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 that shows the precautionary and operational role of cash reserves under liquidity constraints. Using a unique dataset of quarterly financial statements from 2018 and 2022 from Mexican state governments, this paper tests this theory in a setting where local governments face stringent liquidity constraints. To provide causal estimates, I instrument cash reserves with plausibly exogenous variation in the deviation from anticipated monthly distributions of selected federal transfers, which are not correlated with annual financial conditions but lead to temporary changes in states' potential cash holdings. Consistent with the theoretical model, the main results find a positive effect of cash reserves on short-term borrowing. Furthermore, I found evidence that cash reserves induce lower borrowing costs for short-term debt, implying that additional cash holdings make states more attractive to lenders. Complementing these findings, I document that the increase in short-term borrowing is larger for states with lower credit quality. These findings are consistent with theoretical expectations of cash management under liquidity constraints and provide evidence that complements the previous empirical research studying American local governments with softer credit 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 in the absence of liquidity constraints, larger cash holdings should result in lower reliance on short-term debt, yet this relationship reverts when liquidity constraints are binding. Empirical evidence thus far has concluded that higher cash holdings result in less short-term debt. However, these findings are drawn from studies of American local governments and there is little evidence of how this relationship is shaped by governments more likely to be bound by liquidity constraints, 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 shows the precautionary and operational role of cash reserves

(Kling, 2018) when governments face liquidity constraints. 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 from timing errors in the distribution of unconditional transfers from the federal government as an instrumental variable for cash reserves on quarterly data between 2017 and 2022. These timing 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 timing errors increase the amount of short-term debt held by the state governments in Mexico. This is consistent with a model where local governments are bound by strict liquidity constraints and adds to the empirical research situated in the United States where evidence points towards less stringent cash constraints.

The finance literature underscores the trade-off between financial slack (cash reserves) and short-term borrowing as financial management tools. Pecking order theory (Myers, 1984) posits organizations might choose internal borrowing over external financing when the costs of adverse selection is salient on financial markets. However, the public finance literature (Hendrick, 2006; Joyce, 2001) provides suggestive evidence on governments choosing external financing when they have low fiscal flexibility (i.e. government's ability to adjust spending and revenue decisions based on their current financial conditions and available resources). For governments with low fiscal flexibility, cash holdings could signal solvency and promote access to debt markets at low borrowing costs (Marlowe, 2011).

Mexican state governments experience low fiscal flexibility in the terms identified by the public finance literature. They have significant dependence on federal transfers (90% of total revenues), and most transfers are for non-discretionary (i.e. earmarked) purposes. Discretionary (unconditional) transfers represent roughly 47% of total revenues and are mostly used to cover current expenditures that are highly inertial. States usually observe deficits at their net operating balances at the end of the fiscal year. Furthermore, unlike U.S. state governments, Mexican governments lack rainy day funds as an established tool to cope with fiscal distress. In sum, their capacity to generate excess cash is relatively constrained and limits their ability to accumulate financial slack.

Rules governing federal budgeting of intergovernmental transfers create a setting in which state governments face plausibly exogenous liquidity shocks coming from timing errors on funds channeled through the General Participations Fund (FGP, for its acronym in Spanish), which is the main source of discretionary revenues for state governments. While each state's annual allocation is determined by formulas established on the Fiscal Coordination Law, the pace at which these funds are transferred to states during the fiscal year is determined by the Ministry of Finance without the influence of state governments. Deviations between observed and expected tax collection translate into cash windfalls (positive shock) when payments are ahead of calendar or in revenue gaps (negative shock) when they are below it.

The main results from this paper find a positive and statistically significant (10% level) relationship between cash reserves and short-term borrowing. An increase in cash holdings equivalent to one percentage point of the state's discretionary revenues derives in an increase in short-term debt liabilities equivalent to 0.19 percentage points of discretionary revenues. Furthermore, evidence from the empirical analysis suggests that potential endogeneity between these two variables is likely to attenuate coefficient estimates. 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).

The literature on financial slack highlights some reasons that could rationalize these results. Governments facing heightened uncertainty in the political and economic environment are more likely to accumulate slack, when available. Hence, they are more likely to manage cash flows through short-term borrowing and keep cash holdings as contingency reserves. This could be interpreted as fiscally responsible behavior by government officials. Governments with less fiscal flexibility are more prone to use short-term borrowing to manage cash-flows as their ability to influence slack generation is constrained, relative to governments with more fiscal flexibility.

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 4 describes the fiscal structure of state governments in Mexico, along with the nature and magnitude of the liquidity shocks. Section 5 describes the empirical strategy used to study this research question, while Section 6 shows the main results. I present an alternative empirical model at Section 7, and finally 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 smoothing 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 and Kioko, 2021).

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). For instance, some contend slack fosters 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).

The public finance literature on budget stabilization funds sheds some light on the extent to which governments accumulate cash as a precautionary measure. 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). Thus, 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. In particular, municipalities with few or volatile revenue sources are more likely to hold cash, whereas governments with more dependence on state revenues are 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 during crisis episodes. Moreover, 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, rather 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 firms will first resort to issuing safer instruments before risky (e.g. fixed-income instruments over common stock). In other words, firms' preferences for financing are summarized by: internal funds first, debt second, and equity as the last option (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 align with the pecking order theory: California cities were more likely to manage cash flows through financial slack, rather than short-term debt when both were available. Furthermore, their paper confirms a key stylized fact observed in the literature: municipalities with 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.

An empirical limitation faced by previous studies looking at the effect of financial slack on short-term borrowing is the extent to which the decision to hold cash reserves is determined by short-term debt. Current literature on government short-term

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

borrowing directly addresses the sampling bias on the decision to issue debt by thinking of it as a two-step process. In the first step the government makes the binary decision of issuing short-term debt, and in the second step determines the amount of borrowing. This has been implemented through Heckman selection models (Su and Hildreth, 2018), linear hurdle models (Lofton and Kioko, 2021) and Tobit models (Lofton, 2022). A strength of these approaches is they deal with the censoring problem on the amount of short-term borrowing (i.e. high percentage of the sample is valued at zero). However, none of these methods directly addresses the potential endogeneity between short-term debt and cash reserves. On the extent to which the determinants of the first stage are the same confounders between financial slack and short-term borrowing, then the excluded instrument required for causal identification on all these methods should be effective in dealing with the reverse causality problem. Nonetheless, few discussion is found in these studies around this issue.

This paper adds to the literature on government liquidity management and short-term borrowing by providing causal evidence on the effect of financial slack on short-term borrowing in a setting where subnational governments observe low fiscal flexibility and cash constraints are binding due to increased dependence on federal revenues, high current expenditure pressures, and limited access to financial markets.

3 Theoretical Model

Models dealing with liquidity constraints often highlight the operational role of cash as an incentive for holding cash reserves. Literature following the cash-in-advance constraint first proposed by Svensson (1985) argues preferences for cash are determined by transactional/operational value: agents hold cash in order to buy goods and services.

Expanding this work to financial markets, economic theory finds that agents have incentives to hold cash for precautionary reasons as well. Koskela and Viren (1984) formulates a dynamic model where liquidity constraints create incentives to hold cash in order to ease access to financial markets. If agents expect tighter credit markets, they will increase their savings to smooth consumption.

Kling (2018) provides a formal examination of this dual role of cash reserves on firms' 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 lenders' (investors) perception of the solvency of the firm measured by their cash-generating capabilities. Firms observe a short-term credit line that depends on their cash savings and their long-term leverage.

Arguably, this phenomenon is also present among subnational governments. Uncertainty on provision costs and revenue collection influences the operational role of cash for public entities. Governments save financial slack as a buffer to ensure smooth provision of local public goods. Similar to private organizations, for governments the precautionary role of cash is also determined by lenders' perception of their solvency. This is consistent with empirical evidence suggesting governments hold cash to preserve and promote creditworthiness (Marlowe, 2011).

Following the spirit at Koskela and Viren (1984) and Kling (2018) I formulate a theoretical model of government short-term borrowing under liquidity constraints. In this setting, the government chooses the level of short-term borrowing that promotes smooth provision of local public goods, under exogenous tax revenues.

