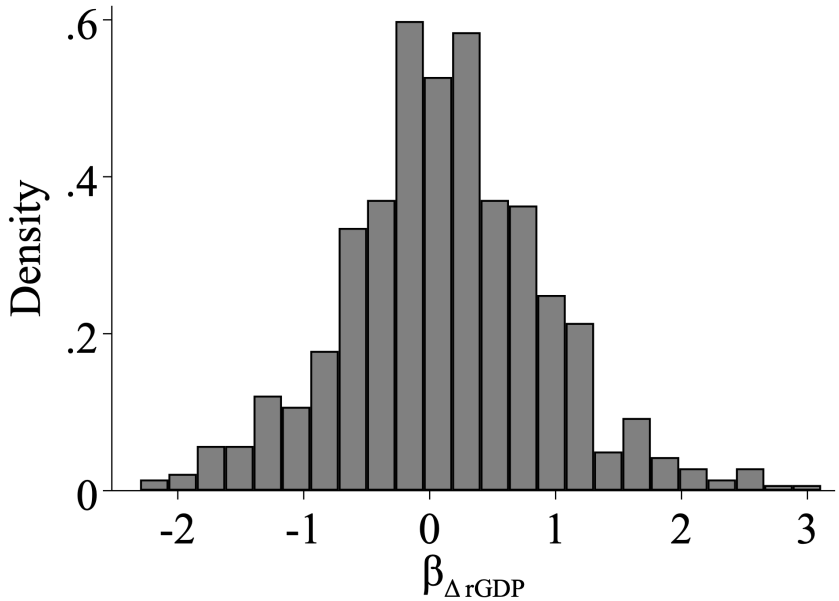


Cross-Sectional Risk Exposure - Business Cycle

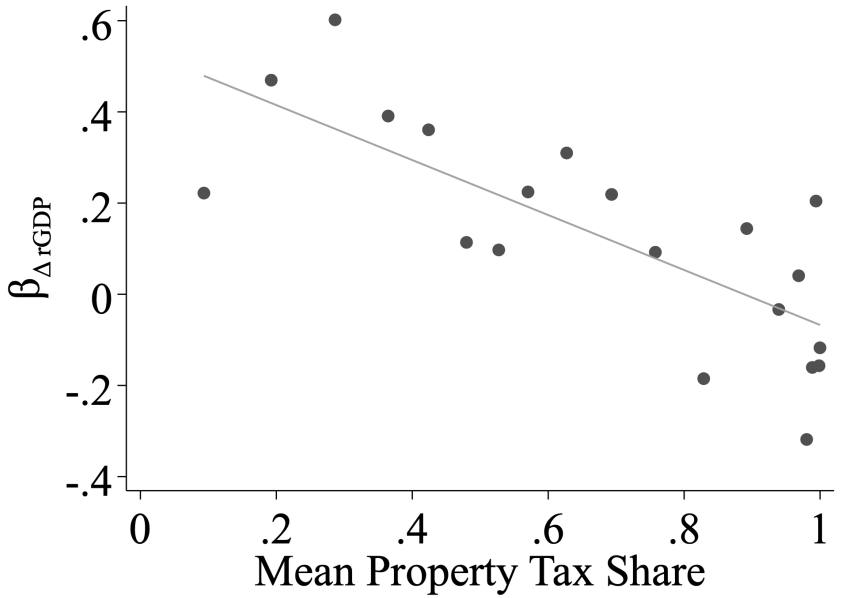
	ΔlnOwnSource	
	(1)	(2)
Real GDP growth rate	0.126***	0.563***
	(0.0340)	(0.0844)
Share property tax rate		0.00207
		(0.00201)
Real GDP growth rate × Share property tax rate		-0.635***
		(0.114)
R^2	0.001	0.002
City FE	✓	✓
City Time Trend	✓	✓
Observations	26094	26094

⇒ Local governments' receipts is strongly exposed to the business cycle; exposure depends e.g. on the source of revenues.

Cross-Sectional Risk Exposure Heterogeneity



(a) CX Exposure Real GDP

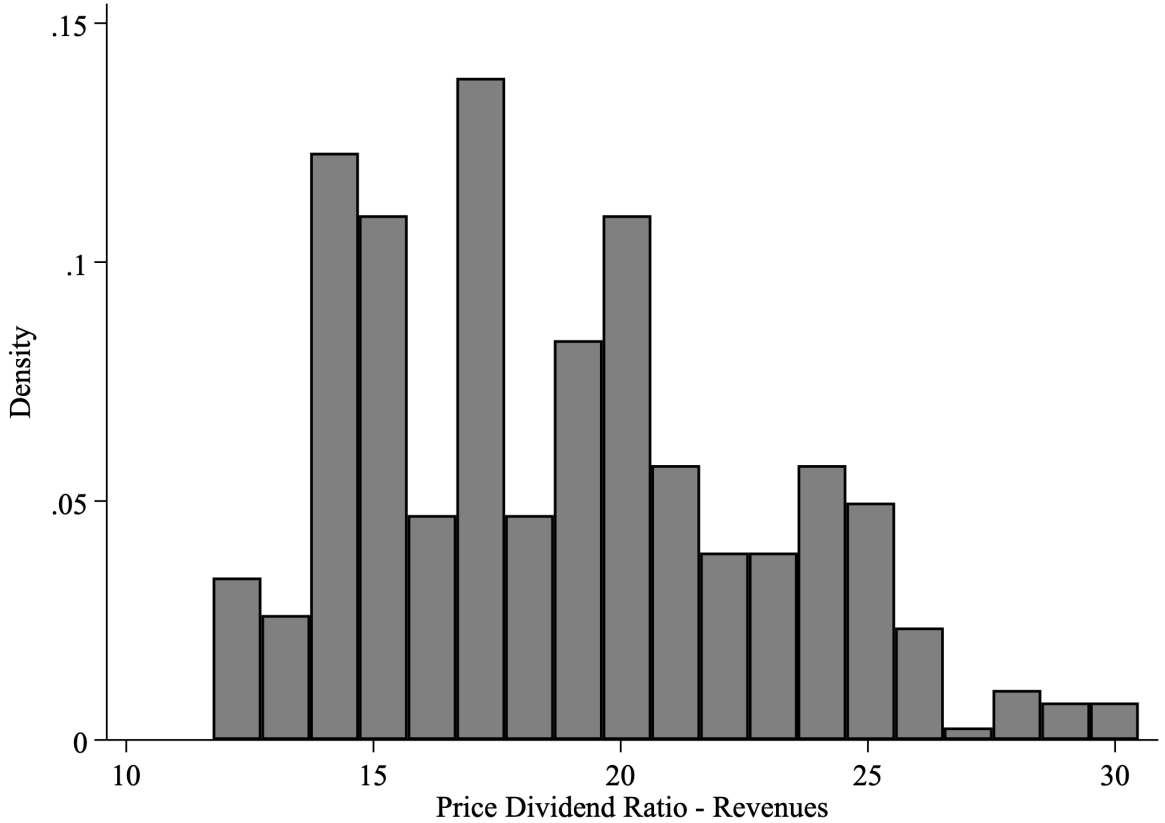


(b) Exposure and Mean Property Tax Share

⇒ Large heterogeneity in the exposure to the business cycle.

