



O'Neill School of Public and Environmental Affairs

Cash Reserves and Short-Term Debt Under Liquidity Constraints

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Introduction

- **Research Question:** What is the effect of cash reserves on short-term borrowing?
- **Theory:** Liquidity constraints play a crucial role in determining the relationship between cash reserves and short-term borrowing (Kling, 2018). Depending on the stringency of the constraint, cash and debt might behave like substitutes or complements.
- **Empirical Analysis:** Mexico's fiscal system provides a setting with liquidity-constrained state governments facing liquidity shocks from exogenous variation in federal IG transfers.



Findings Preview: cash and debt behave like complements!

- **Estimated Effect:**  1 SD on Cash Reserves (% Discretionary Revenues, DR) \approx  3.75% of DR in outstanding short-term debt. **Effect Size (Implied Elasticity):** 0.6 SD of outstanding ST Debt

Mechanisms and Liquidity Management



- **Cash Reserves:** stronger effects for less capitalized states.
 - **Temporal Heterogeneity:** stronger effects closer to the beginning/end of fiscal year.
 - **Credit risk:** larger effects for lower rated governments.
-
- **Implication:** Liquidity-constrained governments might prefer to manage cash-flows via short-term debt, even if they face a high interest rate.

Theoretical Motivation: Liquidity Constraints

I developed a theoretical model that shows the complementarity/substitutability between cash and debt depends on the stringency of the liquidity constraints faced by the government.

Without Liquidity Constraints: Cash and debt behave like substitutes.

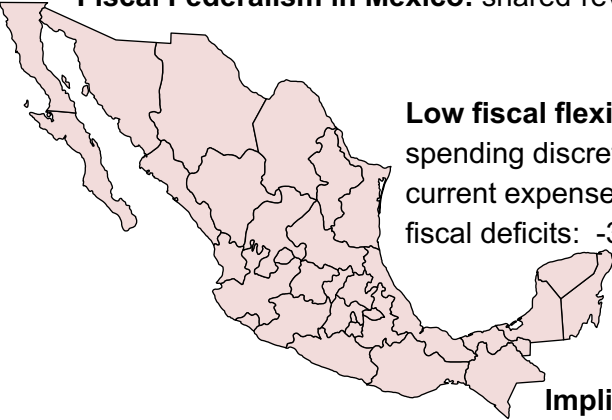
- **Pecking order theory:** Organizations prefer internal over external financing. Debt carries interest and opens the door to the scrutiny of third parties (Jensen, 1986; Myers, 1984).
- **Implication:** finance liquidity gaps with cash reserves.

- **With Liquidity Constraints:** Relationship is ambiguous. Empirical question!
- Cash reserves have an operational and precautionary role (Kling, 2018). Governments maintain cash reserves to preserve creditworthiness (Marlowe, 2011) and signal solvency to access financial markets.
- **Implication:** finance liquidity gaps with short-term debt.



Empirical Setting: State Governments in Mexico (2018 – 2022)

Fiscal Federalism in Mexico: shared-revenue system with centralized tax collection.



Low fiscal flexibility: for each dollar states have, they have spending discretion on 50 cents, but ≈ 90 cents must go to cover current expenses + transfers to local governments. Persistent fiscal deficits: -3.5% of total revenues (average, 2000-2022).





Implication: state governments observe reduced space to generate excess cash-flows and have few tools under the belt to cope with liquidity shocks.



RQ: What is the effect of cash reserves on short-term borrowing?

- **Reduced Form Model:**

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

- OLS estimation of δ is likely biased due to endogeneity between cash and debt.
-  State Economic Activity \rightarrow  Own-Source Revenues \rightarrow  Cash Holdings  ST debt.
- **Implication:** endogeneity bias is likely negative. OLS could underestimate δ .
- We need exogenous variation on cash holdings!



