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 re-

serves) 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 fis-

cal 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 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 flexibil-

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

ity 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:

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

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.

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

Convexity of both $C()$ and $R()$ implies that under this set of assumptions, cash and debt behave like substitutes. An increase in cash reserves leads to a decrease

[2]For detailed formulation of this model, check Appendix 9.

[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.

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 $C_2'' R_d R_s < 0$ while $C_1'' > 0$.

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

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).

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

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:

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

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

To understand properly the mechanisms through which Mexican state governments experience liquidity pressures, first I must describe the main factors that characterize state government's fiscal structure under Mexico's federalist arrangement. Mexican state governments operate in a revenue-shared system where tax collection is mainly

undertaken by the federal government. A proportion of federal fiscal revenues stemming is redistributed to state and local governments through a set of discretionary and earmarked funds governed by the rules and formulas established in the Fiscal Coordination Law.

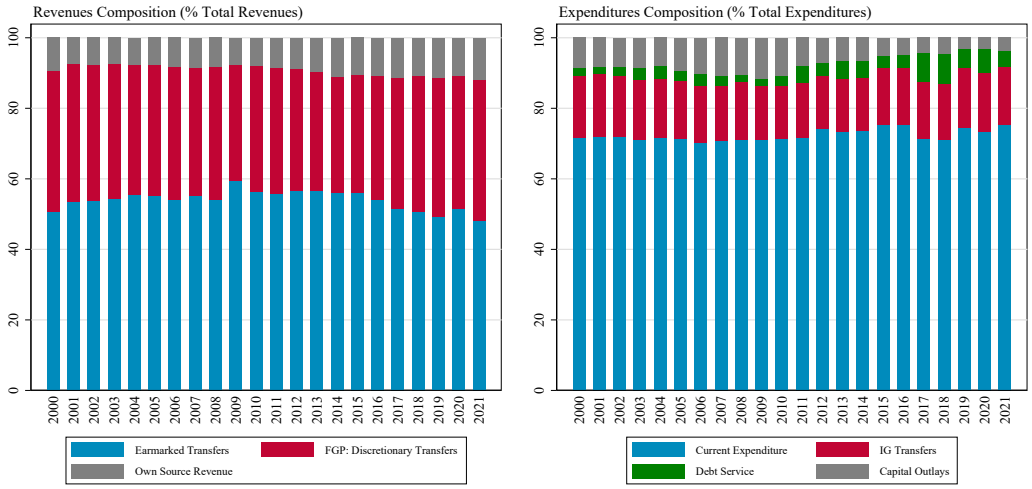
Since tax collection is mainly done at the central level, state and local governments have relatively few tools at their disposal for own-source revenue collection. Using data on subnational government finances from the Ministry of Finance, the right panel in Figure 1 shows the composition of state government revenues from 2000-2021.[4] During this period, earmarked transfers represented on average 53% of total state revenues. Hence, 47% of total revenues are discretionary: 37% from FGP transfers, and 10% of own source revenues. The left panel shows how these funds are allocated across spending categories. As the graph shows, 74% of the expenditures are used to finance current spending. Approximately 16% is transferred to municipal governments, 5% serves to cover debt service, and the remaining 4% finances capital projects.

Following the definition provided in the Fiscal Discipline Law for State and Local Governments, discretionary revenues for state governments are comprised of the sum of FGP transfers and own source revenues. While these represent roughly half of the state's revenues, both current expenditures and IG transfers to municipalities are highly inertial (i.e. is hard for state governments to reallocate expenses from these categories to others) and account for almost 90% of total expenditures. These factors, along with the persistent fiscal deficits observed in recent years, characterize states' exposure to liquidity shocks. The average net operating balance (difference between total revenues and total expenditures) between 2000 and 2021 is estimated at -3.6% of total revenues. See Figure 3 in the Appendix. Given the significant dependence on federal revenues and high current expenditure pressures, we could expect Mexican state governments to have stronger incentives to accumulate slack when available (Hendrick, 2006; Joyce, 2001). Altogether, these factors provide suggestive evidence of the reduced fiscal flexibility observed by governments and how cash constraints might be binding for cash flow management. [5]

[4]For the empirical analysis I only consider data from 2018 onwards. However, I display historical trends to show that the fiscal structure of state governments has remained stable over time.