⇒ Exposure is associated with the share of receipts from property taxes.

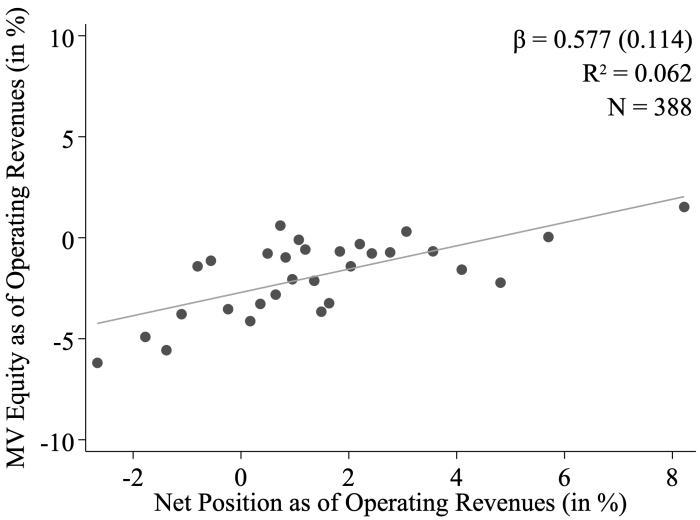
Price-to-Dividend Ratios



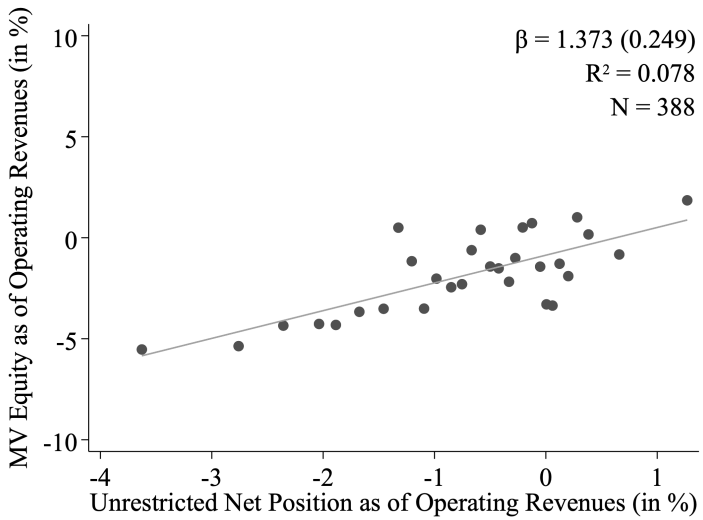
(a) Price-to-Dividend Ratio Revenues

⇒ Risk exposure determines the price-to-dividend ratio of local governments' receipts and expenditures.

Market vs. Book Valuations



(a) Net Position



(b) Unrestricted Net Position

⇒ Positive correlation between book and market valuation of equity.

⇒ Market valuation are overall consistent with the book valuations of equity; some additional variation that is not captured in the book valuations.

Conclusion

- Overall deterioration of financial conditions $\Rightarrow$ some *negative* book equity position.
- Book valuation provide an incomplete assessment: *backward-looking*.
- Market valuations–*forward-looking*–of equity are positively correlated with the book valuation.
- Little dispersion in credit spreads despite large difference in equity position suggests implicit insurance by federal and state governments.

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National Sample – Summary Statistics

	mean	p25	p50	p75	count
Operating Revenues 2018 (in '000)	161871.62	16231.00	36396.78	83926.94	1,803
GF Balance as of Op. Rev 2007 (%)	25.94	11.89	20.58	34.74	1,802
GF Balance as of Op. Rev 2018 (%)	33.40	16.83	26.93	42.74	1,802
Total liability over EGL 2007 (%)	-1.12	-1.83	-0.98	-0.45	1,726
Total liability over EGL 2018 (%)	-3.22	-3.97	-2.34	-1.18	1,784
Δ Total liability over EGL 07-18 (%)	-1.88	-2.49	-1.10	-0.29	1,719
Unr. Net. Pos. as of Op. Rev 2007 (%)	32.54	11.50	28.40	54.43	1,803
Unr. Net. Pos. as of Op. Rev 2018 (%)	-34.99	-84.62	-18.97	22.08	1,803
Δ Unr. Net. Pos. as of Op. Rev 07-18 (%)	-67.53	-112.86	-59.18	-14.73	1,803
Fraction Negative Unr. Net. Pos. 2018	0.61	0.00	1.00	1.00	1,803
Fraction Negative Net Position 2018	0.15	0.00	0.00	0.00	1,803
Net OPEB as of Op. Rev 2018 (%)	-34.89	-50.61	-11.96	-2.12	1,803
Net Pension as of Op. Rev 2018 (%)	-43.04	-62.04	-28.77	-8.93	1,803
Population (Census 2010)	59435.05	10292.00	21193.00	46746.00	1,803
Median House Value (Census2010)	266039.45	135700.00	210800.00	330600.00	1,803
Per Capita Income (ACS 2010)	31609.13	22418.00	27941.00	36467.00	1,802
Share 65+ Age (Census2010)	0.14	0.11	0.14	0.17	1,803
Share White (Census2010)	0.81	0.74	0.87	0.93	1,803
Share Black (Census2010)	0.08	0.01	0.03	0.10	1,803
Share Asian (Census2010)	0.04	0.01	0.02	0.04	1,803
Home Ownership (Census2010)	0.67	0.56	0.66	0.78	1,803

Back

National Sample – Geographic-Distribution

National sample has wide geographic coverage.

