O’Neill School of Public and Environmental Affairs

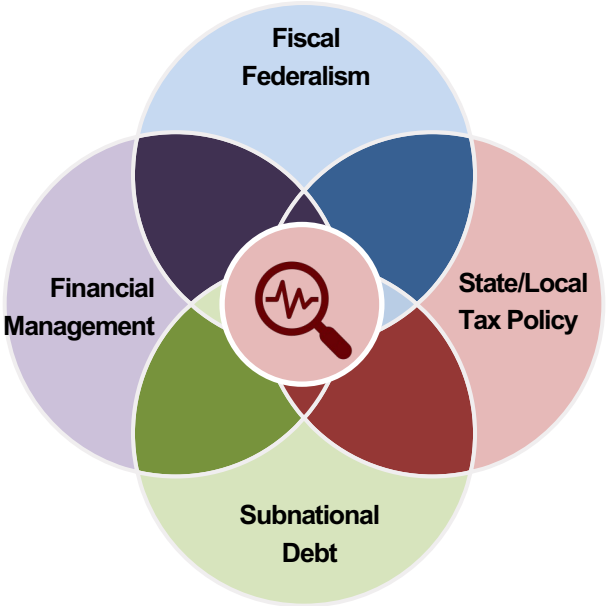
Cash Reserves and Short-Term Debt Under Liquidity Constraints

Luis Navarro

Job Market Talk
November 2024

INDIANA UNIVERSITY BLOOMINGTON

Introduction – Luis Navarro



Research Work

In Progress

- **Navarro, Luis** (2024). ***Cash Reserves*** *and* ***Short-Term Borrowing*** *under* ***Liquidity Constraints****.*
- **Navarro, Luis** (2024). ***Federal Assistance and Municipal Borrowing****: Unpacking the effects of the* ***CARES Act*** *on Government Liquidity Management. -* ***Curro Award, Best Graduate Student Paper, ABFM 2024***
- Navarro, Luis (2024). *Preferences for* ***Local Public Goods*** *and the* ***Gig Economy***

Published, Under Review

- Johnson, Craig L., **Luis Navarro**, & Andrey Yushkov (2023). *The* ***fiscal structure of county governments*** *from 2002 to 2019: the impact of the Great Recession and the run-up to the COVID-19*
- Johnson, Craig L., Andrey Yushkov & **Luis Navarro** (2023). *The* ***structure of county government debt*** *from 2002 to 2020: the financial crisis, the Great Recession, and the COVID-19 pandemic*
- Lozano-Rojas, Felipe & **Luis Navarro** (2024) ***Liquidity and Volatility in the Municipal Bond Market****: Evidence from the Municipal Liquidity Facility and other early interventions*
- Duncan, Denvil, **Luis Navarro** & Shellye Suttles (2024) *Automatic Nutritional Stabilizers and the Role of the* ***Charitable Food Assistance during Times of Crisis***

Today's Talk: Cash Reserves and Short-Term Borrowing

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Research Question

My Research Question: how does the level of cash reserves influences the reliance on short-term borrowing to cope with revenue/expenditure uncertainty?

Cash-flow management is daily task for households…

RESOURCES

Should you use credit, debit or cash for everyday purchases? We asked an expert

With their many perks and rewards, credit cards can be a financially sound decision for all your purchases — but don't totally rule out debit cards and cash just yet. Rod Griffin of Experian tells us why.

Updated Tue, Nov 14 2023

Elizabeth Gravier

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Getty Images

Source: CNBC https://www.cnbc.com/select/cash-debit-or-credit-for-everyday-purchases/

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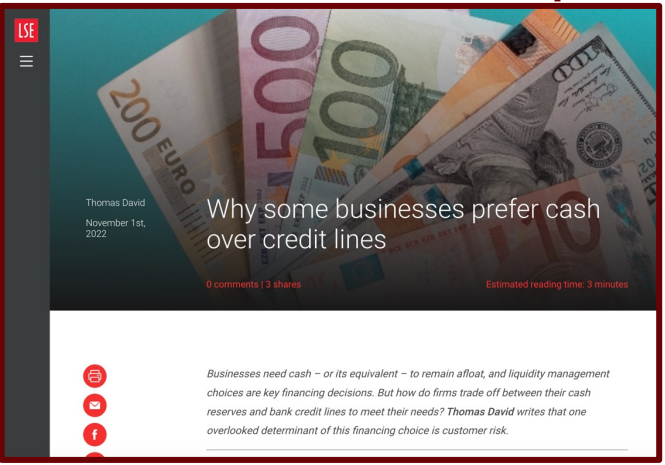
Household Cash Buffer Management from the Great Recession through COVID-19

July 2023

Source: JP Morgan Chase https://www.jpmorganchase.com/institute/all-topics/financial-health-wealth-creation/household-cash-buffer-management-from-the-great-recession-through-covid-19

… also for businesses, non-profits, …



Source: Blog LSE https://blogs.lse.ac.uk/businessreview/2022/11/01/why-some-businesses-prefer-cash-over-credit-lines/

Source: https://www.kff.org/health-costs/issue-brief/most-nonprofit-hospitals-and-health-systems-analyzed-had-adequate-or-strong-days-of-cash-on-hand-in-2022-though-about-one-in-ten-did-not/

… and for state and local governments!

Silver Falls School Board approves taking out short-term loan to avoid running out of cash

Friday, April 12th, 2024

Source: https://schoolboardspotlight.org/silver-falls-school-board-approves-taking-out-short-term-loan-to-avoid-running-out-of-cash/

Roles of Cash and Liquidity Constraints

Dual role of cash: operational and precautionary (Kling, 2018)

- **Operational:** finance expenses.
- **Precautionary:** signal solvency to lenders (banks, investors) .

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Key concept for this talk

- **Liquidity** = level of cash reserves.
- **Liquidity constrained** = low levels of cash reserves.
- **Stringent constraints =** lower levels of liquidity or cash.

Example: State of Indiana (Financial Indicators, FY 2023)

	FY 2023 (millions of USD)
Statement of Activities	
Total Revenues	$52,075
Total Expenditures	$47,599
Fiscal Balance	$4,476
Statement of Net Position	
Total Assets	$ 45,752
Cash and Equivalents	*$16,750*
Total Liabilities	$ 20,187
Short-Term Liabilities (< 1 year)	*$8,905*

Source: Annual Comprehensive Financial Report for the State of Indiana 2023.

Example: State of Indiana (Financial Indicators, FY 2023)

	FY 2023 (millions of USD)	Example: Revenue Shock -10 billion
Statement of Activities		
Total Revenues	$52,075	**$42,075**
Total Expenditures	$47,599	$47,599
Fiscal Balance	$4,476	**-$5,524**
Statement of Net Position		
Total Assets	$ 45,752	
Cash and Equivalents	*$16,750*	***A***
Total Liabilities	$ 20,187	
Short-Term Liabilities (< 1 year)	*$8,905*	***B***

Source: Annual Comprehensive Financial Report for the State of Indiana 2023.

- Suppose the state of Indiana experiences a revenue shock of $10 billion.
- **A)** How much **cash** should they save/use?
- **B)** How much **debt** should they issue?

Theory: Economic Model of Government Liquidity Management

Without liquidity constraints

- **Model:** Cash only has an operational role.
- **Result: Cash and debt behave like substitutes.**
- **Link with the literature:** Pecking order theory (Jensen, 1986; Myers, 1984).

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- **Result: Cash and debt behave like substitutes.**
- **Link with the literature:** Pecking order theory (Jensen, 1986; Myers, 1984).
- **Intuition:** debt carries interest and requires opening the books to lenders.
- **Implication:** Upon a **cash windfall**, governments will **reduce** their reliance on **debt.**

Theory: Economic Model of Government Liquidity Management

With liquidity constraints

- **Model:** Cash has an operational and a precautionary (solvency signaling) role.
- **Result: Cash and debt might behave like complements!**
- **Link with the literature:** Hold cash to maintain creditworthiness (Marlowe, 2011).

Theory: Economic Model of Government Liquidity Management

With liquidity constraints

- **Model:** Cash has an operational and a precautionary (solvency signaling) role.
- **Result: Cash and debt might behave like complements!**
- **Link with the literature:** Hold cash to maintain creditworthiness (Marlowe, 2011).
- **Intuition:** when cash reserves are low, governments might use debt and not deplete the reserves.
- **Implication:** Upon a **cash windfall**, governments will **increase** their reliance on **debt.**

Theoretical Question of this Paper

How does the level of cash reserves shape the **complementarity**/**substitutability** of **cash and debt** for liquidity management?

Reduced Form Model of Interest

$$ShortTermDebt_{it} = \boldsymbol{\delta} CashReserves_{it} + \beta X_{it} + a_i + b_t + \epsilon_{it}$$

- Let i represent a government (states), and t time (quarter).
- $\boldsymbol{\delta < 0} \rightarrow$ cash and debt behave like **substitutes.**
- $\boldsymbol{\delta > 0} \rightarrow$ cash and debt behave like **complements.**

Intuition of Research Design

	FY 2023 (millions of USD)	Example: Revenue Shock -10 billion
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Source: Annual Comprehensive Financial Report for the State of Indiana 2023.

- **Regression Model:** Effect of A on B.
- **Problem:** these are simultaneously determined. Endogeneity.

Reduced Form Model of Interest

$$ShortTermDebt_{it} = \boldsymbol{\delta} CashReserves_{it} + \beta X_{it} + a_i + b_t + \epsilon_{it}$$

- OLS estimation of $\boldsymbol{\delta}$ is likely biased due to endogeneity between cash and debt.
- ⬆️ State Economic Activity → ⬆️ Own-Source Revenues→ ⬆️ Cash Holdings ⬇️ ST debt.
- **Implication:** endogeneity bias is likely **negative**. OLS could **underestimate** $\boldsymbol{\delta}$.

Empirical Setting

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Why Mexico ?

- Liquidity constrained and limited options aside from cutting services, borrowing, spending down cash.
- Federal-to-State discretionary grants have a random component mimicking idealized lottery.

