Cash Reserves and Short-Term Borrowing Under Liquidity Constraints

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Abstract

Governments ensure uninterrupted service delivery with timely payments on operating expenses by maintaining sufficient cash reserves and/or resorting to short-term borrowing. A theoretical model of cash-flow management shows that the precautionary role of cash reserves shapes the liquidity constraints experienced by low-capitalized governments. I test this theory by looking at state governments from Mexico that face stringent liquidity constraints. To provide causal estimates, I instrument cash reserves with plausibly exogenous variation in the deviation from anticipated monthly distributions of one of the largest federal grants, which are not correlated with annual financial conditions but lead to temporary changes in states' current cash holdings. Empirical evidence indicates that cash reserves have a positive impact on short-term borrowing, with an implied elasticity between 0.6 and 1.3. The magnitude of this effect is influenced by the stringency of liquidity constraints faced by state governments, which in this analysis is explored capitalization levels, credit quality, and the stage of the fiscal year. These findings are consistent with theoretical expectations of cash-flow management under liquidity constraints and provide evidence that complements the previous empirical research studying American local governments with less stringent liquidity constraints.

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1 Introduction

Efficient cash flow management in the face of volatile revenues is essential for uninterrupted public goods provision over the fiscal year. To keep continuous operations at desirable levels, governments must maintain sufficient cash levels to provide timely payments on their operating expenses. Holding too little cash risks events where governments must either cancel or delay services. On the other hand, holding too much cash is also inefficient as it implies higher than necessary taxes on the private sector or fewer public services for the amount of revenues collected. Consequently, the public finance literature has been normatively interested in the optimal combination of cash holdings and short-term borrowing as part of governments' cash flow management plan, as well as positive evidence on the actual behavior of governments.

Broadly, normative theory suggests that larger cash holdings should result in lower reliance on short-term debt (Donaldson, 1961; Myers, 1984; Su and Hildreth, 2018), yet this relationship could revert under the presence of liquidity constraints (Almeida et al., 2004; Kling, 2018). Empirical evidence thus far has concluded that governments with larger cash holdings rely less on short-term debt (Lofton and Kioko, 2021; Su and Hildreth, 2018). However, these findings drawn from American local governments shed little evidence on how this relationship is influenced by the stringency of the liquidity constraints faced by governments, demonstrating a theoretical proposition not addressed in the empirical literature.

This paper revisits the role of cash reserves on short-term borrowing by formulating a model that demonstrates how capitalization levels shape the liquidity constraints faced by governments and highlights how the precautionary role of cash reserves (Kling, 2018) determines the complementarity/substitutability between cash and debt as cash-flow management tools. The empirical analysis tests this theory by drawing evidence from Mexican state governments which, in contrast to the American local governments previously studied, face much stricter liquidity constraints.

To provide causal evidence, I exploit plausibly exogenous variation coming from budget deviations in the distribution of one of the largest intergovernmental grants as an instrumental variable for cash reserves on quarterly data between 2018 and 2022. These budget errors are not correlated with longer-term economic conditions and represent deviations from the expected cash holdings for the quarter. To preview the results, I find that increases in quarterly cash holdings induced by these budget errors increase the amount of short-term debt held by the state governments. This is consistent with a model where the benefits of holding cash on interest rate reductions outweigh the borrowing costs of issuing another dollar of debt, and highlights how the precautionary role of cash plays a crucial role in the cash-flow management of governments facing liquidity constraints.

Earlier literature on pecking order theory (Donaldson, 1961; Myers, 1984) argued that organizations might choose internal borrowing over external financing when adverse selection and information asymmetries amplify the risk premiums faced by borrowers. Governments might choose to manage cash-flows via cash reserves if interest rates are too high. On the other hand, governments have incentives to keep cash reserves to signal solvency to borrowers, preserve their creditworthiness, and ensure access to debt markets and low borrowing costs (Marlowe, 2011). Governments with low fiscal flexibility (i.e., space to adjust spending and revenue decisions based on their current financial conditions and available resources) might prefer external financing (Hendrick, 2006; Joyce, 2001) albeit facing borrowing costs.

The fiscal environment of Mexican state governments allows for the testing of the theory of cash reserves, as they are characterized by low fiscal flexibility and a lack of tools to cope with unexpected liquidity shocks. These governments have a considerable reliance on federal transfers and grants (90% of total revenues) to finance expenditures, with discretion exercised over only approximately 50% of their revenues. Furthermore, the majority of state spending is allocated to highly inertial budget lines (approximately 92% of spending), which significantly constrains their ability to enhance their operating balance.

The rules that govern the federal budgeting of intergovernmental transfers create a context in which state governments are exposed to plausible exogenous liquidity shocks resulting from budgetary errors on the General Participations Fund (FGP), which is the primary source of discretionary revenues for state and local governments. These budget errors, henceforth referred to as FGP errors, represent the discrepancy between the budgeted transfers from the FGP and the actual transfers observed in any given month during the fiscal year. They capture the variation in the pace at which funds are disbursed to states, rather than deviations in the annual size of the grant. In a nutshell, the plausible exogeneity of these deviations is explained by the limited influence of states on the observed level of FGP transfers, as well as the lack of information on the determination of the monthly calendar of federal grants disbursement.

Consistent with theoretical predictions, the empirical analysis finds a positive relationship between cash reserves and outstanding short-term debt. The results from the preferred econometric specification suggest that one standard deviation increase in cash reserves leads to an increase in outstanding short-term debt equivalent to 24.6% of the annual budget of discretionary revenues (DR). To assess the magnitude of this effect, this is equivalent to an increase of 0.6 standard deviations of outstanding short-term debt in this sample, which I interpret as the implied elasticity of the model for policy implications. These results are consistent with a theory where governments use financial slack to build up reserves when they are facing revenue volatility and undertake active efforts to preserve credit quality and long-term access to debt markets (Hendrick, 2006; Joyce, 2001).

To examine the mechanisms through which liquidity constraints shape the relationship between cash and short-term debt, I test the robustness of the model to heterogeneity driven on the distribution of cash reserves, credit rating, and stage of the fiscal year. All these results confirm theoretical predictions showing the effect of cash reserves on debt is amplified by the stringency of the liquidity constraints, and align with empirical findings on governments incentives to hoard cash to preserve their creditworthiness (Marlowe, 2011). These results suggest an upper bound on the elasticity of cash and debt of 1.3 when liquidity constraints are more stringent.

To assess the validity of the identification strategy, I test the predictive power of FGP errors on measures of regional economic activity that could simultaneously influence levels of cash holdings and incentives to issue debt. These results lend support to the validity of the exclusion restriction in this setting. Furthermore, I test the robustness of the results to using budget errors from other relevant federal grants finding that the variation from FGP errors is the best candidate to disentangle the endogeneity that contaminates results from the OLS estimation.

This paper contributes to the literature on government liquidity management and short-term borrowing by bringing insights from corporate finance literature (Almeida et al., 2004; Kling, 2018) to formulate and test a theory of government cash-flow management under liquidity constraints. Empirical evidence from this paper adds to the literature on American governments (Lofton and Kioko, 2021; Su and Hildreth, 2018) that, consistent with pecking order theory, suggests that cash and debt behave like substitutes and governments will prefer to manage cash-flows through cash reserves rather than debt, when both are available. This paper expands these results by providing a scenario in which liquidity constraints could explain deviations from the predictions of pecking order theory and, by doing so, sheds some light on the stringency on the prevailing liquidity constraints faced by American local governments previously studied in the literature.

The rest of the paper is organized as follows. Section 2 explores the literature on financial slack and short-term borrowing, underlining the relationship between the two as well as the empirical underpinnings of the current literature. Section 3 describes the theoretical model that motivates the empirical question. Section 4 describes the relevant features of fiscal federalism in Mexico that influence government cash-flow management. Section 5 describes the empirical strategy used to study this research question. Section 6 shows the main findings as well as the potential mechanisms behind them. I conduct several robustness checks and assess some threats to validity in Section 7. Section 8 provides a concluding discussion on the results.

2 Literature Review

In this section, I examine the literature looking at the incentives an organization faces, particularly local governments, regarding the decision to accumulate cash reserves and the drivers of using them as a cash flow management tool. Given the uncertainty surrounding tax collection and spending needs during the fiscal year, governments need cash flow management tools that allow them to hedge public spending against revenue declines due to economic conditions or delays in intergovernmental transfers. Typically, state and local governments face this challenge through short-term debt and/or the use of financial slack like unassigned general fund balances, excess unrestricted cash holdings, and budget stabilization funds (Lofton, 2022).

Slack is generally defined as the pool of resources available to an organization that is in excess of the minimum level required to produce the desired output or once it has fulfilled its primary roles (Nohria and Gulati, 1996). These include excess cash or liquidity, discretionary capital outlays, idle capital projects, and redundant organizational structure positions (Cyert and March, 1963; Su and Hildreth, 2018). Cash reserves and quantifiable resources (usually accounting-based) are categorized as financial slack, while non-financial slack encompasses all the intangible items.

The literature has mixed views on the role of slack in organizational management. On one hand, organizational theory scholars argue slack is accumulated for political motivations and helps to reduce uncertainty and risks associated with internal organization management, as well as providing a buffer against detrimental shocks. This last part stems from literature arguing slack improves an organization's ability to adapt to the conditions of the external environment (Sharfman et al., 1988). Slack could foster innovation as it allows organizations to experiment with new strategies that could boost productivity and undertake projects that might not be approved when financial constraints are binding (Cyert and March, 1963). In this sense, financial slack provides a way to relax shareholders' control of the organization's decision-making.

On the other hand, there is literature arguing slack is the result of economic inefficiencies derived from the prevailing principal-agent problem between managers and shareholders. For instance, financial slack could diminish incentives for innovation (Nohria and Gulati, 1996) or even promote reckless behavior among managers as they can pursue pet projects that they wouldn't under a cash-constrained environment (Jensen, 1986). For firms, financial slack provides flexibility to managers to increase stockholder compensation through dividends and change the control structure as it allows them to repurchase stock. Jensen (1986) argues debt undercuts agency costs of free cash flow by limiting slack available for spending at the manager's discretion. Debt financing requires transparency from the borrower (e.g. disclosing the use of proceeds with the lender). Increased accountability and supervision limit managers' discretion. Furthermore, debt opens the door to taking the firm to bankruptcy court if it fails debt service payments. This underlying threat of debt financing helps align the organization's incentives to be more efficient.

These rationales are also present in government financial management. Governments could benefit from slack accumulation when they operate in risky and uncertain fiscal and political environments. Risk-averse policymakers are more likely to accumulate slack if they are able to (Hendrick, 2006). Cash reserves provide fiscal flexibility and a natural buffer for governments to cope with unexpected shocks, without the need of undertaking structural changes to the current fiscal policy. Incentives to accumulate slack are also influenced by governments' fiscal structure. Governments facing tax limitations, high reliance on intergovernmental transfers and federal grants (less reliance on own source revenues), dependence on volatile revenue sources, and high levels of current expenditure have less flexibility to cope with unexpected shocks (Hendrick, 2006; Joyce, 2001).

Rainy day funds are perhaps the main tool used by state and local governments to deal with budgetary shocks. These funds are usually replenished when there are unassigned fund balances at the end of the fiscal year and when they are below their optimal size. A common rule of thumb observed in practice is that rainy-day funds should represent approximately five percent of general fund expenditures.

However, research concurs that optimal fund size is not a one-size-fits-all policy (Joyce, 2001; Marlowe, 2011; Navin and Navin, 1997; Vasche and Williams, 1987). For instance, Navin and Navin (1997) analyzed Ohio's rainy day fund and concluded the target for the state should be around 13% of general fund expenditures. Vasche and Williams (1987) looked at California's experience between 1974 and 1985, finding that forecasting errors should motivate the state to maintain a balance of 6% of annual revenues.

Gore (2009) points out that for local governments there is no straightforward relation between access to credit markets and cash reserves. On one hand, governments facing high borrowing costs or limited access to financial markets (e.g. low-rated governments) might use slack as a buffer. On the other hand, municipal governments rarely lack access to financial markets and they often observe relatively low financing costs (compared to firms and non-profits). Municipalities have more space to create capital gains by investing in projects whose return exceeds the rate at which they borrow. In this study, Gore (2009) finds in a nationwide sample of municipal governments (cities, towns, boroughs, and villages) from 1997-2003 that governments accumulate cash for operational and precautionary reasons. Municipalities with few or volatile revenue sources were more likely to hold cash, whereas governments with more dependence on state revenues were less prone to accumulate slack.

Marlowe (2011) argues governments might accumulate slack to preserve or improve their creditworthiness. When available, governments might use financial slack to cover debt service payments, which adheres to recommendations made by the

Government Finance Officers Association and credit rating agencies. In this sense, Marlowe (2011) posits the optimal level of fiscal slack should depend on its effect on credit quality. This paper looks at GO bonds issued by local governments between 2007 and 2010 and estimates ordered probit regressions to assess the relationship between financial slack (measured by unreserved general fund balances) on credit quality. The study finds that while keeping some slack has benefits in terms of preserving credit quality, excess cash has no effect on improving credit ratings. Excessive slack accumulation might be inefficient since it entails keeping idle resources (above their optimal level) with no positive effect on government creditworthiness. Moreover, smaller or distressed governments might observe larger benefits from accumulating slack (in terms of its effect on credit quality) relative to larger or wealthier governments.

Empirical evidence also shows the extent to which slack allows governments to deal with budgetary shocks. State governments with more slack either through the form of well-capitalized rainy day funds (Douglas and Gaddie, 2002; Sobel and Holcombe, 1996) or larger fund balances (Poterba, 1994) cope better with fiscal distress. There are marked differences in the way state and local governments manage financial slack. While most state governments had budget stabilization funds that get replenished when there is slack, local governments rarely establish reserve funds. However, this does not imply municipal governments do not observe slack. It means they accumulate it in their fund balances (difference between current assets and current liabilities at the end of the fiscal year) instead of setting it in a separate account for stabilization purposes (Marlowe, 2005; Wolkoff, 1987).

Most of the studies analyzing the decision to choose slack over short-term debt follow the pecking order theory as a guiding framework. In its original version, this theory posits that firms prefer internal over external financing, and when external financing is required, then they will first resort to issuing safer instruments before risky (e.g. fixed-income instruments over common stock). In other words, firm's preferences for financing are summarized by: internal funds first, debt second, and equity as the last option (Donaldson, 1961; Myers, 1984). Firms prefer internal financing to avoid the adverse selection problem (overvalued firms have incentives to sell equity while undervalued firms do not) which raises borrowing costs faced by organizations. Furthermore, external financing requires monitoring and transparency. Organizations that want to keep their information outside the scrutiny of financial intermediaries might avoid external financing, and rely on internal financing instead (Jensen, 1986).