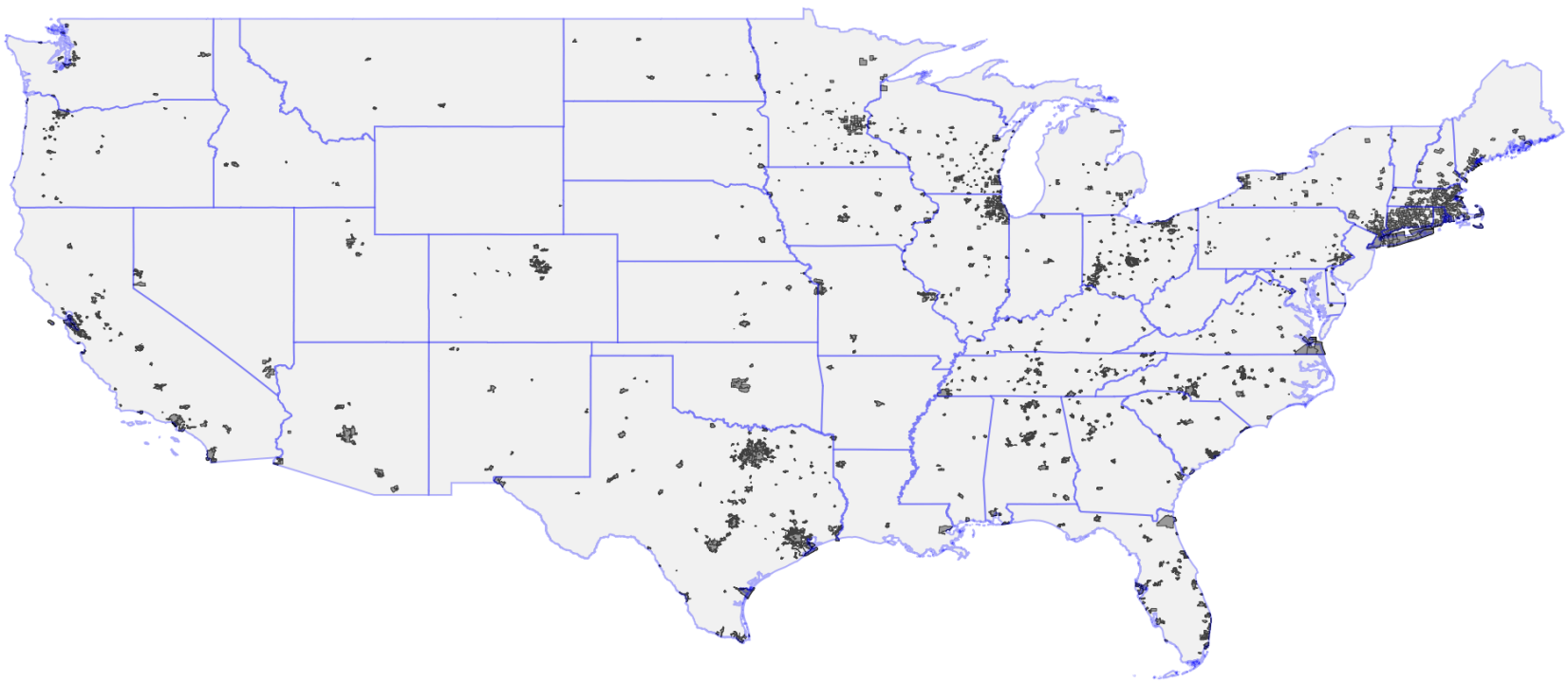

Figure: National Sample - Geographic Distribution

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Certainty Sample – Geographic-Distribution

The certainty sample has wide geographic coverage.