In this short-run model, tax policy is fixed (i.e. exogenous tax revenues) and governments engage in short-term borrowing to ensure provision of public goods G is at optimal levels. The government is endowed with cash reserves S that could be used to finance public spending. In this two-period economy, the government chooses provision levels G_t and short-term borrowing D subject to the intertemporal revenue constraint.[2]

Following Belsey (2007), I define a welfare function $W_t(G, T) = G_t - \gamma C(T_t)$ where $C()$ is a strictly convex excess burden (deadweight loss) function and γ represents the marginal cost of public funds. Short-term debt liability is modeled through a strictly convex debt liability function, $R(D)$. Defining β as the intertemporal discount factor, the program solved by the benevolent social planner is summarized by the following unconstrained optimization problem:

[2]For detailed formulation of this model, check Appendix 10.

$$\max_{G_1,G_2,D} \quad G_1 - \gamma C(G_1 - D - S) + \beta\Big(G_2 - \gamma C(G_2 + R(D))\Big) \tag{1}$$

The first-order condition on D captures the intertemporal trade-off between the excess burden of taxation across periods. Note this takes the form of the standard Euler equation observed in dynamic models. [3]

$$\frac{\partial W}{\partial D} = C_1' - \beta C_2' R_d = 0 \tag{2}$$

To simplify the analysis, without losing generality I assume government actions promote no deviations from the determined levels of provision G_1 and G_2 (thus $dG_1 = dG_2 = 0$). Under this assumption, total differentiation of Equation 2 yields the expression that captures the effect that cash reserves S have on the supply for short-term debt D.

$$\frac{dD}{dS} = -\frac{C_1''}{C_1'' + \beta\big(C_2' R_{dd} + C_2'' R_d\big)} < 0 \tag{3}$$

Convexity of both $C()$ and $R()$ implies that under this set of assumptions, cash

[3] To clarify the notation: C_t' is the derivative of the excess burden function in period t. To be clear $C_t' = C'(T_t)$ where: $C_1' = C'(G_1 - D - S)$ and $C_2' = C'(G_2 + R(D))$. Equivalent notation is used for the second-order derivative. $C_t'' = C''(T_t)$. Similarly (but with different notation), R_d and R_{dd} are the first and second-order derivatives of the gross debt liability function with respect to D, respectively. This difference in notation is required to clarify the marginal effects on the liability function when it becomes a multivariate function in the next section.

and debt behave like substitutes. An increase in cash reserves leads to a decrease in the demand for short-term borrowing. This relationship is picked up by the theoretical literature on pecking order theory and aligns with the findings on empirical literature on American governments Lofton and Kioko (2021); Su and Hildreth (2018).

3.1 Liquidity Constraints

Following Koskela and Viren (1984) and Kling (2018), I expand the model and incorporate liquidity constraints by making the gross debt liability function dependent on cash endowment, $R(D, S)$ that characterizes the behavior or risk-averse investors/lenders.

Assumption 1 (Risk Averse Investors) *Let the gross debt liability function $R(D, S)$ be a continuous and twice differentiable function: i) increasing on short-term debt D, ii) decreasing in cash reserves S, iii) convex on both S and D, and iv) with a negative cross partial derivative between debt and cash reserves.*

This assumption broadly captures the possibility of default as perceived by investors (for $D > 0$), the absence of an infinitely elastic supply of investment opportunities (for $D < 0$) (Belsey, 2007) and the role of cash as a solvency-signaling device. Incorporating this assumption into the model leads to an optimality condition that includes the endogenous effect of cash reserves on debt pricing. The main implication of lenders risk aversion (and the main takeaway from this model) is that the relationship between cash reserves and short-term debt is ambiguous under liquidity constraints. It suffices to note that $C_2''R_dR_s < 0$ while $C_1'' > 0$.

$$\frac{dD}{dS} = -\frac{C_1'' + \beta\big(C_2'R_{ds} + C_2''R_dR_s\big)}{C_1'' + \beta(C_2'R_{dd} + C_2''R_d)\big)} \tag{4}$$

The last expression could be decomposed to show the operational and precautionary role of cash reserves. The first term (also present in Equation 3) captures the non-linear relationship of taxation on the excess burden present in standard economic theory. The new terms added to the equation broadly reflect the precautionary and operational role of cash suggested by Kling (2018).

$$\underbrace{C_1''}_{\text{Change in Excess Burden}} + \underbrace{\beta C_2'R_{DS}}_{\substack{\text{Precautionary Role of Cash} \\ \text{(Substitution Effect)}}} + \underbrace{\beta C_2''R_DR_S}_{\substack{\text{Operational Role of Cash} \\ \text{(Income Effect)}}} \tag{5}$$

The second term captures the precautionary role of cash as a moderator of the marginal effect of leverage on gross debt liability. The last term on the equation reflects the operational role of cash which shows the trade-off between leverage and provision of G. To clarify the intuition of this result, take for instance the following gross liability function $R(D, S) = D(1 + r(S))$ where the government pays principal plus some interest, that depends on their cash endowment. Under this definition:

$$\underbrace{C_1''}_{\text{Change in Excess Burden}} + \underbrace{\beta C_2' r'(S)}_{\substack{\text{Precautionary Role of Cash} \\ \text{(Substitution Effect)}}} + \underbrace{\beta C_2''(1 + r(S)) D r'(S)}_{\substack{\text{Operational Role of Cash} \\ \text{(Income Effect)}}} \quad (6)$$

The direction of the last two terms is determined by the sign of $r'(S)$, which stems from the risk-aversion assumption imposed on investor behavior. The precautionary role of cash is captured by $r'(S)$ being negative. Risk premium asked by investors is decreasing on cash reserves. This creates incentives to hoard cash in order to obtain lower debt pricing. This could be thought of as the substitution effect of cash on short-term borrowing. On the other hand, the last term captures the operational role of cash and shows the income effect of cash. Holding cash reserves creates incentives for short-term borrowing as the government has more slack to cover debt service. However, the increase in leverage reduces the available resources in the second period for the provision of G_2. Thus, leading the government to hold cash in order to ensure the provision of good G at desired levels.

While the nature of lenders' risk-aversion in this model (i.e. interest rate depends on cash reserves) differs from the one at Kling (2018) and Koskela and Viren (1984), the moral of the model is similar: organizations have incentives to hoard cash to ensure smooth production of output (operational) and access to financial markets at competitive prices (precautionary). This model shows that under reasonable assumptions and without cash constraints, short-term debt, and cash reserves operate as substitute goods (an increase in cash reserves leads to a decrease in short-term debt issued). Under liquidity constraints, the model shows the relationship between short-term debt and cash reserves becomes ambiguous where such ambiguity is driven by the precautionary and operational roles of cash.

4 Institutional Setting and Budgetary Shocks

State governments in Mexico operate in a revenue-shared 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 left Panel on Figure 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. This is the definition of discretionary revenues that is used across all the analysis presented in this paper.

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 2).

As mentioned in the previous section, one limitation of the literature looking at short-term borrowing and cash holdings is the potential endogeneity between these two variables. In this paper, I address this concern by using plausibly exogenous variation in the timing at which transfers from the General Participations Fund (FGP henceforth, for its acronym in Spanish) are received by state governments. The FGP is the primary source of discretionary revenues for state and local governments in Mexico as it represents approximately 75% (average 2018-2022) of the total discretionary transfers channeled through the Participaciones funds.

Allocations across state governments are determined by population size and local economic growth, following the formulas in the Fiscal Coordination Law where, 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). Given the population dynamics have been stable over time, state shares of the FGP have also remained relatively constant. For instance, an analysis of these shares between 2000 and 2022 shows that the average state observed a coefficient of variation of 0.056, thereby underlining the stability of this distribution over time (see Table A.1).

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

For the purpose of this paper, I define these deviations as timing errors. To be specific, as the difference between the budgeted amount and the transfer observed by state governments at any given month. It is important to highlight the distinction between forecasting errors as commonly understood in the public finance literature [add citations on forecasting errors] since these timing 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 transfers.

State governments have no influence on the determination of the annual shares of the FGP, nor in the determination of the monthly calendar. The Fiscal Coordination Law only deals with the formulas used to compute the distribution of the annual budget across funds and states, with no criteria related to the disbursement of these funds during the fiscal year. To the best of my knowledge there is no information publicly available on how the federal government determines the annual calendar of these transfers. Intuitively, however, one could argue the schedule should reflect federal expectations on how fiscal revenues will be collected during the fiscal year such that this calendar does not creates liquidity pressures for the federal government.