While pecking order theory had been widely used to analyze capital structure for firms (Myers, 1984) and non-profit organizations (Denison, 2009). Su and Hildreth (2018) is perhaps the first study that uses this framework to analyze government cash flow management. In this study, the authors look at a sample of 58 California cities between 2003 and 2011 and estimate a Heckman selection model on the effect of beginning-of-year cash holdings on municipal cash management notes issuance. Authors find negative coefficients suggesting that slack not only lowers the probability of engaging in short-term borrowing for cash-flow management but also reduces the principal amount of such notes issued in a fiscal year. Point estimates imply that an increase in the unreserved general fund balance equivalent to 10 % of total operating expenditures leads to a contraction in the principal amount of notes issued equivalent to 1.93% of general fund revenues. These results show that California cities were more likely to manage cash flows through financial slack, rather than short-term debt when both were available, which confirms the predictions of pecking order theory. Furthermore, their paper confirms a key stylized fact observed in the literature: larger shares of non-discretionary spending restrict governments' flexibility, hence increasing their dependence on short-term debt as a cash flow management strategy.

Lofton and Kioko (2021) examined the drivers of short-term debt issuance among general-purpose governments (i.e. counties, cities, towns, and villages) in New York State between 1995 and 2016. Their findings align with Su and Hildreth (2018) suggesting governments with low levels of cash assets (relative to total assets) or that experienced reductions in budget surplus in prior years are more prone to issue short-term debt. This study estimates a linear hurdle model to examine the factors driving short-term borrowing. Using the proportion of assets not easily convertible to cash as a percentage of total expenditures as a measure of government's iliquidity, the study finds that an increase of 1% in illiquidity increases the probability of issuing short-term debt between 0.6% and 1.3% for New York local governments. Moreover, evidence from this paper suggests that less fiscal flexibility is associated with increased reliance on short-term debt. Governments with a large dependence on federal aid, and high current expenditure pressures (measured by payroll expenses) are more likely to use short-term debt for cash flow management, instead of slack.

When governments face limited access to financial markets, the extent to which governments rely on short-term debt to smooth cash flows along the fiscal year could influence their cash holdings. Literature on financial intermediation highlights the role of information determining municipal borrowing costs (Peng and Brucato, 2004), in particular through credit ratings (Capeci, 1991; Cornaggia et al., 2018; Johnson and Kriz, 2005). Credit rating agencies consider liquidity measures (e.g. cash reserves) to determine issuer's credit rating.[1] These ratings determine government borrowing costs, both short-term and long-term. Governments might prefer to manage cash flows through short-term borrowing in order to avoid decreasing their cash reserves, which could hinder their creditworthiness (Marlowe, 2011). Alternatively, managers could avoid using financial slack in order to keep fund balances at prudential levels (Kriz, 2003), like the 5% rule of thumb underlined in the literature (Joyce, 2001; Marlowe, 2011). This could be consistent with fiscally responsible behavior as managers aim to ensure long-term access to financial markets. Hence, for governments with constrained slack generation capabilities, as well as limited access to financial markets, cash reserves might be determined by government's reliance on debt markets to finance their operation.

3 Theoretical Model

Literature on liquidity constraints often highlights the operational role of cash as an incentive to keep cash reserves. For instance, models incorporating cash-in-advance

[1]For example, Fitch ratings consider three factors to determine the rating: revenues, expenditures, and liquidity/debt.

constraints (Svensson, 1985) argue agents preferences for cash are determined by its transactional value (i.e. agents hold cash in order to buy goods and services). However, this is not the unique role of cash. Agents might hold cash to cope with uncertainty. Cash reserves provide with additional liquidity to cope with unexpected revenue or expenditure shocks. Yet, keeping resources liquid comes at the expense of lower returns on savings as it leads to lower levels of investment on more profitable (riskier) assets.

If agents can access debt markets without significant frictions and they can obtain returns on investment larger than their borrowing costs, then they might prefer to cover liquidity shocks via debt and keep their savings invested. The key condition for this to occur, however, is access to debt markets at competitive prices. This underlines the role of cash as a solvency signal. Agents might hold cash in order to signal investors their repayment capacity, and hence ensure they can cover their borrowing needs (Koskela and Viren, 1984).

Kling (2018) examines this dual role of cash in a model for firm cash-flow management. In this model, the operational role of cash reserves stems from the uncertainty surrounding a firm's net working capital (i.e. differences between current assets and current liabilities), and the precautionary role is determined by the signal it provides to investors on the firm's repayment capabilities.

State and local governments face similar incentives regarding cash. Governments facing uncertainty on provision costs and revenue collection might hold some cash to cope with unexpected revenue/expenditure shocks. At the same time, governments also hold cash to signal solvency to investors on municipal debt markets (Marlowe, 2011). In this sense, finding the optimal amount of cash holdings is a question that has received a lot of attention in the literature.

To illustrate the relationship between cash and debt from a cash-flow management perspective, following the spirit at Koskela and Viren (1984) and Kling (2018) I formulate a theoretical model of government short-term borrowing with lender risk-aversion that highlights both roles of cash reserves and how they influence government's decision to manage cash-flows via short-term borrowing, relative to tapping into their cash holdings. See Section 10 in the Appendix for a detailed formulation of the model.

In this short-run model, tax policy is fixed (i.e. exogenous non-stochastic tax revenues) and governments engage in short-term borrowing to ensure provision of public goods G is at desired levels and smooth across the fiscal year. In this two-period economy, the government chooses provision levels G_t and short-term borrowing D subject to their revenue constraint. Intuitively, each period of the model represents one segment of the fiscal year. Following Belsey (2007), I define a welfare function $W_t(G,T) = \alpha ln(G_t) - \gamma C(T_t)$ where $C()$ is a strictly convex excess burden function and γ represents the marginal cost of public funds.

First consider the scenario where cash holdings only have an operational role and can be used to manage cash-flows. For simplicity, assume the government is endowed with exogenous cash reserves S and let β be the intertemporal discount factor. In this case, the program solved by a benevolent social planner is the following.

$$
\begin{aligned}
\max_{G_1,G_2,D} \quad & \alpha ln(G_1) - \gamma C(T_1) + \beta\Big(\alpha ln(G_2) - \gamma C(T_2)\Big) \\
\text{s.t.} \quad & G_1 = T_1 + S + D \\
& G_2 = T_2 - (1+r)D
\end{aligned}
\tag{1}
$$

Since cash reserves and tax revenues are exogenously determined, assuming spending targets are met (i.e., budget constraints are satisfied with equality) implies there is closed-form solution for the amount of short-term debt issued by the government.

$$
D^*(S) = \frac{T_2}{(1+\beta)(1+r)} - \frac{\beta}{1+\beta}(T_1 + S) \tag{2}
$$

Note that in this case cash reserves and short-term debt behave like substitutes. Governments with larger cash endowments will rely less on debt to finance spending. This result is directly implied by the assumption that cash reserves only have an operational role and can only be used to finance spending. In this simple model the marginal rate of substitution between cash and debt is negative and determined by the impatience parameter β .

$$
\frac{dD}{dS} = -\frac{\beta}{1+\beta} < 0 \tag{3}
$$

To examine the precautionary role of cash, I expand the model making two further assumptions. First, let's assume risk-averse lenders that determine the interest rate faced by the government depending on the level of cash reserves available when the debt service is due (i.e., at the end of the fiscal year). Risk-aversion implies that lenders will charge a larger premium for governments with lower levels of cash reserves. Second, let's assume that government reliance on cash reserves in the first period is determined by parameter $\theta \in [0, 1]$. This implies that $1 - \theta$ represents the proportion of cash reserves available at the end of the fiscal year. These new assumptions translate into the following budget constraints.

$$\begin{aligned} G_1 &= T_1 + \theta S + D \\ G_2 &= T_2 - (1 + r((1-\theta)S)D \end{aligned} \tag{4}$$

In this notation, $r((1-\theta)S)$ denotes that the interest rate is a function of remaining cash reserves $(1 - \theta)S$ and risk aversion implies that $r' < 0$. Since the structure of the problem do not changes with these assumptions, the closed form solution at Equation 2 remains the same, with the caveat that the interest rate depends on $(1-\theta)S$ and the available resources in the first period are $T_1 + \theta S$. With these new features, however, the relationship between cash reserves and short-term borrowing becomes ambiguous. In other words, cash and debt can behave like complements. Simplifying the notation by dropping the functional dependence of r, the effect of cash on debt is given by Equation 5.

$$\frac{dD}{dS} = -\frac{\beta}{1+\beta}\left[\frac{r' T_2 (1-\theta)}{\beta(1+r)^2} + \theta\right] \tag{5}$$

Since $r' < 0$ then for some levels of θ and S the precautionary role of cash could dominate the operational role and make the previous expression positive. To illustrate this idea consider the boundary cases for the proportion of cash holdings used for cash-flow management. If the government uses all its cash reserves to cover spending needs in the first period ($\theta = 1$), then Equation 5 simplifies to Equation 3 and the operational role of cash determines that cash and debt behave like substitutes. If the government maintains all its reserves to signal solvency ($\theta = 0$), then Equation 5 is positive and the precautionary role of cash implies that cash and debt behave like complements. These two cases underline how liquidity levels influence the decision of the government to manage cash-flows between cash holdings and short-term borrowing. This is consistent with some theoretical implications found by corporate finance literature on liquidity management (Almeida et al., 2004; Kling, 2018).

Solving for the value of θ that determines the direction of Equation 5 yields the implied liquidity constraint observed by the government. Denote $\delta = \frac{r' T_2}{\beta(1+r)^2}$. If the proportion of cash holdings maintained as reserves to signal liquidity and solvency to lenders falls below $\frac{1}{1-\delta}$, then Equation 5 is positive, cash and debt behave like complements, and the government will increase its debt issuance in response to a cash windfall because it has incentives to preserve such cash as reserve and minimize the risk-premium associated with the lack of liquidity. [2]

$$1 - \theta < \frac{1}{1 - \delta} \tag{6}$$

[2] Note that since $r' < 0$, then $\delta < 0$ and $1 - \delta > 0$. An implicit restriction of this model is that $\delta \neq 1$.

Alternatively, if the proportion of cash holdings maintained as reserves is above this threshold, then the government has incentives to reduce its reliance on debt for cash-flow management and use cash holdings instead. This highlights the trade-off on the decision to hold cash: for each additional dollar from cash holdings used to manage cash-flows, there is a reduction on the debt service via a decrease in the amount borrowed, and an increase in the interest payment via a higher interest rate. On the extent that the latter is larger than the former, then the government will prefer to increase its reliance on borrowing albeit facing high borrowing costs.

The prevalence of the precautionary role of cash translates into a liquidity constraint for the government since it implies it needs to hold some cash as reserves to mitigate the effect of the risk premium on borrowing costs and ensure prompt access to debt markets. To examine how the stringency of this constraint is influenced by government cash holdings, suppose there are two governments with different levels of cash holdings $S_0 < S_1$. For simplicity, assume debt pricing is linear on S such that r' is a constant common for both governments. In this case, the government with lower cash reserves faces a larger interest rate $r_0 > r_1$, which implies $\delta_0 < \delta_1$ and the right-hand side becomes larger for the government with lower cash reserves. In other words, governments with lower levels of reserves face a more stringent liquidity constraint as the threshold at which they face interest rate premiums due to lack of liquidity is larger. In response to cash windfall, the government with lower reserves has stronger incentives to incorporate those revenues into its reserves and manage cash-flows through short-term borrowing, despite having cash available.

This model implies that for well-capitalized governments the precautionary role of cash plays a minor role once they hold cash reserves above the level required to minimize their credit risk premium. This is consistent with empirical findings that show small improvements on governments credit rating when rainy day funds are well capitalized (Marlowe, 2011). If cash reserves get too low, then the precautionary role increases the incentives to save cash and minimize the additional debt burden associated with the liquidity risk-premium attached to borrowing costs. These results highlight the dual role that cash reserves have for government financial management and how in order to preserve creditworthiness and access to debt markets, governments will hold cash reserves even if that implies increasing the reliance on short-term borrowing to meet spending targets. This de-facto translates into a liquidity constraint for governments, that is more stringent for governments with low levels of reserves. In the following sections I will test some of the hypothesis implied by this theory of cash reserves and liquidity constraints.

4 Institutional Setting and Budgetary Shocks

State governments in Mexico operate in a shared-revenue system with centralized tax collection done by the federal government. Fiscal revenues are redistributed to state and local governments through several funds and grants in adherence to the rules and formulas established in the Fiscal Coordination Law. This legislation establishes the fiscal rules and procedures that the federal government adheres to in the distribution of funds to other governmental entities.

Historically, states have relied heavily in federal grants to finance state spending. Roughly half of state revenues (48% as of 2022) come from earmarked funds (Aportaciones) that finance the provision of key public services like education, healthcare, security, and some welfare programs. Around 40% of state revenues come from funds with no spending restrictions (Participaciones), that along with the 12% of revenues coming from local tax collection give governments full discretion on the spending of roughly half of their total fiscal revenues (see Figure A.1). This is reflected in the definition of discretionary revenues (DR) set forth in the Fiscal Discipline Law (i.e., the legislation that establishes fiscal rules for state and local governments), which is defined as the sum of own-source revenues and transfers from the Participaciones funds.

Albeit this level of discretion, the structure of state spending limits their ability to create fiscal space to boost large expenditure programs or improve their fiscal stance. Around 75% of state spending goes to cover current expenditures (i.e. payroll and personnel expenses, supplies and materials, contracted services, as well as subsidies and grants to local governments), and 17% goes as a direct transfer to municipalities, where these two spending categories have been highly inertial (i.e. is hard for state governments to reallocate expenses from these categories to others). This leaves states with less than 10% of their spending space to finance capital projects and cover debt service. These factors could arguably explain the persistent fiscal deficits observed by most governments. Between 2000 and 2022, the average net operating balance (difference between total revenues and total expenditures) is estimated at -3.55% of total revenues (See Figure A.2).

For the empirical analysis of this paper I center my attention on the General Participations Fund (FGP henceforth, for its acronym in Spanish), the main federal grant that provides discretionary revenues to state and local governments in Mexico. For instance, between 2018-2022 it represented approximately 71% of total discretionary transfers, and roughly 27% of state's total budgets. The allocation of this fund across state is determined by population size and local economic growth, following the formulas in the Fiscal Coordination Law. Due to the arithmetic structure of the formula, population size is the main determinant of the distribution of funds across states (Arechederra and Carbajal, 2017; Arechederra and Urzua, 2017).

To illustrate the conceptual framework motivating the analysis, define b_i as the annual budgeted FGP allocation for state i and B as the federal budget for the FGP of all states, both for some fixed fiscal year. Hence, $b_i = \alpha_i B$ where α_i is the proportion that state i receives from the national FGP budget computed using the formulas in the Fiscal Coordination Law. Given the population dynamics have been stable over time, state shares α_i have also remained relatively constant (see Figure A.3). Hence, there is few variation in states annual FGP shares explained by changes in states population and economic characteristics.