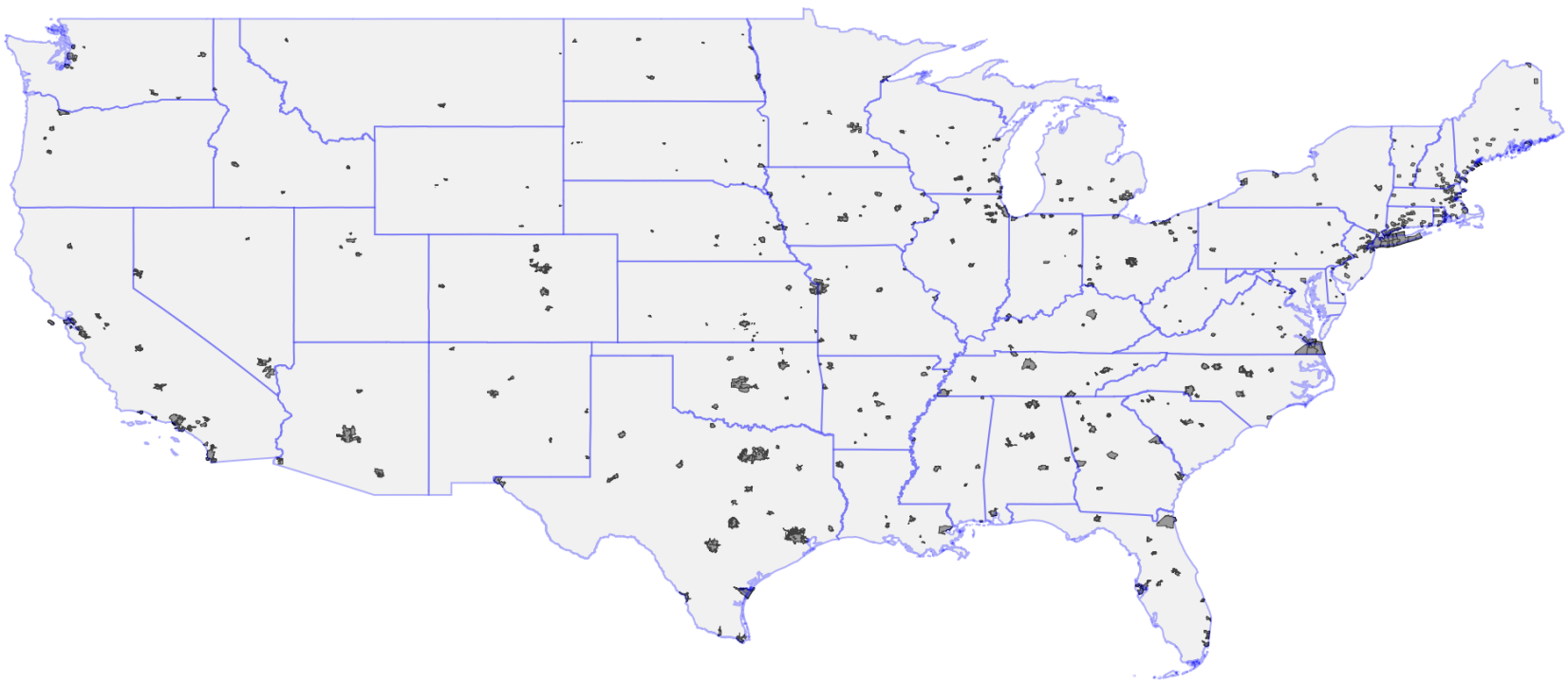

Figure: Certainty Sample - Geographic Distribution

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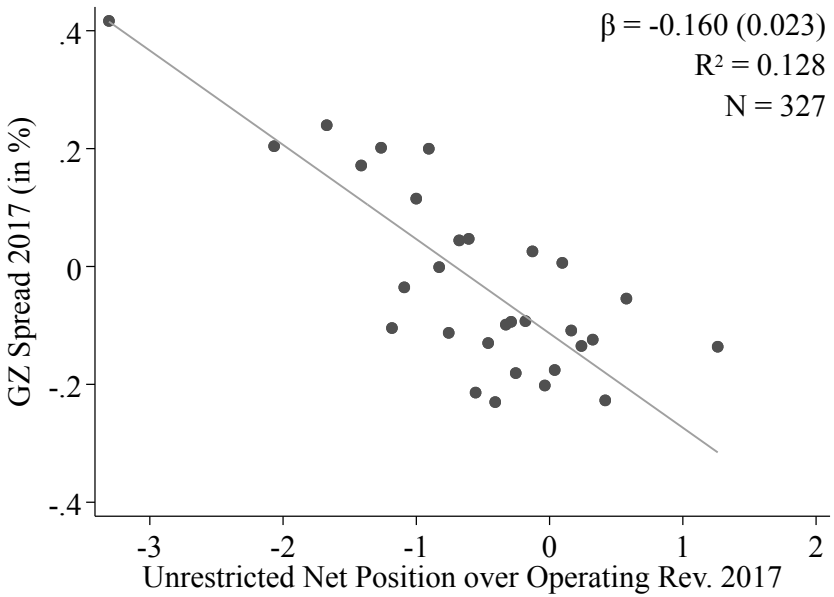
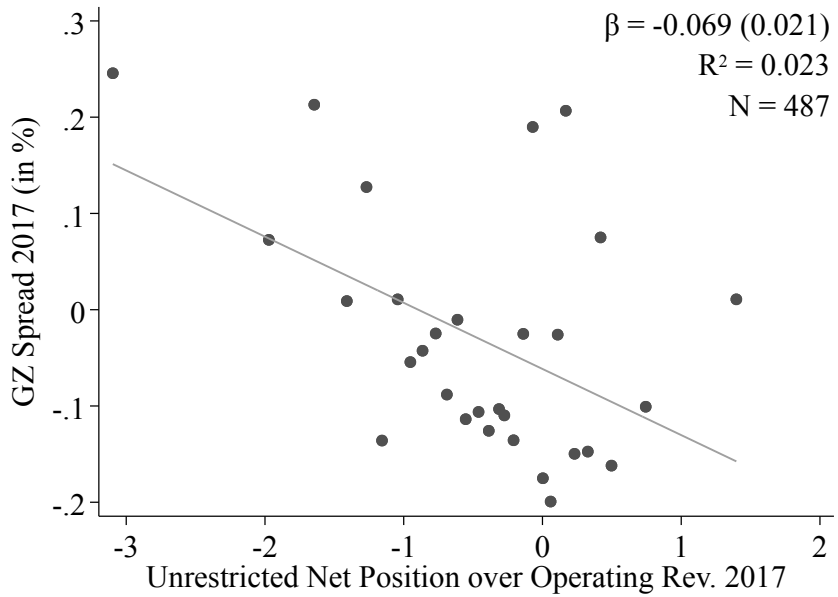
Certainty Sample – Unrestricted Net Position

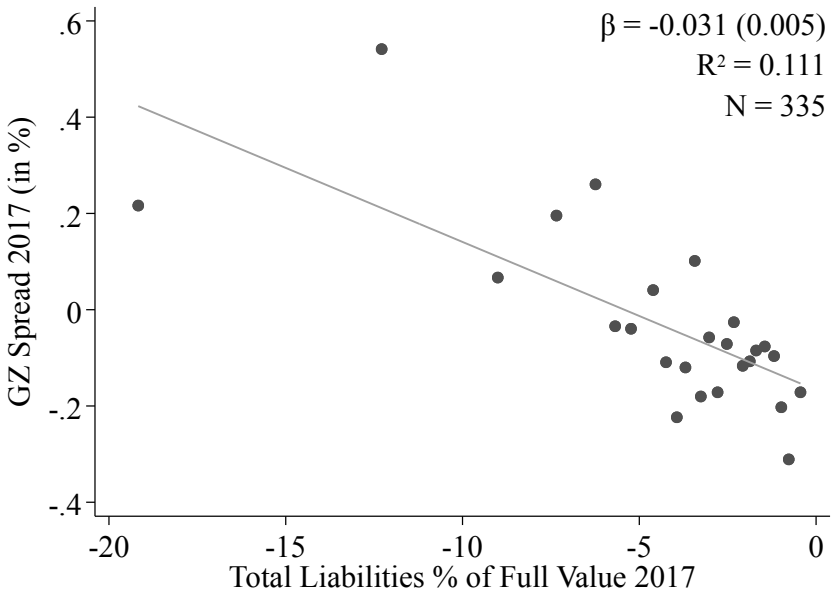


(a) GZ Spread - Unrestricted Net Position - Primary

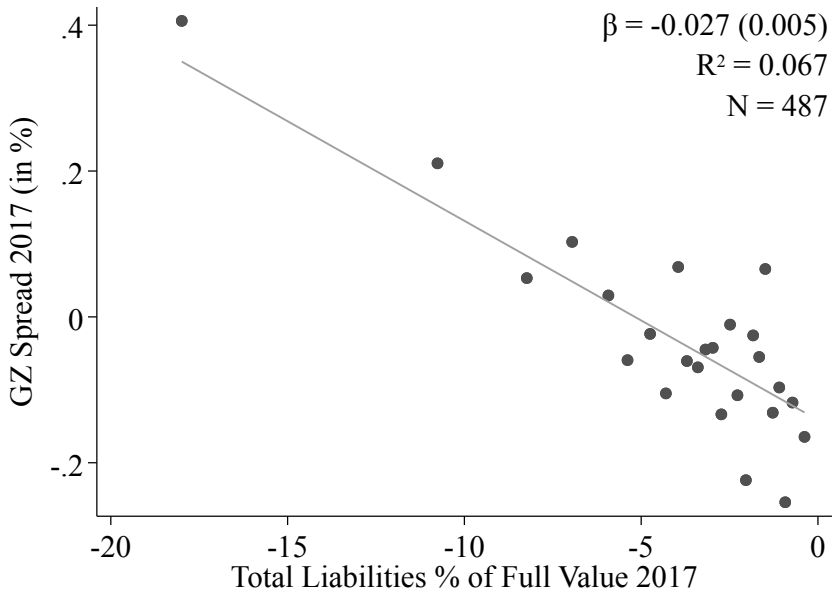


(b) GZ Spread - Unrestricted Net Position - Secondary

Certainty Sample – Total Liability over Full Value



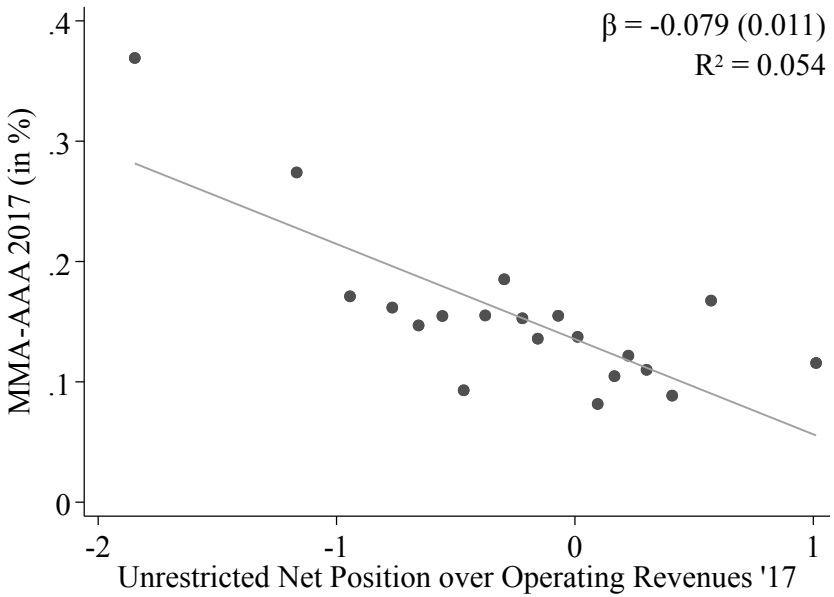
(c) GZ Spread - Total Liability over Full Value - Primary