Why Mexico? Liquidity Constrained Governments

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Low fiscal flexibility: i) 90% of revenues come from federal grants, ii) 90% of expenditures cover current spending and transfers to local governments, iii) persistent fiscal deficits: -3.5% of total revenues (avg, 2000-2022).

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Short-Term (ST) Debt Fiscal Rules: bank loans i) only for cash-flow management, ii) unsecured, iii) debt ceiling: 6% of total revenues; iv) ST debt = 0 at the end of the administration.

Policy Description: General Participations Fund (FGP)

- **Fiscal Federalism in Mexico:** shared-revenue system with centralized tax collection.
- States have spending discretion (in average) on 50% of their revenues: 40% discretionary grants + 10% own-source revenues.
- **General Participations Fund (FGP):** main discretionary grant/fund→ 75% of total discretionary revenues, 30% of total revenues.

FGP and Revenue Shocks

1. Before the FY begins, federal government estimates size of state grants, along with a monthly disbursement calendar. States have no say on this calendar.

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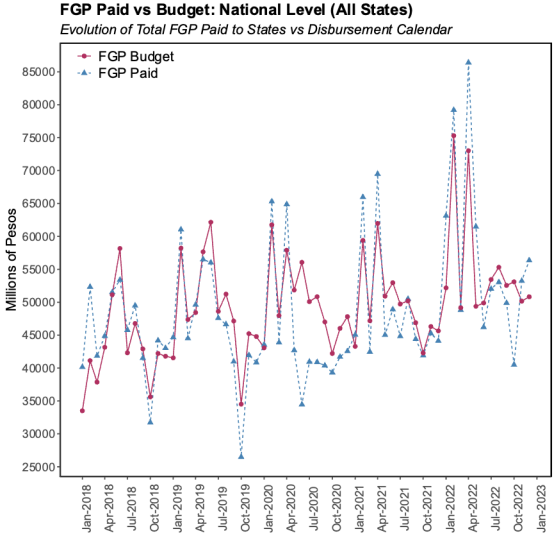
2. Actual disbursements depend on the observed level of centralized tax collection.

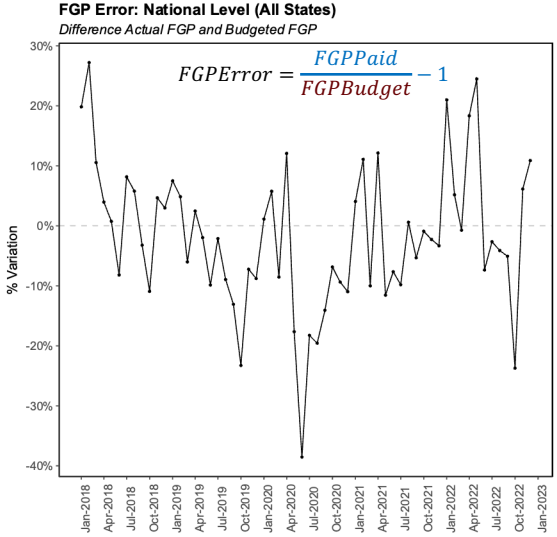
3. Each month states could observe deviations from their budgeted transfers.

4. **Key:** direction and magnitude of these deviations mimics a lottery. For some states, deviations could be positive/negative, regardless of the difference observed at the national level.

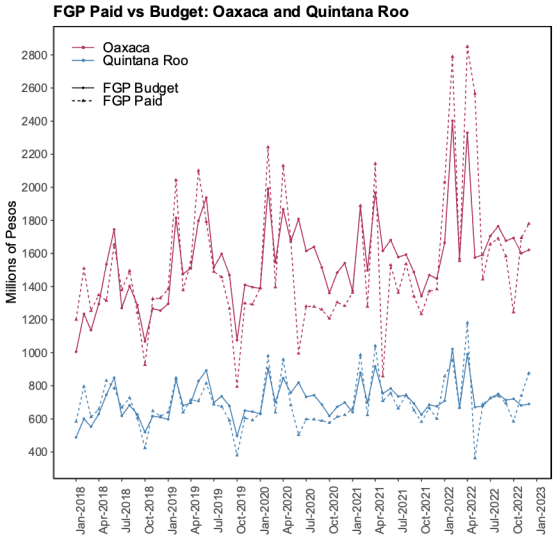
General Participations Fund (FGP) Error

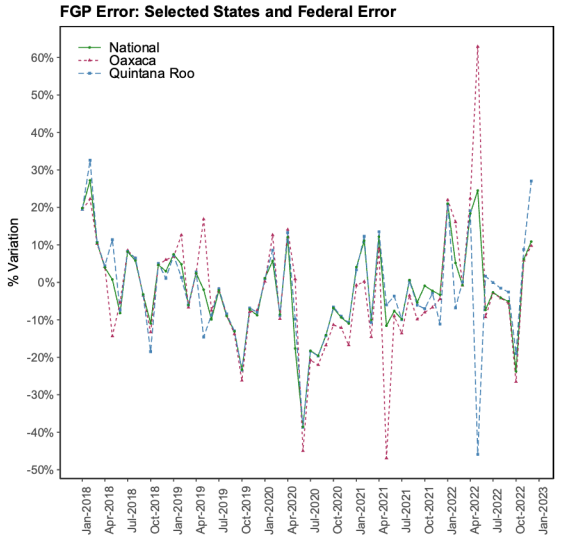
FGP Error: Difference between **budgeted** and **actual** FGP transfers within the same FY



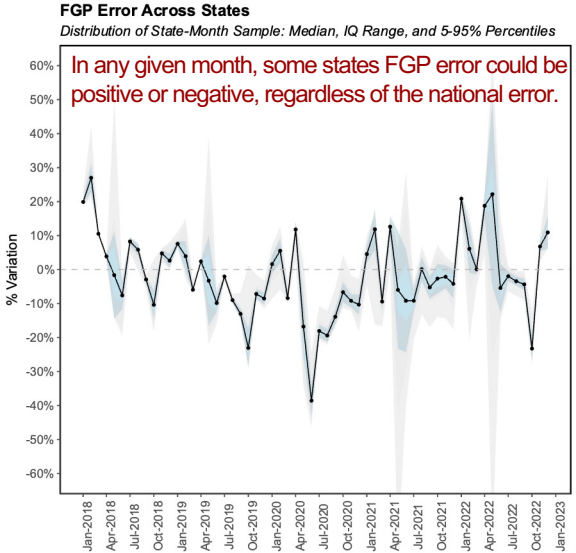


Across states there is variation between budgeted and actual FGP transfers.



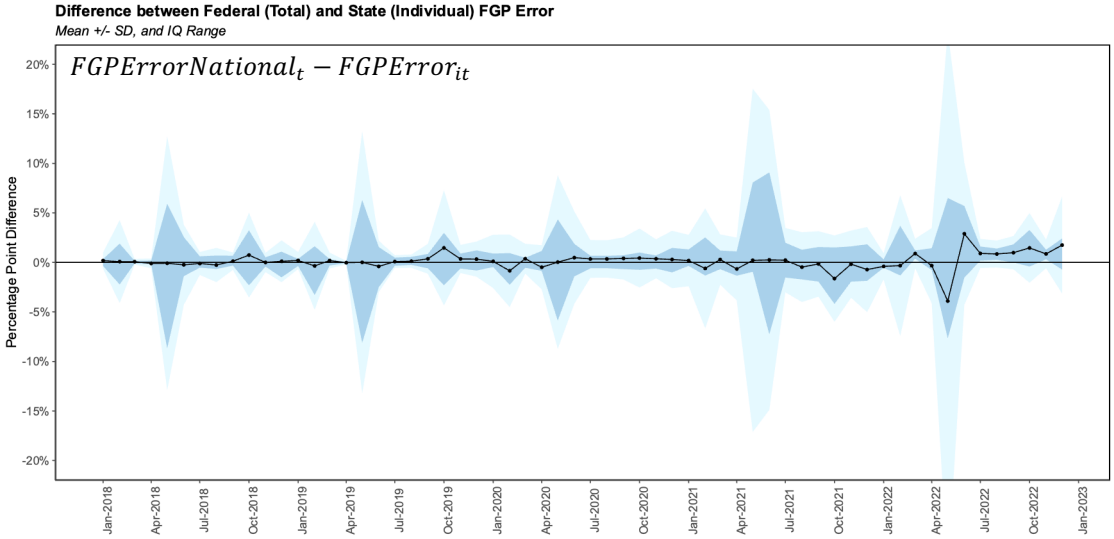


FGP Error Distribution Over Time, 2018-2022



Notes: The panel on the left shows the distribution of the FGP timing error across time. The panel on the right shows the distribution of the residuals from running a linear model of FGP errors regressed on month-by-year and state fixed effects. The solid line represents the mean across states by month-year. The dark-shaded area shows the percentiles between 25%-75%, as well as the area within one standard deviation form the mean.

Differences between national FGP error and states' FGP errors are not systematic.

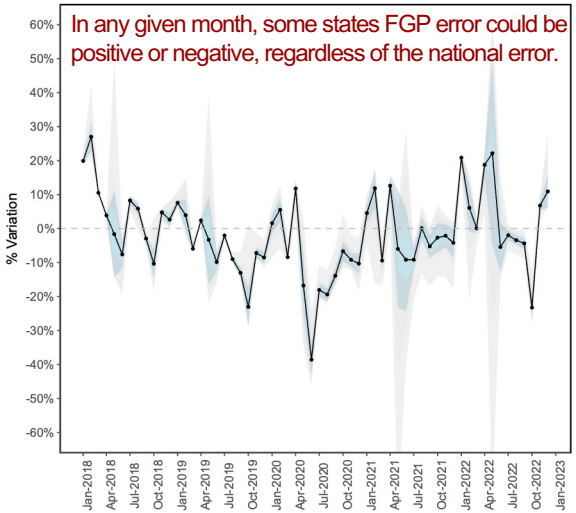


Notes: This graph shows the distribution of the difference between the FGP error in the federal budget and the FGP error observed by states. The solid line represents the mean across states by month-year. The dark-shaded area shows the percentiles between 25%-75%. The light shaded area is within one standard deviation form the mean.