As part of the federal budget process, each fiscal year the Ministry of Finance first estimates the total size of the fund B, as well as the annual allocations for each state

α_i according to the formulas mentioned above. Then, before the beginning of the next fiscal year, it discloses the monthly calendar with estimated disbursements of all the grants and transfers to state governments, including the FGP. This monthly calendar informs state governments on the pace at which these funds will flow to their local treasuries and influences states spending smoothing along the fiscal year. State governments have no direct influence in the determination of the annual shares of the FGP, nor the monthly calendar. The formulas in the Fiscal Coordination Law set the mechanism to compute the annual shares. However, to the best of my knowledge there is no publicly available information on how the federal government determines the monthly calendar of federal transfers to state and local governments.

Considering this calendar, define the budgeted FGP transfers for state i in month t as $b_{it} = \delta_t b_i$ where δ_t is the proportion of the annual state allocation that gets disbursed in month t. Empirical analysis of data from the monthly calendars from 2018 to 2022 reveal that the federal government assumes the same proportion δ_t for all state governments. This is shown in the top left panel at Figure 3. It stands out that while there is some cyclical component, the monthly shares considered for budgeting purposes differ across fiscal years.

Since federal tax collection rarely coincides with budgeted amounts, in any given month there are differences between the actual FGP transfers (g_{it}) and budgeted ones (b_{it}). For the purpose of this paper, I define these deviations as FGP errors. To be specific, $FGPError_{it} = g_{it} - b_{it}$ is the error observed by state i on month t in some fixed fiscal year. [3] The top panels at Figure 1 display the differences between the budgeted and actual FGP transfers at the national level (left panel) and across state governments (right panel). While in average the distribution to states follows a similar trend to the one observed at the national level, there is some variation across state governments.

Interestingly, there is no systematic relationship between FGP errors at the federal level and the FGP errors observed across state governments. The bottom left panel at Figure 1 shows the distribution of the percentage point difference between the federal FGP error and the one observed by state governments. This difference highlights that there is no systematic pass-through of federal FGP errors to the FGP errors observed by each state. This reveals that there is some unobserved factor driving these temporal differences.

In other words, actual FGP transfers g_{it} could be defined as $g_{it} = \gamma_{it} g_i$, where γ_{it} is the proportion of total annual FGP transfers g_i for state i during month t.[4] The top left panel at Figure 3 shows the variation of γ_{it} across time. It stands out that not only differs from proportions δ_t used in the federal budget, but also has some variation across states i (displayed by the shaded area around the trend line).

[3] It is important to highlight the distinction between forecasting errors as commonly understood in the public finance literature (Brogan, 2012; Williams, 2012; Williams and Kavanagh, 2016) since these FGP errors do not necessarily relate with deviations on the annual budgeted amounts, but rather on the variation on the pace at which such annual allocations are disbursed during the fiscal year. For instance, if federal tax collection is above the expected level during the first part of the fiscal year, then state governments might observe transfers above amounts established on the calendar. Similarly, if federal tax collection falls behind the calendar promised to states, then the latter might experience liquidity shocks through lower discretionary revenues.

[4] Likewise, g_i can be defined as the proportion α_i of total FGP transfers G.

Since the federal government arguably considers proportions δ_t when disbursing the actual transfers, then I define $\gamma_{it} = \delta_t + \upsilon_{it}$ where υ_{it} is an unobserved factor varying across states and time. With this new definition, I rewrite FGP errors as a function of the annual and monthly shares, as well as this unobserved factor, $FGPError_{it} = \alpha_i\big[\delta_t(G - B) + \upsilon_{it}G\big]$. Figure 2 shows the variation of FGP errors across states between 2018 and 2022. The left panel shows the distribution of these errors. First, it stands out that while most of the variation is within a deviation of +/- 10%, there are some cases in which states observed larger revenue shocks. Moreover, the interquartile range (shaded area in the graph) reveals that for the same month, while some states observed a positive deviation, others experienced a negative one.

To explore further the variation from these errors, the right panel shows the variation of FGP errors not explained by state and time invariant factors. That is, the residuals from a running a regression of FGP errors on state and time fixed-effects. Assuming the definition above is correct, then these residuals should capture the unobserved factor υ_{it}. This graph reveals that the unexplained variation in FGP errors mimics a random walk. This plausibly exogenous revenue shock is particularly relevant for cash flow management as it could translate into liquidity pressures for governments given the relevance of the FGP on state revenues.

Albeit each state experiences FGP errors of different magnitudes, at the end of the fiscal year the cumulative difference between budgeted and received transfers does not seems to vary systematically across states. Hence, there should not be relevant concerns on some states experiencing consistent surpluses (or deficits) on this fund across time (see bottom right panel at Figure 1). In other words, annual errors are not systematically benefiting (or harming) a specific group of states. This provides some suggestive evidence on the states sharing similar risk exposure to liquidity shocks stemming from FGP errors.

While there are tools and fiscal rules that help states to cope with liquidity shocks and smooth their cash flows during the fiscal year, these instruments do not explicitly deal with FGP errors. For instance, every four months the Ministry of Finance makes a compensating transfer to some states depending on whether FGP shares were computed accurately with the information available. This compensating transfer could either take the form of cash windfalls (if FGP shares were underestimated) or payment from the state to the federal government (if FGP shares were overestimated).[5] These compensations are designed to address any differences on states annual FGP allocations α_i. They are not related to the total size of the fund nor its monthly calendar. Furthermore, since the shares had been relatively static over time, adjustments from this source fade out as a proportion of total DR.

Another liquidity management tool states could access is the revenue stabilization fund for state and local governments (i.e. FEIEF, for its acronym in spanish, a rainy-

[5]The Fiscal Coordination Law establishes that FGP shares should be estimated with the latest information available on states population. When the federal budget is crafted, the Ministry of Finance uses the results of a quarterly employment survey conducted by the National Statistics Agency (INEGI, for its acronym in spanish) for this calculation. However, when INEGI releases the official figures on population (usually during the first quarter of the calendar year), the Ministry of Finance updates the calculation of the FGP shares and compensates for any positive (or negative) deviation.

day fund for states funded at the federal level). However, states cannot tap into this fund at their discretion. These transfers are triggered whenever, due to lower tax revenues at the federal level, the observed transfers of all Participaciones funds are below the budgeted amounts for that fiscal year. In this case payments to each state are proportional to their specific difference between budgeted and paid amounts.

While this tool could alleviate some of the liquidity pressures created by FGP errors, in the past years the size of this fund has decreased significantly. For instance, in 2018 the endowment of this fund reached historically high levels (approximately 110 billion pesos), yet after the disbursements done in 2019 and 2020 the size of this fund dropped to 30 billion pesos by the end of 2021, and 20 billion pesos in 2022. This has led to pressing concerns on this rainy day fund being underfunded and therefore insufficient to cover liquidity gaps on state budgets (Fitch Ratings, 2019, 2021, 2023a,b). Moreover, the transfers observed by state governments through this channel are relatively small when compared to the magnitude of the annual FGP surplus/deficit. Hence, in the best scenario this tool could partially alleviate some of the liquidity gaps experienced by state governments.

In sum, Mexican state governments are exposed to liquidity risks stemming from budget errors on the main source of discretionary revenues. These FGP errors contain some unobserved component that mimics a random disturbance, which could translate into relevant liquidity shocks. Moreover, state governments in Mexico have reduced fiscal flexibility that effectively constraints their space to cutback spending or increase own-source revenues. Along with the absence of rainy-day funds, these governments have few strategies to generate financial slack that allows them to cope with these liquidity shocks.[6]

5 Empirical Model

5.1 Data

For the empirical analysis, I rely on data from several public sources. Data on states cash reserves and short-term debt comes from the forms submitted by state governments to the Ministry of Finance in compliance with the Fiscal Discipline Law that requires subnational governments to report on quarterly basis information on their main financial and fiscal indicators, including cash holdings, current liabilities (including short-term borrowing), as well as details on their outstanding loans including borrowing costs, percentage of revenues used as collateral, and maturity.[7]

Relying on web and text scraping techniques, I collected and processed all available forms to build a strongly balanced panel of state governments with quarterly observations of these financial variables. Since the Fiscal Discipline Law was enacted in 2016, information is available starting in the 1Q-2017. However, it was until 1Q-2018 that the Ministry of Finance required states to report data on their cash

[6] As of 2023, only five states (Aguascalientes, Baja California, Campeche, Oaxaca, and Zacatecas) and Mexico City have a state-level rainy day fund.

[7] The data on these forms is used by the Ministry of Finance to determine each state's long-term debt ceiling through the indicators of the early warning system (Sistema de Alertas).

holdings. For this reason, the empirical analysis looks only at quarterly data from 2018 to 2022.

Information on state government's fiscal structure comes from the statistics of state and municipal public finance available at INEGI. This data set comes from an annual survey that gathers information on state and local revenues and expenditures. With this data I calculated the level of annual DR for each state according to the definition described on the previous section. Credit ratings information was web-scrapped from Fitch Ratings website. This data set contains all credit rating actions observed by state governments since they got their first rating from the agency.[8] Data on economic covariates as the state level comes from both INEGI and the Ministry of Finance.

To compute the FGP errors described in the previous section I used the monthly data on IG transfers to state governments (available at the Ministry of Finance website), as well as each annual publication of the disbursement calendar of IG grants and transfers (available at the Official Registrar). To build the final sample used for the analysis I exclude the state of Tlaxcala and Mexico City as their institutional setting differs from other states.[9] This leads to a strongly balanced panel of 30 states across 20 quarters covering from 2018 to 2022. From this panel, I drop from the sample the observations for the State of Mexico and Morelos for 4Q-2018, as well

[8]A couple of states (Nayarit and Tabasco) are not rated by Fitch Ratings, for those states I took the ratings provided by local agency HR Ratings and coded them according to the scale equivalence between agencies.

[9]Tlaxcala has a no public debt policy, hence according to state law the government is not able to borrow money. Much like Washington D.C. in the case of the United States, Mexico City's status as the capital state/city results in different fiscal institutions than the other states.

as Durango for 3Q-2021, since these states did not reported information on these relevant variables for such period.

5.2 Research Design

To examine the role of cash reserves on short-term borrowing, adhering to the previous literature (Lofton and Kioko, 2021; Su and Hildreth, 2018) I consider the following reduced-form regression model. In this notation $ShortTermDebt_{it}$ and $CashReserves_{it}$ denote the level of outstanding short-term debt and the stock of cash reserves held by state government i by the end of quarter-year t, respectively.

$$ShortTermDebt_{it} = \delta CashReserves_{it} + X_{it}\alpha + a_i + b_t + \epsilon_{it}. \tag{7}$$

Both dependent and independent variables are expressed as stocks (rather than flows), and as percentage of each state's average DR between 2009 and 2016. This window is designed to exclude observations that capture the effects of the Great Recession and that are before the enactment of the Fiscal Discipline Law, which changed significantly the regulation faced by state and local governments in Mexico.[10]

[10] A benefit from studying these variables as stocks is that it shows net changes in borrowing/saving behavior. For instance, an increase in outstanding short-term debt implies that the amount of short-term debt issued surpassed the amount of short-term debt paid. Similarly, with the stock of cash reserves. An increase in the level of reserves implies cash inflows were larger than cash outflows. These measurements provide a more detailed view on how liquidity pressures shape cash flow management.

The motivation behind this scaling follows several rationales. First, DR provide a direct measurement of government funds that could lead to an increase in cash holdings as there is no room for slack generation on earmarked transfers. For this same reason, short-term debt can only be covered with DR. This implies that coefficient estimates from this model capture changes in the overall stock of debt, expressed in units proportional to each state's space for liquidity management.

Second, while previous literature has used current expenditures as scaling variable (Su and Hildreth, 2018), without proper measurement of the proportion of these expenditures financed through earmarked transfers, scaling by this variable might lead to wrongful comparisons as the denominator might capture the heterogeneity in the relevance of earmarked transfers in each state budget. Third, DR is one of the main definitions used in the Fiscal Discipline Law to establish expenditure limits and debt ceilings. Hence, the estimates from this model are expressed in units relevant to state policymakers.

The vector of controls X_{it} includes measures of fiscal structure like current expenditures as percentage of total expenditures, contemporaneous DR as percentage of total revenues,primary (net operating) balance as percentage of total revenues, and the FGP surplus/deficit observed in the previous fiscal year, as percentage of contemporaneous DR. From these controls, it stands out that the average government in this sample observed negative net operating balances equivalent to 6.02% of their DR (see Table 1 and Figure A.2).

To account for factors driven by the conditions under which state governments access the debt market, this vector also includes a discrete credit rating variable, taking values from 1 (AAA) to 6 (not rated), the percentage of FGP funds that are pledged as collateral for long-term debt (53.3% for the average state in the sample) , and the level of outstanding long-term debt as percentage of total outstanding debt (67.2% for the average state in the sample). Including these factors as control variables stems from the fact that FGP funds are the backbone of the municipal debt market in Mexico as they are the main payment source of long-term loans. The fungibility and long-run stability of this fund makes standard practice in the Mexican debt market to assign a percentage of the cash-flows from the FGP as main payment source (and collateral) for long-term loans.[11]

In addition, to capture changes in short-term debt issuance driven by regional economic factors I include as controls the unemployment rate and the number of active taxpayers, both with variation at the quarterly level. To account for the composition of the labor force as well as different consumption patterns that could influence state spending, this vector includes the percentage of the population at different age groups (below 18, between 19-35, and between 36-65 years old). These latter variables vary at the annual level. Moreover, since liquidity management could be influenced by the seasonality of tax collection, I include quarter-by-year fixed effects b_t in all econometric specifications.

[11] It should be noted that this feature is only available for long-term loans. According to the Fiscal Discipline Law, short-term loans can only be used for cash-flow management purposes while long-term loans can only be used for capital projects financing. The legislation prevents state and local governments from managing cash flows through long-term debt. For this reason, short-term loans are always unsecured.

Altogether, these control variables and the time fixed-effects should partial-out some of the factors explaining structural liquidity pressures driven by revenue and expenditure profiles, as well by state capacity for excess slack generation. Thus, the remaining variation in the distribution of outstanding short-term debt ought to be explained by liquidity needs faced during the fiscal year, which are arguably proportional to the level of cash holdings held by states.

5.3 Instrumental Variable Design

As discussed in Section 3, the sign of δ is theoretically ambiguous as it depends on the stringency of the liquidity constraints faced by state governments. Previous literature estimate $\hat{\delta}$ to be negative for US local governments, suggesting that increased cash holdings reduce the propensity to issue or hold short-term debt (Lofton and Kioko, 2021; Su and Hildreth, 2018). However, as described in Section 4, state governments in Mexico operate in an environment with lower fiscal flexibility and are likely to observe stricter liquidity constraints. Hence, it is reasonable to hypothesize that δ could be positive for this set of governments.

A challenge on estimating this parameter via OLS, however, is the endogeneity bias induced by the reverse causality between cash reserves and short-term borrowing. Under stringent liquidity constraints, governments might adjust their cash reserves based on their borrowing needs. Governments may opt to utilize short-term borrowing as a means to maintain their cash reserves and preserve their creditworthiness (Marlowe, 2011). Similarly, managers may choose to refrain from utilizing financial slack in order to maintain fund balances at prudential levels (Joyce, 2001; Kriz, 2003; Marlowe, 2011) in order to secure long-term access to financial markets.