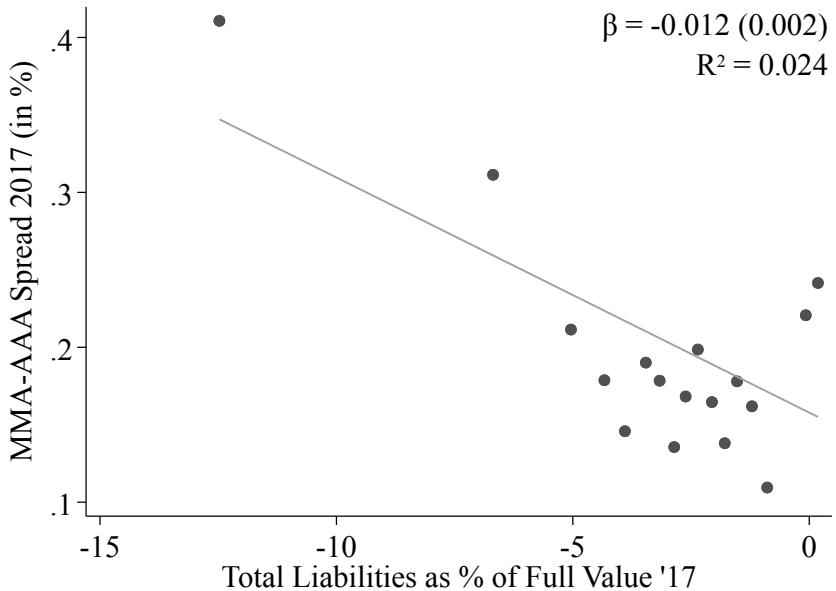
(d) GZ Spread - Total Liability over Full Value - Secondary

MMA-AAA Spread

MMA research releases a yield curve for AAA rated municipal bonds which is widely used as a benchmark in the municipal bond market. In short, we call the spread with respect to this benchmark MMA-AAA Spread.



(a) Spread - U. Net Position



(b) Spread - Total Liabilities

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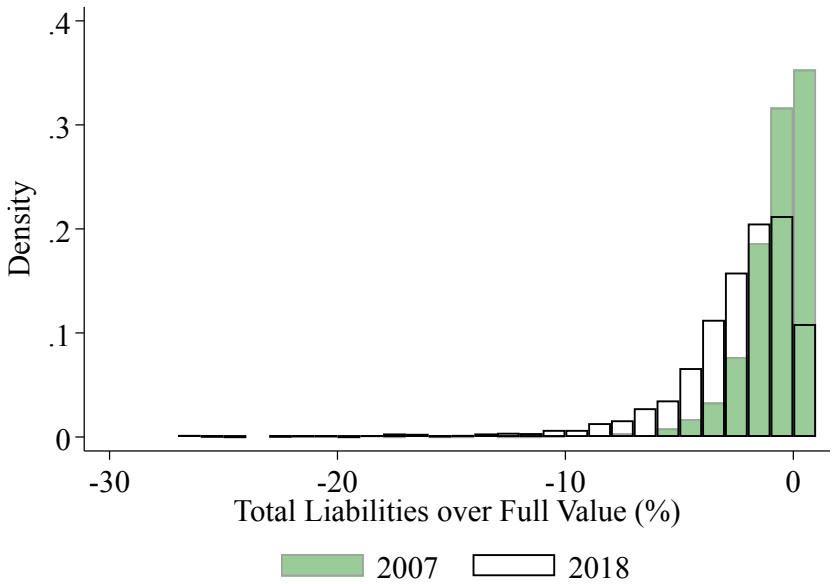
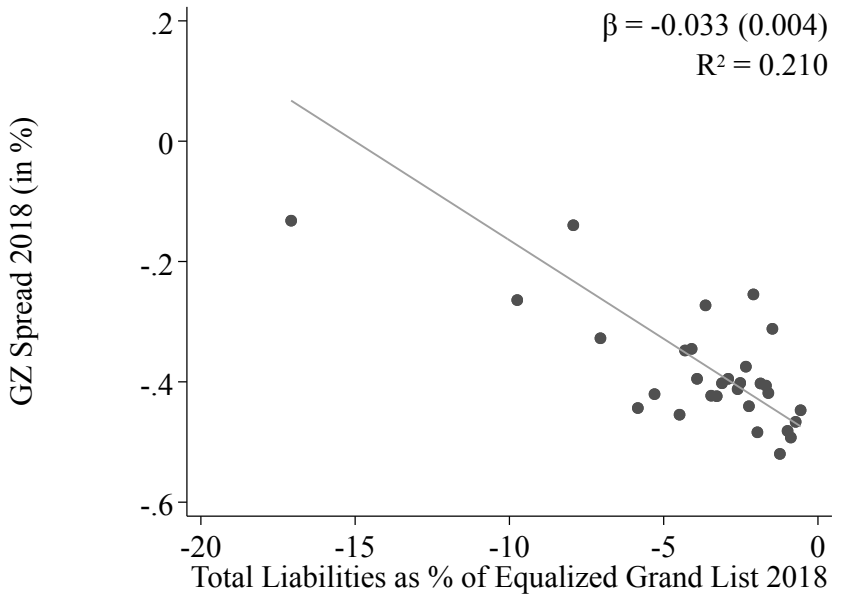
Fiscal Indicator – Total Debt over Full Value

Nationwide sample shows deteriorating fiscal position as measured by total debt over full value. Total debt over full value is strongly associated with spreads in the municipal bond market.



