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 known 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
⇒ Disadvantage: Book values are backward-looking.

**2 Approach:** Estimate market values of local governments equity position
⇒ 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)

⇒ *Document state and trajectory of local governments’ financial position.*


⇒ *Price large cross-section of non-traded claims.*
Roadmap

1. Introduction
2. Financial Conditions
3. Market Valuation
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 ⇒ 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

**Sample:**
- Restrict to observations with non-missing financial information for 2007 and 2018 -> avoid composition effect in temporal change.
- Final sample contains 1,803 local governments – 107 million residents in 2010.
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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).
Financial Conditions of Local Governments

Density

Unrestricted Net Position as % of Operating Revenues

2007

Composition BS TS
Financial Conditions of Local Governments

<table>
<thead>
<tr>
<th>Density</th>
<th>Unrestricted Net Position as % of Operating Revenues</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.005</td>
<td>0</td>
</tr>
<tr>
<td>0.01</td>
<td>0</td>
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<td>0.015</td>
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Composition:
- BS
- TS
Financial Conditions of Local Governments

⇒ Median: 28.40% ↓ -18.97% and 5% percentile: -25.02% ↓ -190.62%
Financial Conditions of Local Governments

⇒ Median: 28.40% ↘ -18.97% and 5% percentile: -25.02% ↘ -190.62%
Balance sheet financial indicators show strong association with duration matched yield spread over treasuries ("GZ spread").

\[ \beta = -0.101 \ (0.014) \]

\[ R^2 = 0.060 \]
Roadmap

1 Introduction

2 Financial Conditions

3 Market Valuation
Market Value of Equity

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

\[
Equity = Assets - Liabilities
\]

And express assets and liabilities by its components:

\[
Assets = PV(Revenues) + Cash
\]
\[
Liabilities = PV(Expenditures) + PV(Pension Obligations) + PV(OPEB) + PV(Debt)
\]

The **market value of equity** is:

\[
Equity = PV(Revenues) + Cash - PV(OPEB) - PV(Debt) - PV(Expenditures) - PV(Pension Obligations) \quad (1)
\]

- Debt obligations are valued using credit spread of bond portfolio.
Introduction  Financial Conditions  Market Valuation  References

Asset Pricing Model

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

$$ z_{t+1} = \Psi z_t + u_{t+1} = \Psi z_t + \Sigma^{1/2} \varepsilon_{t+1} $$

(2)

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

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

$$ m_{t+1}^s = -y_t^s(1) - \frac{1}{2} \Lambda_t' \Lambda_t - \Lambda_t' \varepsilon_{t+1} $$

(3)

where $m_{t+1}^s = \log(M_{t+1}^s)$ the short rate is $y_t^s(1)$ and the $\Lambda_t = \Lambda_0 + \Lambda_1 z_t$ vector prices the sources of risk in the structural innovations $\varepsilon_{t+1}$. 
Asset Pricing - Nominal Yields

1yr Nominal Yield

2yr Nominal Yield

10yr Nominal Yield

20yr Nominal Yield

30yr Nominal Yield

Real Yields
Asset Pricing - Municipal Index

[Graph showing Municipal 10 Benchmark Yield with data and model lines]

Yield (in %)

Year


12 10 8 6 4
## Cross-Sectional Risk Exposure - Business Cycle

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<td>(1)</td>
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<tr>
<td>Real GDP growth rate</td>
<td>0.126***</td>
</tr>
<tr>
<td></td>
<td>(0.0340)</td>
</tr>
<tr>
<td>Share property tax rate</td>
<td>0.00207</td>
</tr>
<tr>
<td></td>
<td>(0.00201)</td>
</tr>
<tr>
<td>Real GDP growth rate $\times$ Share property tax rate</td>
<td>-0.635***</td>
</tr>
<tr>
<td></td>
<td>(0.114)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.001</td>
</tr>
<tr>
<td>City FE</td>
<td>✓</td>
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<tr>
<td>City Time Trend</td>
<td>✓</td>
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<td>Observations</td>
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</table>

⇒ 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

\(\beta_{\Delta rGDP}\)

(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

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.