[5]Enhancements in slack generation could be driven by strategies aiming to improve local tax collection, optimize debt service payments, cutback capital outlays/selling state-owned assets, and the extent to which governments could break budgetary inertia to create fiscal space and reduce deficit spending.

Figure 1: Fiscal Structure of Mexican State Governments



Notes: i) 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). FAFEF and FORTAMUN funds are somewhat fungible as they could be used to cover expenses in almost all the previous categories, still they are not considered discretionary; ii) discretionary revenues are defined as the sum of FGP (unconditional) transfers and own source revenues; iii) current expenditures include payroll expenses, operating expenses and services, and transfers to state agencies and local governments; iv) according to the Fiscal Coordination Law, at least 20% of each state's FGP allocation should be further transferred to municipal governments as discretionary revenues.

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, for its acronym in Spanish) are observed by state governments. This fund is the most relevant source of discretionary revenues for state and local governments in Mexico. It is comprised of 20% of the federal revenues subject to redistribution to subnational governments. Allocations across state governments are determined by population size and local economic growth, following the formulas in the Fiscal Coordination Law. Hence, governments cannot directly influence the size of their allocation.[6] Since population dynamics have been stable over time, states' shares in the general fund are relatively static. Table 6 in the Appendix shows the aver-

[6]Due to the arithmetic structure of the formula, population size is the main determinant of

age share of each state from the FGP. The last column on the right displays the coefficient of variation for each state. Since the average coefficient of variation for all states between 2000 and 2021 is 0.80 there is some evidence of the low temporal variability in the FGP distribution between states, thus underlining its stability over time.

From the budget process standpoint, once distribution across states is computed using the formulas referred on the paragraph above, states' FGP monthly allocations are determined through a two-stage process in which first the size of the shared fund is determined consistent with the federal government's expectations for macroeconomic activity and tax collection, and second a monthly calendar with the payments for each state is published at the Official Registrar before the beginning of the new fiscal year. The monthly calendar provides a more nuanced description of the federal government's expectations of economic activity and tax collection. Timing errors appear when tax collection does not occur at the pace expected by the government. For instance, if federal tax collection is above the expected level during the first part of the fiscal year then state governments will observe transfers above the monthly allocations determined by the Ministry of Finance. In contrast, if federal tax collection is behind the calendar promised to states, then the latter might experience liquidity shocks through lower discretionary transfers.

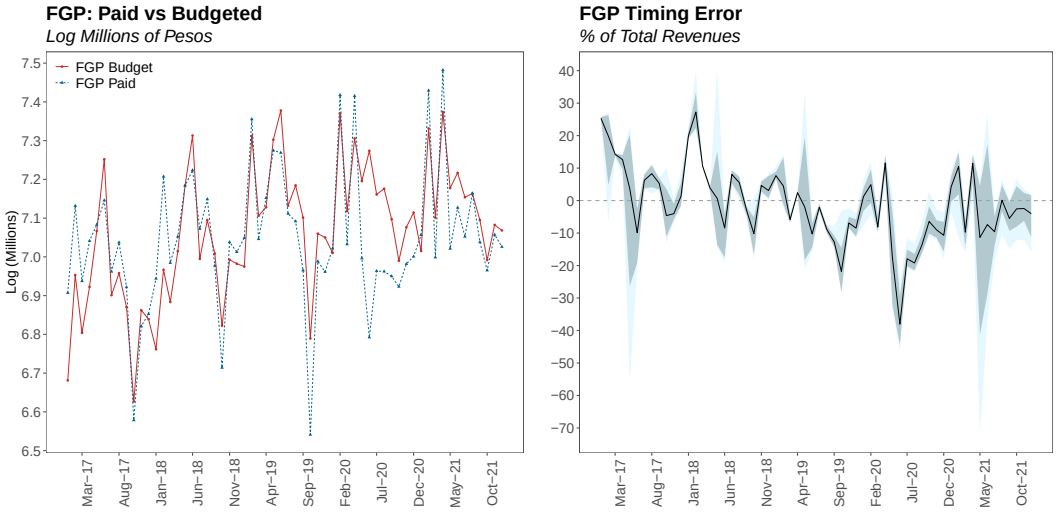
While the validity of the macroeconomic assumptions used by the government could be contrasted with the expectations of other agents, there is no information on how the federal government determines the annual calendar of transfers. Intuitively, however, one could argue the schedule should reflect the government's expectation on how fiscal revenues will be collected during the fiscal year such that this does not translate into liquidity shocks for the federal government as well. It should be underlined that state governments have no influence on how annual allocations and the calendar at which they are distributed during the fiscal year. States observe the calendar and incorporate it into their own budgets, thus underlining the mechanism through which this translates into cash flow spillovers.