FGP Error Distribution Over Time, 2018-2022

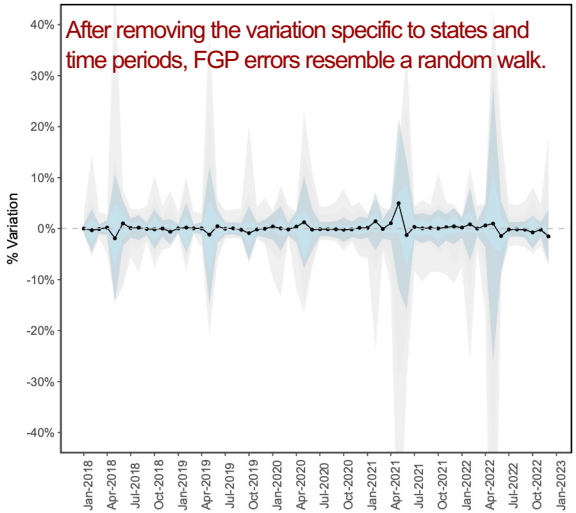
FGP Error Across States

Distribution of State-Month Sample: Median, IQ Range, and 5-95% Percentiles



Unexplained Variation in FGP Error by FE

Distribution of Residuals from Regression of FGP Errors on state and time FE



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Research Design

IV Design: Fixed-Effects 2SLS Estimator + Robust-Clustered Standard Errors (State Level)

First Stage:

$$CashReserves_{it} = \beta FGPError_{it} + \alpha X_{it} + a_i + b_t + \epsilon_{it}$$

Second Stage:

$$OutShortTermDebt_{it} = \delta \widehat{CashReserves_{it}} + \alpha X_{it} + a_i + b_t + \upsilon_{it}$$

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Variable Scaling and Coefficient Interpretation

- Variables measured as stocks. Outstanding short-term debt and cash-holdings at end-of-Q.
- Dependent, endogenous, and instrumental variables expressed as % of average level of DR (2009-2016). State by quarter strongly balanced panel.

Data

- **Financial Variables (Cash and Debt):** **text-scraped** from state-reported forms submitted to the Ministry of Finance.

- **Fiscal Variables (Revenues, Expenditures):** annual survey of state and local government finances. State-by-year.

Note: Tlaxcala and Mexico City are excluded from the analysis as they are subject to different fiscal rules.

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- **Credit Ratings: web-scraped** from Fitch Ratings website.
- **Control Variables:** National Statistics Agency (INEGI) surveys and IRS data.

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- **Credit Ratings:** **web-scraped** from Fitch Ratings website.
- **Control Variables:** National Statistics Agency (INEGI) surveys and IRS data.
- **Final Sample:** quarterly observations for 30 states between 2018-2022.

Note: Tlaxcala and Mexico City are excluded from the analysis as they are subject to different fiscal rules.

Main Variables

Descriptive Stats	Mean	Std.Dev.
DepVar: Short-Term Debt (% DR)	0.0519	0.0635
EndVar: Cash Reserves (% DR)	0.2289	0.1548
InstVar: FGP Error (% DR)	-0.0043	0.0235
FGP Annual Difference (%DR, Lag = 1yr)	-0.0130	0.0655
Primary Balance (% Rev, Lag = 1yr)	-0.0623	0.1261
Current Expenditures (% Exp, Lag = 1 yr)	0.7375	0.0600
Discretionary Revenues (% Rev, Lag = 1yr)	0.4766	0.0781
Long Term Debt (% Debt, Lag = 1yr)	0.6726	0.5133
Credit Rating	3.1273	1.0700
FGP as Collateral (%)	0.5332	0.2163
Unemployment Rate	0.0346	0.0129
Taxpayers (% Population)	0.5574	0.1015
Age < 18 (% Population)	0.0584	0.0040
Age 19-35 (% Population)	0.0438	0.0022
Age 36-65 (% Population)	0.0847	0.0047

Controls

liquidity needs

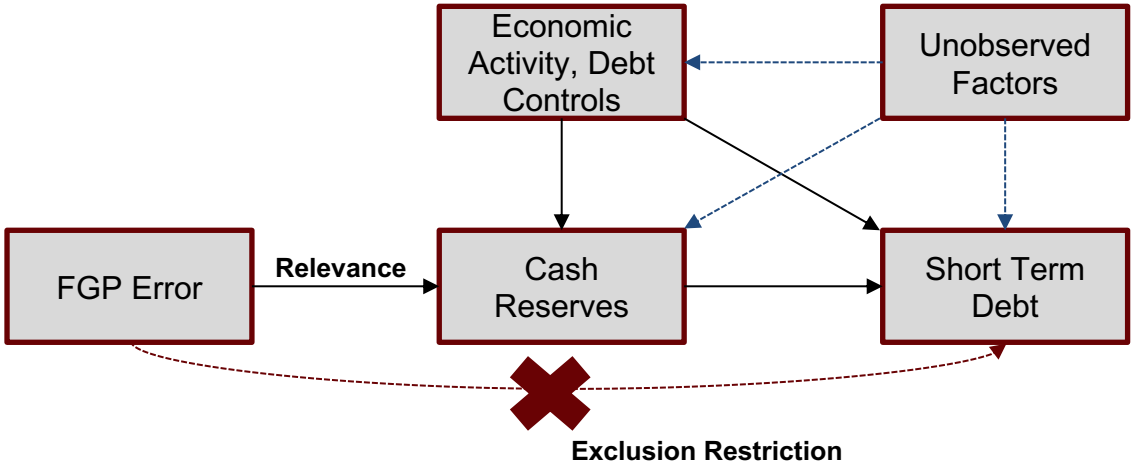
fiscal structure

debt burden

economic activity

Notes: This panel shows the descriptive statistics of the main variables used for the analysis. N= 597 for all variables. The first two columns show the sample mean and standard deviation. Considering the distribution of ratings I grouped them in 3 categories AAA,AA = 1, A = 2, and BBB,BB,NR = 3. Short-Term borrowing, cash reserves, FGP budget error, and fiscal balance measures are expressed as a percentage of the average discretionary revenues (DR) observed between 2009 and 2016. That is, outside the analysis period to avoid endogeneity concerns. All these fiscal variables correspond to one-year lagged measures.

Identification Assumptions

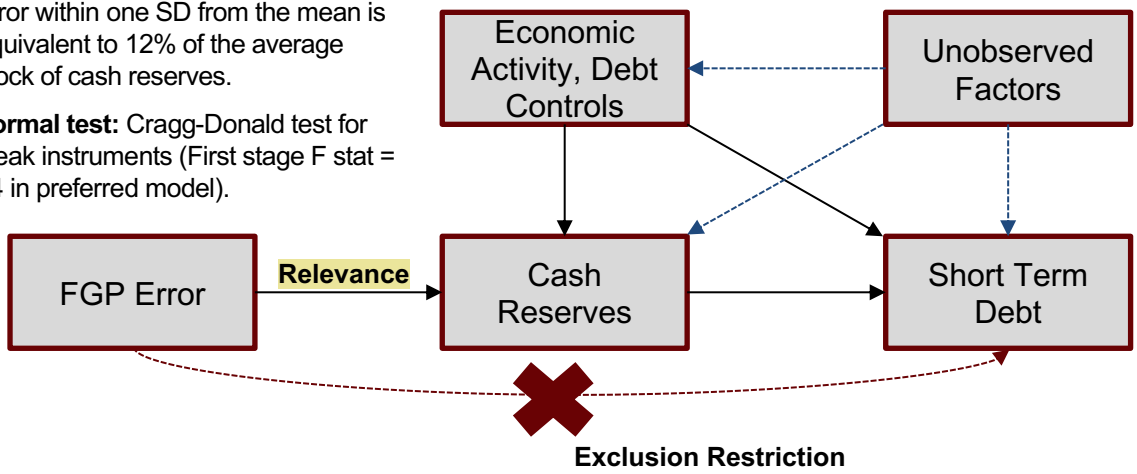


Identification Assumptions

Relevance Assumption

Descriptive Stats: observing a FGP error within one SD from the mean is equivalent to 12% of the average stock of cash reserves.

Formal test: Cragg-Donald test for weak instruments (First stage F stat = 24 in preferred model).



Identification: Exclusion Restriction

FGP Errors only influence short-term debt through cash reserves

- FGP annual shares had been historically stable. Determined mainly by population.
- Tax collection done by the federal government with no intervention of the states.
- Monthly calendar is determined by the federal government with no clear rules.
- No systematic pass-through of national FGP error to states FGP error.

IV Validity: FGP Errors do not predict state economic activity.

Exclusion Restriction: FGP errors only influence short-term debt via cash-reserves.