References II


References V


<table>
<thead>
<tr>
<th>Data Category</th>
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<th>p50</th>
<th>p75</th>
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<tr>
<td>Operating Revenues 2018 (in '000)</td>
<td>161871.62</td>
<td>16231.00</td>
<td>36396.78</td>
<td>83926.94</td>
<td>1,803</td>
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<tr>
<td>GF Balance as of Op. Rev 2007 (%)</td>
<td>25.94</td>
<td>11.89</td>
<td>20.58</td>
<td>34.74</td>
<td>1,802</td>
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<tr>
<td>GF Balance as of Op. Rev 2018 (%)</td>
<td>33.40</td>
<td>16.83</td>
<td>26.93</td>
<td>42.74</td>
<td>1,802</td>
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<tr>
<td>Total liability over EGL 2007 (%)</td>
<td>-1.12</td>
<td>-1.83</td>
<td>-0.98</td>
<td>-0.45</td>
<td>1,726</td>
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<td>Total liability over EGL 2018 (%)</td>
<td>-3.22</td>
<td>-3.97</td>
<td>-2.34</td>
<td>-1.18</td>
<td>1,784</td>
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<td>Total liability over EGL 07-18 (%)</td>
<td>-1.88</td>
<td>-2.49</td>
<td>-1.10</td>
<td>-0.29</td>
<td>1,719</td>
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<td>Fraction Negative Unr. Net. Pos. 2018</td>
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<td>1.00</td>
<td>1.00</td>
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<td>Fraction Negative Net Position 2018</td>
<td>0.15</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1,803</td>
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<td>Net OPEB as of Op. Rev 2018 (%)</td>
<td>-34.89</td>
<td>-50.61</td>
<td>-11.96</td>
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<td>1,803</td>
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<tr>
<td>Population (Census 2010)</td>
<td>59435.05</td>
<td>10292.00</td>
<td>21193.00</td>
<td>46746.00</td>
<td>1,803</td>
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<td>Median House Value (Census2010)</td>
<td>266039.45</td>
<td>135700.00</td>
<td>210800.00</td>
<td>330600.00</td>
<td>1,803</td>
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<tr>
<td>Per Capita Income (ACS 2010)</td>
<td>31609.13</td>
<td>22418.00</td>
<td>27941.00</td>
<td>36467.00</td>
<td>1,802</td>
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<tr>
<td>Share 65+ Age (Census2010)</td>
<td>0.14</td>
<td>0.11</td>
<td>0.14</td>
<td>0.17</td>
<td>1,803</td>
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<tr>
<td>Share White (Census2010)</td>
<td>0.81</td>
<td>0.74</td>
<td>0.87</td>
<td>0.93</td>
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<td>Share Black (Census2010)</td>
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<td>0.01</td>
<td>0.03</td>
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<td>Share Asian (Census2010)</td>
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<td>0.01</td>
<td>0.02</td>
<td>0.04</td>
<td>1,803</td>
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<tr>
<td>Home Ownership (Census2010)</td>
<td>0.67</td>
<td>0.56</td>
<td>0.66</td>
<td>0.78</td>
<td>1,803</td>
</tr>
</tbody>
</table>
National Sample – Geographic-Distribution

National sample has wide geographic coverage.

Figure: National Sample - Geographic Distribution
The certainty sample has wide geographic coverage.

**Figure:** Certainty Sample - Geographic Distribution
Certainty Sample – Unrestricted Net Position

(a) GZ Spread - Unrestricted Net Position - Primary

(b) GZ Spread - Unrestricted Net Position - Secondary
(c) GZ Spread - Total Liability over Full Value - Primary

β = -0.031 (0.005)
R² = 0.111
N = 335

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

β = -0.027 (0.005)
R² = 0.067
N = 487
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.

\[ \beta = -0.079 \pm 0.011 \]  
\[ R^2 = 0.054 \] (a) Spread - U. Net Position

\[ \beta = -0.012 \pm 0.002 \]  
\[ R^2 = 0.024 \] (b) Spread - Total Liabilities
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
Median unrestricted net position shows material decline in 2015 and 2018. Left skew increases substantially on both years.
The municipal bond market started to differentiate municipal credit more strongly past 2008.
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.

\[ \Delta \text{Total Liabilities as % of Full Value 07-18} \]

\[ \beta = -0.015 \pm 0.003 \]

\[ R^2 = 0.049 \]
The unrestricted net position is primarily composed of legacy obligations; that is, net pension and net OPEB liabilities.
While cities carry mostly positive budget balances the unrestricted net position may assume negative values.
# Stylized Balance Sheet

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash &amp; Invest.</td>
<td>Net Position</td>
</tr>
<tr>
<td>Capital Assets</td>
<td>LT Debt</td>
</tr>
<tr>
<td>Other Assets</td>
<td>Pensions</td>
</tr>
<tr>
<td></td>
<td>OPEB</td>
</tr>
<tr>
<td></td>
<td>Other Liabilities</td>
</tr>
</tbody>
</table>
State Variables

We include a rich set of state variables:

<table>
<thead>
<tr>
<th>Position</th>
<th>Variable</th>
<th>Variable Mean</th>
<th>Sample Mean</th>
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<td>$\Delta d_t$</td>
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<tr>
<td>12</td>
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<td>$cs_0$</td>
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</table>
Real Yields
Cross-Sectional Asset Pricing

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

\[ \Delta \log w_{t+1} = w_0 + \beta' z_{t+1} + U' \eta_{t+1} \]  

(4)

The Euler equation for the price dividend is given by:

\[ PD^w_t(h + 1) = \mathbb{E}_t \left[ M_{t+1} PD_{t+1}(h) \frac{W_{t+1}}{W_t} \right] \]  

(5)

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

\[ PD^w_t = \sum_{h=0}^{\infty} \exp(A^w(h + 1) + B^w(h + 1)' z_t) \]  

(6)

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