Furthermore, unobserved local economic factors could influence both cash holdings and short-term borrowing, thus confounding the relationship. For instance, improvements in local economic activity lead to higher own-source revenues and potentially increase cash holdings. If stronger local economic growth results in lowering deficit spending due to larger tax revenues, then omitted variable bias stemming from this source could downwardly bias OLS estimates of parameter δ in Equation 7.

To address this issue I use the quarterly budget errors on FGP transfers as an instrumental variable for cash reserves. To keep consistency with the dependent and independent variables, this instrument is also scaled by the average annual DR between 2009 and 2016. [12]This yields the following system of equations that describes the first stage and the reduced form estimated for this analysis.

$$CashReserves_{it} = \beta FGPError_{it} + X_{it}\alpha + a_i + b_t + \epsilon_{it} \tag{8}$$

$$ShortTermDebt_{it} = \delta Cash\hat{R}eserves_{it} + X_{it}\gamma + a_i + b_t + \omega_{it} \tag{9}$$

Estimation of this model is done using a 2SLS estimator with fixed effects. To assess the extent to which these estimates could be driven by omitted variable bias I

[12]This time-invariant scaling factor is estimated outside the analysis period to avoid inducing mechanical endogeneity due dividing the relevant variables by a contemporaneous transformation of the variable used as instrument.

present estimates under specifications with and without the vector of control variables and state fixed effects. The preferred specification of this paper, however, includes controls and both sets of fixed effects. Statistical inference is done assuming robust-clustered standard errors at the state level.

In this case, coefficient $\hat{\delta}$ captures the local average treatment effect (LATE) of an increase of cash reserves on the outstanding amount of short-term debt held by state governments. For this estimate to be causal, however, the identification assumptions of an instrumental variables design need to hold. In other words, cash holdings should be correlated with FGP errors (relevance assumption) and should only influence the decision to borrow through its effect on cash holdings (exclusion restriction).

Descriptive statistics at Table 1 and Figure A.4 lend some evidence on the relevance assumption. For instance, the average state government in the sample has outstanding short-term loans equivalent to 5.19% of their historic annual DR, whereas cash reserves represent 22.89%.[13]Quarterly FGP errors in average mounted to -0.43% of annual DR, with a standard deviation of 2.35%, varying between -11.35% and 8.48%, and where 60% of the observations were negative (i.e. paid amount was below the budgeted one).

To add some context to these statistics, if an average state on a given quarter observes a FGP error that is within one standard deviation of the observed distribu-

[13]It stands out that most governments hold cash reserves above the 5% percent rule of thumb commonly found in the public finance literature (Marlowe, 2005, 2011).

tion of this variable, this shock would be equivalent to approximately 12.1% of that state's cash holdings. This highlights the magnitude and thus the relevance of the instrument on cash reserves. In addition to this descriptive evidence, I directly test for the relevance assumption following standard practice on instrumental variable literature by conducting a Cragg-Donald test for weak instruments. When there is only one endogenous regressor, this corresponds to the F-statistic on the first stage regression (Stock and Yogo, 2005).

Satisfying the exclusion restriction implies arguing for no-back door influence of FGP errors on short-term borrowing (Cunningham, 2021; Huntington-Klein, 2022). The characteristics of the institutional setting through which FGP funds are allocated and disbursed lends some support to this idea. First, the distribution of annual FGP shares has been historically stable. Hence, the underlying variation of FGP errors does not systematically varies with population dynamics and regional economic growth. To support this hypothesis, in Section 7 I test the predictive power that FGP errors have on measures of local economic activity.

Second, observed FGP transfers are determined by national tax collection. A benefit of revenue-sharing systems is that they average-out the variation that regional economic activity has on centralized tax collection. Furthermore, tax collection is done by the federal government, with no intervention of state governments. Hence, any variation potential associated with the bureaucratic aspects of tax collection is likely uncorrelated with state-specific characteristics. These factors highlight the limited influence that state governments have on the pace at which tax revenues are collected and, therefore, the magnitude of the potential deviation from the FGP monthly calendar.

Third, since state governments have no direct influence on the formulation of the disbursement calendar, any variation on FGP errors driven by bureaucratic idiosyncratic factors should be associated with the characteristic of the federal government, not state governments. However, state governments might adjust their borrowing behavior considering past observations of FGP errors in IG transfers, including the FGP. To address this concern, the regression model considers both quarter-by-year and state fixed-effects. Together, this set of fixed-effects should partial-out any variation driven by the seasonality of tax collection, as well as any components related to long-term state fiscal policy. Hence, the remaining variation in short-term borrowing should not be correlated with any seasonal or state-specific factors that could be present on FGP errors. Altogether, these factors suggest that the underlying variation of FGP errors (i.e., the unexplained component υ_{it} described in Section 4) mimics a random revenue shock and, therefore, the exclusion restriction likely holds in this setting. Nonetheless, in Section 7 I conduct robustness checks that examine some scenarios where the validity of the instrument might be hindered.

6 Results

Table 2 contains the estimates for the baseline model. Panel A shows estimates of $\hat{\delta}$ using OLS while Panel B depicts the results using the 2SLS instrumental variable approach. For the preferred specification both OLS and 2SLS point towards a positive and statistically significant relationship (5% level) between outstanding short-term debt and cash holdings. OLS results imply that increasing cash holdings by one unit leads to an increase in short-term borrowing equivalent to 9.3% of DR. IV estimates, on the other hand, suggest this effect is larger as the coefficient estimate implies an increase equivalent to 24.6% of DR.

To assess the magnitude of the effect size, suppose that cash reserves observe an increase equivalent to one standard deviation (i.e. 15.5% of DR). In this case, the implied effect from the 2SLS coefficient is equivalent to an increase in outstanding short-term debt of 3.75% of the annual DR. This is approximately 0.6 times the standard deviation of outstanding short-term debt. In other words, a standard deviation increase on cash reserves leads to an increase in outstanding short-term debt of 0.6 standard deviations. Considering this result is calculated using the same units for both variables, it provides a direct measure of the implied elasticity between cash reserves and short-term debt.

Coefficient estimates from the first stage regression show a positive and statistically significant relationship between cash holdings and FGP errors across all specifications. For the preferred specification this estimate suggests that a positive (quarterly) FGP error equivalent to one percent of annual DR leads to an increase of cash reserves equivalent to 1.46% of annual DR. These results support the view that governments characterized by low fiscal flexibility are more likely to accumulate financial slack when available (Hendrick, 2006; Joyce, 2001). Specifications with state fixed effects show first stage F-statistics above 24, thus clearly rejecting the null hypothesis of under-identification and giving evidence on the strength of the instrument.

The results at Table 2 showcase how endogeneity bias might be present in OLS results, as well as the extent to which such bias is addressed by the instrumental variable. Panel A shows that in the absence of control variables and state-fixed effects, OLS estimates suffer from attenuation bias and are sensitive to the econometric specification. The first column in Panel A suggests a strong and negative relationship between financial slack and short-term borrowing. After including the vector of control variables, the effect increases from -0.15 to -0.04 percentage points. The sign of this coefficient flips when including state fixed effects, and increases in magnitude and precision once controls and such fixed effects are considered on the estimation.

Estimates from the 2SLS estimation at Panel B, in contrast, point towards a positive relationship between cash holdings and outstanding short-term debt at all specifications. These results are consistently larger than their OLS counterparts and are less sensitive to the presence of controls and state-fixed effects. This reduced variability suggests the instrumental variable is effectively addressing the endogeneity bias present in OLS. Moreover, finding increased estimation precision as controls and state fixed effects are included in the specification supports the view that these components alleviate omitted variable bias concerns, yet do not solve the potential endogeneity between cash and short-term debt.

6.1 Mechanisms

Cash Reserves: As described in Section 3, the stringency of the liquidity constraints determines the direction and magnitude of coefficient δ. To test this hypothesis I partitioned the dataset according to the distribution of cash reserves observed in 2018. That is, creating four groups with the same number of states where each group contains the states at each quartile of the distribution of cash reserves. This allows to compare the magnitude of the effect of cash reserves on short-term borrowing, holding constant the level of cash reserves observed by each state at the beginning of the analysis window.

Table 3 shows the results for this analysis. Descriptive statistics reveal that outstanding short-term debt is larger for states with lower cash reserves. While the average of the dependent variable for the states on the first quartile was approximately 6.9% of historic annual DR, this statistic monotonically decreased until reaching 2.6% for the states at the top quartile. This is consistent with a model where governments prefer internal financing over external financing if they have some idle reserves, and supports the view that short-term borrowing is shaped by the stringency of the liquidity constraints.

The predictive power of the instrument is only present at the bottom two quartiles of the distribution, to the extent that the Cragg-Donald F-statistic is decreasing along the cash-reserves distribution. This is consistent with the hypothesis tested as governments with lower cash reserves observe larger liquidity shocks stemming from FGP errors. To examine whether this weak-instrument problem is explained by the level of cash holdings, Figure A.5 shows the distribution of cash reserves and FGP errors across the quartile-groups used for this analysis. This graph reveals no systematic variation on the instrument across these groups. Neither the magnitude, nor the direction of the liquidity shock induced by FGP errors is correlated with the level of cash holdings. This rules out the possibility of the instrument strength being solely determined by the distribution of cash reserves across governments. The results for the second quartile show that a one standard deviation increase in cash reserves leads to an increase in outstanding short-term debt equivalent to 5.3% of DR, which yields an implied elasticity of 0.77, significant at the 10% level.

Credit Rating: Creditworthiness plays a crucial role when accessing debt markets. Ratings provide useful information to lenders on government's solvency and their capacity for repayment.[14]Moreover, the effects of cash-reserves and short-term debt on credit ratings work in opposite directions. While large cash holdings increase state's solvency, high levels of leverage increase credit risk perceptions among lenders. In this sense, governments face incentives to hoard cash for credit quality maintenance (Marlowe, 2011), even if that derives in increasing their level of indebtedness. This implies that lower-rated governments might use short-term borrowing over cash reserves to finance liquidity gaps, albeit facing relatively higher borrowing costs associated to their credit risk premium. In other words, lower rated governments likely face more stringent liquidity constraints and hence cash reserves have a

[14]This is particularly relevant for the Mexican debt market as short-term loans must be unsecured.

stronger effect on short-term debt.

To examine this hypothesis, I partitioned the sample in four credit rating groups: i) AAA, ii) AA, iii) A, and iv) BBB,BB. States with rating below or that were not rated in a specific quarter were excluded from this analysis. Table 5 shows the results of estimating Equation 9 in each group. Descriptive statistics show that levels of outstanding short-term debt are decreasing with credit ratings. That is, lower rated governments rely in larger proportion on short-term borrowing. This is likely consistent with the results found at Table 3 since higher rated governments tend to be better capitalized.[15]

With the exception of AAA-rated states, first stage coefficients are significant for all rating groups. Given that the majority of the sample is at the A-rated and BBB,BBB-rated groups, both the fist-stage coefficients and the point estimates for $\hat{\delta}$ show improved statistical precision at these models. These results show that increasing cash reserves by one standard deviation leads to an increase in outstanding short-term debt of 3.3% DR for A-rated governments and 8.3% DR for BBB,BB-rated governments. The implied elasticities for these groups are 0.54 (significant at the 10% level) and 1.33 (significant at the 5% level). These results align with previous literature finding that government's incentives to hoard cash decrease as their credit rating rises (Marlowe, 2011). Moreover, this lends support to the tested hypothesis where lower rated governments face more stringent liquidity constraints,

[15]This result also suggest that any potential frictions faced by lower-rated governments when accessing the debt market do not necessarily translate into stringent entry-barriers as these governments are able to obtain loans from the banking sector.

hence are more likely to finance liquidity gaps through short-term debt so they keep cash reserves to preserve their credit rating.

The intuition behind the previous results, however, challenges pecking order theory since lower-rated governments are more likely to observe higher borrowing costs on bond markets (Capeci, 1991; Johnson and Kriz, 2005). Under this theory, managers prefer internal financing because costs from external financing might be too high or do not reflect accurately the organization's creditworthiness. Government's incentives to manage cash flows via cash reserves increase along with the borrowing costs they face (Myers, 1984; Su and Hildreth, 2018). In other words, governments might choose cash financing over short-term borrowing so long the net benefits of using financial slack outweigh the borrowing costs observed in financial markets. This could be consistent with situations where managers accumulate cash as a way to hedge against uncertainty in the external environment (Hendrick, 2006; Sharfman et al., 1988).

Liquidity Management and Non-Defferable Expenses: One of the main threats to validity this instrument face is associated with the seasonality of the distribution of FGP errors. If FGP errors follow a systematic pattern within the months of the fiscal year, then this could pose a threat to validity if governments adjust their borrowing behavior in anticipation to the liquidity shock. The right panel at Figure 3 provides some descriptive evidence on this issue. From this panel it stands out that the average FGP error is negative at all months, with the exception of January, February, and April. Moreover, the largest negative deviation usually appears during June, followed by a reduction in the variation of the errors for the rest of the year.

The bottom left panel at Figure 3 provides more nuanced evidence towards this idea as it shows the variation of monthly FGP errors by states. Visual inspection of this figure reveals no apparent differences on the magnitude of the FGP errors. In other words, if there is some systematic component driving the variation of FGP errors, it does not seems vary across states. Hence, it likely influences states in the same way.

State finances observe a seasonal component around the ending/beginning of the fiscal year as they engage in liquidity management strategies to accommodate end-of-year (e.g. payroll benefits) and non-deferrable expenses.[16] Figure 4 highlights this point. Each panel shows the temporal distribution of the outstanding short-term debt and cash-reserves during the analysis period. From both figures stand out a marked peak/dive on the levels of debt and cash, respectively. That is, states tend to simultaneously observe an increase in short-term borrowing and a decrease in cash holdings during the last quarter of the fiscal year.

This could be explained by governments rushing to meet some of the budgetary targets placed on contracted services and federal IG transfers, thus requiring additional slack to cover end-of-year spending. Furthermore, the trend on the average levels of cash and debt show that states tend to decrease the levels of short-term borrowing during the first 3 quarters, thus freeing up space to accommodate the

[16] In Mexico, the fiscal year aligns with the calendar year for both federal and state governments.

borrowing needs of that fiscal year. Similarly, the trend on the average level of cash reserves shows immediate rebounds on cash-holdings after the decrease commonly observed during the fourth quarter. Then states build-up reserves during 2Q to observe a slight decrease in 3Q, probably associated with early liquidity management strategies.

Considering these factors, to test the robustness of the results at Table 2 to this seasonal variation I estimate the preferred specification of Equation 9 within the observations from the same quarter.[17] Table 4 shows that the predictive power of the instrument concentrates mainly on the 2Q and 4Q sub-samples. Since the strength of the instrument relies on the magnitude of the deviation, this is consistent with the descriptive evidence at Figure 3 showing that, in average, the largest deviation appears in June.