Table: Instrument Validity: Effect of FGP Errors on Local Economic Activity

Dependent Variable	(1)	(2)
Unemployment Rate	0.031	0.006
	(0.023)	(0.024)
Active Taxpayers (% Population)	-0.024	0.000
	(0.041)	(0.031)
Industrial Activity Index	-0.024	0.000
	(0.041)	(0.031)
Quarterly Economic Activity Index	0.140	0.133
	(0.237)	(0.199)
Informal Labor (% Population)	0.006	0.005
	(0.022)	(0.018)
Num.Obs.	597	597
Controls	No	Yes
State FE	Yes	Yes
Time FE	Yes	Yes

Notes: These panels show the results from estimating Equation 9 across different subsets of the data set. In this case, with observations from each quarter of the calendar year. All coefficients correspond to the 2SLS specification with controls, state and quarter-by-year fixed effects. All the dependent, independent, and instrumental variables are expressed as a percentage of each state's average discretionary revenues (DR) from 2009-2016. Time FE = Quarter-Year FE. Standard errors clustered by state. Significance level: +p < 0.10, *p < 0.05 , ** p < 0.01 , *** p < 0.001

Results

Table: Effects of Cash Reserves on Short-Term Debt

	(1)	(2)	(3)	(4)
Panel A: OLS Estimates				
Cash Reserves (% DR) $\delta\hat{}$	-0.152***	-0.043	0.067*	0.093**
	(0.030)	(0.031)	(0.036)	(0.036)
Panel B: 2SLS IV Estimates				
Cash Reserves (% DR) $\delta\hat{}$	0.194	0.325	0.211*	0.246**
	(0.149)	(0.200)	(0.107)	(0.107)
First Stage: FGP Error $\beta\hat{}$	1.565**	1.131**	1.661***	1.467***
	(0.573)	(0.454)	(0.415)	(0.365)
Cragg-Donald F-Statistic	7.4171	6.9449	30.0677	24.2066
Short-Term Debt (Mean)	0.0519	0.0519	0.0519	0.0519
Short-Term Debt (SD)	0.0635	0.0635	0.0635	0.0635
Cash Reserves (SD)	0.1548	0.1548	0.1548	0.1548
Num.Obs.	597	597	597	597
Controls	No	Yes	No	Yes
State FE	No	No	Yes	Yes
Quarter-by-Year FE	Yes	Yes	Yes	Yes

Notes: Panel A shows the results of estimating Equation 7 with an OLS estimator across several specifications. Panel B displays the results from estimating Equation 9 with a 2SLS estimator using the timing error as instrument for cash reserves. All the dependent, independent, and instrumental variables are expressed as a percentage of each state's average discretionary revenues (DR) from 2009-2016. Time FE = Quarter-Year FE. Standard errors clustered by state. Significance level: *p < 0.10 , ** p < 0.05 , *** p < 0.01

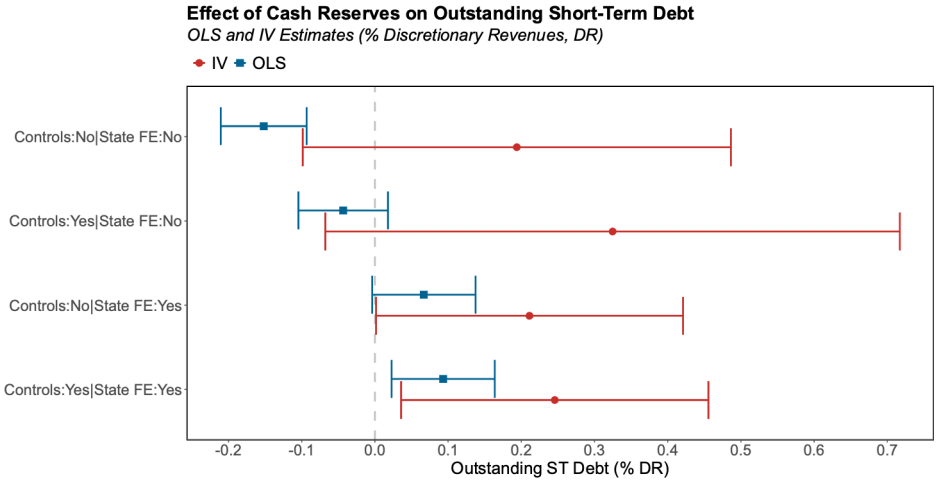
Results

If cash reserves ⬆ 1 SD_{cash} , then outstanding short-term debt:

IV : ⬆ 3.80% DR: **Eff Size:** 0.60 SD_{debt}

Implied Elasticity	First Stage F-Stat
0.47	7.41
0.79	6.95
0.51*	30.06
0.60**	**24.20**

Significance level: *p < 0.10 , ** p < 0.05 , *** p < 0.01



Mechanisms and Robustness Checks

Research Design: sample partition by specific strata (cash reserves quartiles, credit rating categories, quarter of the FY) and model estimation in independent samples.

Specification	⬆ in ST Debt for a 1 SD ⬆ in Cash Reserves	Implied Elasticity
Baseline	3.8% of DR	0.60**
Cash Reserves < Median	5.3% of DR	0.77*
Lower Rated Governments	8.3% of DR	1.33**
End-of-Year (Q4) Sample	6.7% of DR	0.85*

*Significance level: *p < 0.10 , ** p < 0.05 , *** p < 0.01*

More stringent liquidity constraints lead to stronger complementarity effects.

Relation with the Literature

- **Theoretical Extension:** This paper provides a model that shows the moderating role of cash reserves on the complementarity-substitutability of cash and debt.
- **New Empirical Evidence:** Contrasting evidence to literature on US local governments that find cash and debt are substitutes (Su and Hildreth 2018; Lofton and Kioko, 2021).

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Why I find cash and debt behave like complements?

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Why I find cash and debt behave like complements?

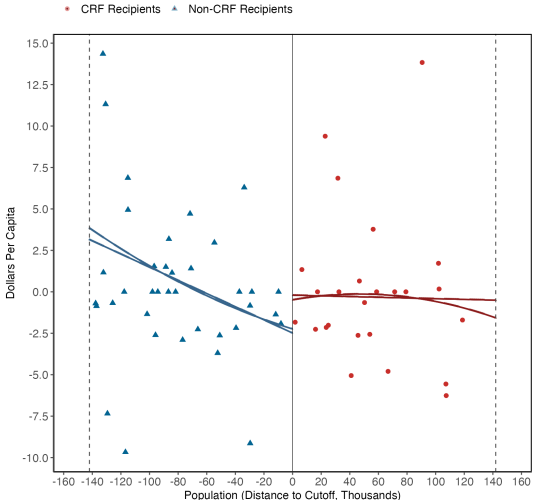
- **Institutional setting amplifies the stringency of liquidity constraints:** Fiscal rules limit ability to generate excess cash and use long-term debt for liquidity management.

Is this only present in developing or centralized economies like Mexico?

- **No!** In my second dissertation chapter I document **similar evidence for U.S. local governments during the pandemic.**

Federal Assistance and Municipal Borrowing (Chapter 2)

Primary Market Debt Issuance: ⬆️ $1.7- $5.0 per capita, 0.13-0.39 SD



Crow-in effects of federal aid on local borrowing: An ⬆️ in revenues (cash) led to an ⬆️ in per capita debt issuance.

Rationale: ⬇️ tax revenues + ⬆️ spending to cope with the crisis + ⬆️ uncertainty on the duration and magnitude of the pandemic = **more stringent liquidity constraints**.

Note: This figure shows the scatter binned plot of the dependent variables around the cutoff for treatment assignment. The gray dashed lines show the optimal bandwidth used for the estimation of the Local Average Treatment Effect. Both linear and quadratic estimations are reported.

Policy Implications and Conclusions

- Underline the relevance of liquidity management tools (e.g., rainy day funds) and access to debt markets for cash-flow management.

- Liquidity-constrained governments might prefer to manage cash-flows via short-term debt , even if they face a high interest rate. These governments might benefit from credit-enhancing policies/strategies (e.g., collateralized bonds, debt guarantees).

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- Liquidity-constrained governments might prefer to manage cash-flows via short-term debt , even if they face a high interest rate. These governments might benefit from credit-enhancing policies/strategies (e.g., collateralized bonds, debt guarantees).

- **Optimal level of cash reserves:** minimum required to avoid liquidity premiums on the bond market.

- **Lessons from institutional setting:** shared-revenue systems could lead to fiscal spillovers that translate into liquidity shocks for subnational governments.

Current Research Agenda

- **Fiscal federalism and financial management:** vertical and horizontal interactions of state/local governments and their implications in local tax policy and financial management strategies.

- **Local referendums, tax policies and the gig economy:** effects of local referendums (bond measures and property tax referendums) on the development of the gig economy, and its effects on economic outcomes related to public finance and education.

- **Financial markets and social equity:** borrowing costs premiums explained by sociodemographic characteristics. Assess the presence of discrimination in the municipal bond market. Unintended social equity consequence of financial market policies.

Future Research Agenda

- **Fiscal Federalism and Social equity:** unintended consequences of federal tax policy on state and local economic outcomes.

- **Fiscal Rules and Externalities:** tax competition and shared tax bases. Implications for local tax policy and governance.

Public finance + relevant policy areas:

- Disaster management and climate change. Muni bond climate premiums. Fiscal resilience and drivers of financial recovery after a disaster. Natural experiments for liquidity management research.
- Fiscal stress and quality of public goods and services. Implications for healthcare (hospitals), security (police budgets) and education (school districts).

Thanks for your attention!

Scan to learn more about my research.

Contact: Luis Navarro lunavarr@iu.edu

INDIANA UNIVERSITY BLOOMINGTON

Appendix

Theoretical Model

Theoretical Model: No Liquidity Constraints

Periods 1 and 2 partition the FY. The government chooses spending *(G)* across the FY and the amount of short-term debt *(D)* to issue to maximize social welfare. Cash reserves *(S)*, tax revenues *(T)* and the interest rate are exogeneous. *C(T)* measures the excess burden induced by taxation.

$$\max_{G_1,G_2,D} \alpha \ln(G_1) - \gamma C(T_1) + \beta[\alpha \ln(G_2) - \gamma C(T_2)]$$

$$s.t. \quad G_1 = \mathrm{T}_1 + \mathrm{S} + \mathrm{D}$$
$$G_2 = \mathrm{T}_2 - (1 + \mathrm{r})\mathrm{D}$$

$$\frac{\mathrm{dD}}{\mathrm{dS}} = -\frac{\beta}{1+\beta} < 0$$

- **Model:** Cash only has an operational role. **Result:** Cash and debt behave like substitutes.
- **Intuition:** cash can only be used to finance spending (operational role). Government minimizes borrowing costs by choosing lowest level of D possible.