Timing errors are particularly important for cash flow management as they could translate into liquidity pressures for governments given the relevance of FGP on state revenues. To examine the magnitude and trend of these budgetary shocks, the left panel in Figure 4 displays the time series of the timing error, expressed as percentage of an estimate of monthly DR (i.e. annual DR divided by 12). For instance, in 2018 the average timing error was approximately equivalent to 5% of monthly DR, -5.37% in 2019, and then dropped to -10.18% during 2020.

Albeit each state experiences timing 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 right panel at Figure 4). 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 these timing 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 these timing 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).[4] These compensations are designed to address any differences on states annual FGP allocations. 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 (see

[4]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.

Table A.1).

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-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 timing 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 add Fitch and CIEP citations. 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 partially alleviated some of the liquidity gaps experienced by local governments.

In sum, state governments in Mexico are exposed to liquidity risks stemming from timing errors on the main source of discretionary revenues that, along with the reduced space to cutback spending and the absence of rainy-day funds, leaves these governments with few tools to generate financial slack to cope with liquidity shocks.[5]

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. [6]

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

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

[6] 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.[7] Data on economic covariates as the state level comes from both INEGI and the Ministry of Finance.

To compute the timing errors 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. [8] 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 on xxx and statey on yyy, since they did not reported information

[7] 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.

[8] 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.

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, but are before the enactment of the Fiscal Discipline Law, which changed significantly the regulation faced by state and local governments in Mexico.[9]

This time-invariant scaling factor is estimated outside the analysis period to avoid

[9] 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.

inducing mechanical endogeneity due dividing the relevant variables by a contemporaneous transformation of the variable used as instrument. 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 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 that 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. [10]

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

[10] 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.

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.

Altogether, these 15 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 $\hat{\delta}$ is theoretically ambiguous as it depends on the stringency of the liquidity constraints faced by state governments. Previous literature estimate δ 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 binding 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 timing 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. This yields the following system of equations that describes the first stage and the reduced form estimated for this analysis.

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

$$ShortTermDebt_{it} = \delta Cash\hat{Reserves}_{it} + X_{it}\gamma + a_i + b_t + \upsilon_{it} \quad (9)$$

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 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 the timing error (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.1 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%.[11]Quarterly timing 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

[11]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).

below the budgeted one).

To add some context to these statistics, if an average state on a given quarter observes a timing error that is within one standard deviation of the observed distribution 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 timing errors on short-term borrowing add citation on no-back doors formulation. 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 (see Table A.1 in the Appendix). Hence, the underlying variation of the timing 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 timing 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 timing 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 timing 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 timing errors. Altogether, these factors suggest that the underlying variation of FGP timing errors mimics a random liquidity shock and, therefore, the exclusion restriction likely holds in this setting. Nonetheless, in Section 7 I conduct a couple 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 (i.e. equivalent to the average historic annual DR) 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 of 24.6% .

To assess the magnitude of the effect size, consider that these coefficient estimates reflect the marginal effect of a unitary increase on the percentage of cash reserves, where the scale of this variable implies that such increase would be equivalent to passing from 0% to 100% of annual DR. Assuming an increase equivalent to one standard deviation of the distribution of cash reserves (i.e. 15.5% of DR), the implied effect from the 2SLS coefficient is equivalent to an increase in outstanding short-term debt of 3.75% of the annual DR, which itself is roughly equivalent to 0.6 times the standard deviation of this dependent variable. In other words, the implied effect is equivalent to observing an increase in the average outstanding short-term debt equivalent to 0.6 standard deviations.

Coefficient estimates from the first stage regression suggest a positive and statistically significant relationship between cash holdings and timing errors across all specifications. For the preferred specification this estimate suggests that a positive (quarterly) timing error equivalent to one percent of annual DR leads to an increase of cash reserves equivalent to 1.46% of annual DR. These results align with the theoretical rationales underlined by the literature where governments with low fiscal flexibility are more likely to accumulate financial slack, when available (Hendrick, 2006; Joyce, 2001). Specifications with state fixed effects observe Cragg-Donald 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 are attenuated (negatively biased). 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. This not only highlights the sensitivity of OLS estimates to the econometric specification, but also the direction of the bias potentially present in these results.

Estimates at Panel B, on the other hand, demonstrate that results from the 2SLS estimation are less sensitive to the presence of controls and state-fixed effects. This reduced variability suggests the instrumental variable is effective in addressing the endogeneity bias present in OLS results. Coefficients at all specifications point towards a positive relationship between cash holdings and outstanding short-term debt. Furthermore, across all specifications IV estimates are larger than OLS ones. If the instrumental variable is successfully addressing the endogeneity bias, then this is consistent with a scenario where the endogeneity bias is pushing downwards the direction of coefficient of interest.

6.1 Mechanisms: Cash Reserves, Credit Quality and Borrowing Costs

To examine the mechanisms through which cash reserves shape short-term borrowing I estimate Equation 9 in different subsets of the sample that could shed some light on the factors driving the results.

Cash Reserves: As described in Section 3, the stringency of the liquidity constraints faced by local governments could shift the sign 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 exercise. 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 timing errors. To examine whether this weak-instrument problem is explained by the level of cash holdings, Figure 5 shows the distribution of cash reserves and timing 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 timing errors is correlated with the level of cash holdings. This supports the strength of the instrument as it shows it is not correlated with the initial distribution of cash reserves. Point estimates for $\hat{\delta}$ at Table 3 show large standard errors. Only the results for the second quartile sample are significant at the 10%. The effect size of this estimate is equivalent to 0.77 the observed standard deviation of outstanding short-term debt, which is slightly larger than the one from the baseline specification.

Credit Rating: Cash reserves influence short-term borrowing both from the supply and demand-side of the market. Supply-side effects are driven by the magnitude of the liquidity gaps aimed to be covered with short-term borrowing. Moreover, governments also face incentives to hoard cash for credit quality maintenance (Marlowe, 2011). This implies that governments with low cash reserves might use short-term borrowing over cash reserves to finance liquidity gaps when both are available. Demand-side effects are associated with lenders perception on government's solvency and capacity for repayment. Credit rating is one of the main factors considered by lenders when deciding the conditions under which loans are given to states. Risk perceptions on government's liquidity could shape the level of borrowing that governments could receive from lenders. Hence, from both sides there are some arguments that suggest that credit quality might shape the effect of cash-reserves on short-term debt.

To examine this relationship, I partitioned the sample by credit rating category and estimate Equation 9 across states with the same credit rating. For this exercise I group states in four categories: 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 displays the results from these models. Like described for the heterogeneity by cash-reserves, descriptive statistics on the dependent variable show that the level of outstanding short-term debt is decreasing with credit ratings. That is, lower rated governments observe larger levels of short-term borrowing (as percentage of their DR). This suggests 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. At the same time, this is consistent with the results found at Table 3 as higher rated governments are likely to hold larger cash reserves.

With the exception of AAA-rated states, first stage coefficients are significant for all rating categories. 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. The effect size for the A-rated group is equivalent to an increase in short-term borrowing equivalent to 0.54 standard deviations of this variable. The effect for the BBB,BB rated group, on the other hand, suggests an increase in outstanding short-term debt of 1.33 standard deviations, which is considerably larger than the one estimated for A-rated states. These results suggest that government's incentives to hoard cash decrease as their credit rating rises (Marlowe, 2011), which are consistent with a model where lower rated governments face more stringent liquidity constraints and are more likely to finance liquidity gaps through short-term debt so they preserve cash holdings to hedge against borrowing costs hikes.

Borrowing Costs: 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.

In this sense, government incentives to manage cash flows via cash reserves rather than short-term debt 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).

To examine the role the role of borrowing costs on this relationship I estimate the Equation 9 using loan spreads as dependent variable. This model, unlike the previous ones, is estimated in a sample of short-term loans received by state governments during this period. This data comes from the public debt registrar of all the outstanding loans by state and local governments held by the Ministry of Finance.[12]. To avoid over-fitting, the model is simplified by replacing quarter-by-year fixed effects, by quarter and year dummies. Moreover, age composition variables are also excluded from the vector of controls.