(a) Full Value Share



(b) GZ Spread - Full Value Share

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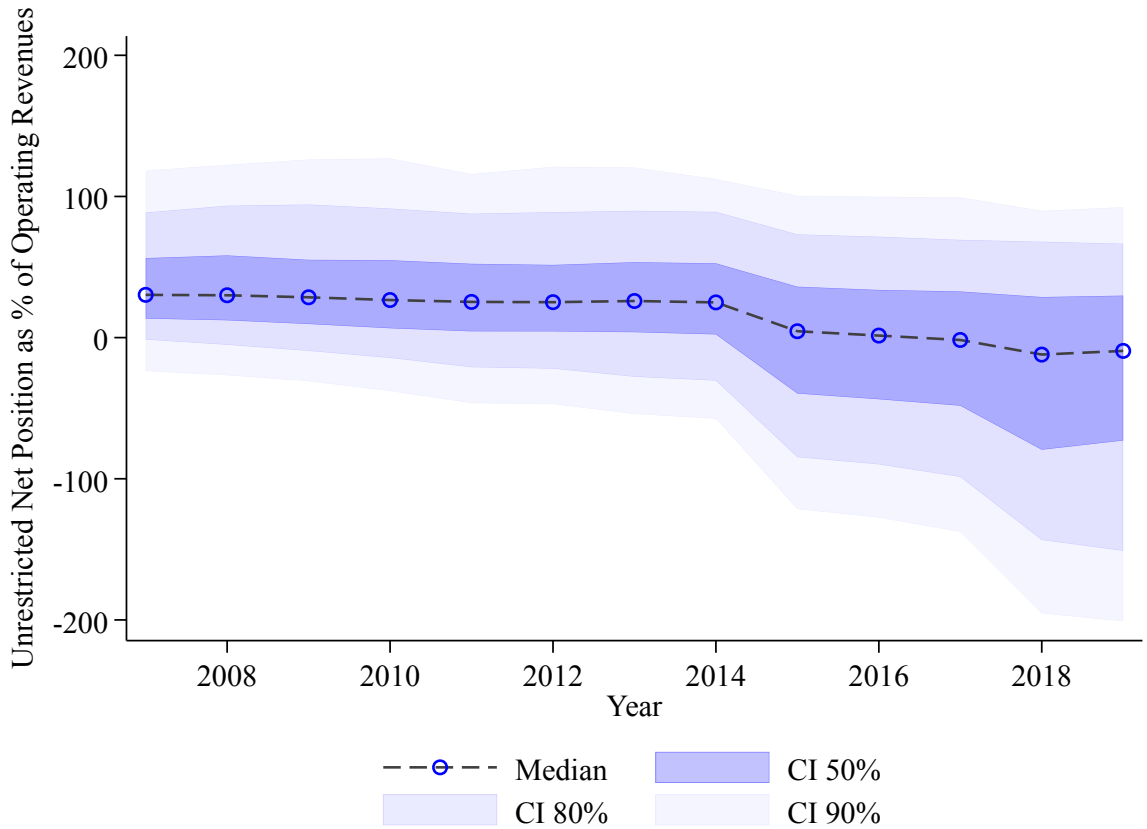
CX distribution of Unrestricted Net Position by Year

Median unrestricted net position shows material decline in 2015 and 2018. Left skew increases substantially on both years.



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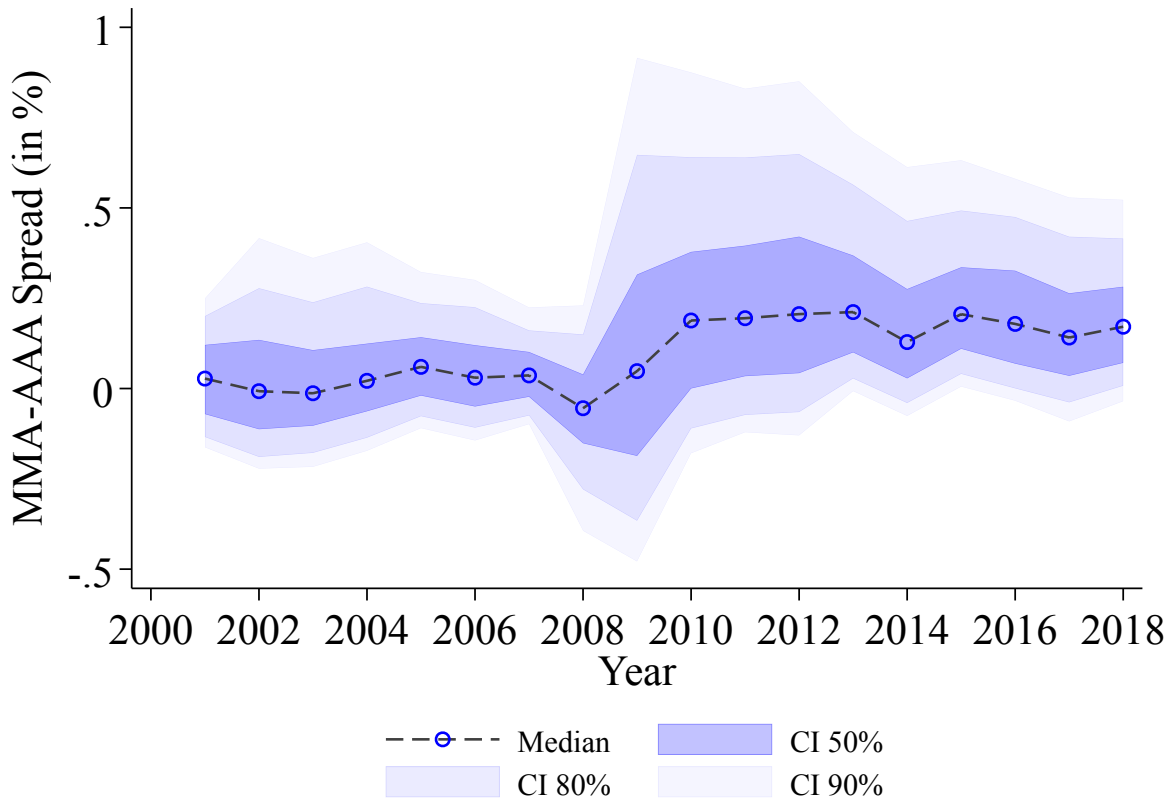
CX distribution of MMA-AAA Spread

The municipal bond market started to differentiate municipal credit more strongly past 2008.