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 2 displays the monthly time series of the budgeted FGP transfers

the distribution of funds across states. See Arechederra and Urzua (2017) and Arechederra and Carbajal (2017) for a discussion on this.

through each fiscal year's schedule against the actual FGP payments between 2017 and 2022. The right panel shows the implied forecasting error between the two as it displays the percentage difference between FGP paid and budgeted. This graph underlines the magnitude of the liquidity pressures experienced by state governments. For instance, while between 2018 and 2019 the average timing error was 5.05% and -5.37%, respectively, during 2020 the average difference was -10.18% and peaked at -38.17% in June 2020, the largest deviation observed in the analyzed period.

Figure 2: Timing Errors in the General Participations Fund



Notes: The Left panel shows the difference between paid and budgeted FGP allocations. The right panel depicts this difference in terms of unconditional revenues. The dark-shaded area shows quantiles between 5% and 95%, while light-shaded area quantiles 1% to 99% (excluding outliers).

There are some policy tools in place at the central level that help smooth the state's cash flow during the fiscal year. For instance, every four months the federal government adjusts FGP payments depending on observed data for population and local economic growth. These adjustments could translate into a cash windfalls (if FGP shares were underestimated) or into payment from the state to the federal government (if FGP shares were overestimated). These adjustments, however, are associated with forecasting mistakes on the allocations (shares) between states but are not related to the size of the fund nor its annual calendar. Furthermore, since the shares are relatively static over time, adjustments from this source fade out as a proportion of total discretionary revenues. See Table 6 in the Appendix.

While Mexican governments lack individual rainy-day funds, they do have access to a macroeconomic revenue stabilization fund (FEIEF, for its acronym in Spanish) that aims to fill revenue gaps derived from the differences between budgeted and observed tax collection. This fund de facto operates as a state rainy day fund, with the difference that states cannot tap these resources at their discretion. A natural benefit from this fiscal tool is that hedges all governments, regardless of their fiscal stance as disbursements from this fund are determined by the same shares used to distribute the General Participations Fund.[7]

In sum, state governments in Mexico are characterized by high dependence on formula-based transfers that mainly finance current expenditures that are highly inertial. FGP transfers provide the main source of discretionary revenue for states, making them vulnerable to liquidity shocks stemming from exogenous forecasting mistakes from the federal government either on the size of federal tax revenues or on the calendar through which such fiscal revenues are observed.

5 Empirical Approach

The research question of this paper is in principle examined by the following regression of short-term debt liabilities on cash reserves:

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

This equation follows the basic structure of the models estimated in the previous literature by Su and Hildreth (2018) and Lofton and Kioko (2021) where i represent the governmental unit and t the time period, and the measurement of cash reserves and short-term debt is specific to each context.[8] For this study, i denotes Mexican state governments, and t the financial quarter from Q1 of 2018 to Q4 of 2022. The main dependent variable is end-of-quarter short-term debt liabilities while

[7] During the analyzed period the balance of this fund decreased significantly since 2018. Local credit rating agency, HR Ratings, argues this is explained by the slowdown Mexico's economy has experienced (which translates into lower fiscal revenues) and large withdrawals made during 2020 and 2021 to cope with the effects of the COVID-19 pandemic (HR Ratings, 2022).