Point estimates for the model on 4Q (column 4 at Table 4) show that if cash reserves increase by one standard deviation, then outstanding short-term debt increases by 6.7% of DR, which yields an implicit elasticity of 0.85 (significant at the 10% level). While estimates at Table 4 might suffer from a weak-instrument problem due to the smaller sample size at each sub-sample, the slightly larger elasticity between cash and debt estimated at the 4Q sub-sample is within the magnitude of the baseline estimation. If baseline results are mainly driven by the variation observed during the last quarter of the year, then estimates for the 4Q sub-sample confirm the overall findings at Table 2 since adding the variation from the other quarters leads

[17]Under this specification, the quarter-by-year fixed effects are automatically replaced by year-fixed effects as now they effectively vary only by year.

to precision gains on coefficient estimates.

On the other hand, if states liquidity management strategies take place across the fiscal year, then a direct comparison of the estimates on each quarter sample allow to directly test the influence of liquidity constraints stringency on the relationship between cash and debt. Cash reserves reach their lowest point during this quarter while outstanding short-term borrowing is at is peak. Hence, liquidity constraints during 4Q are arguably more stringent relative to other quarters of the year. Results at Table 4 align with this view, albeit observing large standard errors on the estimates for the other quarters. In any case, when comparing 4Q results with the coefficients from the other sub-samples, as well with the baseline estimates, the larger implied effect in the 4Q sub-sample lends support to the tested hypothesis as it shows stronger effects when liquidity constraints are tighter.

7 Robustness Checks

7.1 Instrument Validity

If FGP errors are correlated with regional economic activity, then they might influence short-term borrowing through channels different from cash reserves. For instance, upon a regional slowdown, state governments might finance counter-cyclical spending via short-term debt. This poses a threat to validity as it represents a violation of the exclusion restriction. To rule out this scenario I estimate Equation 8 using several predictors of local economic activity as dependent variable. In particular, I consider state-by-quarter measurements of the unemployment rate, the number of active taxpayers (as percentage of the population), the industrial activity index (i.e. that tracks secondary production activities), the quarterly economic activity index (ITAE, for its acronym in spanish, an index that serves as and advanced estimate of states GDP), and the level of informal labor (as percentage of the population).[18] This could be interpreted as placebo tests since the validity of the exclusion restriction is consistent with finding no effects on this test.

Table 6 shows the results for this analysis. For the preferred specification, FGP errors are not a relevant predictor of any of the measures of regional economic activity. With the exception of the model on the quarterly economic activity index, the models on the rest of predictors (across econometric specifications) yield coefficient estimates for FGP errors virtually equal to zero. Albeit the model on the quarterly economic activity index shows a positive coefficient, this is not precisely estimated when accounting for state fixed-effects, thus suggesting that results on columns (1) and (2) might suffer from omitted variable bias. Together these results lend strong support to the validity of the exclusion restriction in this case as FGP errors are not correlated with local economic activity. Hence, any influence on short-term borrowing is likely operating through levels of cash holdings.

[18]Since the unemployment rate and the percent of active taxpayers are control variables for the baseline model, they are excluded from the set of controls considered for this analysis.

7.2 Alternative Instrumental Variables

Section 4 shows that FGP transfers are the main source of DR for state governments and therefore provide useful variation to study the liquidity shocks faced by these governments. However, these budget errors are not only present in FGP transfers. The publication on the Official Registrar that discloses the disbursement calendar for FGP transfers includes the planned disbursements of the main discretionary (Participaciones) and earmarked (Aportaciones) funds that state governments receive each year.

Given that deviations from the budgeted amounts on the rest of grants that states receive from the federal governments could also translate into liquidity shocks, as a robustness check I test the sensitivity of the results at Table 2 for different choices on the instrumental variable used to partial-out the endogeneity between short-term borrowing and cash reserves. Table 7 shows the results of the 2SLS estimation using three alternative instrumental variables, budget errors on: i) all discretionary IG transfers, ii) all earmarked IG transfers, and iii) all IG transfers.

Results from the model using budget errors on all discretionary IG revenues, albeit showing a strong first-stage, they lack of statistical precision and imply no significant relationship between cash reserves and short-term borrowing. Finding strong first-stage results is intuitive as the FGP represents approximately 75% of total discretionary IG transfers, thus the budget errors from this fund mainly drive the variation present in this alternative instrument. The remaining 25% of discretionary

IG transfers includes grants funded with the revenues from use taxes on tobacco, alcohol, and gasoline, as well as property taxes on cars, fiscal incentives related to local tax collection, and oil revenues. The determinants of each state's allocation on each of these funds depends more on their regional economic activity and the policies they implement to strength their local tax collection. This could hinder the validity of the instrument as it could pose a violation of the exclusion restriction since factors shaping local economies could influence states incentives to engage in short-term borrowing.

On the other hand, given the reduced fungibility of earmarked IG revenues, this instrumental variable has no predictive power on the levels of cash holdings. A similar story is found on the results where all IG transfers are used as instrument. Moreover, the reduced-form results form these two specifications lead to inconclusive results with large standard errors.

Altogether, the results from the models with these alternative instruments show that states budgets are more sensitive to liquidity shocks stemming from budget errors on discretionary transfers, rather than the ones coming from earmarked ones. Since the FGP is the main source of DR and is less driven by factors associated with the local economic activity, it represents the best alternative for a source of plausibly exogenous variation to partial-out the endogeneity bias that could contaminate OLS estimates.

7.3 Alternative Specification: Heckman Selection Model

Literature in short-term borrowing often models debt issuance as a two-stage process in which the government first chooses whether to issue (or not) debt, and in a second step decides how much debt to issue. Statistical modeling is done through Heckman-type selection models (Su and Hildreth, 2018) or hurdle models (Lofton and Kioko, 2021) that explicitly deal with each stage of this process. As a robustness check, following Su and Hildreth (2018) I estimate a Heckman selection model on this sample using the two-step estimation algorithm proposed by Heckman (1979). Similar to an instrumental variable design, Heckman models require satisfying an exclusion restriction to yield causal estimates: there should be a variable in the selection equation that is excluded from the outcome equation. This variable acts as an instrument for selection into the sample (i.e., it only affects the outcome through the selection equation). For this estimation, the selection equation I consider is a Probit model on the probability of increasing the amount of outstanding short-term debt on the instrumental variable $FGPError_{it}$, the vector of controls X_{it} used in the baseline model, as well as state, quarter and year fixed effects (implemented via dummy variables). To identify the extent to which estimates on the outcome equation are sensitive to the econometric specification, I keep the selection equation constant across models. That is the reason behind coefficients at Panel B of Table 8 being constant across models.

There are a couple of methodological differences between the model I estimate and the specification at Su and Hildreth (2018). First, while not stated explicitly, the excluded instrument in Su and Hildreth (2018) is the local unemployment rate. In this case the exclusion restriction requires that incentives to issue short-term debt respond to changes in the unemployment rate, but the amount of debt issued is not determined by observed employment levels. So long local employment influences both the decision to borrow and the amount borrowed, then results could lead to biased estimates of the effect of cash holdings on short-term debt. To overcome this challenge in my setting I use FGP errors as the excluded instrument. This also allows to keep consistency with the baseline results. Second, my selection model includes state and quarter and year fixed effects while Su and Hildreth (2018) only includes the vector of explanatory variables.

Table 8 shows the results. Similar to the findings at Table 2, the specifications without state fixed effects point towards a negative relationship between cash and debt. However, this effect seems to be attenuated by omitted variable bias since including state fixed effects and controls leads to positive estimates, although not significant at traditional levels. Results from the model without controls and state fixed effects yields estimates similar to the ones at Su and Hildreth (2018) which imply that an increase of one percentage point on operating expenses, short-term notes (as a percentage of general fund revenues) decreased by 0.193 percentage points.

The results from the first two columns in Table 2 imply a negative relationship between short-term borrowing and cash holdings. The main results at Su and Hildreth (2018) align with these findings since their coefficients imply that with an increase of one percentage point on operating expenses, short-term notes (as a percentage of general fund revenues) decreased by 0.193 percentage points.

A potential limitation of two-stage selection models in this setting is that they aim to address the sampling bias on the decision to issue debt. Yet, this approach does not necessarily solves the endogeneity between cash reserves and short-term borrowing. On the extent the factors driving the sampling bias coincide with the ones behind the endogeneity between cash and debt, then this issue does not represents a threat to validity. In such case, point estimates from the Heckman model should be similar to baseline IV estimates. The general direction and magnitude of the coefficients from the Heckman model align with the findings from the OLS estimation at Table 2 and yield lower estimates relative to the results from the baseline IV estimation. This could be consistent with a scenario where the Heckman model could alleviate the sampling bias, but not the endogeneity bias. Alternatively, it could be explained by a weak-instrument problem in this setting. [19]

The results of this analysis shed some light on the previous findings of the literature using this type of empirical models (Lofton and Kioko, 2021; Su and Hildreth, 2018). If factors driving the decision to issue debt are correlated with the levels of cash reserves, but such levels do not influence the amount of debt issued (i.e. the exclusion restriction for the Heckman model is satisfied), then the two-stage Heckman estimator will yield unbiased estimates of the effect of cash on debt. Note this is consistent, with a model in which the governments studied in these papers (i.e.

[19] A potential explanation behind the weaker results found on the selection equation is the limited variation on the binary outcome used as dependent variable as it overlooks the magnitude on the increase/decrease of outstanding short-term debt and only captures net increases in this variable.

California and New York municipalities) do not face stringent liquidity constraints. Alternatively, if the amount of debt issued by these governments is influenced by their levels of cash holdings, then results presented in these studies constitute lower-bound estimates of the effect of cash on debt, as they could be downwardly biased due to the potential endogeneity of these two variables. In any case, the evidence from this analysis lends support to the view that Mexican state governments experience more stringent liquidity constraints relative to US municipalities previously studied in this literature.

8 Conclusions

Liquidity management is essential to smooth cash flows during the fiscal year and ensure there are no significant disruptions in the delivery of public goods and services that could derive in negative welfare effects for the population. This paper provides fresh evidence of the relationship between cash holdings and short-term borrowing in a setting where subnational governments observe low fiscal flexibility and face strict liquidity constraints. The findings from this paper suggest that, under these conditions, governments are more prone to cope with liquidity shocks through short-term borrowing, instead of using cash reserves. These results highlight the precautionary role of cash reserves to signal solvency and ensure access to financial markets.

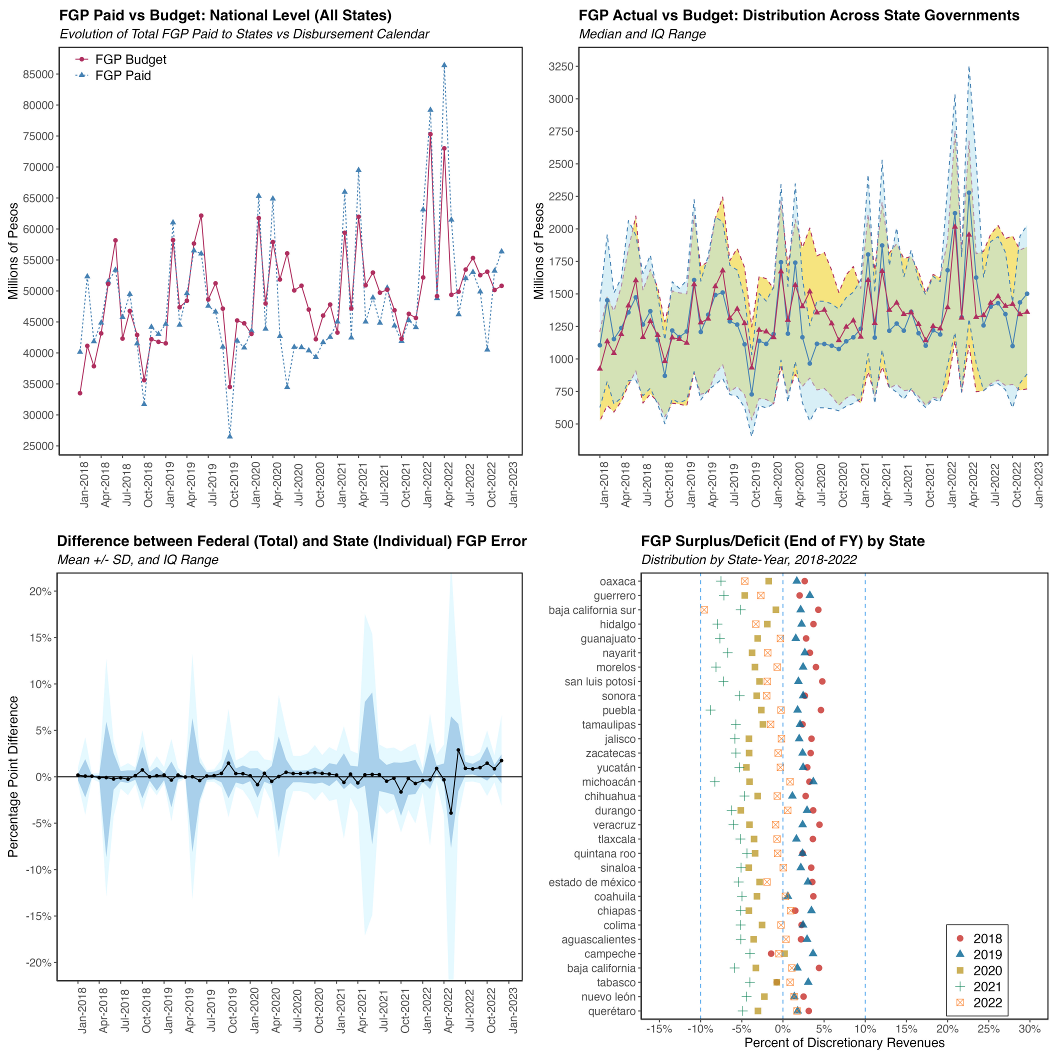
While past literature has dealt with the sampling bias of short-term borrowing, previous studies have not directly addressed endogeneity concerns between short-term debt and financial slack. Economic conditions can simultaneously influence both the available cash reserves and the need for short-term financing. To overcome this, I exploit an institutional quirk of the Mexican fiscal system where there are unexpected deviations on federal transfers to state governments. This exogenous variation is employed as an instrument to provide a plausibly causal estimate because these have no effect on the long-term financial standing of the state government outside their effect on the ability to impact short-term financial management.

This analysis reveals that an increase in cash reserves by one standard deviation leads to a corresponding increase in short-term borrowing equivalent to 24.6% of annual discretionary revenues, which imply an elasticity of 0.6 between cash reserves and short-term debt. These results are robust to the econometric specification and showcase the endogeneity bias present in OLS estimations. Moreover, I test for heterogeneity driven by the level of cash reserves, credit quality, and stage of the fiscal year, finding (as predicted by theory) stronger complementarity between cash and debt when liquidity constraints are more stringent. These estimates suggest an upper bound of 1.33 for the elasticity between cash and debt.