The dependent variable for these regressions is the spread that banks offer to states when contracting the loans. This spread is relative to the short-term (28 days) reference interest rate of the economy (TIIE, for its acronym in spanish).

[12]This data set is updated constantly and suffers from attrition once the loan matures. This is particularly problematic to study short-term borrowing as getting observations becomes unfeasible through the Ministry's website. To overcome this challenge, I manually collected all the available versions of the data set on the Wayback Machine, since this registrar was implemented (in 2016, following the enactment of the Fiscal Discipline Law). The Wayback Machine observed snapshots of the website for almost every month since 2017 to this date. My final data set contains a sample of short-term loans issued by state governments between 2017 and 2022

Hence, borrowing costs are determined by the spread that banks assign to the loan when negotiating the terms with state and local governments.[13]

Table 8 describes the results of replicating the baseline analysis on the sample of short-term loans issued by state governments. Coefficient estimates points toward a positive and significant relationship between cash reserves and borrowing costs, suggesting that states observe higher borrowing costs upon an increase on their cash reserves.

6.2 Instrument Validity

Temporal Heterogeneity and Anticipation: One of the main threats to validity this instrument face is associated with the seasonality of the distribution of FGP timing errors. If within the fiscal year timing errors follow a systematic pattern, then state policymakers could learn and adapt their spending calendar to mitigate the liquidity shocks. Moreover, it could translate into issuing short-term debt at specific moments of the fiscal year.

To examine this issue Figure 4 shows the distribution of the timing error at each calendar month between 2018-2022. From the left panel it stands out that the average

[13]For the most part, both short-term and long-term loans contracted by state and local governments are variable rate loans that are indexed to the reference short-term interest rate of the economy (TIIE, for its acronym in spanish). It should be noted that according to the Fiscal Discipline Law, short-term loans can only be used for cash-flow management purposes, cannot be secured/collateralized with FGP funds, and are not required to be contracted through a competitive sale

timing error is negative at all months, with the exception of January, February, and April. Moreover, while the largest negative deviation usually appears during June, after that there is a reduction in the variation of the timing errors for the rest of the year.

The inclusion of quarter-by-year fixed effects in baseline specification should partial-out the seasonality on the timing errors so long such seasonal components are common across state governments. The right panel at Figure 4 provides some descriptive evidence towards this idea as it shows the variation of monthly timing errors across states. Visual inspection of this figure reveals no apparent differences on the magnitude of the timing errors across states and calendar months. In other words, any underlying variation that could be systematically driving the timing errors across months, does not seems to have a state-specific component, thereby influencing all states in the same way.

To formally examine the robustness of the results at Table 2 to the presence of seasonality of anticipation effects, I partitioned the dataset across quarters. That is, each subset contains a panel of state-by-year observations (holding constant the quarter) and estimate Equation 9 at each sub-sample.[14] Table 4 shows the results from this exercise. For simplicity, this table only depicts the results from the preferred specification of the 2SLS estimator. Results for the first-stage regression show the predictive power of the instrument concentrates mainly on the observations from the second quarter. Intuitively, the strength of the instrument relies on the magnitude

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

of the deviation. This is consistent with the descriptive evidence at Figure 4 showing that, in average, the largest deviation appears in June.

Interestingly, results for the model on the last quarter show larger effects on both the first stage and reduced form coefficients. In other words, FGP timing errors translate into larger changes in cash-reserves, which also lead to a larger effect on short-term borrowing (significant at the 10% level). For some context on the effect size, the point estimate of 0.52 percentage points is equivalent to an increase of 0.85 times the standard deviation of the dependent variable in this sub-sample.

A potential explanation behind these results comes from the duration of the fiscal year. In Mexico, the fiscal year aligns with the calendar year for both federal and state governments. This implies, that during the last quarter of the year one could observe spending hikes as state governments rush to meet some of the budgetary targets placed on contracted services and federal IG transfers. For this reason, some states might increase their issuance of short-term borrowing during the last quarter to cover some end-of-year (e.g. payroll benefits) or non-deferrable expenses. Descriptive statistics on Table 4 support this view as the average level of outstanding short-term debt is larger at the last quarter of the year. This trend is consistent with a scenario where states increase their borrowing towards the end of the fiscal year, and reducing it during the first two quarters of the fiscal year, when the FGP timing errors could provide some cash windfalls (see Figure A.3).

While the results at Table 4 might suffer from a weak-instrument problem due to the smaller sample size at each sub-sample, they shed some light on the underlying factors driving short-term borrowing. The estimated effect on the model for the last quarter is within the magnitude of the baseline estimate at Table 2 and is consistent with a model where short-term borrowing is used as a cash-flow management tool towards the end of the fiscal year.

Placebo Tests: If timing 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. To test this hypothesis, 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).[15]

Table 6 shows the results for this exercise. For the preferred specification, timing 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 yield coefficient estimates for timing errors virtually

[15]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 exercise.

equal to zero. Albeit the model on the quarterly economic activity index shows a positive coefficient, on the preferred specification this is not precisely estimated. Together these results lend strong support to the view that FGP timing errors are not correlated with local economic activity, thus any influence on short-term borrowing is operating through a different mechanism.

7 Robustness Checks

Literature on short-term borrowing highlights that an empirical challenge is that governments might be excluded from financial markets due to size or entry costs (high-interest rates). In other words, there could be non-systematic factors driving the decision to issue short-term borrowing. In my sample, there are four states (Campeche, Guanajuato, Puebla, and Queretaro) that do not issue short-term debt at any point in the sample.

Table [redacted] in the Appendix replicates the coefficients at Table [redacted] excluding the governments that did not issue short-term debt during the analyzed period. These estimates suggest a milder effect of cash reserves on debt, coefficient estimates point towards an increase of 0.17 percentage points. After excluding these governments, the coefficient on the first stage implies an increase equivalent to 2.13 percentage points of discretionary revenues on cash holdings, upon a positive budgetary shock of 1 percentage point of discretionary revenues. It should be highlighted that in this sample the strength and relevance of the instrument increased significantly. Cragg-Donald

F statistic for the preferred specification is estimated at 32.76, hence suggesting a strong and significant first-stage relationship.

7.1 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, timing 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, timing errors on: i) all discretionary IG transfers, ii) all earmarked IG transfers, and iii) all IG transfers.

Results from the model using timing 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 timing 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 non-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 the timing 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.

7.2 Alternative Specification: Heckman Selection Model

Scholars often model short-term debt issuance as a two-stage process in which first they choose whether to issue (or not) debt, and in a second step they decide how much debt to issue. Statistical modeling of this process often takes the form of Heckman-type selection models (Su and Hildreth, 2018) or hurdle models (Lofton and Kioko, 2021) that explicitly deal with each stage of this decision 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). Just like instrumental variables, Heckman selection 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. In this sense, this variable acts as an instrument for selection into the sample (i.e. it only affects the outcome through the selection equation).

To ensure consistency with the main results, I use FGP timing errors as the excluded instrument in the selection equation. To be clear, the selection equation is a Probit model on the decision of government i on quarter t of issuing short-term debt conditional on the instrumental variable $TimingError_{it}$, the vector of controls X_{it} used in the baseline model, as well quarter fixed effects (implemented via dummy variables). To keep consistency with the main results, I present estimates with and without controls and state fixed effects on the outcome equation. Also, to identify properly 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 **??** being constant across models.

Table 9 shows the results from this approach. It should be noted that Column (2) is the closest model to the main specification at Su and Hildreth (2018). However, there are a couple of methodological differences between these two approaches. First, while both models aim to control for the same theoretical categories (measures of revenue diversification and current expenditure pressures), the variables are somewhat different. The model at Su and Hildreth (2018) includes a vector of regressors for both the selection and the outcome equations: cash reserves, intergovernmental revenues, payroll expenses, debt service expenses, and population. While not stated in these terms, the excluded instrument in Su and Hildreth (2018) is the local unemployment rate. The exclusion restriction for causal identification requires that the government's incentives for issuing short-term debt respond to changes in the unemployment rate, but the amount of debt issued is not determined by observed employment levels. As long as 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 due to a violation of the exclusion restriction. To overcome this challenge, as mentioned above, I use timing errors as the excluded instrument. Second, my selection model includes state and quarter-fixed effects while Su and Hildreth (2018) only includes the vector of explanatory variables. This addition to the regression equation tests the sensitivity of the estimates to the econometric specification while providing results robust to omitted variable bias.