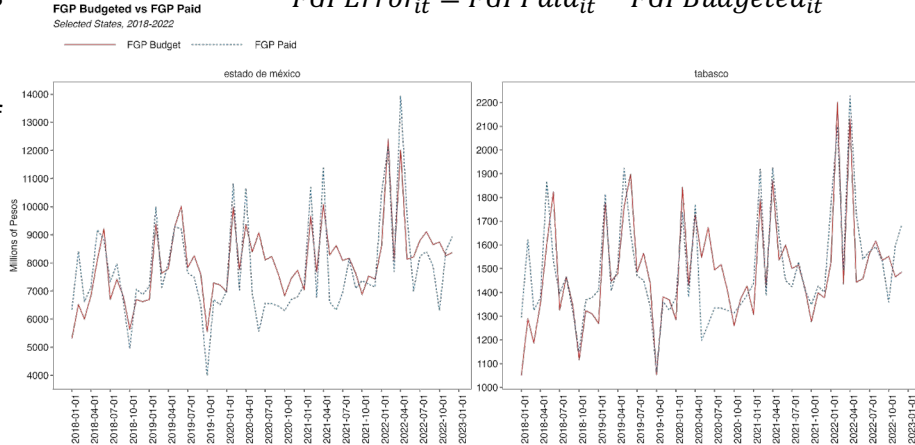
Plausible Exogenous Variation: FGP error

- General Participations Fund:** main

discretionary revenues (DR) grant/fund. 75% of total DR, 30% of total revenues.

- FGP Error:** Difference between the budgeted amount and observed transfer within the same fiscal year.

$$FGPError_{it} = FGPPaid_{it} - FGPBudgeted_{it}$$



FGP Institutional Setting

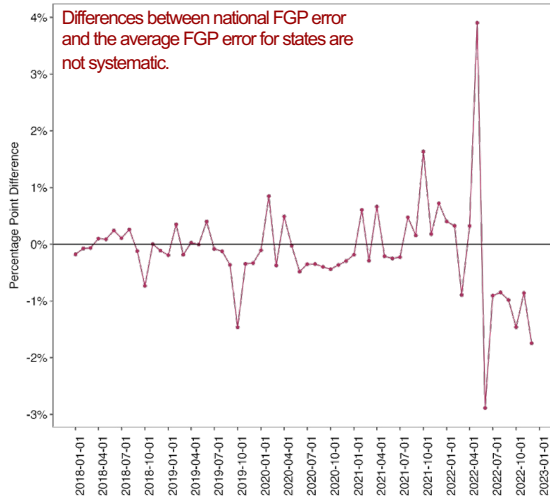
1. Before the FY begins, federal government discloses the estimated size of IG funds, along with a monthly calendar of disbursements.
2. States have no say on the calendar nor participate on tax collection. They just incorporate this calendar into their budgets.
3. However, actual disbursements depend on the observed level of centralized tax collection.
4. Each month states could observe deviations from their budgeted transfers.
5. **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.
6. Plausibly random component on the federal FGP error to states (i.e., random liquidity shock).



FGP Error Distribution Over Time, 2018-2022

FGP Error: Difference between Centralized Error and Average State Error

Distribution of state-month sample, 2018-2022



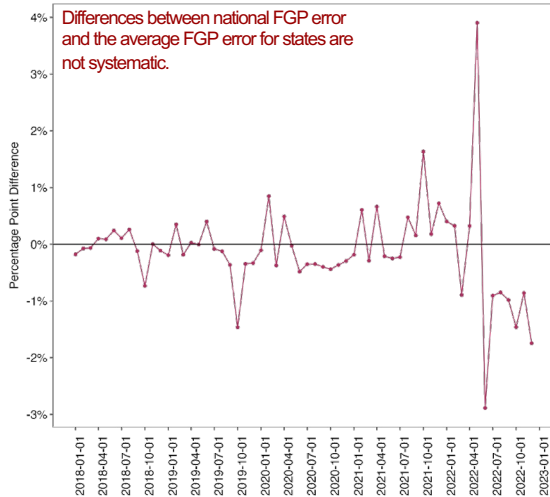
Notes: The panel on the left shows the difference between aggregated (national) FGP error and the average state FGP error. The panel on the right shows the distribution of the FGP timing error across time. The solid line represents the mean across states by month-year. The dark-shaded area shows the percentiles between 25%-75%, as well as the area within one standard deviation from the mean, while the light-shaded areas percentiles 1% to 99% (excluding outliers) and 5%-95%. For illustrative purposes, dashed blue lines show the interval between $\pm 10\%$ of discretionary revenues.