Theoretical Model: With Liquidity Constraints

Suppose risk-averse lenders that charge an interest rate depending on cash savings. Let θ be the proportion of cash spent to manage cash flows.

$$\max_{G_1,G_2,D} \alpha \ln(G_1) - \gamma C(T_1) + \beta[\alpha \ln(G_2) - \gamma C(T_2)]$$

$$s.t. \quad G_1 = \mathrm{T}_1 + \theta \mathrm{S} + \mathrm{D}$$
$$G_2 = \mathrm{T}_2 - (1 + \mathrm{r}((1-\theta)\mathrm{S})\mathrm{D}$$

$$\frac{\mathrm{dD}}{\mathrm{dS}} = -\frac{\beta}{1+\beta}\left[\frac{r' T_2 (1-\theta)}{\beta(1+r)^2} + \theta\right]$$

- **Model:** Cash has an operational and signaling role. **Result:** Cash and debt could behave like complements.
- **Intuition:** since cash signal solvency to lenders, it leads to a liquidity constraint that represents the inflection point between the complementarity/substitutability of cash and debt.

Theoretical Model: With Liquidity Constraints

If $\theta = 1$, states spend all cash reserves. Cash only has an operational role. Then, cash and debt behave like substitutes.

$$\frac{\mathrm{dD}}{\mathrm{dS}} = -\frac{\beta}{1+\beta}\left[\frac{r'T_2(1-\theta)}{\beta(1+r)^2} + \theta\right] \qquad \theta = 1 \rightarrow \frac{\mathrm{dD}}{\mathrm{dS}} = -\frac{\beta}{1+\beta} < 0$$

If $\theta = 0$, states save all cash reserves. Cash only has a signaling role. Then, cash and debt behave like complements.

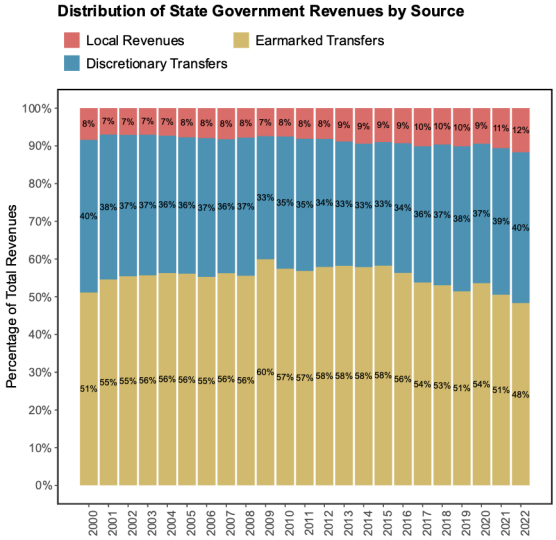
$$\theta = 0 \rightarrow \frac{\mathrm{dD}}{\mathrm{dS}} = -\frac{1}{1+\beta}\left[\frac{r'T_2}{(1+r)^2}\right] > 0$$

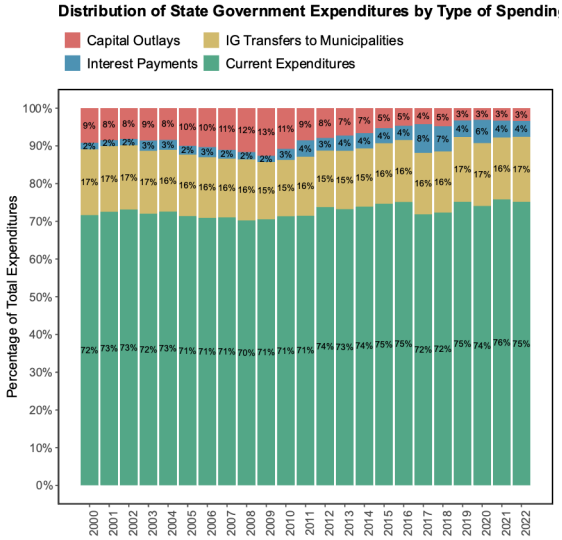
Liquidity constraint: minimum level of cash required to avoid liquidity premiums on the bond market.

$$1-\theta < \frac{1}{1-\delta} \qquad \delta = \frac{r'T_2}{\beta(1+r)^2}$$

Instrument Validity

Revenue and Expenditure Structure of State Governments



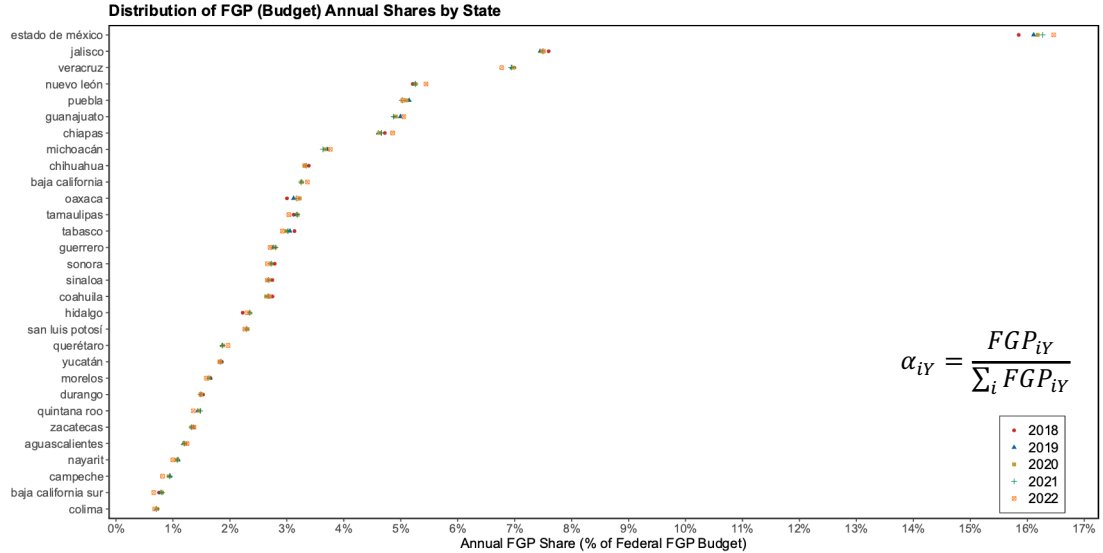


Notes: The panel on the left shows the distribution of revenues by source. Earmarked transfers (Aportaciones) include funds to finance education payroll (FONE) and infrastructure development (FAM, FAETA), health care (FASSA), social development and welfare programs (FAIS), security and policing (FASP). Discretionary transfers (Participaciones) include FGP transfers. **Source: INEGI.**

FGP Error: Conceptual Framework

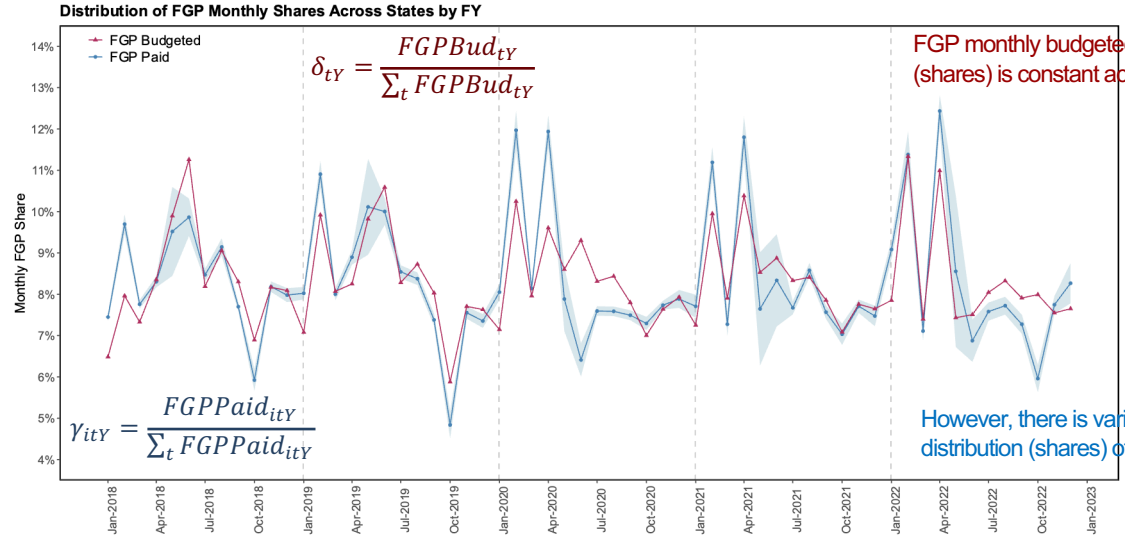
- Let g_{it} be actual FGP transfers and b_{it} be budgeted ones. Then, $FGPError_{it} = g_{it} - b_{it}$
- Let b_i be annual allocation of the FGP to state i, and B be the annual national budget for the FGP.
- Denote α_i as the proportion of national budget B received by state i. Hence, $b_i = \alpha_i B$.
- Denote δ_t as the proportion of annual allocation b_i scheduled for month t. Hence, $b_{it} = \alpha_i \delta_t B$.
- For budgeting purposes, the federal government assumes the same δ_t for all states i
- However, actual FGP transfers g_{it} show variation by state and month. Hence, $g_{it} = \alpha_i \gamma_{it} G$.
- Arguably, $\gamma_{it} = \delta_t + \upsilon_{it}$ where υ_{it} is an unobserved factor.
- Then we can write: $FGPError_{it} = \alpha_i[\delta_t(G - B) + \upsilon_{it} G]$

Annual FGP Shares had been stable over time. Mainly determined by population.



Notes: The panel on the left shows the annual shares of the FGP by state.