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. Moreover, similar to the results from the OLS models in Table 2, estimates from the Heckman selection model are sensitive to the econometric specification. After controlling for government fixed effects (state in this case) the effect is attenuated and indistinguishable from zero, both for the cases with and without control variables. This provides suggestive evidence that the negative relationship between cash holding and short-term borrowing could be mainly driven by fiscal structure characteristics like dependence on federal transfers and current spending pressures (Hendrick, 2006; Joyce, 2001). The findings from this analysis suggest the potential endogeneity between financial slack and short-term borrowing that is attenuating the coefficient estimates might not be fully addressed when correcting for sampling bias through the Heckman selection model, hence underlining the benefits of the instrumental variable.

This modeling approach is particularly useful when measuring the propensity to issue short-term debt as it first estimates the probability of issuance conditional on several covariates. address the empirical challenge described above by modeling the decision of issuing short-term debt as a two-stage process in which first governments choose whether they'll choose to issue debt, and the second involves deciding how much debt to issue. This is often implemented through Heckman selection models (Su and Hildreth, 2018) or hurdle models (Lofton and Kioko, 2021). It should be noted this approach directly addresses sample selection bias, yet it does not account for potential endogeneity between cash reserves and short-term borrowing.

8 Conclusions

Liquidity management is essential to smooth cash flows during the fiscal year and ensure there are no significant disruptions in public goods provision 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 cash constraints. The findings from this paper suggest governments under these conditions 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 cope with budget gaps.

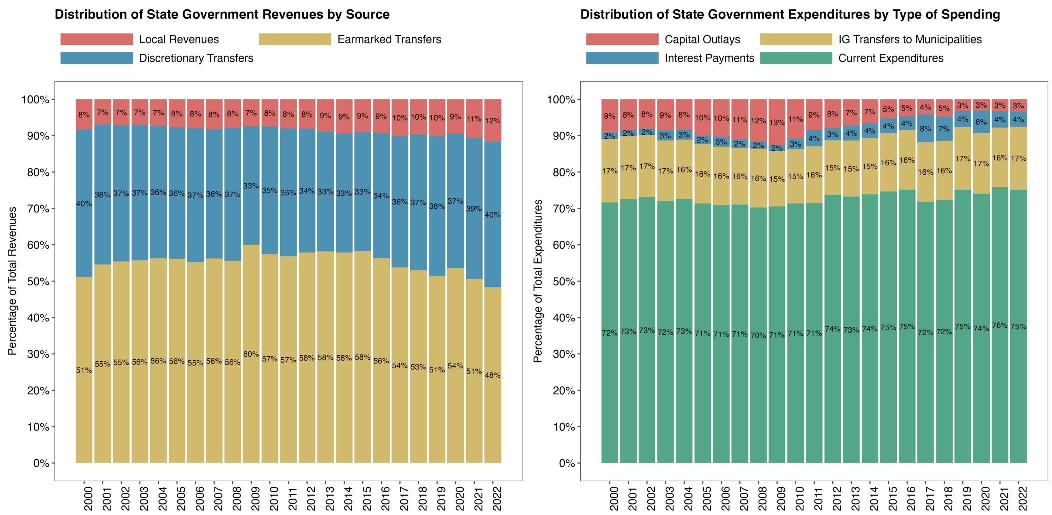
This analysis reveals that an increase in cash reserves by one percentage point of state's discretionary revenues leads to a corresponding increase in short-term borrowing by 0.20 percentage points of discretionary revenues. I also find that these cash reserves induce lower borrowing costs for short-term debt, implying that the additional cash holdings make the states more attractive borrowers in the financial markets and are rewarded with lower interest rate on debt. Complementing this interpretation is that the results appear to be driven by states with lower credit ratings. In summary, an exogenous cash advance in expected revenues enables Mexican state governments to turn to the financial market and borrow at lower interest rates, and this is particularly utilized by states with low credit ratings.

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 advances or delays in the timing of federal distributions 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 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. Similarly, this field of research could benefit from theoretical modeling that studies the substitution/complementarity of these two strategies given the tools at governments' disposal and their budget constraints. 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.

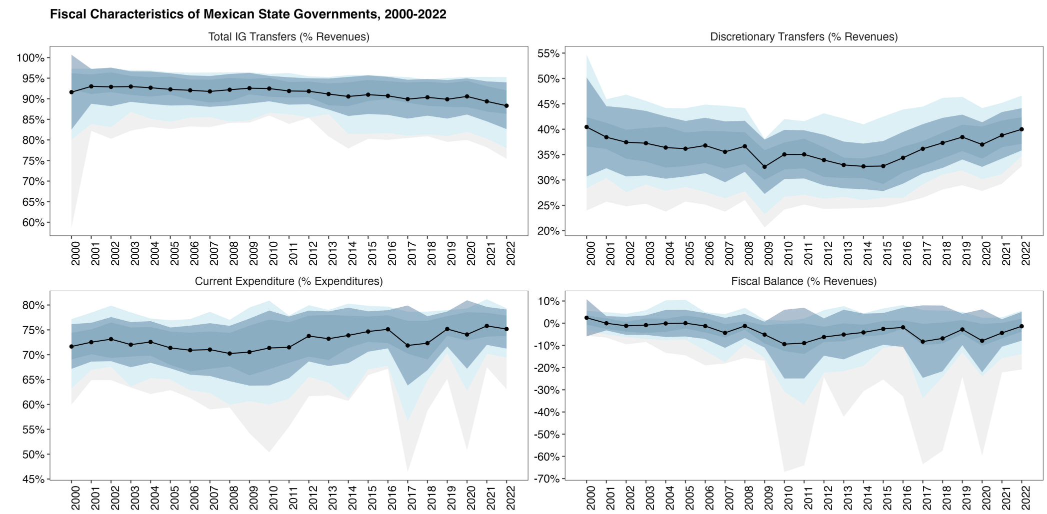
9 Figures and Tables

Figure 1: 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 2: Fiscal Characteristics of State Governments



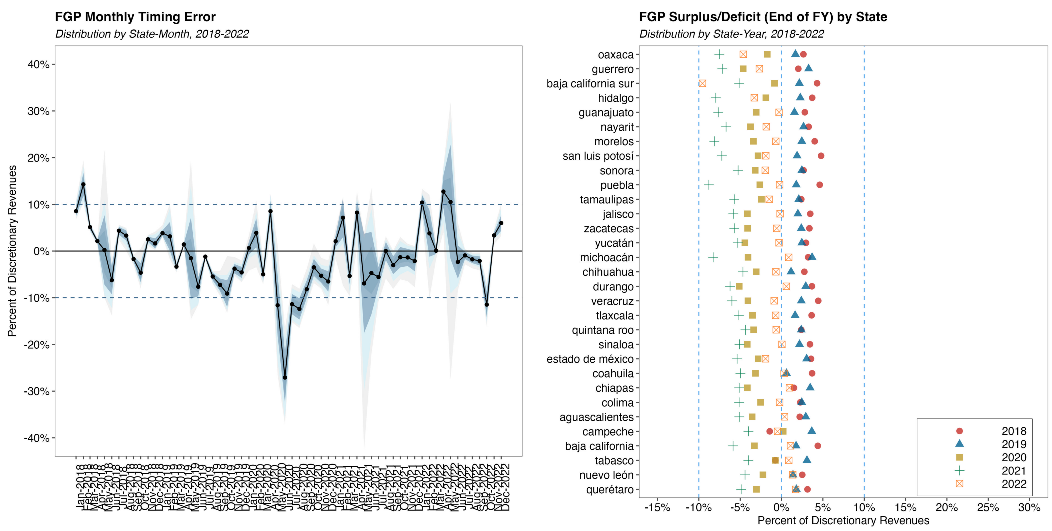
Notes: Each panel shows the distribution of key fiscal indicator. The solid line represents the mean across states by year. The dark-shaded area shows the percentiles between 25%-75%, as well as the area within one standard deviation form the mean, while the light-shaded areas percentiles 1% to 99% (excluding outliers) and 5%-95%.