FGP Error Distribution Over Time, 2018-2022

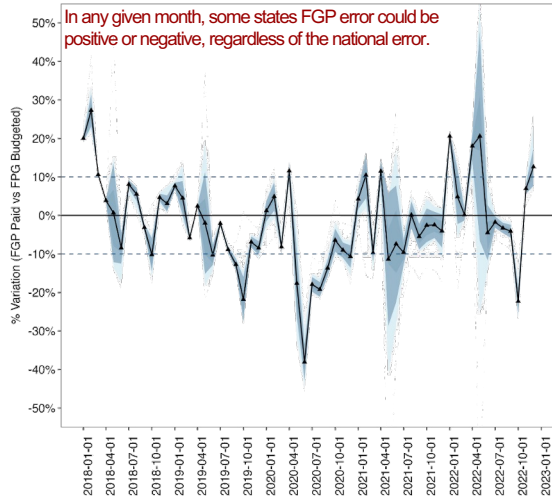
FGP Error: Difference between Centralized Error and Average State Error

Distribution of state-month sample, 2018-2022



FGP Error by State

Distribution of state-month sample, 2018-2022



Notes: The panel on the left shows the difference between aggregated (national) FGP error and the average state FGP error. The panel on the right 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 from the mean, while the light-shaded areas percentiles 1% to 99% (excluding outliers) and 5%-95%. For illustrative purposes, dashed blue lines show the interval between +/- 10% of discretionary revenues.



Research Design

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

First Stage:

$$\text{CashReserves}_{it} = \beta \text{FGPError}_{it} + X_{it}\alpha + a_i + b_t + \epsilon_{it}$$

Second Stage:

$$\text{OutShortTermDebt}_{it} = \delta \widehat{\text{CashReserves}_{it}} + X_{it}\alpha + a_i + b_t + v_{it}$$

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).
- Controls: fiscal structure, liquidity needs from current and previous FY, debt burden.



Identification

Relevance Assumption: FGP Errors influence the level of cash reserves.

- **Descriptive Stats:** observing a quarterly 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).

Exclusion Restriction (ER): Institutional Setting of the FGP

ER: FGP Errors only influence short-term debt through cash reserves.

- FGP annual shares had been historically stable.
- 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.



Results

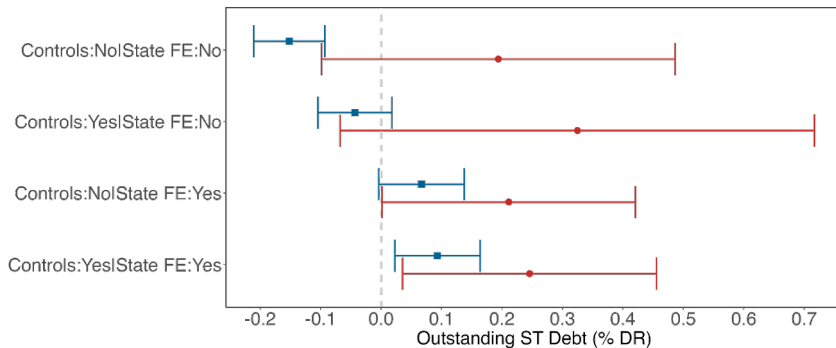
Implied Elasticity	First Stage F-Stat
0.47	7.41
0.79	6.95
0.51*	30.06
0.60**	24.20

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

Effect of Cash Reserves on Outstanding Short-Term Debt

OLS and IV Estimates (% Discretionary Revenues, DR)

◆ IV ◆ OLS



If cash reserves $\uparrow 1 SD_{cash}$, then outstanding short-term debt:

- **OLS:** $\uparrow 1.43\%$ DR. **Eff Size:** $0.22 SD_{debt}$ **IV :** $\uparrow 3.80\%$ DR: **Eff Size:** $0.60 SD_{debt}$
- **Endogeneity bias < 0:** addressing OVB leads to $\uparrow \widehat{\delta}_{ols}$. Also, $\widehat{\delta}_{ols} < \widehat{\delta}_{iv}$
- IV estimates are less sensitive to the econometric specification. Strong first stage.