Monthly FGP Shares across FYs



$$\delta_{tY} = \frac{FGPBud_{tY}}{\sum_t FGPBud_{tY}}$$

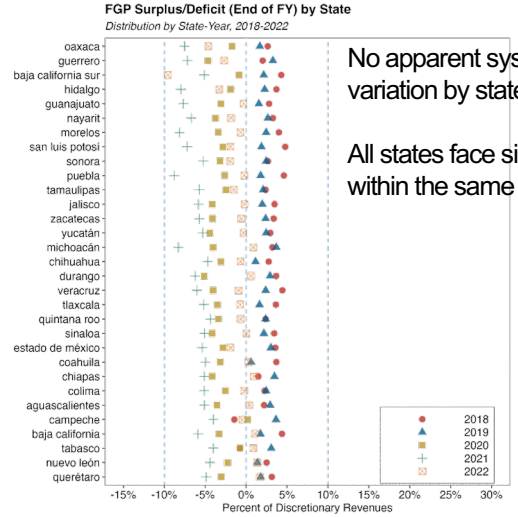
$$\gamma_{itY} = \frac{FGPPaid_{itY}}{\sum_t FGPPaid_{itY}}$$

FGP monthly budgeted distribution (shares) is constant across states.

However, there is variation in the distribution (shares) of actual transfers.

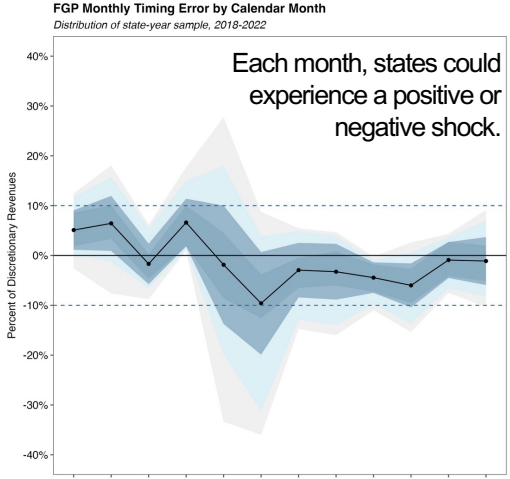
Notes: This panel compares the monthly shares of the FGP, within the FY. From the right panel it stands out that there is no variation on the monthly budgeted shares across states. However, the actual shares (implied by the actual transfers) differ from the budgeted ones, showing variation across states. Shaded area shows the interval within 1 SD from the mean.

FGP Error Distribution Over Time



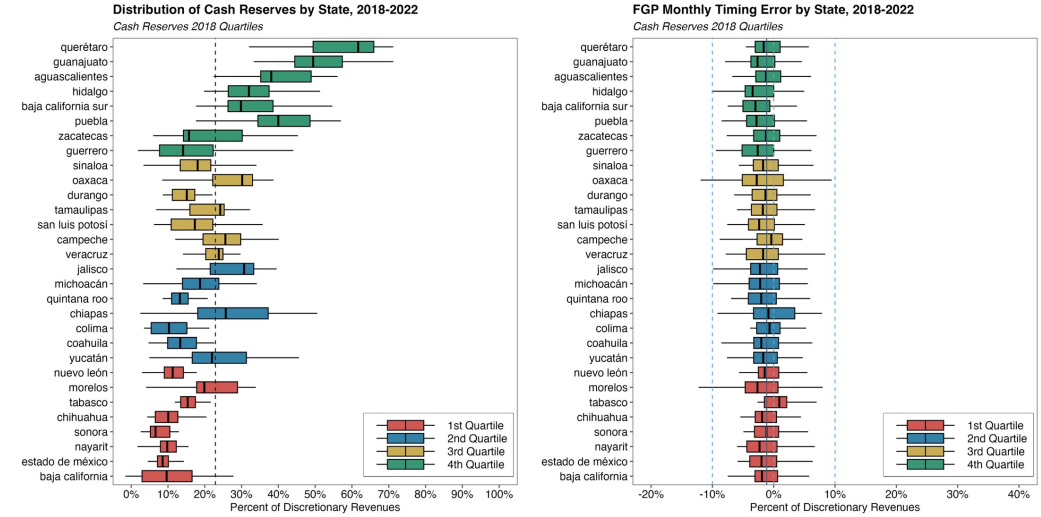
No apparent systematic variation by states.

All states face similar shocks within the same fiscal year.



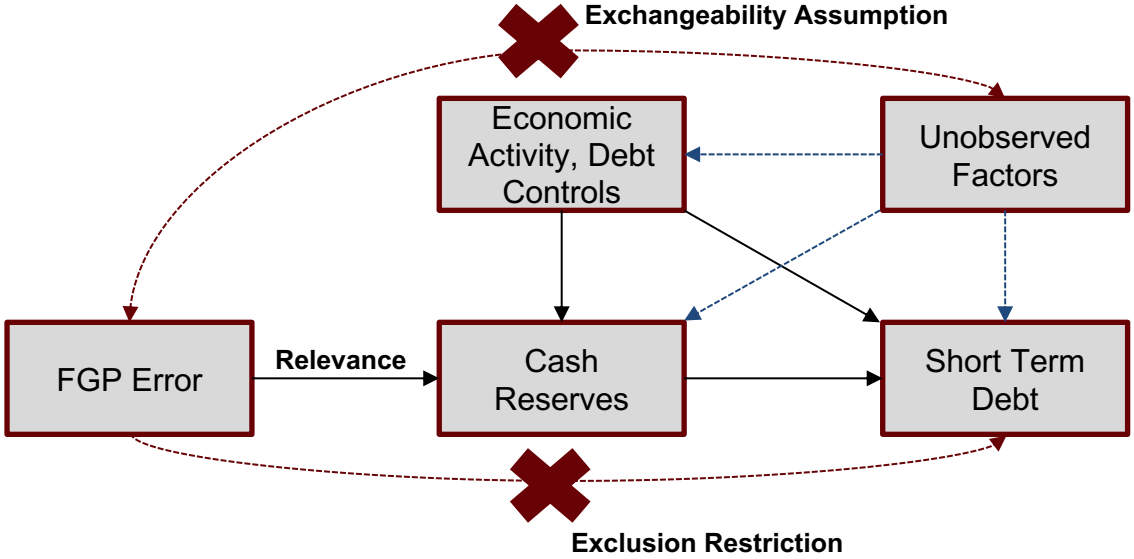
Notes: The panel on the left shows the distribution of the FGP timing error across time. The solid line represents the mean across states by month-year. The dark-shaded area shows the percentiles between 25%-75%, as well as the area within one standard deviation form the mean, while the light-shaded areas percentiles 1% to 99% (excluding outliers) and 5%-95%. The panel on the right shows the end-of-year cumulative difference between the FGP paid and FGP budgeted across years, expressed as percentage of discretionary revenues. The solid vertical line shows the sample mean. For illustrative purposes, dashed blue lines show the interval between +/- 10% of discretionary revenues.

FGP errors do not seem to vary with the level of cash reserves.



Notes: Both panels shows the distribution of cash reserves (left) and FGP errors (right) by state across quarter-years. Each boxplot depicts the distribution by state, excluding outlier observations. States are partitioned into groups depending on quartiles of the distribution of cash reserves in FY 2018. Variables expressed as percent of discretionary revenues. For illustrative purposes, dashed blue lines on the left panel show the interval between +/- 10% of discretionary revenues.

Identification Assumptions



Results

Table: First Stage Regression Results

	(1)	(2)	(3)	(4)
First Stage: FGP Error $\hat{\beta}$	1.565**	1.131**	1.661***	1.467***
	(0.573)	(0.454)	(0.415)	(0.365)
Cragg-Donald F-Statistic	7.4171	6.9449	30.0677	24.2066
Short-Term Debt (Mean)	0.0519	0.0519	0.0519	0.0519
Short-Term Debt (SD)	0.0635	0.0635	0.0635	0.0635
Cash Reserves (SD)	0.1548	0.1548	0.1548	0.1548
Num.Obs.	597	597	597	597
Controls	No	Yes	No	Yes
State FE	No	No	Yes	Yes
Quarter-by-Year FE	Yes	Yes	Yes	Yes

Notes: Panel A shows the results of estimating Equation 7 with an OLS estimator across several specifications. Panel B displays the results from estimating Equation 9 with a 2SLS estimator using the timing error as instrument for cash reserves. All the dependent, independent, and instrumental variables are expressed as a percentage of each state's average discretionary revenues (DR) from 2009-2016. Time FE = Quarter-Year FE. Standard errors clustered by state. Significance level: *p < 0.10 , ** p < 0.05 , *** p < 0.01

Exclusion Restriction Check: FGP errors and State Economic Activity

Table: Instrument Validity: Effect of FGP Errors on Local Economic Activity

Dependent Variable	(1)	(2)	(3)	(4)
Unemployment Rate	0.084	0.044	0.031	0.006
	(0.076)	(0.036)	(0.023)	(0.024)
Active Taxpayers (% Population)	0.067	0.158	-0.024	0.000
	(0.460)	(0.226)	(0.041)	(0.031)
Industrial Activity Index	0.067	0.158	-0.024	0.000
	(0.460)	(0.226)	(0.041)	(0.031)
Quarterly Economic Activity Index	0.475**	0.381**	0.140	0.133
	(0.178)	(0.169)	(0.237)	(0.199)
Informal Labor (% Population)	-0.063	0.002	0.006	0.005
	(0.048)	(0.040)	(0.022)	(0.018)
Num.Obs.	597	597	597	597
Controls	No	Yes	No	Yes
State FE	No	No	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Notes: These panels show the results from estimating Equation 9 across different subsets of the data set. In this case, with observations from each quarter of the calendar year. All coefficients correspond to the 2SLS specification with controls, state and quarter-by-year fixed effects. All the dependent, independent, and instrumental variables are expressed as a percentage of each state's average discretionary revenues (DR) from 2009-2016. Time FE = Quarter-Year FE. Standard errors clustered by state. Significance level: *p < 0.10 , ** p < 0.05 , *** p < 0.01

Exchangeability Assumption: State Economic Activity and FGP Errors

Table: Instrument Validity: State Economic Activity Predicting FGP Errors
(Dep Var: FGP Errors)