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
Timing 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

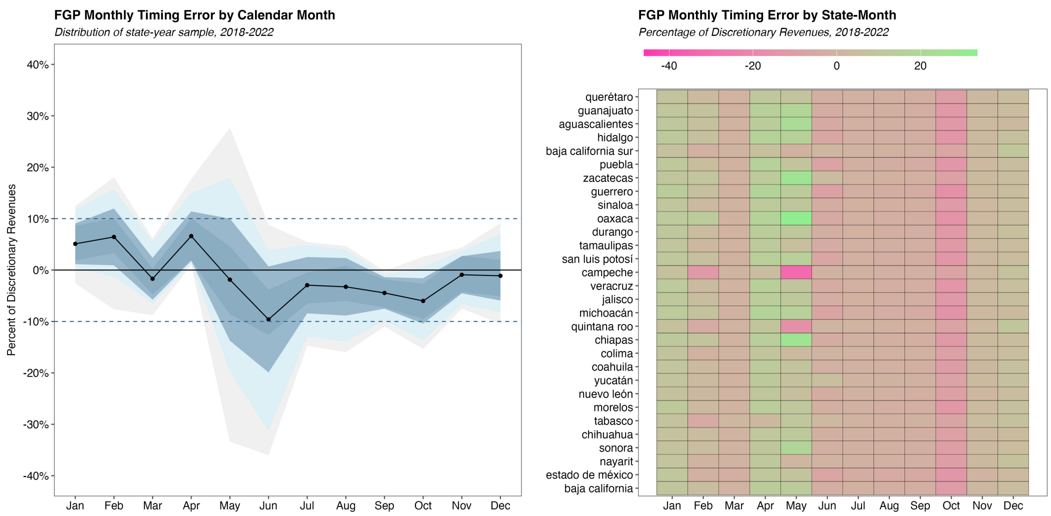
Notes: This panel shows the descriptive statistics of the main variables used for the analysis. The first two columns show the sample mean and standard deviation. P25, P50 and P75 show the 25, 50 and 75 percentiles, respectively. Credit rating is coded such that a higher number is associated with a higher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

Figure 3: FGP Monthly Timing Errors and End-of-Year Balance



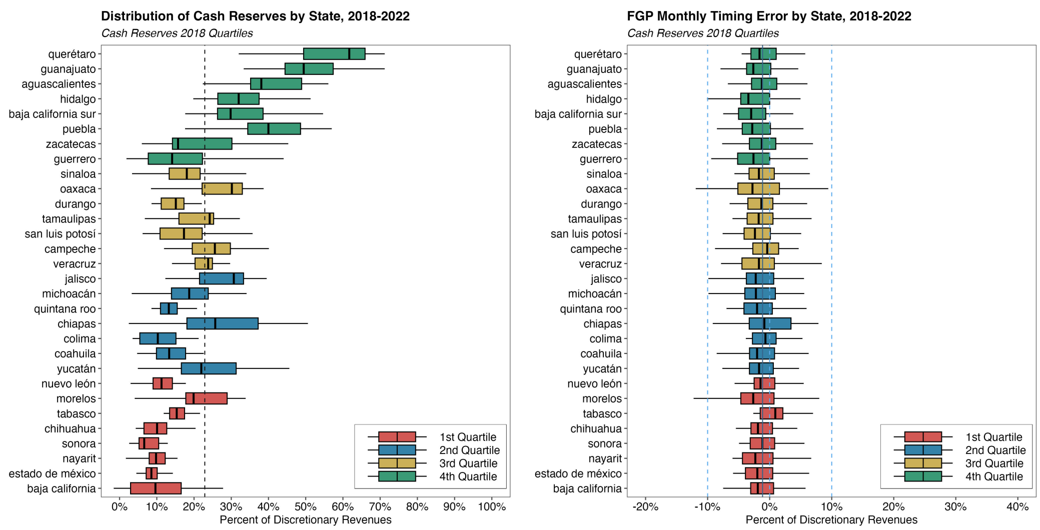
Notes: The panel on the left shows the distribution of the FGP timing error across time. The solid line represents the mean across states by month-year. The dark-shaded area shows the percentiles between 25%-75%, as well as the area within one standard deviation form the mean, while the light-shaded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

Figure 4: Distribution of FGP Timing Errors by Calendar Month



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

Figure 5: Cash Reserves and FGP Monthly Timing Errors



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

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: Timing 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 the timing error as instrument for cash reserves. All the dependent, independent, and instrumental variables are expressed as a percentage of each state's average discretionary revenues (DR) from 2009-2016. Time FE = Quarter-Year FE. Standard errors clustered by state. Significance level: $+p < 0.10$, $*p < 0.05$, $** \ p < 0.01$, $*** \ p < 0.001$

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: Timing 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: $+p < 0.10$, $*p < 0.05$, $**\ p < 0.01$, $***\ p < 0.001$

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: Timing 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: $+p < 0.10$, $*p < 0.05$, $**\ p < 0.01$, $***\ p < 0.001$

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: Timing 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: $+p < 0.10$, $*p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Instrument Validity: Effect of Timing 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 **??** using an OLS estimator. The independent variable is the timing 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: $+p < 0.10$, $*p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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

	(1)	(2)	(3)	(4)
IV: Discretionary Revenues Timing Error				
Cash Reserves (% DR) $\hat{\delta}$	-0.040	0.048	0.002	0.037
	(0.116)	(0.111)	(0.072)	(0.087)
First Stage: Timing 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 Timing Error				
Cash Reserves (% DR) $\hat{\delta}$	0.150	0.433	0.434	0.435
	(1.604)	(0.660)	(0.332)	(0.345)
First Stage: Timing 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 Timing Error				
Cash Reserves (% DR) $\hat{\delta}$	-0.064	-0.103	-0.163	-0.163
	(0.259)	(0.340)	(0.273)	(0.351)
First Stage: Timing 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 **??** through 2SLS using different instrumental variables. First stage coefficients are also reported. All the dependent, independent, and instrumental variables are expressed as a percentage of each state's average discretionary revenues (DR) from 2009-2016. Time FE = Quarter-Year FE. Standard errors clustered by state. Significance level: $+p < 0.10$, $*p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: Effects of Cash Reserves on Short-Term Borrowing Costs

	(1)	(2)	(3)	(4)
Panel A: OLS Estimates				
Cash Reserves (% DR) $\hat{\delta}$	-0.012	0.007	0.017***	0.029***
	(0.008)	(0.005)	(0.004)	(0.001)
Panel B: 2SLS IV Estimates				
Cash Reserves (% DR) $\hat{\delta}$	0.017	0.098	0.026*	0.030***
	(0.101)	(0.135)	(0.011)	(0.002)
First Stage: Timing Error $\hat{\beta}$	1.244	1.528	4.478+	10.398***
	(1.885)	(2.445)	(2.131)	(2.253)
Cragg-Donald F-Statistic	1.8105	2.9009	28.8463	230.9476
Mean Dep Var	0.1151	0.1151	0.1151	0.1151
Std.Dev. Dep Var	0.0641	0.0641	0.0641	0.0641
Num.Obs.	111	111	111	111
Controls	No	Yes	No	Yes
State FE	No	No	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Notes: This table shows the results of estimating Equation 9 using loan spreads as dependent variable. Panel A shows the results of the linear regression model across several specifications. Panel B displays the results of the 2SLS regression where the budget error instruments cash reserves. All the dependent, independent, and instrumental variables are expressed as a percentage of each state's average discretionary revenues (DR) from 2009-2016. Time FE = Quarter-Year FE. Standard errors clustered by state. Significance level: $+p < 0.10$, $*p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: Heckman Selection Model: Short Term Borrowing and Cash Reserves

	(1)	(2)	(3)	(4)
Panel A: Second Stage (Outcome Model)				
Cash Reserves (% DR)	–0.0716***	–0.0109	0.0552**	0.0909***
	(0.0254)	(0.0258)	(0.0263)	(0.0268)
Panel B: First Stage (Selection Model)				
Timing Error (% DR)	19.0228**	19.0228**	19.0228**	19.0228**
	(8.1516)	(8.1516)	(8.1516)	(8.1516)
Mean Dep Var	0.0519	0.0519	0.0519	0.0519
Std.Dev. Dep Var	0.0635	0.0635	0.0635	0.0635
Num.Obs.	597	597	597	597
Controls	No	Yes	No	Yes
State FE	No	No	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Notes: 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: $+p < 0.10$, $*p < 0.05$, $**\ p < 0.01$, $***\ p < 0.001$

10 Appendix: Theoretical Model

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 economy 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 (deterministic) tax revenues T_1, T_2.[16] During the second period, the government pays back the issued debt with collected tax revenues, net of the chosen level for the provision of G_2. Following Belsey (2007), I define a welfare function $W(G,T) = G - \gamma C(T)$ where $C()$ is a strictly convex function that models the excess burden of taxation and γ reflects the marginal cost of public funds. Let $R(D)$ be a strictly convex gross debt liability function.