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 (0.023)	0.006 (0.024)
Active Taxpayers (% Population)	-0.024 (0.041)	0.000 (0.031)
Industrial Activity Index	-0.024 (0.041)	0.000 (0.031)
Quarterly Economic Activity Index	0.140 (0.237)	0.133 (0.199)
Informal Labor (% Population)	0.006 (0.022)	0.005 (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



Mechanisms

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.



Conclusions and Discussion

- Theory suggests that liquidity constraints shape the complementarity between cash reserves and short-term borrowing.
- Evidence for Mexican states suggests cash and debt behave like complements. Upon a cash windfall, states will build up reserves and manage cash-flows via short-term borrowing.
- Contrasting evidence to literature on US local governments that find cash and debt are substitutes (Su and Hildreth 2018; Lofton and Kioko, 2021)
- Estimates suggest an implied elasticity between 0.60-1.33, depending on the stringency of liquidity constraints.
- Liquidity-constrained governments might prefer to manage cash-flows via short-term debt , even if they face a high interest rate.



Thanks for your attention!



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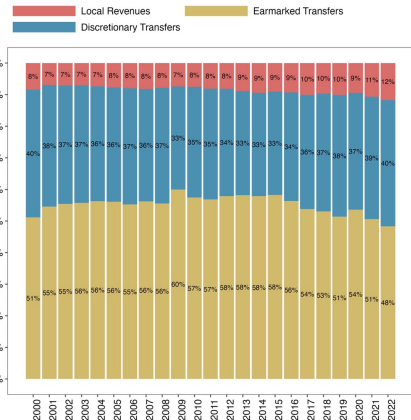
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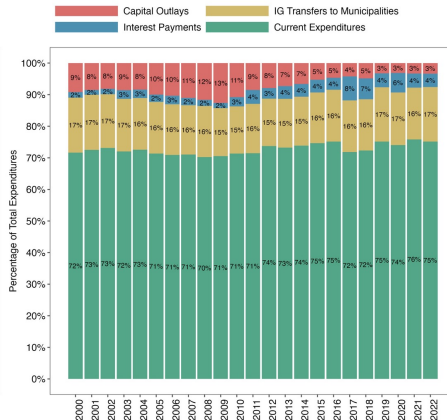
Appendix

Fiscal Structure of Mexican State Governments, 2000-2022

Distribution of State Government Revenues by Source



Distribution of State Government Expenditures by Type of Spending



- 90% of revenues come from IG transfers. 50% earmarked and 40% discretionary.
- High levels of current expenditures (75%) and IG transfers to local governments (17%).
- Less than 10% of spending space for capital projects, debt service, and to improve fiscal stance.

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. The panel on the right shows the composition of state expenditures by type of spending. Current expenditures include payroll expenses, operating expenses and services, and transfers to state agencies and local governments. **Source:** INEGI.



Results: Effects of Cash Reserves on Short-Term Debt

	(1)	(2)	(3)	(4)
Panel A: OLS				
Cash Reserves (% DR) δ^{\wedge}	-0.152*** (0.030)	-0.043 (0.031)	0.067* (0.036)	0.093** (0.036)
Panel B: 2SLS				
Cash Reserves (% DR) δ^{\wedge}	0.194 (0.149)	0.325 (0.200)	0.211* (0.107)	0.246** (0.107)
First Stage: Timing Error β^{\wedge}	1.565** (0.573)	1.131** (0.454)	1.661*** (0.415)	1.467*** (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

If cash reserves $\uparrow 1 SD_{cash}$, then outstanding short-term debt:

- **OLS:** $\uparrow 1.43\%$ DR. **Eff Size:** $0.22 SD_{debt}$
- **IV :** $\uparrow 3.80\%$ DR: **Eff Size:** $0.60 SD_{debt}$
- **Endogeneity bias < 0:** addressing OVB leads to $\uparrow \widehat{\delta}_{ols}$. Also, $\widehat{\delta}_{ols} < \widehat{\delta}_{iv}$
- IV estimates less sensitive to econometric specification.
- **Strong instrument:** Cragg Donald F-Stat > 24
- **First Stage:** a timing error equivalent to 1% of DR leads to an \uparrow in cash reserves of to 1.46% DR.