Independent Variable	(1)	(2)	(3)	(4)
Unemployment Rate	0.068	0.059	0.087	0.019
	(0.045)	(0.046)	(0.060)	(0.072)
Active Taxpayers (% Population)	0.001	0.004	-0.044	0.000
	(0.005)	(0.006)	(0.069)	(0.072)
Industrial Activity Index	0.001	0.004	-0.044	0.000
	(0.005)	(0.006)	(0.009)	(0.072)
Quarterly Economic Activity Index	0.020*	0.018*	0.009	0.009
	(0.010)	(0.010)	(0.018)	(0.013)
Informal Labor (% Population)	-0.036	0.002	0.013	0.010
	(0.029)	(0.033)	(0.047)	(0.036)
Num.Obs.	597	597	597	597
Controls	No	Yes	No	Yes
State FE	No	No	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Notes: These panels show the results from estimating Equation 9 across different subsets of the data set. In this case, with observations from each quarter of the calendar year. All coefficients correspond to the 2SLS specification with controls, state and quarter-by-year fixed effects. All the dependent, independent, and instrumental variables are expressed as a percentage of each state's average discretionary revenues (DR) from 2009-2016. Time FE = Quarter-Year FE. Standard errors clustered by state. Significance level: *p < 0.10 , ** p < 0.05 , *** p < 0.01

Alternative IV: Effects of Cash Reserves on Short-Term Debt

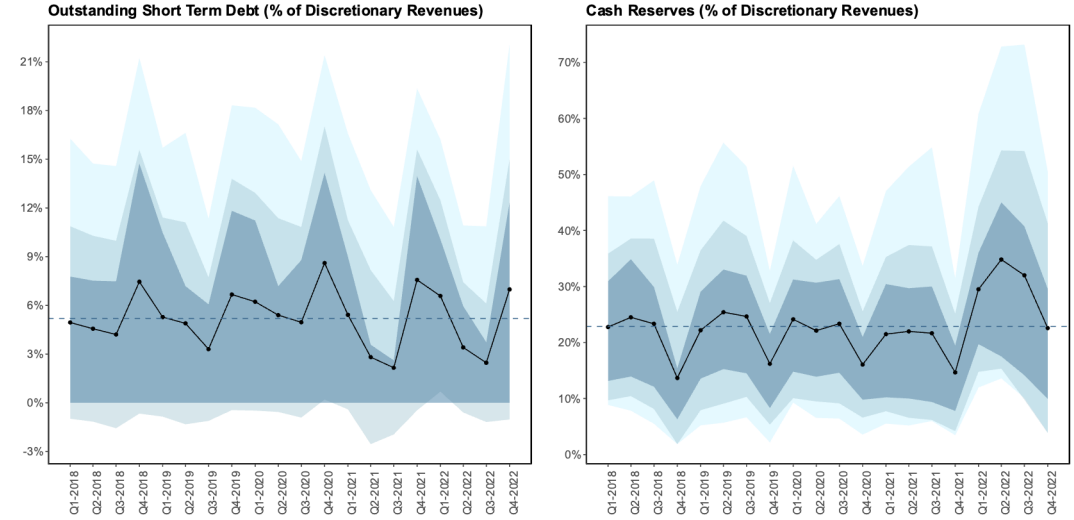
IV: Discretionary Revenues Timing Error				
Cash Reserves (% DR) $\delta\hat{}$	-0.040	0.048	0.002	0.037
	(0.116)	(0.111)	(0.072)	(0.087)
First Stage: Timing Error $\beta\hat{}$	1.282**	0.837**	0.968***	0.829***
	(0.456)	(0.267)	(0.240)	(0.211)
Cragg-Donald F-Statistic	21.5163	15.9941	38.1511	28.4921
IV: Earmarked Revenues Timing Error				
Cash Reserves (% DR) $\delta\hat{}$	0.150	0.433	0.434	0.435
	(1.604)	(0.660)	(0.332)	(0.345)
First Stage: Timing Error $\beta\hat{}$	-0.163	-0.287	-0.303	-0.301
	(0.374)	(0.254)	(0.206)	(0.237)
Cragg-Donald F-Statistic	0.2911	1.5095	3.0999	3.3204
IV: IG Transfers Timing Error				
Cash Reserves (% DR) $\delta\hat{}$	-0.064	-0.103	-0.163	-0.163
	(0.259)	(0.340)	(0.273)	(0.351)
First Stage: Timing Error $\beta\hat{}$	0.576+	0.317	0.373+	0.287
	(0.316)	(0.228)	(0.197)	(0.189)
Cragg-Donald F-Statistic	8.41	4.2607	10.149	6.3185
Mean Dep Var	0.0519	0.0519	0.0519	0.0519
Std.Dev. Dep Var	0.0635	0.0635	0.0635	0.0635
Num.Obs.	597	597	597	597
Controls	No	Yes	No	Yes
State FE	No	No	Yes	Yes

- Discretionary IG Transfers have predictive power, yet estimates are smaller and noisy.
- **Challenge:** this instrument might violate the exclusion restriction.
- **Earmarked and all IG transfers:** weak instruments.
- **Takeaway:** FGP timing errors are the best candidate for exogenous variation.

Notes: This table show the results from estimating baseline model through 2SLS using different instrumental variables. First stage coefficients are also reported. All the dependent, independent, and instrumental variables are expressed as a percentage of each state's average discretionary revenues (DR) from 2009-2016. Time FE = Quarter-Year FE. Standard errors clustered by state. Significance level: +p < 0.10, *p < 0.05 , ** p < 0.01 , *** p < 0.001

Mechanisms

Dependent and Independent Variables



Notes: Each panel shows the distribution of the main dependent (outstanding short-term debt, left) and independent (cash reserves) variables, both expressed as percentage of discretionary revenues. The solid line represents the mean across states by year. The dark-shaded area shows the percentiles between 25%-75%, as well as the area within one standard deviation form the mean, while the light-shaded areas percentiles 1% to 99% (excluding outliers) and 5%-95%.

Descriptive Statistics

	Mean	Std.Dev.	Min	P25	P50	P75	Max
DepVar: Short-Term Debt (% DR)	0.0519	0.0635	0.0000	0.0000	0.0244	0.0940	0.2890
EndVar: Cash Reserves (% DR)	0.2289	0.1548	-0.0157	0.1174	0.1897	0.3117	0.9322
InstVar: FGP Error (% DR)	-0.0043	0.0235	-0.1135	-0.0185	-0.0039	0.0075	0.0848
FGP Annual Difference (%DR, Lag = 1yr)	-0.0130	0.0655	-0.2141	-0.0641	-0.0114	0.0484	0.0964
Primary Balance (% Rev, Lag = 1yr)	-0.0623	0.1261	-0.7499	-0.0833	-0.0296	0.0006	0.0853
Current Expenditures (% Exp, Lag = 1 yr)	0.7375	0.0600	0.4278	0.7121	0.7515	0.7775	0.8212
Discretionary Revenues (% Rev, Lag = 1yr)	0.4766	0.0781	0.3016	0.4186	0.4731	0.5394	0.6562
Long Term Debt (% Debt, Lag = 1yr)	0.6726	0.5133	0.0000	0.2834	0.5727	0.8585	2.2558
Credit Rating	3.1273	1.0700	1.0000	3.0000	3.0000	4.0000	6.0000
FGP as Collateral (%)	0.5332	0.2163	0.0880	0.3317	0.5477	0.7500	1.0000
Unemployment Rate	0.0346	0.0129	0.0081	0.0259	0.0326	0.0401	0.0978
Taxpayers (% Population)	0.5574	0.1015	0.2840	0.4850	0.5565	0.6376	0.7356
Age < 18 (% Population)	0.0584	0.0040	0.0518	0.0554	0.0578	0.0606	0.0724
Age 19-35 (% Population)	0.0438	0.0022	0.0405	0.0425	0.0433	0.0449	0.0514
Age 36-65 (% Population)	0.0847	0.0047	0.0691	0.0814	0.0858	0.0882	0.0924

Notes: This panel shows the descriptive statistics of the main variables used for the analysis. N= 597 for all variables. The first two columns show the sample mean and standard deviation. P25, P50 and P75 show the 25, 50 and 75 percentiles, respectively. Credit rating is coded such that a higher number is associated with a higher credit rating. Considering the distribution of ratings I grouped them in 3 categories AAA,AA = 1, A = 2, and BBB,BB,NR = 3. Short-Term borrowing, cash reserves, FGP budget error, and fiscal balance measures are expressed as a percentage of the average discretionary revenues (DR) observed between 2009 and 2016. That is, outside the analysis period to avoid endogeneity concerns. All these fiscal variables correspond to one-year lagged measures.

Mechanisms: Levels of Cash Reserves

Table 3: Effect of Cash Reserves on Short-Term Debt: Heterogeneity by Distribution of Cash Reserves

	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile
Cash Reserves (% DR) $\hat{\delta}$	0.012	0.511*	0.701	-0.287
	(0.320)	(0.262)	(0.426)	(0.338)
First Stage: FGP Error $\hat{\beta}$	1.706***	1.677***	0.483	0.445
	(0.469)	(0.362)	(0.438)	(0.374)
Cragg-Donald F-Statistic	7.8162	4.6089	1.3406	0.8011
Short-Term Debt (Mean)	0.0699	0.0671	0.0457	0.0263
Short-Term Debt (SD)	0.0596	0.0693	0.0647	0.0506
Cash Reserves (SD)	0.0823	0.1045	0.0836	0.1849
Num.Obs.	158	140	139	160

Notes: These panels show the results from estimating Equation 9 across different subsets of the data set. In this case, with the states at each quartile of the cash reserves distribution observed in 2018. All coefficients correspond to the 2SLS specification with controls, state and quarter-by-year fixed effects. All the dependent, independent, and instrumental variables are expressed as a percentage of each state's average discretionary revenues (DR) from 2009-2016. Time FE = Quarter-Year FE. Standard errors clustered by state. Significance level: *$p < 0.10$, **$p < 0.05$, *** $p < 0.01$

- **Descriptive Stats:** States with less cash rely more on debt.
- **First Stage:** FGP Timing errors have more predictive power for states with less cash.
- **IV 2nd Quartile:** ⬆️ 5.3% DR.
- **Eff Size:** 0.77 SD_{debt}