The intertemporal optimization problem solved by the benevolent social planner is the following. Let β be the intertemporal discount factor.

[16]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.

$$\max_{G_1,G_2,D} \quad G_1 - \gamma C(T_1) + \beta\Big(G_2 - \gamma C(T_2)\Big)$$
$$\text{s.t.} \quad T_1 + S + D = G \tag{10}$$
$$T_2 = G_2 + R(D)$$

By incorporating the constraints into the objective function, I transform this into an unconstrained optimization problem with the following first-order conditions. To clarify the notation, let C_t' be the derivative of the excess burden function in period t. To be specific $C_t' = C'(T_t)$ where: $C_1' = C'(G_1 - D - S)$ and $C_2' = C'(G_2 + R(D))$. Equivalent notation is used for the second-order derivative. $C_t'' = C''(T_t)$. Similarly (but with different notation), let R_d and R_{dd} be the first and second-order derivatives of the gross debt liability function with respect to D, respectively.

$$\max_{G_1,G_2,D} \quad G_1 - \gamma C(G_1 - D - S) + \beta\Big(G_2 - \gamma C(G_2 + R(D))\Big) \tag{11}$$

$$\frac{\partial W}{\partial G_1} = 1 - \gamma C_1' = 0 \tag{12}$$

$$\frac{\partial W}{\partial G_2} = \beta\big(1 - \gamma C_2'\big) = 0 \tag{13}$$

$$\frac{\partial W}{\partial D} = \gamma C_1' - \gamma \beta C_2' R_d = 0 \tag{14}$$

As usual, Equations 12 and 13 lead to the efficiency condition on the excess burden of taxation. Equation 14, in contrast, gives the traditional Euler condition. Dividing both sides by γ, we can rewrite Equation 14 to visualize the effect that debt has on the welfare function.

$$F = C_1' - \beta C_2' R_d = 0 \tag{15}$$

The theoretical relationship of interest is the effect that cash reserves S have on the supply for short-term debt D. Computing the total derivative of Equation 15 it yields the following expression: [17]

$$f_{G_1} dG_1 + f_{G_2} dG_2 + f_D dD + f_{S_0} dS = 0 \tag{16}$$

where:

[17] To be clear, recall the definition of the total derivative. To compute the total derivative of a function $F(x, y) = 0$

$$f_x(x, y)dx + f_y(x, y)dy = 0$$

$$\frac{dy}{dx} = -\frac{f_x(x, y)}{f_y(x, y)}$$

$$f_{G_1} = C_1'' \tag{17}$$

$$f_{G_2} = -\beta R_d C_2'' \tag{18}$$

$$f_D = -\big(C_1'' + \beta C_2'' R_d + \beta C_2' R_{dd}\big) \tag{19}$$

$$f_S = -C_1'' \tag{20}$$

Short-term borrowing is chosen with the objective of smooth provision of public goods. If the government is successful meeting this objective then we should not observe any deviations from the determined levels of provision G_1 and G_2. In this scenario, we can make the simplifying assumption that $dG_1 = dG_2 = 0$ and rewrite Equation 16 to obtain the theoretical relationship between short-term borrowing and cash reserves.

$$\frac{dD}{dS} = -\frac{C_1''}{C_1'' + \beta(C_2' R_{dd} + C_2'' R_d)\big)} < 0 \tag{21}$$

Convexity of both $C()$ and $R()$ yields the sign of this derivative to be negative.

This implies that, under this set of assumptions, cash and debt behave like substitutes. An increase in cash reserves leads to a decrease in the demand for short-term borrowing.

10.1 Endogenous Liquidity Constraints

To expand the previous model to encompass how investors respond to the level of cash reserves held by local governments I generalize the definition of the gross debt liability function to be dependent on the cash endowment, $R(D, S)$ that reflects the preferences of risk-averse investors.

Assumption 2 (Risk Averse Investors) *Let the gross debt liability function $R(D, S)$ be a continuous and twice differentiable function: i) increasing on short-term debt D, ii) decreasing in cash reserves S, iii) convex on both S and D, and iv) with a negative cross partial derivative between debt and cash reserves.*

- $R_d > 0$
- $R_s < 0$
- $R_{dd} > 0$
- $R_{ss} > 0$
- $R_{ds} \leq 0$

The intuition behind this assumption is straightforward. First-order derivatives capture how leverage D and cash buffers S shape debt pricing made by investors. Higher leverage increases the probability of default, thus leading to larger risk-premia $R_d > 0$. At the same time, larger cash holdings alleviate default risks, thus reducing credit risk $R_s < 0$. The convexity of these functions reflects investors' risk-aversion. As highlighted by Belsey (2007) convexity captures the possibility of default as perceived by investors (for $D > 0$) and the absence of an infinitely elastic supply of investment opportunities (for $D < 0$). This implies non-linear debt-pricing for different levels of leverage and cash holdings. For instance, as leverage increases then the probability of default converges more rapidly to 1, thus increasing at the same pace the risk premia asked by investors ($R_{dd} > 0$). Similarly, increases in cash holdings reduce the probability of default more rapidly as it approaches to zero ($R_{ss} > 0$). Risk aversion also implies that the marginal effect of borrowing on the liability function is decreasing on cash holdings ($R_{ds} < 0$)[18].

Incorporating this assumption into the model does not change the optimality conditions, it is reflected on the total derivative as Equation 20 is expanded to include the endogenous effects of cash reserves on debt pricing.

[18] As I'll show below the main results of this model do not hinge in this assumption. Without losing generality, we can impose that this cross partial derivative is equal to zero and assume the only channel through which cash reserves influence the debt service is through the direct effect on the interest rate.

$$f_S = -\Big(C_1'' + \beta\big(C_2' R_{ds} + C_2'' R_d R_s\big)\Big) \tag{22}$$

Keeping the smooth provision assumption, the main implication of the risk-aversion assumption is that the sign of Equation 22 is now ambiguous. It suffices to note that $C_2'' R_d R_s < 0$ while $C_1'' > 0$. This further leads to observe an ambiguous relationship between cash reserves and short-term borrowing.

$$\frac{dD}{dS} = -\frac{C_1'' + \beta\big(C_2' R_{ds} + C_2'' R_d R_s\big)}{C_1'' + \beta(C_2' R_{dd} + C_2'' R_d)\big)} \tag{23}$$

The main takeaway from the previous expression is clear when we decompose the effects implied in the optimality condition.

$$\underbrace{C_1''}_{\text{Change in Excess Burden}} + \underbrace{\beta C_2' R_{DS}}_{\substack{\text{Precautionary Role of Cash} \\ \text{(Substitution Effect)}}} + \underbrace{\beta C_2'' R_D R_S}_{\substack{\text{Operational Role of Cash} \\ \text{(Income Effect)}}} \tag{24}$$

The first term captures the convexity of the excess burden function and is unambiguously positive. As cash reserves rise, government borrowing decreases, thus reducing the excess burden experienced on the economy. This reflects the standard result of economic theory showing the quadratic relationship of taxes on excess burden. Aligning with the theoretical model proposed by Kling (2018), holding cash has both precautionary and operational role for local governments. The second term captures the precautionary role of cash as moderator of the marginal effect of leverage on the gross debt liability. The last term on the equation reflects the operational role of cash which shows the trade-off between leverage and provision of G.