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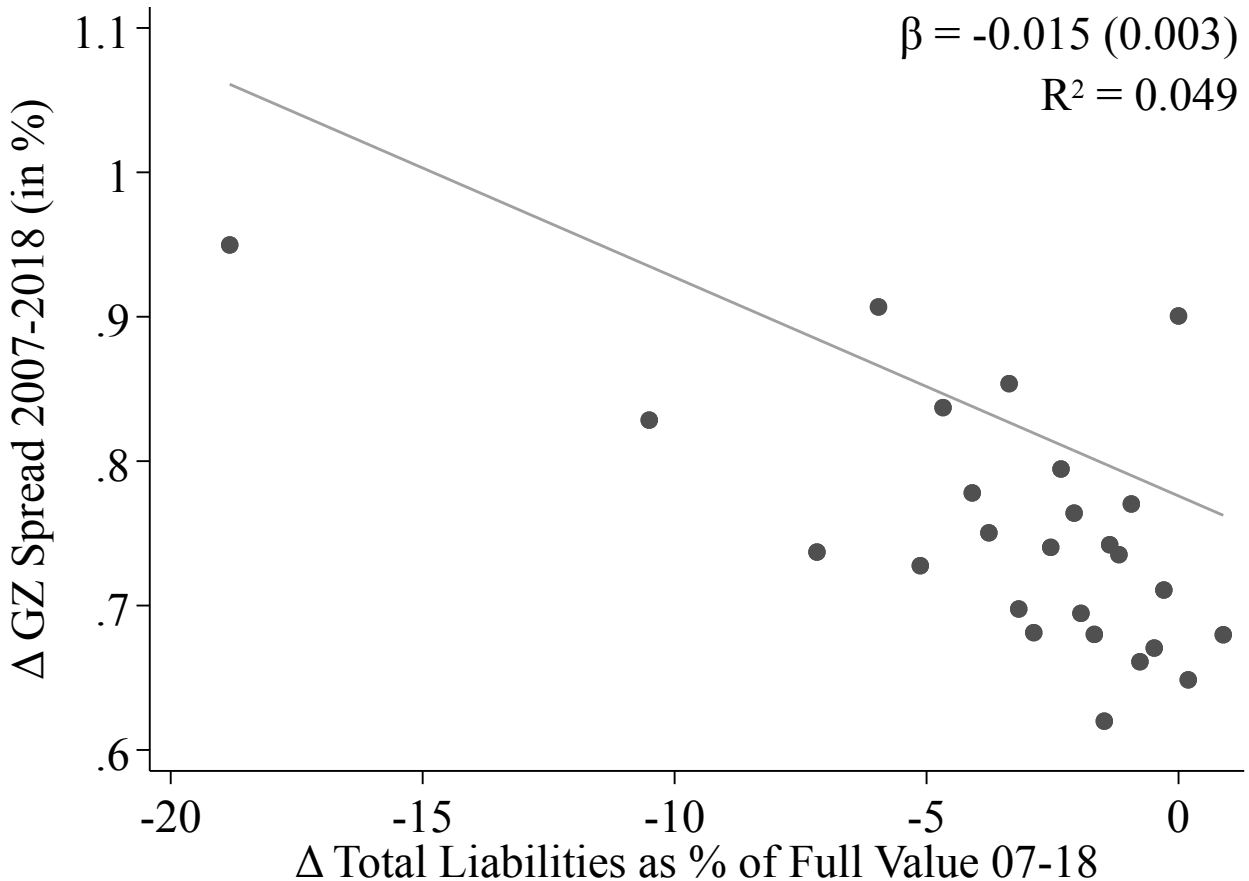
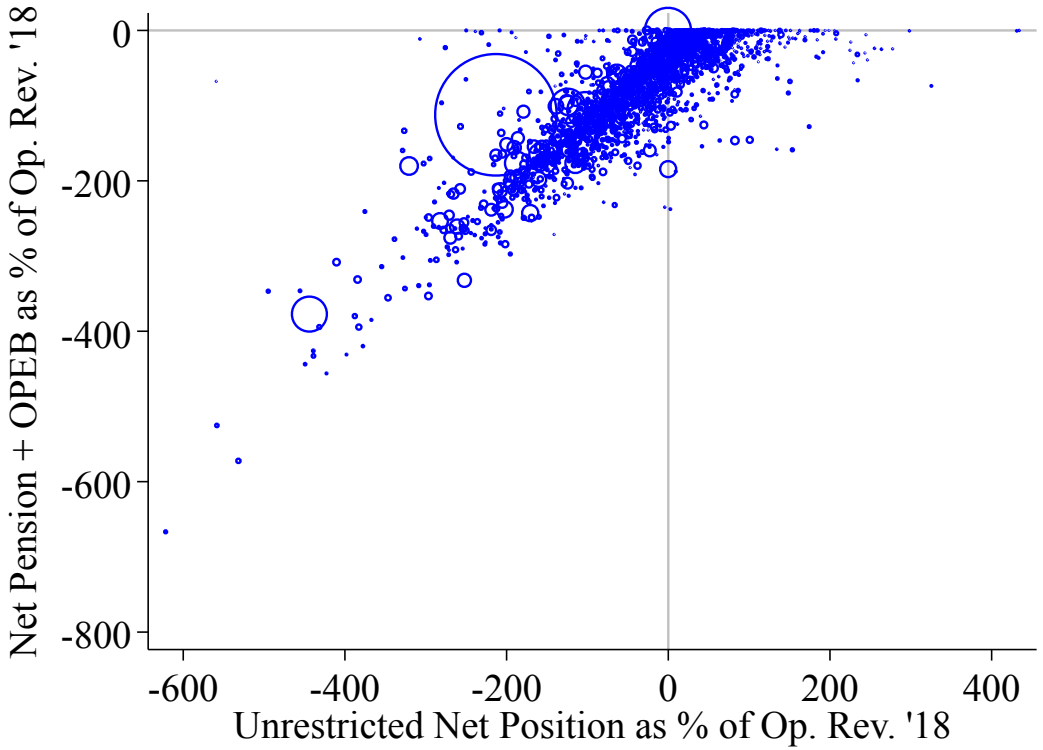
1st Difference GZ Spread and Total Liabilities over Full Value

Capital markets price the change in total liabilities over full value between 2007 and 2018.



Unrestricted Net Position Composition

The unrestricted net position is primarily composed of legacy obligations; that is, net pension and net OPEB liabilities.



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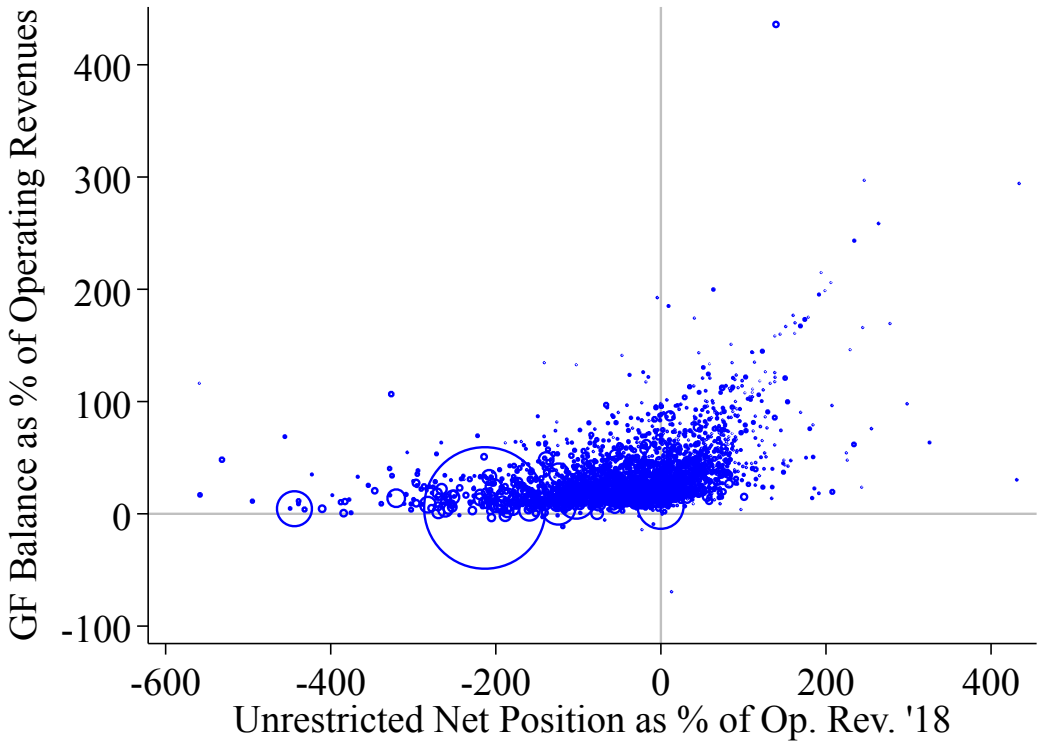
Unrestricted Net Position and Budget Balance

While cities carry mostly positive budget balances the unrestricted net position may assume negative values.