Back to Results

Mechanisms: Temporal Heterogeneity and Anticipation Effects

Table 4: Effect of Cash Reserves on Short-Term Debt: Heterogeneity by Quarter

	Q1	Q2	Q3	Q4
Cash Reserves (% DR) $\hat{\delta}$	0.120	0.064	0.489	0.519*
	(0.182)	(0.103)	(0.471)	(0.305)
First Stage: FGP Error $\hat{\beta}$	1.377*	1.296***	1.827	2.737**
	(0.693)	(0.464)	(1.156)	(1.014)
Cragg-Donald F-Statistic	3.5495	11.3331	1.8524	6.33
Short-Term Debt (Mean)	0.0569	0.0422	0.0343	0.0746
Short-Term Debt (SD)	0.0605	0.0552	0.049	0.0787
Cash Reserves (SD)	0.141	0.1625	0.1674	0.1292
Num.Obs.	150	150	149	148

Notes: These panels show the results from estimating Equation 9 across different subsets of the data set. In this case, with the observations from each quarter of the calendar year. All coefficients correspond to the 2SLS specification with controls, state and quarter-by-year fixed effects. All the dependent, independent, and instrumental variables are expressed as a percentage of each state's average discretionary revenues (DR) from 2009-2016. Time FE = Quarter-Year FE. Standard errors clustered by state. Significance level: *$p < 0.10$, **$p < 0.05$, *** $p < 0.01$

- **Descriptive Stats:** Debt stocks are higher closer to the end/beginning of the FY.
- **First Stage:** FGP errors have more predictive power in Q2 and Q4
- **Q4:** ⬆️ 6.7% DR. **Eff Size:** 0.85 SD_{debt}
- **Implication:** States smooth cash-flows via short-term debt and preserve cash-reserves.

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Mechanisms: Credit Quality

Table 5: Effect of Cash Reserves on Short-Term Debt: Heterogeneity by Credit Rating

	AAA	AA	A	BBB,BB
Cash Reserves (% DR) $\hat{\delta}$	-0.041	0.134	0.293*	1.123**
	(0.086)	(0.084)	(0.159)	(0.368)
First Stage: FGP Error $\hat{\beta}$	1.527	1.335**	1.925**	1.551***
	(2.402)	(0.378)	(0.741)	(0.428)
Cragg-Donald F-Statistic	0.9127	4.3514	24.4371	5.5323
Short-Term Debt (Mean)	0.0029	0.0121	0.0522	0.0898
Short-Term Debt (SD)	0.0146	0.0261	0.0622	0.0627
Cash Reserves (SD)	0.24	0.1632	0.1148	0.0744
Num.Obs.	46	74	302	146

Notes: These panels show the results from estimating Equation 9 across different subsets of the data set. In this case, according to the credit rating of each state at any given period of the sample. All coefficients correspond to the 2SLS specification with controls, state and quarter-by-year fixed effects. All the dependent, independent, and instrumental variables are expressed as a percentage of each state's average discretionary revenues (DR) from 2009-2016. Time FE = Quarter-Year FE. Standard errors clustered by state. Significance level: $*p < 0.10$, $**p < 0.05$, $***$ $p < 0.01$

- **Descriptive Stats:** Lower rated states rely more on debt.
- **First Stage:** FGP errors have more predictive power for lower rated states.
- **A:** ⬆️ 3.3% DR. **Eff Size:** 0.54 SD_{debt}
- **BBB,BB:** ⬆️ 8.3% DR. **Eff Size:** 1.33 SD_{debt}

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Robustness Checks

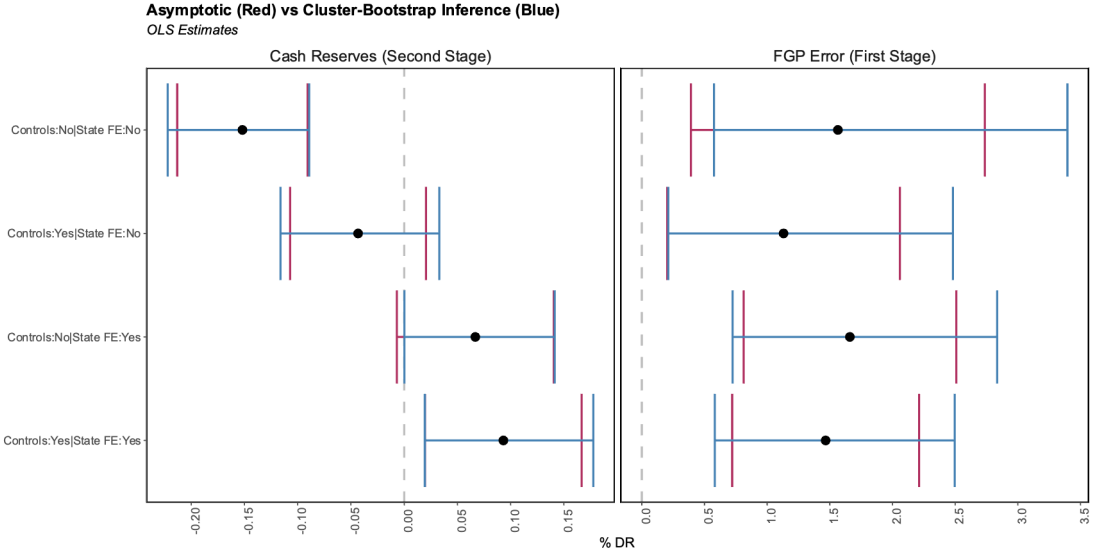
Robustness Checks: Heckman Selection Model

Table 8: Heckman Selection Model: Short Term Borrowing and Cash Reserves

	(1)	(2)	(3)	(4)
Panel A: Second Stage (Outcome Model)				
Cash Reserves (% DR)	–0.1737***	–0.0790	0.0218	0.0357
	(0.0535)	(0.0536)	(0.0544)	(0.0506)
Panel B: First Stage (Selection Model)				
FGP Error (% DR)	2.3512	2.3512	2.3512	2.3512
	(5.1012)	(5.1012)	(5.1012)	(5.1012)
Mean Dep Var	0.0519	0.0519	0.0519	0.0519
Std.Dev. Dep Var	0.0635	0.0635	0.0635	0.0635
Num.Obs.	597	597	597	597
Controls	No	Yes	No	Yes
State FE	No	No	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Notes: Panel A shows the results from the second stage regression. Panel B shows displays the results of the instrument used for the selection model. Estimation is done using Heckman's (1979) two-step efficient estimates of parameters and standard errors. Results in Column (5) replicate the econometric specification at (Su and Hildreth, 2018). All the dependent, independent, and instrumental variables are expressed as a percentage of each state's average discretionary revenues (DR) from 2009-2016. Standard errors clustered at the state level. Significance level: *$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Robustness Checks: Cluster Bootstrap Standard Errors.



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CRF and Liquidity Management

Federal Assistance and Municipal Borrowing (Chapter 2)

- **RQ:** What is the role of federal aid on local government borrowing during macroeconomic crises ?
- **Policy:** The Coronavirus Relief Fund (CRF) creates a quasi-experimental setting in which some governments (i.e., population > 500K) received direct aid from the Treasury.

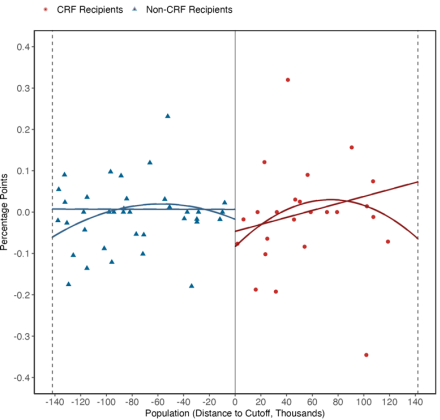
Federal Assistance and Municipal Borrowing (Chapter 2)

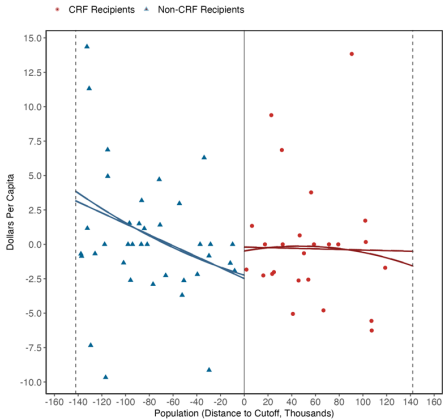
- **RQ:** What is the role of federal aid on local government borrowing during macroeconomic crises ?
- **Policy:** The Coronavirus Relief Fund (CRF) creates a quasi-experimental setting in which some governments (i.e., population > 500K) received direct aid from the Treasury.
- Using a regression discontinuity design (RDD), I estimate the effect of CRF funding on local government borrowing costs and amount of debt issued.
- **Similarity with Ch1:** for governments around the cutoff for CRF eligibility, CRF payments mimic a random liquidity shock.

Federal Assistance and Municipal Borrowing (Chapter 2)

Primary Market Bond Spreads:
⬇ 7−9 bps, 0.12-0.17 SD

Primary Market Debt Issuance:
⬆ $1.7- $5.0, 0.13-0.39 SD





Note: These figures display the scatter-binned plots of the dependent variables around the cutoff for treatment assignment. The gray dashed lines show the optimal bandwidth used for the estimation of the Local Average Treatment Effect. Both linear and quadratic estimations are reported. The top-left scatter-plot (spreads at issue) restricts the vertical axis to exclude an outlier observation that obscures the visualization results.

Crow-in effects of federal aid on local borrowing: An ⬆ in revenues (cash) led to an ⬆ in per capita debt issuance.

Rationale: ⬇ tax revenues + ⬆ spending to cope with the crisis + ⬆ uncertainty on the duration and magnitude of the pandemic = **more stringent liquidity constraints**.

O’Neill School of Public and Environmental Affairs

Cash Reserves and Short-Term Debt Under Liquidity Constraints

Luis Navarro

Job Market Talk
November 2024

INDIANA UNIVERSITY BLOOMINGTON