To clarify the intuition of this decomposition consider the standard definition of the gross liability function $R(D, S) = D(1 + r(S))$ where the government pays principal plus some interest, that depends on their cash endowment. Under this definition, Equation 24 takes the following form:

$$\underbrace{C_1''}_{\text{Change in Excess Burden}} + \underbrace{\beta C_2' r'(S)}_{\substack{\text{Precautionary Role of Cash} \\ \text{(Substitution Effect)}}} + \underbrace{\beta C_2''(1 + r(S))Dr'(S)}_{\substack{\text{Operational Role of Cash} \\ \text{(Income Effect)}}} \tag{25}$$

The direction of the last two terms is determined by the sign of $r'(S)$, which stems from the risk-aversion assumption imposed on investor behavior. The precautionary role of cash is captured by $r'(S)$ being negative. Risk premium asked by investors is decreasing on cash reserves. This creates incentives for the government to hoard cash in order to obtain lower debt pricing. This could be thought as the substitution effect of cash. The last term captures the operational role of cash and shows the income effect of cash. Holding cash reserves creates incentives for short-term borrowing as the government has more slack to cover debt service. However, the increase in leverage reduces the available resources on the second period for the provision of G_2. Thus, leading the government to hold cash in order to ensure the provision of good G at desired levels.

A Appendix: Figures and Tables

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

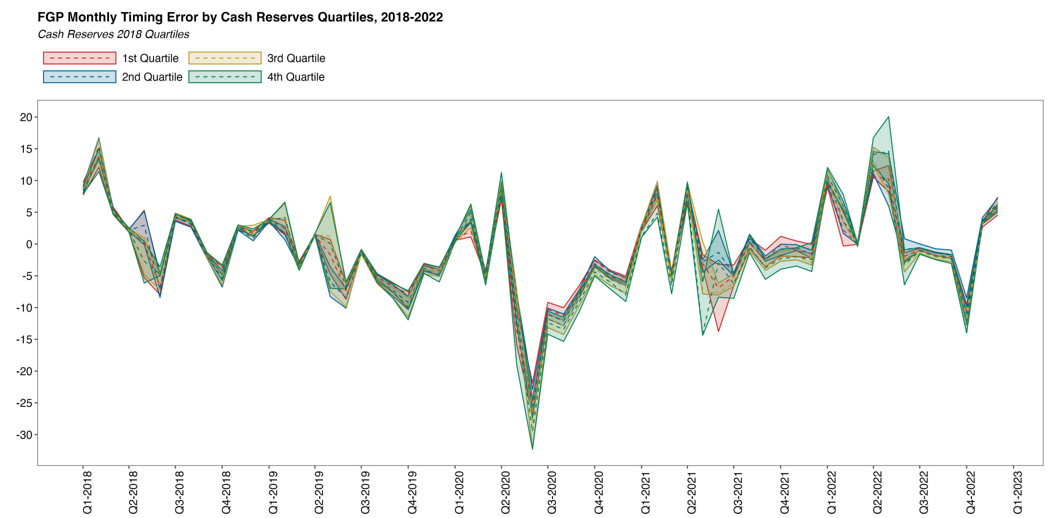
State	Mean	SD	CV
Aguascalientes	0.0129	0.0006	0.0475
Baja California	0.0323	0.0012	0.0373
Baja California	0.0079	0.0004	0.0519
Campeche	0.0131	0.0013	0.0965
Chiapas	0.0452	0.0019	0.0411
Chihuahua	0.0336	0.0012	0.0354
Coahuila	0.0269	0.001	0.038
Colima	0.0082	0.0005	0.0659
Durango	0.015	0.0007	0.0451
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.1: Distribution and Correlation of Main Variables

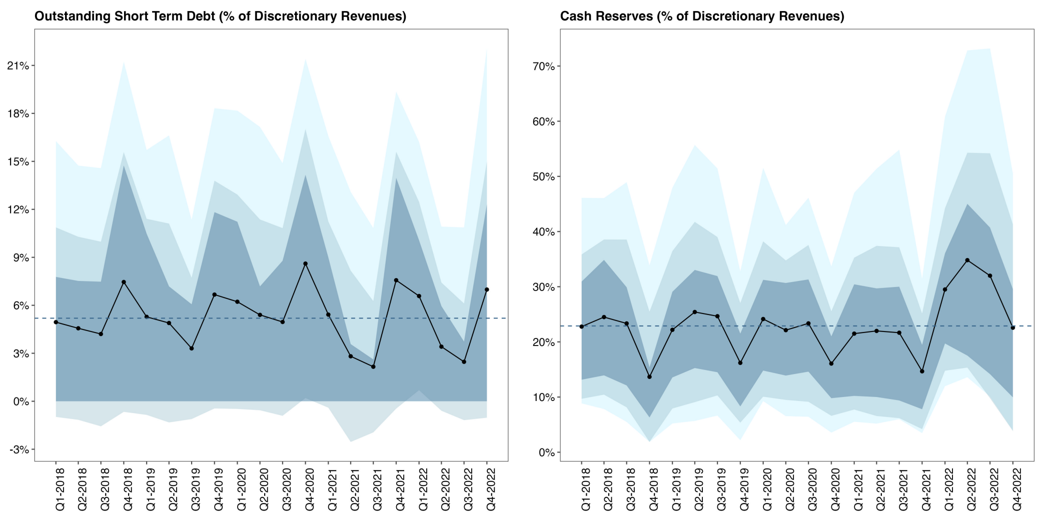
Notes: This panel shows the scatter plots (with fitted univariate linear regression lines) of the main variables used for the analysis, across the distribution of cash reserves observed in 2018. Upper diagonal panels show the correlation across variables, at each quartile of the cash reserves distribution. 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.2: FGP Timing Errors by Cash Reserves Distribution



Notes: This graph shows the distribution of the timing error 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.

Figure A.3: 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 A.2: Effect of Cash Reserves on Short-Term Borrowing (Only Active Governments)

	(1)	(2)	(3)	(4)
Panel A: OLS Estimates				
Cash Reserves (% DR) $\hat{\delta}$	–0.1449***	–0.0330	0.0638	0.0842
	(0.0504)	(0.0488)	(0.0469)	(0.0508)
Panel B: 2SLS IV Estimates				
Cash Reserves (% DR) $\hat{\delta}$	0.2162	0.2174*	0.1756*	0.1715*
	(0.1842)	(0.1220)	(0.1019)	(0.0990)
First Stage: Timing Error $\hat{\beta}$	1.6206**	1.8572***	2.1104***	2.1102***
	(0.6560)	(0.4395)	(0.4119)	(0.3746)
Cragg-Donald F statistic	6.1034	17.8553	26.2499	31.7261
Mean of Dep Var	0.0801	0.0801	0.0801	0.0801
Observations	542	542	542	542
Controls	No	Yes	No	Yes
State FE	No	No	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Notes: Panel A shows the results of the linear regression model across several specifications. Panel B displays the results of the 2SLS regression where the budget error instruments 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: $*p < 0.05$, $**$ $p < 0.01$, $***$ $p < 0.001$

Table A.3: Descriptive Statistics by Credit Rating Group

	(1)	(2)	(3)
	AAA,AA	A	BBB,BB,NR
Short-Term Debt (% DR)	0.0112	0.0704	0.1065
Cash Reserves (% DR)	0.4644	0.2677	0.2585
FGP Budget Error (% DR)	-.0105	-.0040	-.0056
Net Operating Balance (% DR)	-.0072	-.0660	-.0853
% FGP Securing LT debt	0.5184	0.5084	0.5918
Long Term Debt (% DR)	0.4492	0.7925	1.3769
Current Expenditure (% Total Expenditure)	0.7579	0.7365	0.7276
Discretionary Revenue (% Total Revenue)	0.5209	0.4519	0.4850
Observations	121	325	180

Notes: This panel show the descriptive statistics of the main variables used for the analysis by credit rating group. The first two columns show the sample mean and standard deviation. P25, P50 and P75 show the 25, 50 and 75 percentiles, respectively. Short-Term borrowing, cash reserves, FGP budget error, and Net Operating Balance 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. Net operating balance, current expenditures, and discretionary revenues correspond to one year lagged measures.

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