This paper highlights how liquidity constraints shape the opportunity cost of internal financing over issuing public debt. Further research could expand the understanding of this relationship by looking at this issue from the lens of optimal finance structure theories like the Miller-Modigliani theorem for corporate capital structure or the Ricardian equivalence for governments. In addition, in using an instrumental variable approach, this paper provides a local average treatment effect estimate arising from exogenous shifts in the timing of revenue delivery. A different source of exogenous variation might produce different estimates. For instance, if a federal policy exogenously mandated states to hold more cash in reserve according to an accounting or budgetary rule or restricted the conditions under which rainy day funds could be drawn down, then the induced effect of cash reserves on short-term borrowing would potentially produce a different local average treatment effect. This paper provides the first of hopefully many investigations of exogenous events that provide insight into liquidity management practices.

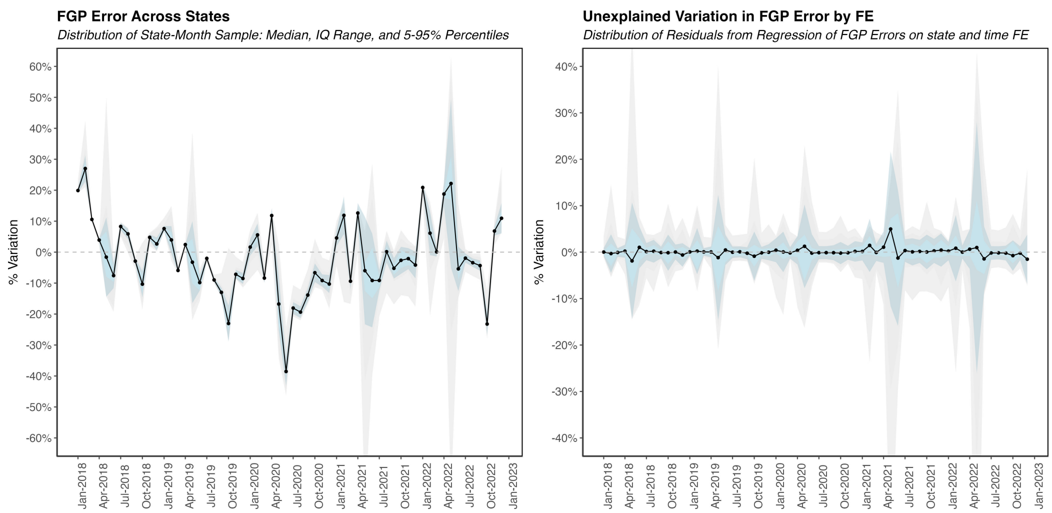
9 Figures and Tables

Figure 1: FGP Errors: Distribution Across States Over Time



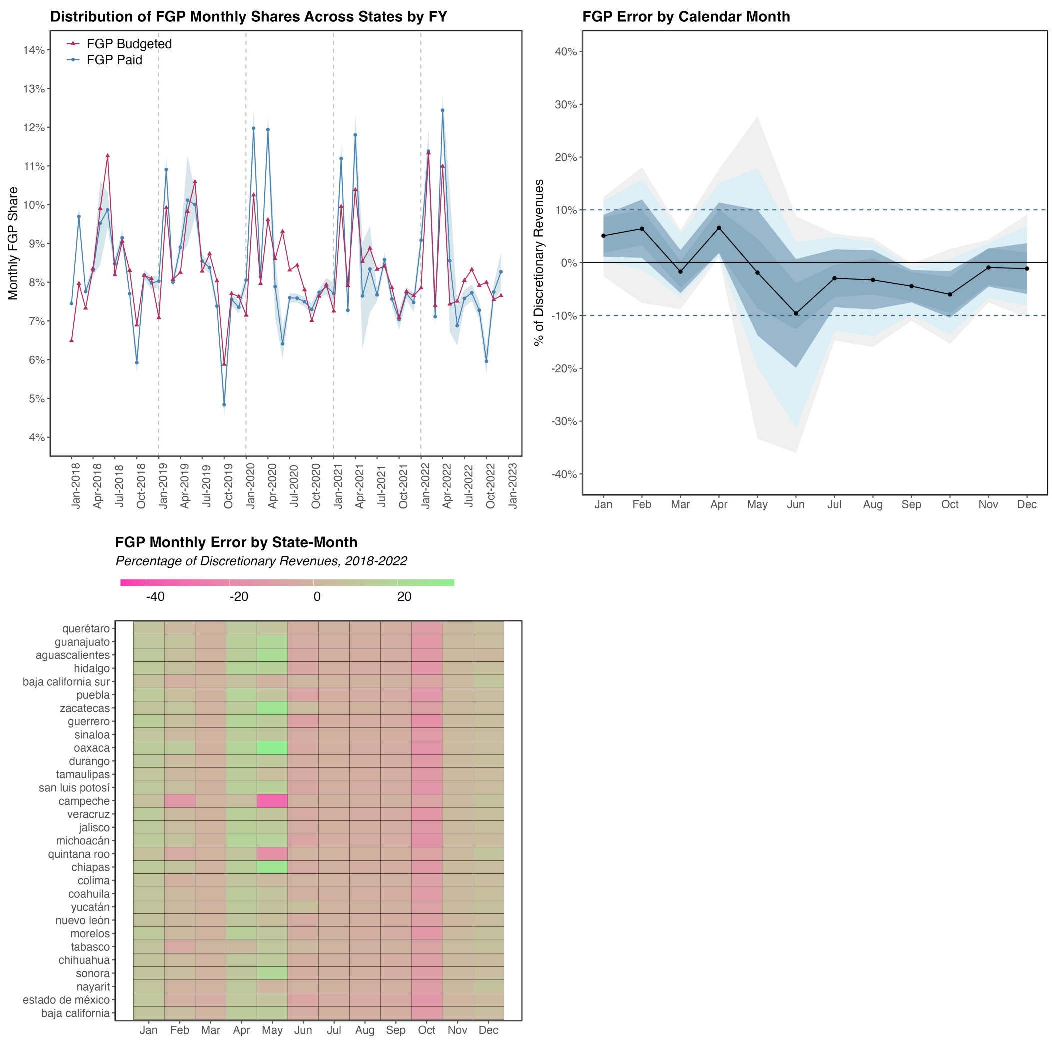
Notes: The top left panel shows the trend on the budgeted and actual amounts of the FGP at the national level. The top right panel showcases the distribution of budgeted and actual FGP transfers for state governments. Solid lines represent the median amount across states, while the shaded areas the IQ range. The bottom left panel shows the percentage point difference between the FGP error at the national level and the FGP error observed for each state. Shaded areas display the IQ range (dark blue) and the area within one standard deviation from the mean (light blue). The bottom right panel 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.

Figure 2: FGP Errors: Unexplained Variation by State and Time Invariant Factors



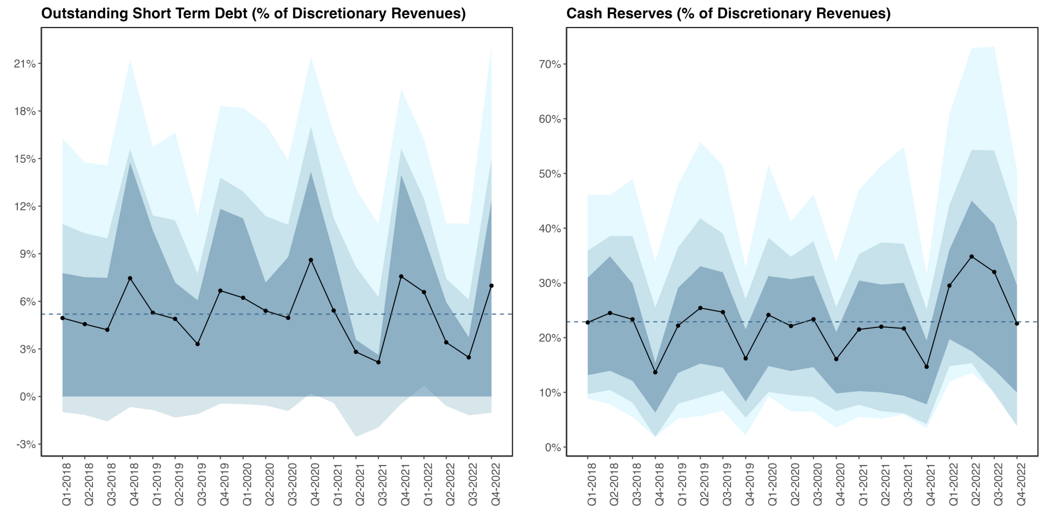
Notes: The panel on the left shows the distribution of the FGP error across states over time. The panel on the rights shows the residuals from running a linear model of the FGP error on state and month-by-year fixed effects. That is, the variation on the FGP error that is not explained by state and time invariant factors. This is the variation effectively used as instrumental variable for the empirical analysis. For both panels, the solid line represents the median across states for that month, the blue-shaded areas enclose the inter quartile range, and the light-gray shade denotes the area within the 5-95% percentiles of the distribution.

Figure 3: FGP Errors: Within Fiscal Year Variation by Month



Notes: The top left panel compares the monthly FGP shares, both for budgeted and actual amounts. That is, the percentage of the annual FGP allocation paid/budgeted for each month. Shaded area shows the variation within one standard deviation from the mean. The fact that FGP budgeted shares show no variation across states implies that the federal government assumes the same monthly share for all states. However, having variation on the actual monthly shares suggests there is no systematic differences between federal budgeted FGP monthly shares and observed monthly shares. The top right panel shows the distribution of the FGP errors 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 bottom left panel shows a heatmap of the FGP error across calendar month and state.

Figure 4: Cash Reserves and Short-Term Debt (2018-2022)



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%.

Table 1: Descriptive Statistics

	Mean	Std.Dev.	Min	P25	P50	P75	Max	N
Short-Term Debt (% DR)	0.0519	0.0635	0.0000	0.0000	0.0244	0.0940	0.2890	597
Cash Reserves (% DR)	0.2289	0.1548	-0.0157	0.1174	0.1897	0.3117	0.9322	597
FGP Error (% DR)	-0.0043	0.0235	-0.1135	-0.0185	-0.0039	0.0075	0.0848	597
FGP Lagged Annual Difference	-0.0130	0.0655	-0.2141	-0.0641	-0.0114	0.0484	0.0964	597
Current Expenditures (% Total Expenditures)	0.7375	0.0600	0.4278	0.7121	0.7515	0.7775	0.8212	597
Primary Balance (% Total Revenues)	-0.0623	0.1261	-0.7499	-0.0833	-0.0296	0.0006	0.0853	597
Discretionary Revenues (% Total Revenues)	0.4766	0.0781	0.3016	0.4186	0.4731	0.5394	0.6562	597
Long Term Debt (% Total Debt)	0.6726	0.5133	0.0000	0.2834	0.5727	0.8585	2.2558	597
Credit Rating	3.1273	1.0700	1.0000	3.0000	3.0000	4.0000	6.0000	597
FGP as Collateral (%)	0.5332	0.2163	0.0880	0.3317	0.5477	0.7500	1.0000	597
Unemployment Rate	0.0346	0.0129	0.0081	0.0259	0.0326	0.0401	0.0978	597
Taxpayers (% Population)	0.5574	0.1015	0.2840	0.4850	0.5565	0.6376	0.7356	597
Age $<$ 18 (% Population)	0.0584	0.0040	0.0518	0.0554	0.0578	0.0606	0.0724	597
Age 19-35 (% Population)	0.0438	0.0022	0.0405	0.0425	0.0433	0.0449	0.0514	597
Age 36-65 (% Population)	0.0847	0.0047	0.0691	0.0814	0.0858	0.0882	0.0924	597

Notes: This panel shows the descriptive statistics of the main variables used for the analysis. 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.

Table 2: Effects of Cash Reserves on Short-Term Debt

	(1)	(2)	(3)	(4)
Panel A: OLS Estimates				
Cash Reserves (% DR) $\hat{\delta}$	-0.152***	-0.043	0.067*	0.093**
	(0.030)	(0.031)	(0.036)	(0.036)
Panel B: 2SLS IV Estimates				
Cash Reserves (% DR) $\hat{\delta}$	0.194	0.325	0.211*	0.246**
	(0.149)	(0.200)	(0.107)	(0.107)
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
Time 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 FGP errors 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: $*p < 0.10$, $**p < 0.05$, $***\ p < 0.01$

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: $*p < 0.10$, $**p < 0.05$, $***\ p < 0.01$

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: $*p < 0.10$, $**p < 0.05$, $***\ p < 0.01$

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: $*p < 0.10$, $**p < 0.05$, $***\ p < 0.01$

Table 6: 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: This table show the results of estimating Equation 7 using an OLS estimator. The independent variable is the FGP error expressed as percentage of discretionary revenues. Each row shows the estimates for different predictors of local economic activity as dependent variables. Time FE = Quarter-Year FE. Standard errors clustered by state. Significance level: *$p < 0.10$, **$p < 0.05$, *** $p < 0.01$

Table 7: Alternative IV: Effect of Cash Reserves on Short Term Debt

	(1)	(2)	(3)	(4)
IV: Discretionary Revenues Budget Error				
Cash Reserves (% DR) $\hat{\delta}$	-0.040	0.048	0.002	0.037
	(0.116)	(0.111)	(0.072)	(0.087)
First Stage: Budget Error $\hat{\beta}$	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 Budget Error				
Cash Reserves (% DR) $\hat{\delta}$	0.150	0.433	0.434	0.435
	(1.604)	(0.660)	(0.332)	(0.345)
First Stage: Budget Error $\hat{\beta}$	-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 Budget Error				
Cash Reserves (% DR) $\hat{\delta}$	-0.064	-0.103	-0.163	-0.163
	(0.259)	(0.340)	(0.273)	(0.351)
First Stage: Budget Error $\hat{\beta}$	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
Time FE	Yes	Yes	Yes	Yes

Notes: This table show the results from estimating Equation 9 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: *$p < 0.10$, **$p < 0.05$, *** $p < 0.01$

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: *$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

References

Almeida, Heitor, Murillo Campello, and Michael S. Weisbach, "The Cash Flow Sensitivity of Cash," *The Journal of Finance*, 2004, *59* (4), 1777–1804. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1540-6261.2004.00679.x.

Arechederra, Fernando and Alan Carbajal, "Statistical Errors in the Fiscal Coordination Law of Mexico: A Note," *Estudios Economicos*, 2017, *32* (2), 317–345.

_ **and Carlos Urzua**, "La Ley de Coordinacion Fiscal en Mexico: Una critica aritmetica," *Sobre Mexico. Temas de Economia*, 2017, *1* (3).

Belsey, Timothy, *Principled Agents?: The Political Economy of Good Government*, Oxford University Press, 2007.

Brogan, Michael, "The Politics of Budgeting: Evaluating the Effects of the Political Election Cycle on State-Level Budget Forecast Errors," *Public Administration Quarterly*, 2012, *36* (1), 84–115. Publisher: SPAEF.