[8] Lofton and Kioko (2021) uses a measure of liquidity instead of cash reserves. Their illiquidity measure is the proportion of assets not easily convertible into unrestricted cash as a percentage of total expenditures. Su and Hildreth (2018) uses unreserved general fund balance as a percentage of total operating expenditures to measure financial slack.

the independent variable is end-of-quarter cash holdings. Both these variables are scaled by the average level of discretionary revenues observed by each state government between 2009 and 2016 (outside the analysis period). To ease endogeneity concerns induced by the mechanical relationship between discretionary revenues and FGP transfers, I use past and time-invariant measures of discretionary revenues as the scaling variable.[9] The motivation behind this scaling follows several rationales. First, discretionary revenues provide a direct measurement of the government's funds that could lead to an increase in cash holdings (i.e. there is no room for slack generation on earmarked transfers). Second, without proper measurement of the proportion of current expenditures financed through earmarked transfers, scaling by current expenditures might lead to wrongful comparisons as the denominator might capture the heterogeneity in the composition of earmarked transfers to each state government. Third, discretionary revenues is one of the main definitions used in the Fiscal Discipline Law to establish expenditure and debt limits, hence providing estimates expressed in units relevant to local decision-makers.

The vector of controls includes variables that aim to measure the liquidity needs the state face during each fiscal year, government's capacity for excess slack generation, and the conditions under which governments access financial markets. Controls included are: i) a categorical variable for credit rating assigned by Fitch ratings[10]; ii) the percentage of FGP funds used as repayment pledge (collateral) for long-term debt; iii) percentage of long-term debt to total outstanding debt (both short-term and long-term); iv) net operating balance measures as a percentage of total revenues; v) percentage of current expenditure to total expenditures; and vi) percentage of discretionary revenues to total revenues. These last three variables are lagged by one year to avoid direct endogeneity. The next subsection provides more details on these variables and their data sources.

Since liquidity management could be influenced by the seasonality of tax collection, I include quarter-by-year fixed effects in all econometric specifications. To assess the extent to which my estimates could be driven by omitted variable bias I run the model under specifications with and without the vector of control variables

[9] As a robustness check, I ran the analysis using this variable as the scaling criterion. The results of my analysis are robust to use either as the scaling variable. However, results when using current expenditures yield larger standard errors.

[10] 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.

and state fixed effects. The preferred specification of this paper includes controls and both sets of fixed effects. Furthermore, statistical inference for the main results is done using clustered standard errors at the state level.

As discussed, the sign of δ is theoretically ambiguous, but the findings of the 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. Mexican state governments, in contrast, observe relatively lower fiscal flexibility and are likely to observe stricter liquidity constraints. Thereby, it is reasonable to hypothesize that δ will be positive for this quasi-experimental setting.

OLS estimation of Equation 7 is likely biased due to reverse causality between cash reserves and short-term borrowing. Under strict cash 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 δ in Equation 7.

As described in the previous section, I use the underlying variation from the timing errors on FGP payments during the fiscal year to parse out the endogeneity between cash reserves and short-term borrowing. This timing error is used as an instrumental variable for cash reserves. To be clear, the timing error is computed as the difference between FGP transfers paid and FGP transfers scheduled to state i during quarter t. To keep consistency with the dependent and independent variables, the instrumental variable is also scaled by the average discretionary revenues observed by each state between 2009 and 2016. The following system of equations describes the first stage and the reduced form estimated for this analysis.

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

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

The coefficient estimate δ from Equation 9 retrieves the local average treatment effect from a change in cash reserves on short-term debt induced by these distribution timing errors. For these estimates to be causal, however, the identification assumptions of IV need to hold. In other words, cash holdings should be correlated with the budget error (relevance assumption) and should only influence the decision to borrow through its effect on cash holdings (exclusion restriction).