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, ****p < 0.001



Robustness Checks: Heckman Selection Model

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

	(1)	(2)	(3)	(4)
Panel A: Second Stage				
(Outcome Model)				
Cash Reserves (% DR)	-0.0716*** (0.0254)	-0.0109 (0.0258)	0.0552** (0.0263)	0.0909*** (0.0268)
Panel B: First Stage				
(Selection Model)				
Timing Error (% DR)	19.0228** (8.1516)	19.0228** (8.1516)	19.0228** (8.1516)	19.0228** (8.1516)
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: 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

Summary:

- **OLS:** $\approx \uparrow$ 7–9 bps, 0.12-0.17x SD. Upper bound: 47 bps (0.9xSD).
- Endogeneity bias < 0
- **2SLS IV :** $\approx \uparrow$
- Effect Size:
- IV estimates less sensitive to econometric specification.



Thought Experiment

1. Your employer gives the schedule of the monthly disbursements of your paycheck.
2. However, your monthly payment depends on the level of sales observed each month.
3. Hence, each month you might observe deviations from your budgeted disbursement.
4. **The catch:** observed sales (and the deviations) neither depend on your decisions nor performance.
5. These deviations are hard to anticipate. For you: arguably, as good as random.
6. Would you finance these gaps with your savings (cash reserves) or with your credit card (short-term debt)?



Data

- **Financial Variables (Cash and Debt):** text-scraped from state-reported forms submitted to the Ministry of Finance. State-by-quarter variation. **Consistent data begins in 2018.**
- **Fiscal Variables (Revenues, Expenditures):** annual survey of state and local government finances. State-by-year variation.
- **Credit Ratings:** web-scraped from Fitch Ratings website. State-by-quarter variation.
- **Control Variables:** National Statistics Agency (INEGI) surveys on employment and IRS data on number of active taxpayers. State-by-quarter variation.
- **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.



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: Timing 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
Net Operating 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 (% Total, Lag = 1 yr)	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
Active 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

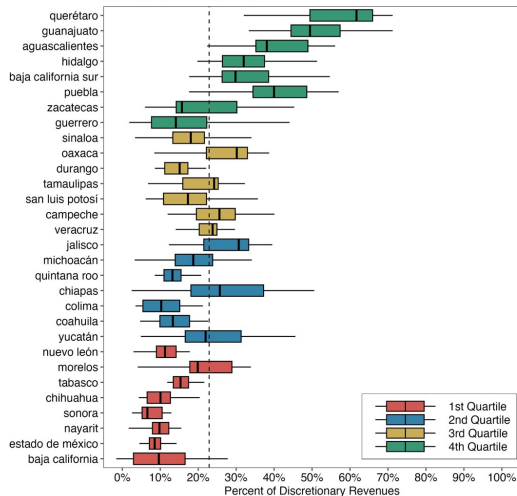
Notes: This panel shows the descriptive statistics of the main variables used for the analysis. N= 597 for all variables. The first two columns show the sample mean and standard deviation. P25, P50 and P75 show the 25, 50 and 75 percentiles, respectively. Credit rating is coded such that a higher number 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.



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

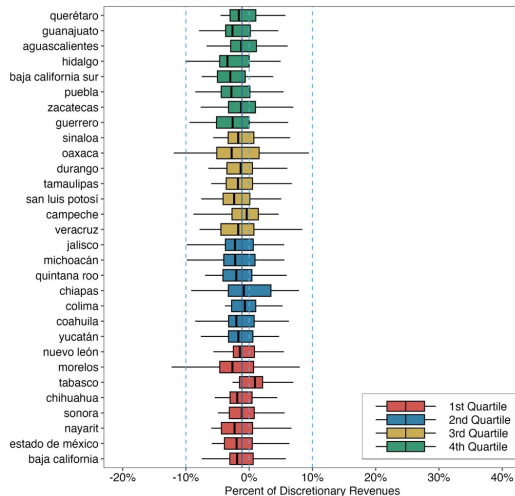
Distribution of Cash Reserves by State, 2018-2022

Cash Reserves 2018 Quartiles



FGP Monthly Timing Error by State, 2018-2022

Cash Reserves 2018 Quartiles



Notes: Both panels shows the distribution of cash reserves (left) and FGP timing 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 $\pm 10\%$ of discretionary revenues.