Capeci, John, "Credit Risk, Credit Ratings, and Municipal Bond Yields: A Panel Study," *National Tax Journal*, December 1991, *44* (4.1), 41–56.

Cornaggia, Jess N., Kimberly J. Cornaggia, and Ryan D. Israelsen, "Credit Ratings and the Cost of Municipal Financing," *The Review of Financial Studies*, June 2018, *31* (6), 2038–2079.

Cunningham, Scott, *Causal inference: the mixtape*, New Haven: Yale University Press, 2021.

Cyert, Richard Michael and James G. March, *A behavioral theory of the firm.* A behavioral theory of the firm., Upper Saddle River, NJ, US: Prentice Hall/Pearson Education, 1963.

Denison, Dwight V., "Which Nonprofit Organizations Borrow?," *Public Budgeting & Finance*, September 2009, *29* (3), 110–123.

Donaldson, Gordon, *Corporate debt capacity; a study of corporate debt policy and the determination of corporate debt capacity*, Boston: Divison of Research, Graduate School of Business Administration, Harvard University, 1961.

Douglas, James W. and Ronald Keith Gaddie, "State Rainy Day Funds and Fiscal Crises: Rainy Day Funds and the 1990–1991 Recession Revisited," *Public Budgeting & Finance*, January 2002, *22* (1), 19–30.

Fitch Ratings, "Activación de FEIEF y Mayor Disciplina Financiera para Subnacionales," Non-Rating Action Commentary July 2019.

_ , "FEIEF Compensa Caída de Participaciones para Estados y Municipios en 2020," Non-Rating Action Commentary January 2021.

_ , "Fitch Rts: Caen Participaciones Federales, Fondo de Estabilización para Estados y Municipios Agotado," Non-Rating Action Commentary March 2023.

_ , "Fondo de Estabilización Se Mantiene sin Compensar Participaciones Federales Esperadas," Non-Rating Action Commentary May 2023.

Gore, Angela K., "Why Do Cities Hoard Cash? Determinants and Implications of Municipal Cash Holdings," *The Accounting Review*, January 2009, *84* (1), 183–207.

Heckman, James J., "Sample Selection Bias as a Specification Error," *Econometrica*, 1979, *47* (1), 153–161.

Hendrick, Rebecca, "The Role of Slack in Local Government Finances," *Public Budgeting & Finance*, March 2006, *26* (1), 14–46.

Huntington-Klein, Nick, *The Effect: An Introduction to Research Design and Causality*, 1 ed., Chapman and Hall/CRC, 2022.

Jensen, Michael C., "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers," *The American Economic Review*, 1986, *76* (2), 323–329.

Johnson, Craig L. and Kenneth A. Kriz, "Fiscal Institutions, Credit Ratings, and Borrowing Costs," *Public Budgeting & Finance*, March 2005, *25* (1), 84–103.

Joyce, Philip G., "What's So Magical about Five Percent? A Nationwide Look at Factors That Influence the Optimal Size of State Rainy Day Funds," *Public Budgeting & Finance*, January 2001, *21* (2), 62–87.

Kling, Gerhard, "A theory of operational cash holding, endogenous financial constraints, and credit rationing," *The European Journal of Finance*, 2018, *24* (1), 59/75.

Koskela, Erkki and Matti Viren, "Credit Rationing and Consumer Intertemporal Choice," *Oxford Economic Papers*, 1984, *36* (2), 241–247.

Kriz, Kenneth A., "The Optimal Level of Local Government Fund Balances: A Simulation Approach," in "Proceedings of the Annual Conference on Taxation" National Tax Association June 2003, p. 78.

Lofton, Michelle L., "The impact of excess taxing capacity on short-term resources," *Public Budgeting & Finance*, March 2022, *42* (1), 3–27.

_ **and Sharon N. Kioko**, "The use of short-term debt by general-purpose governments," *Public Budgeting & Finance*, December 2021, *41* (4), 71–93.

Marlowe, Justin, "Fiscal Slack and Counter-Cyclical Expenditure Stabilization: A First Look at the Local Level," *Public Budgeting & Finance*, September 2005, *25* (3), 48–72.

_ , "Beyond 5 Percent: Optimal Municipal Slack Resources and Credit Ratings: Slack Resources and Local Credit Quality," *Public Budgeting & Finance*, December 2011, *31* (4), 93–108.

Myers, Stewart C., "The Capital Structure Puzzle," *The Journal of Finance*, July 1984, *39* (3), 574–592.

Navin, John C. and Leo J. Navin, "The Optimal Size of Countercyclical Budget Stabilization Funds: A Case Study of Ohio," *Public Budgeting & Finance*, June 1997, *17* (2), 114–127.

Nohria, Nitin and Ranjay Gulati, "Is Slack Good or Bad for Innovation?," *Academy of Management Journal*, 1996, *39* (5), 1245–1264.

Peng, Jun and Peter F. Brucato, "An empirical analysis of market and institutional mechanisms for alleviating information asymmetry in the municipal bond market," *Journal of Economics and Finance*, June 2004, *28* (2), 226–238.

Poterba, James M., "State Responses to Fiscal Crises: The Effects of Budgetary Institutions and Politics," *Journal of Political Economy*, 1994, *102* (4), 799.

Sharfman, Mark P., Gerrit Wolf, Richard B. Chase, and David A. Tansik, "Antecedents of Organizational Slack," *The Academy of Management Review*, 1988, *13* (4), 601–614.

Sobel, Russell S. and Randall G. Holcombe, "The Impact of State Rainy Day Funds in Easing State Fiscal Crises During the 1990-1991 Recession.," *Public Budgeting & Finance*, 1996, *16* (3), 28–48.

Stock, James H and Motohiro Yogo, "Testing for Weak Instruments in Linear IV Regression," in "Identification and Inference for Econometric Models Essays in Honor of Thomas Rothenberg," Cambridge University Press, 2005.

Su, Min and W. Bartley Hildreth, "Does Financial Slack Reduce Municipal Short-Term Borrowing?: Financial Slack and Municipal Short-Term Borrowing," *Public Budgeting & Finance*, March 2018, *38* (1), 95–113.

Svensson, Lars E.O., "Money and Asset Prices in a Cash-in-Advance Economy," *Journal of Political Economy*, 1985, *93* (5), 919–944.

Vasche, Jon David and Brad Williams, "Optimal Governmental Budgeting Contingency Reserve Funds.," *Public Budgeting & Finance*, 1987, *7* (1), 66.

Williams, Daniel W., "The Politics of Forecast Bias: Forecaster Effect and Other Effects in New York City Revenue Forecasting.," *Public Budgeting & Finance*, December 2012, *32* (4), 1–18. Publisher: Wiley-Blackwell.

_ **and Shayne C. Kavanagh**, "Local government revenue forecasting methods: competition and comparison," *Journal of Public Budgeting, Accounting & Financial Management*, March 2016, *28* (4), 488–526.

Wolkoff, Michael, "An Evaluation of Municipal Rainy Day Funds.," *Public Budgeting & Finance*, 1987, *7* (2), 52–63.

10 Appendix: Theoretical Model

10.1 Model without liquidity constraints and exogenous cash reserves

This theoretical model describes government's decision-making on short-term borrowing within the fiscal year in order to ensure the provision of local public goods is at desired levels. To be specific, in this model the tax policy is fixed and the government chooses the level of provision of a public good G given exogenous tax revenues T. The government is endowed with cash reserves S that could be used to finance public expenditures. This model partitions the fiscal year into two periods. In the first period, the government selects the level of short-term borrowing D and provision G_1, given observed cash reserves S and the expected (non-stochastic) tax revenues T_1, T_2.[20] During the second period, the government pays back the issued debt (plus interest r) with collected tax revenues, net of the chosen level for the provision of G_2.

Inspired by Belsey (2007), I define a welfare function $W(G,T) = \alpha ln(G) - \gamma C(T)$ where $C()$ is a strictly convex function that models the excess burden of taxation, γ reflects the marginal cost of public funds. Denote β as the intertemporal dis-

[20] Belsey defines the budget constraint of the government considering that tax revenues are used to provide some good G_t that faces unitary costs of production θ and saves some money S_t for private ends. Unlike Belsey, in my model S represents the government's exogenous cash reserves (endowment). Furthermore, for simplicity (but without losing generality) I assume unitary costs of provision $\theta = 1$ and drop this parameter from the model.

count factor. The optimization problem solved by a benevolent social planner is the following.

$$\begin{aligned} \max_{G_1,G_2,D} \quad & \alpha ln(G_1) - \gamma C(T_1) + \beta\Big(\alpha ln(G_2) - \gamma C(T_2)\Big) \\ \text{s.t.} \quad & G_1 = T_1 + S + D \\ & G_2 = T_2 - (1+r)D \end{aligned} \tag{10}$$

By incorporating the constraints into the objective function I transform this into an unconstrained optimization problem for D where the first order condition leads to standard Euler equation.

$$\max_{D} \quad \alpha ln(T_1 + S + D) - \gamma C(T_1) + \beta\Big(\alpha ln(T_2 - (1+r)D) - \gamma C(T_2)\Big) \tag{11}$$

$$\frac{T_2 - (1+r)D}{T_1 + S + D} = \beta(1+r) \tag{12}$$

Since cash reserves S and tax revenues T_1, T_2 are exogenously determined, I can directly obtain a closed-form solution for the amount of debt issued by the government.

$$D^*(S) = \frac{\beta}{1+\beta}\left[\frac{T_2}{\beta(1+r)} - (T_1 + S)\right] \tag{13}$$

Note that this expression implies that governments with larger cash endowments will issue lower levels of debt. In other words, cash reserves and short-term borrowing behave like substitutes where the marginal rate of substitution between the two is determined by β. Moreover, since $0 < \beta < 1$, then it follows that this rate is always negative and smaller than 1 in absolute value.

$$\frac{dD}{dS} = -\frac{\beta}{1+\beta} < 0 \tag{14}$$

The intuition behind this result is straightforward. In this model, cash reserves can only be used to finance spending on the first period. If the government has a large endowment of reserves, then it needs to rely less on short-term borrowing. This leads to lower interest payments on the second period.

10.2 Model with liquidity constraints and savings

To examine the role of liquidity constraints in the model, I introduce two new assumptions. First, let's assume the interest rate observed by governments depends on the the level of cash reserves they hold during the second period. This implies that lenders/investors adjust the interest rate on government debt depending on the liquidity observed by the government when the debt service needs to be covered. This new feature provides a new use for cash reserves: signaling liquidity and solvency in the financial market. Moreover, I assume that lenders are risk-averse. Hence, they charge a larger interest rate for governments with low levels of cash holdings during the second period.

Second, to model signaling role of cash I introduce a parameter $\theta \in [0, 1]$ that represents the proportion of cash reserves S that are used to smooth cash-flows during the first part of the fiscal year. This means that $(1 - \theta)$ is the proportion of cash that is saved for the second period. For simplicity, I keep the assumption that cash reserves cannot be used to finance spending on the second period. This equivalent to assume that governments preserve some cash reserves for the upcoming fiscal year, so they can smooth cash flows and access the financial market. With these new assumptions the budget constraints take the following form.

$$\begin{aligned} G_1 &= T_1 + \theta S + D \\ G_2 &= T_2 - (1 + r((1-\theta)S)D \end{aligned} \tag{15}$$

where $r((1-\theta)S)$ means that the interest rate is a function of remaining cash reserves $(1-\theta)S$. Note that lender risk aversion implies $r' < 0$ Since the structure of the problem remains the same, the first order condition keeps the same form (with the caveat that r depends on S), and the closed form solution for the amount of debt issued is the following equation.

$$D^*(S) = \frac{\beta}{1+\beta}\left[\frac{T_2}{\beta(1+r((1-\theta)S))} - (T_1 + \theta S)\right] \tag{16}$$

With these new assumptions, cash reserves now influences the amount of debt issued through the proportion used in the first period to smooth cash flows (operational role of cash) and the by the proportion saved to signal liquidity and solvency on the second period (precautionary role of cash). For simplicity, let's drop the notation on the dependence of r on S and write the derivative of debt on cash reserves.

$$\frac{dD}{dS} = -\frac{\beta}{1+\beta}\left[\frac{r'T_2(1-\theta)}{\beta(1+r)^2} + \theta\right] \tag{17}$$

In this case, due to investor risk aversion ($r' < 0$) the relationship between cash reserves and debt becomes ambiguous. To illustrate the relationship with the previous model let's analyze the boundary cases on the values of θ. If the government uses all its cash reserves on the first part of the fiscal year, then $\theta = 1$ and Equation 17 simplifies to Equation 14. Similarly, note that when $\theta = 0$, then Equation 17 becomes unambiguously positive.

$$\frac{dD}{dS} = -\frac{r'T_2}{(1+\beta)(1+r)^2} > 0 \tag{18}$$

In other words, if the government does not uses cash reserves to smooth cash flows on the first period, then for larger cash holdings S the government has more incentives to increase its debt issuance since it faces lower borrowing costs due to the signaling role of cash to lenders. These two cases highlight how the liquidity levels observed by the government might shift the relationship between cash reserves and short-term borrowing. To be specific, cash and debt will behave like complements (i.e., Equation 17 is positive) if the following condition holds.

$$1 - \theta < \frac{\beta(1+r)^2}{\beta(1+r)^2 - r'T_2} \tag{19}$$

In other words, if savings available at the end fiscal year are too low (i.e., the amount of cash used to smooth cash flows is too high), then the precautionary role of cash amplifies the incentives decrease the reliance on cash reserves to smooth cash-flows and preserve some reserves to face a lower interest rate. Note the existence of this threshold de-facto translates into a liquidity constraint for the government. If the proportion of cash holdings maintained as reserves to signal liquidity and solvency to lenders falls below this level, then the risk premium faced by the government due to lack of liquidity is large enough to incentivize the government to maintain its cash holdings as savings and smooth cash flows through short-term borrowing instead.