As described in Table 1 and shown in Figure 4, the timing error could deplete governments' ability to generate excess cash flows when it observes large deviations from the mean. To directly test for the relevance assumption, following standard practice on instrumental variable literature, I report Cragg-Donald F-statistic that tests 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).

Considering local economic growth and population dynamics are the main factors shaping the distribution across state governments, which is historically characterized by low within-state variability (see Table 6 in the Appendix), these timing errors should be uncorrelated with state's long-term fiscal outlook and current economic conditions. Observed FGP payments (and their implied timing errors) are determined by national tax collection, hence diluting the indirect effect stemming from local economic activity. Therefore, the data-generating process of the timing error is mainly driven by the budgetary assumptions made by the federal government and state governments have no direct influence on how the distribution calendar during the fiscal year takes place. Given these factors, I argue this deviation is as good as exogenous for state governments and the exclusion restriction is likely to hold for this variable in this setting.

5.1 Data Collection and Descriptive Statistics

For the empirical analysis, I rely on data from several public sources. Information on state government's fiscal structure comes from the statistics of state and municipal public finance available at INEGI (i.e. National Statistics Agency). This data set comes from an annual survey that gathers information on state and local revenues

(including FGP transfers) and expenditures following the accounting rules established for that matter. With this data, I build measures of discretionary revenues (FGP transfers and own-source revenues) and current expenditures.

Data on states' financial variables comes from forms published by the Ministry of Finance as part of its monitoring role for subnational governments. In compliance with the Fiscal Discipline Law, state governments need 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. These variables are reported through different forms the federal government has in place for data collection. Relying on web-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 first quarter of 2017.

Credit ratings information was web-scrapped from Fitch Ratings website. The obtained data set contains all credit rating changes observed by state governments since they got their first rating from the agency. With this information, I obtained each state's credit rating going back to 2017. To build the analytical sample some filtering assumptions were made. First, I exclude Tlaxcala and Mexico City from the analysis as their institutional setting differs from other states.[11] That leaves a sample of 30 states. Second, since the structure of the forms evolved over time, data from 2017 does not include information on cash holdings. Hence, I exclude data from this year. My final sample for the empirical analysis consists of a strongly balanced panel of 30 states across 21 quarters covering from Q42017 to Q42022.

To perform the analysis, I first normalize the main variables (cash holdings, short-term debt, and FGP forecasting mistake) expressed in pesos by dividing them by the average discretionary revenues (DR) observed by each state government between 2009 and 2016. I consider the historic average of discretionary revenues to avoid mechanically-induced endogeneity on my estimates since the FGP budget error and discretionary revenues both depend on FGP transfers paid to state governments. This provides a measurement expressed in terms of the state's revenues that could

[11] 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.

be potentially used to cope with liquidity shocks, and yield estimates in units relevant to state policymakers.

Table 1 shows the descriptive statistics of the sample used for the empirical analysis. In my sample, the average state government has outstanding short-term loans equivalent to 6.93% of its discretionary revenues, whereas cash reserves represent on average 30.31% of discretionary revenues. The right panel in figure 4 in the Appendix shows the heterogeneity in the distribution of this variable across state governments. It stands out that, as documented by Marlowe (2005) and Marlowe (2011), governments' cash reserves are well above the five percent rule of thumb mentioned in the literature. On average, the forecasting mistake represents about 0.57% of states' discretionary revenue. However, when looking at the percentiles of this variable it stands out that its distribution during the analyzed period is negatively skewed which means the average budgetary shock (timing error) observed by governments is negative. The left panel at figure 4 in the Appendix show the distribution of this variable by each state. Despite the average deviation seems to be relatively small, its inter-quartile range is between +/- 4.0% of discretionary revenues for several governments. Hence, underlining the possibility of experiencing liquidity shocks during the fiscal year could severely toll states' cash reserves. It also stands out that, on average, Mexican state governments observed negative net operating balances (difference between total revenues and total expenditures), which were equivalent to 6.02% of their discretionary revenues. This is consistent with the trend observed in Figure **??** on the Appendix.