Mechanisms: Levels of Cash Reserves

Table: Effect of Cash Reserves on Short-Term Debt by Level of Cash Reserves

	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile
Cash Reserves (% DR) δ^{\wedge}	0.012 (0.320)	0.511+ (0.262)	0.701 (0.426)	-0.287 (0.338)
First Stage: Timing Error β^{\wedge}	1.706** (0.469)	1.677** (0.362)	0.483 (0.438)	0.445 (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, *** p < 0.001



- **Descriptive Stats:** States with less cash rely more on debt.
- **First Stage:** FGP Timing errors have more predictive power for states with less cash.
- Only estimates for second quartile are significant (10%).
- **IV 2nd Quartile:**  5.3% DR.
- **Eff Size:** 0.77 SD_{debt}



Mechanisms: Credit Quality

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

	AAA	AA	A	BBB,BB
Cash Reserves (% DR) δ^{\wedge}	-0.041 (0.086)	0.134 (0.084)	0.293+ (0.159)	1.123* (0.368)
First Stage: Timing Error β^{\wedge}	1.527 (2.402)	1.335* (0.378)	1.925* (0.741)	1.551** (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

- **Descriptive Stats:** Lower rated states rely more on debt.
- **First Stage:** FGP Timing errors have more predictive power for lower rated states.
- Only estimates for A and BBB,BB are significant (10% and 5%).
- **A:**  3.3% DR. **Eff Size:** 0.54 SD_{debt}
- **BBB,BB:**  8.3% DR. **Eff Size:** 1.33 SD_{debt}


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, ***p < 0.001



Temporal Heterogeneity and Anticipation Effects

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

	Q1	Q2	Q3	Q4
Cash Reserves (% DR) δ^{\wedge}	0.120 (0.182)	0.064 (0.103)	0.489 (0.471)	0.519+ (0.305)
First Stage: Timing Error β^{\wedge}	1.377+ (0.693)	1.296** (0.464)	1.827 (1.156)	2.737* (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

- **Descriptive Stats:** Debt stocks increase closer to the end of the fiscal year.
- **First Stage:** FGP Timing errors have more predictive power in Q2 and Q4
- Only estimates for Q4 are significant (10%).
- **Q4:**  6.7% DR. **Eff Size:** $0.85 SD_{debt}$
- **Implication:** States smooth cash-flows via short-term debt and preserve cash-reserves.

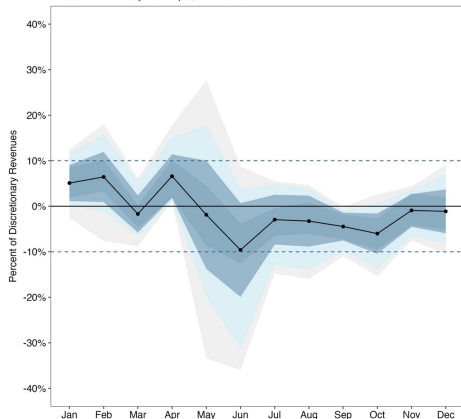
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Instrument Validity: FGP Timing Errors by Calendar Month

FGP Monthly Timing Error by Calendar Month

Distribution of state-year sample, 2018-2022



FGP Monthly Timing Error by State-Month

Percentage of Discretionary Revenues, 2018-2022



Timing errors are in average:

- Positive in Jan, Feb, Apr
- Negative the rest of the year.
- Lowest in Jun.