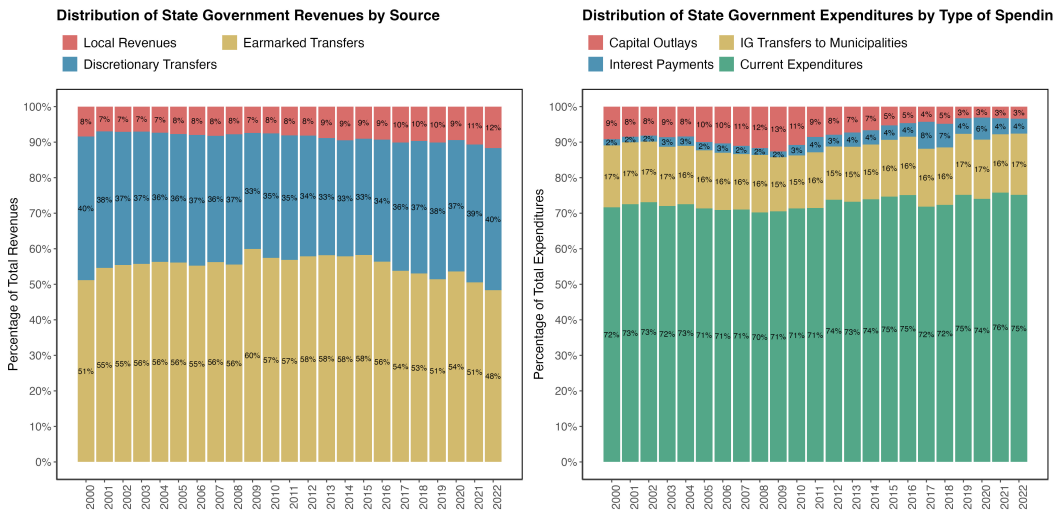
Finally, note that in this the optimal amount of short-term debt issued is decreasing on the proportion of cash reserves used to smooth cash-flows, and this effect is amplified by lender risk aversion.

$$\frac{dD}{d\theta} = \frac{S}{(1+\beta)}\left[\frac{r'T_2}{(1+r)^2} - \beta\right] < 0 \tag{20}$$

If the interest rate does not depends on cash reserves saved, then $r' = 0$ and the derivative simplifies to $\frac{-S\beta}{1+\beta} < 0$. This highlights the operational role of cash in the model. The government relies less on short-term borrowing if the proportion of cash used to manage cash-flows is large. Now note that under lender risk aversion the second term of the equation becomes a larger negative number, thus implying the effect is bigger. For example, if the proportion of reserves used to manage cash-flows decreases, then the incentives to increase in debt issuance will be driven by the liquidity needs observed in the first part of the fiscal year and the reduction in borrowing costs due to more cash reserves on the second part of the fiscal year.

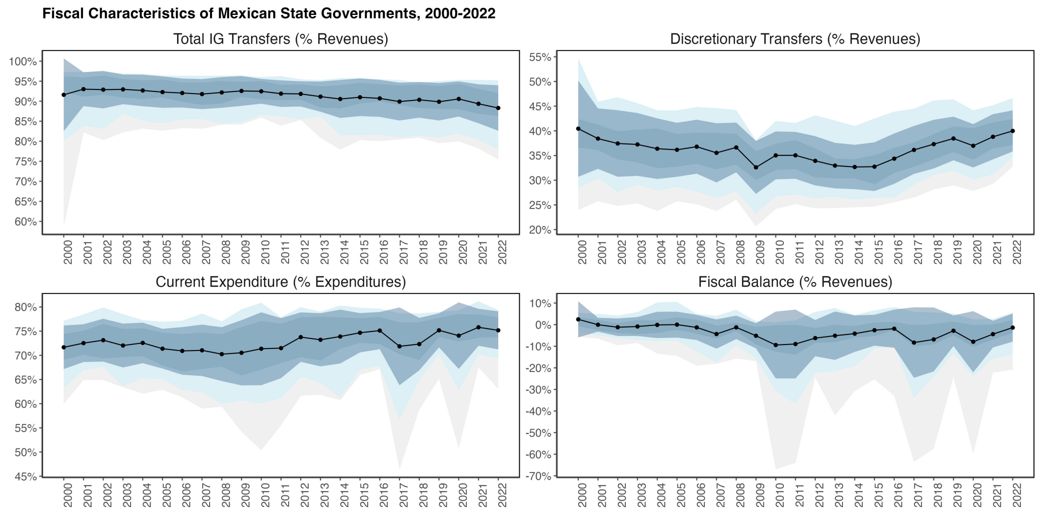
A Appendix: Figures and Tables

Figure A.1: Fiscal Structure of Mexican State Governments



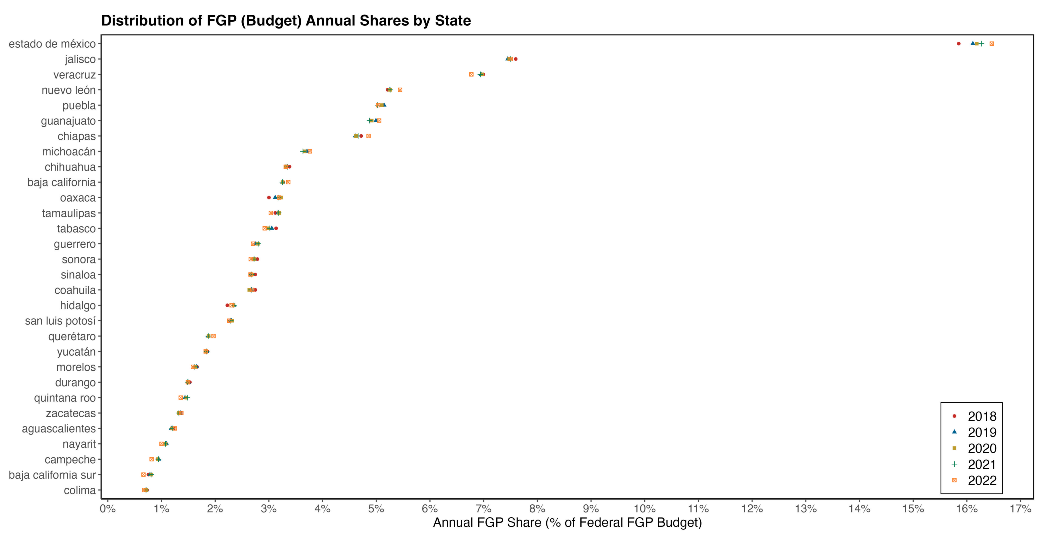
Notes: The panel on the left shows the distribution of revenues by source. Earmarked transfers (Ramo 33, in Mexico's Federal Budget) include funds to finance education payroll (FONE) and infrastructure development (FAM, FAETA), health care (FASSA), social development and welfare programs (FAIS), security and policing (FASP). Unconditional (discretionary) revenues 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.

Figure A.2: Fiscal Characteristics of State Governments



Notes: Each panel shows the distribution of key fiscal indicator. 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%.

Figure A.3: Annual FGP Shares by State (2018-2022)



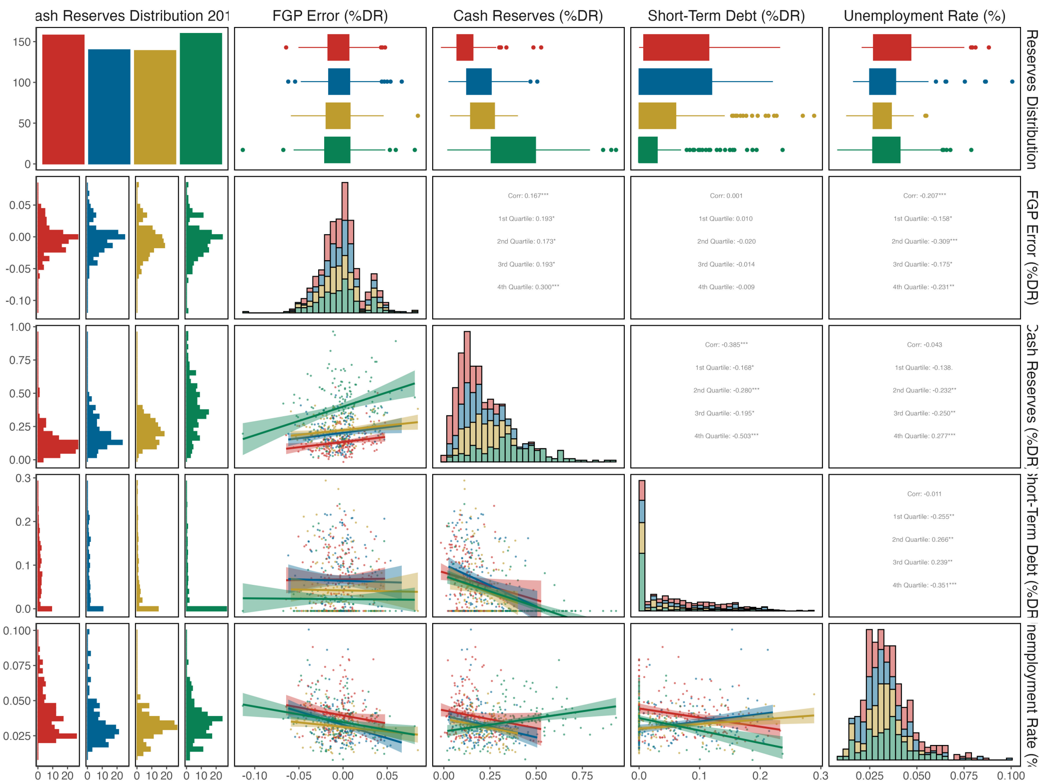
Notes: This graph shows the annual distribution of the FGP across state governments for FY 2018-2022. Each point represents the proportion of each state on the national budget for each FY. It is worth noting that this distribution has been widely stable over time.

Table A.1: FGP State Distribution: Descriptive Statistics of Annual Shares (% total FGP)

State	Mean	SD	CV
Aguascalientes	0.0129	0.0006	0.0475
Baja California	0.0323	0.0012	0.0373
Baja California	0.0079	0.0004	0.0519
Campeche	0.0131	0.0013	0.0965
Chiapas	0.0452	0.0019	0.0411
Chihuahua	0.0336	0.0012	0.0354
Coahuila	0.0269	0.001	0.038
Colima	0.0082	0.0005	0.0659
Durango	0.015	0.0007	0.0451
Guanajuato	0.0452	0.0028	0.0616
Guerrero	0.0249	0.0014	0.0573
Hidalgo	0.0218	0.0008	0.0363
Jalisco	0.0719	0.0027	0.0378
Mexico	0.1419	0.0079	0.0558
Michoacan	0.0349	0.0019	0.0557
Morelos	0.0163	0.0012	0.0735
Nayarit	0.0114	0.0005	0.0415
Nuevo Leon	0.054	0.0018	0.0339
Oaxaca	0.0287	0.001	0.0356
Puebla	0.0472	0.0017	0.0368
Queretaro	0.0195	0.0008	0.0429
Quintana Roo	0.0144	0.0012	0.0851
San Luis Potosi	0.0224	0.0012	0.0516
Sinaloa	0.0281	0.0011	0.0385
Sonora	0.0335	0.002	0.0596
Tabasco	0.0443	0.0098	0.2222
Tamaulipas	0.032	0.0011	0.0352
Tlaxcala	0.0116	0.0006	0.0489
Veracruz	0.0673	0.0035	0.0527
Yucatan	0.0188	0.0006	0.0308
Zacatecas	0.0148	0.0006	0.0414
Total	0.0323	0.0259	0.8041

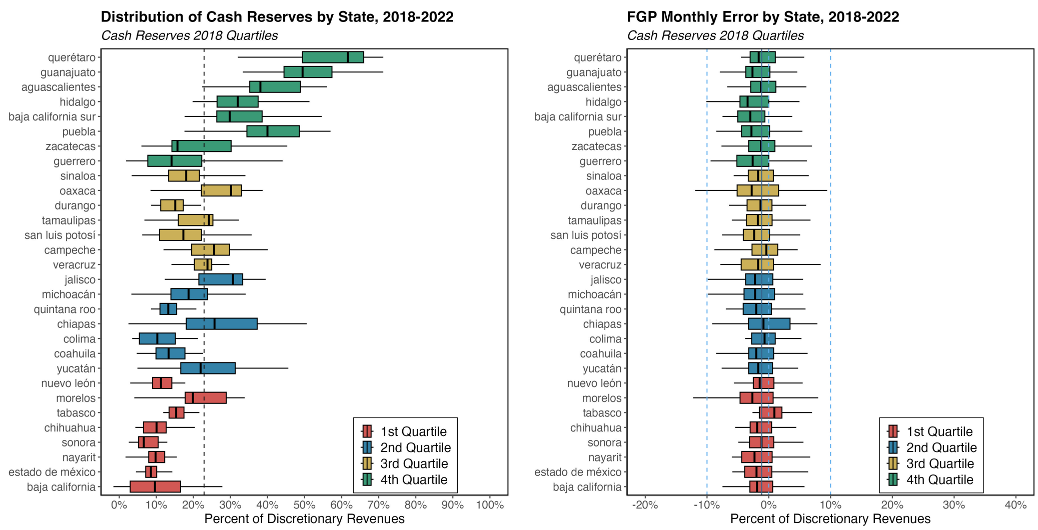
Notes: This table shows the descriptive statistics on the shares/allocations of the FGP each state observed between 2000 and 2021. Shares are computed as the proportion of each state FGP allocation represents out of the total FGP.

Figure A.4: Distribution and Correlation of Main Variables



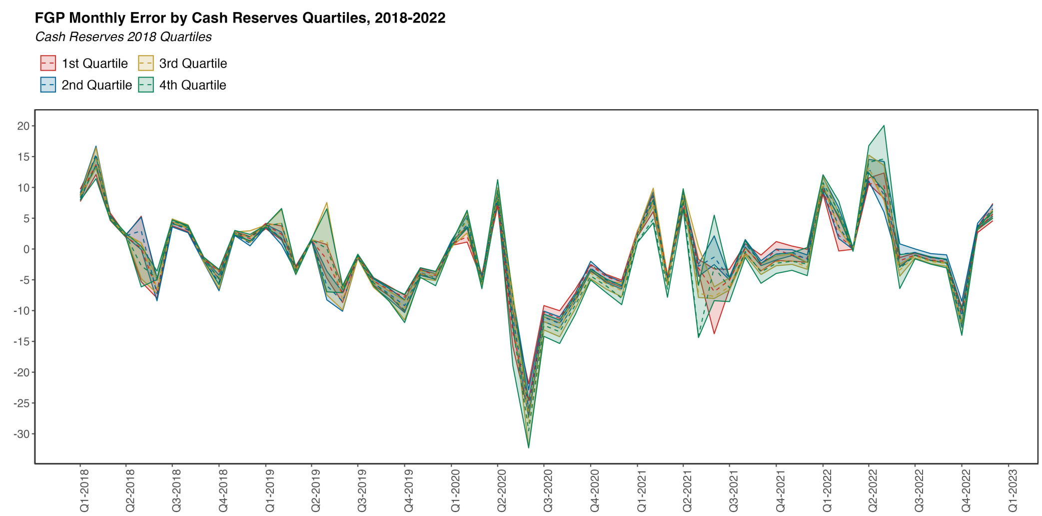
Notes: This panel shows the scatter plots (with fitted univariate linear regression lines) of the main variables used for the analysis, across the distribution of cash reserves observed in 2018. Upper diagonal panels show the correlation across variables, at each quartile of the cash reserves distribution. The graph showcases the distribution of the unemployment rate to highlight the relationship between local economic activity with the rest of the variables.

Figure A.5: Cash Reserves and FGP Monthly Errors



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.

Figure A.6: FGP Errors by Cash Reserves Distribution



Notes: This graph shows the distribution of FGP errors across time and states. States assigned into categories (quartiles) using the distribution of cash reserves (as percentage of discretionary revenues) in 2018. Shaded areas show the interquartile range of the variable, while the dashed line depicts the mean.