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Stylized Balance Sheet

Assets	Liabilities
Cash & Invest.	Net Position
Capital Assets	LT Debt
Other Assets	Pensions
	OPEB
	Other Liabilities

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State Variables

We include a rich set of state variables:

Position	Variable	Variable Mean	Sample Mean
0	π_t	π_0	0.03108
1	x_t	x_0	0.029745
2	$y(1)_t^{\$}$	$y(1)_0^{\$}$	0.04329
3	$yspr_t^{\$}$	$yspr_0^{\$}$	0.005838
4	pd_t	pd_0	3.528392
5	Δd_t	Δd_0	0.060559
6	$\Delta \log \tau_t$	$\Delta \log \tau_0$	-0.006712
7	$\log \tau_t$	$\log \tau_0$	-2.236345
8	$\Delta \log g_t$	$\Delta \log g_0$	0.001887
9	$\log g_t$	$\log g_0$	-2.214822
10	$\Delta \log d_t$	$\Delta \log d_0$	0.003952
11	$\log d_t$	$\log d_0$	-1.042491
12	cs_t	cs_0	-0.003064

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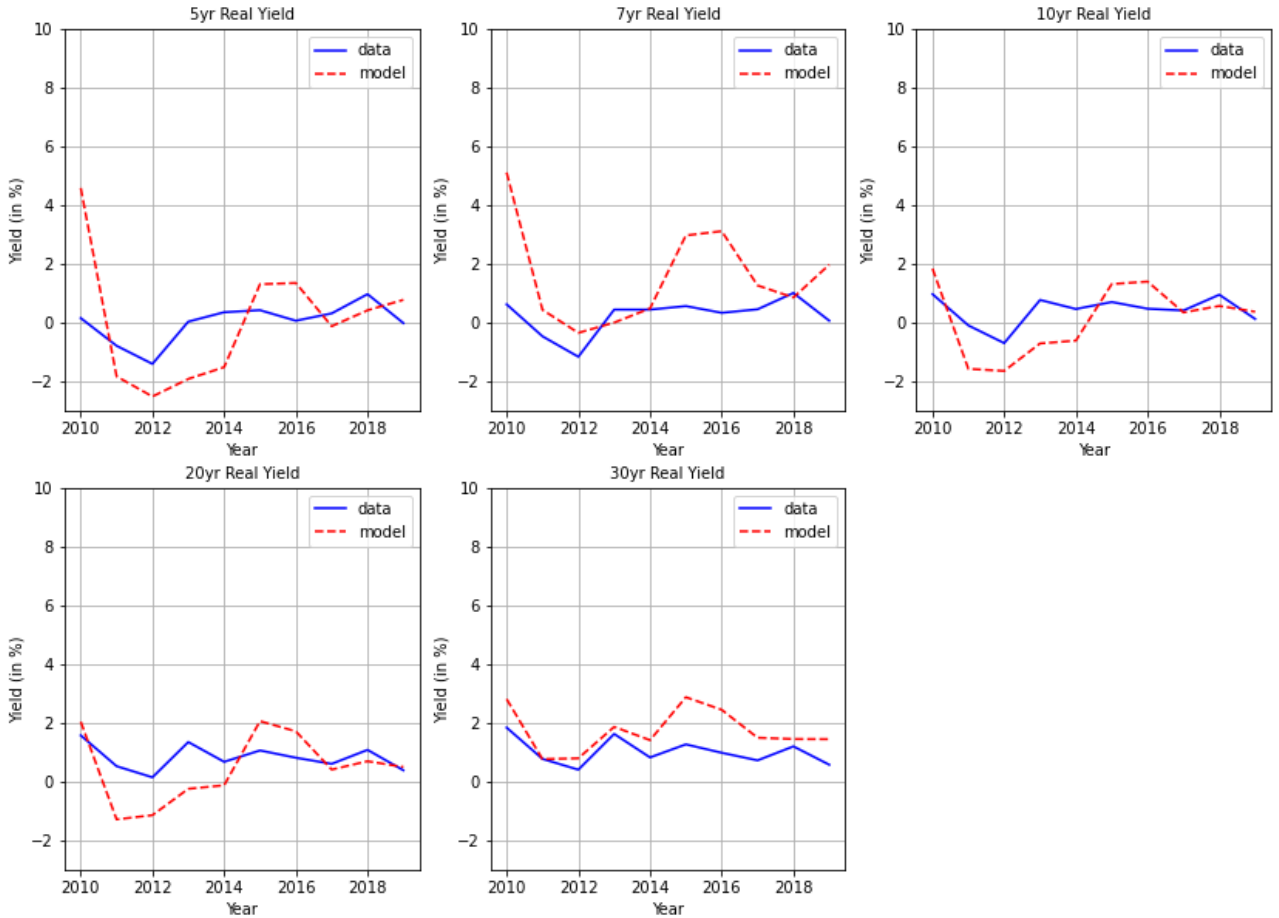
Real Yields


5yr Real Yield
7yr Real Yield
10yr Real Yield
20yr Real Yield
30yr Real Yield
data
model
Yield (in %)
Year
10
8
6
4
2
0
−2
2010
2012
2014
2016
2018

Cross-Sectional Asset Pricing

We postulate that the growth rate in local government claim is spanned by the state vector:

$$\Delta \log w_{t+1} = w_0 + \beta' \mathbf{z}_{t+1} + U' \eta_{t+1} \tag{4}$$

The Euler equation for the price dividend is given by:

$$PD_t^w(h+1) = \mathbb{E}_t \left[M_{t+1} PD_{t+1}(h) \frac{W_{t+1}}{W_t} \right] \tag{5}$$

Hence, the price-dividend ratio of the cum-dividend government claim is:

$$PD_t^w = \sum_{h=0}^{\infty} \exp(A^w(h+1) + B^w(h+1)' z_t) \tag{6}$$

where $A^w(h)$ and $B^w(h)'$ are defined by first-order difference equations.