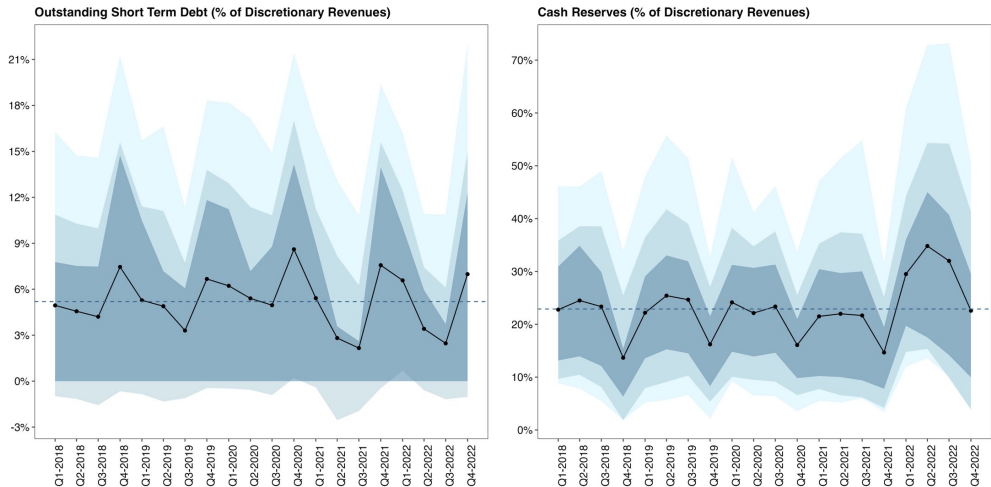
No systematic variation across states within months

- States get the same draw of monthly timing errors within the same fiscal year.

Notes: The panel on the left shows the distribution of the FGP timing error for each month, across state and years. 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 from the mean, while the light-shaded areas percentiles 1% to 99% (excluding outliers) and 5%-95%. The panel on the right shows the distribution of timing errors for each state and calendar month, across year. For illustrative purposes, dashed blue lines show the interval between $\pm 10\%$ of discretionary revenues.



There is some 4Q seasonality on cash and short-term debt



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 from the mean, while the light-shaded areas percentiles 1% to 99% (excluding outliers) and 5%-95%.



Instrument Validity

Alternative Instrumental Variables: budget errors on other IG transfers: i) all discretionary transfers, ii) earmarked transfers, and iii) all IG transfers.

- Result: other instruments are weak and/or pose a violation of exclusion restriction. FGP errors are the best candidate to address endogeneity.



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

IV: Discretionary Revenues Timing Error

Cash Reserves (% DR) δ^{\wedge}	-0.040 (0.116)	0.048 (0.111)	0.002 (0.072)	0.037 (0.087)
First Stage: Timing Error β^{\wedge}	1.282** (0.456)	0.837** (0.267)	0.968*** (0.240)	0.829*** (0.211)
Cragg-Donald F-Statistic	21.5163	15.9941	38.1511	28.4921

IV: Earmarked Revenues Timing Error

Cash Reserves (% DR) δ^{\wedge}	0.150 (1.604)	0.433 (0.660)	0.434 (0.332)	0.435 (0.345)
First Stage: Timing Error β^{\wedge}	-0.163 (0.374)	-0.287 (0.254)	-0.303 (0.206)	-0.301 (0.237)
Cragg-Donald F-Statistic	0.2911	1.5095	3.0999	3.3204

IV: IG Transfers Timing Error

Cash Reserves (% DR) δ^{\wedge}	-0.064 (0.259)	-0.103 (0.340)	-0.163 (0.273)	-0.163 (0.351)
First Stage: Timing Error β^{\wedge}	0.576+ (0.316)	0.317 (0.228)	0.373+ (0.197)	0.287 (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

- **Level of Cash Reserves:** the stringency of liquidity constraints could shift the relationship between cash and debt.
- **Credit Quality:** lower rated governments might experience more stringent liquidity constraints. Governments might hoard cash to maintain creditworthiness (Marlowe, 2011).
- **FY Stage:** liquidity constraints might increase towards the end of the FY as liquidity management strategies are mainly implemented during this period.



Policy Implications

- **Opportunity cost of debt:** borrowing costs + return on savings not earned.
- Welfare losses are accentuated if governments must invest savings in AAA assets. Intermediation spread might be larger for lower rated governments.
- Liquidity management tools could alleviate the welfare costs associated with under-capitalized governments.
- Cash and debt behave like complements for less capitalized governments, and like substitutes for highly-capitalized governments.
- **Implication:** there exists a level of cash reserves at which governments might be indifferent. Key to avoid idle assets (Kling, 2018).
- **Lessons from institutional setting:** shared-revenue systems could lead to fiscal spillovers that translate into liquidity shocks for subnational governments.





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Cash Reserves and Short-Term Debt Under Liquidity Constraints

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Practice Presentation