Regarding the magnitude of states' debt service burden, on average 53.43% of states' FGP allocations serve is used as collateral for long-term debt. Standard practice in the Mexican debt market observes that FGP funds used to secure loan payments shall be managed in special purpose vehicles from which lenders (commercial and development banks) access these funds to cover debt service. This feature, however, is only present for long-term loans as by law short-term loans must be unsecured.[12] Once debt service is covered remaining funds are returned to state governments. Hence, long-term debt as a proportion of discretionary revenues controls for both states' leverage as well as their availability of funds to cover short-term debt service. The average of this variable in my sample is 89.42%. The last two rows on

[12]It should be noted that 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 law prevents state and local governments from managing cash flows through long-term debt.

Table 1: Descriptive Statistics

	Mean	SD	P25	P50	P75	N
Short-Term Debt (% DR)	0.0690	0.0844	0.0000	0.0330	0.1251	596
Cash Reserves (% DR)	0.3080	0.2119	0.1553	0.2536	0.4157	596
FGP Budget Error (% DR)	-.0057	0.0316	-.0251	-.0051	0.0101	596
End of Year Fiscal Surplus (% DR)	-.1241	0.2463	-.1685	-.0660	0.0011	596
FGP Surplus Lagged (% DR)	-.0235	0.0859	-.0881	-.0109	0.0528	596
Local Revenues (% Total Revenues)	0.1014	0.0455	0.0624	0.0965	0.1219	596
Current Expenditure (% Total Expenditure)	0.7374	0.0600	0.7121	0.7518	0.7775	596
Credit Rating	2.0906	0.6922	2.0000	2.0000	3.0000	596

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

Table 1 align with the stylized facts described in Figure 1. Current expenditures are equivalent to 73.82% of the average discretionary revenues observed by each state government. At the same time, discretionary revenues represent 47.48% of total fiscal revenues.

6 Results

6.1 Main Results

This section describes the main results of the empirical analysis. Table 2 contains the estimates for the baseline model. Panel A shows estimates of δ using OLS while panel B depicts the results using 2SLS with the instrumental variable at Equation 9. For the preferred specification both OLS and 2SLS point towards a positive and statistically significant (at the 1% level) relation between short-term borrowing and cash holdings. For example, OLS results imply that increasing cash holdings by the equivalent of one percent of discretionary revenues leads to an increase in short-term borrowing equivalent to 0.07 percentage points of discretionary revenues. IV results, however, suggest this effect is larger as the coefficient estimate implies an increase of 0.20 percentage points in the ratio of short-term borrowing and discretionary revenues. For the average government in the sample, short-term borrowing is equivalent to 6.90% of discretionary revenues, hence implying the effect will place this ratio in

7.10%.

Coefficient estimates from the first stage regression suggest a positive and statistically significant relationship between cash holdings and the forecasting mistake across all specifications. The preferred estimation in column 4 suggests that a positive forecasting mistake equivalent to one percentage point of discretionary revenues, leads to an increase in cash holdings equivalent to 1.63 percentage points of state's discretionary revenues. 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). All specifications, except for the one without controls and state fixed effects observe Cragg-Donald first stage F-statistics above 10, thus rejecting the null hypothesis of underidentification and giving evidence on the relevance of the instrument.

The OLS results in Table 2 contrasted with the IV/2SLS results demonstrate the direction of the endogeneity bias. In the absence of the vector 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 -0.14 to -0.07 percentage points. Column 3 shows the estimates without control variables but with fixed effects. Results from this model imply a positive relationship between financial slack and short-term debt, thus suggesting that time-invariant state-specific unobserved components are downwardly biasing the effect of cash holdings on short-term borrowing. When including both controls and state fixed effects, the coefficient estimate increases from 0.065 to 0.075 percentage points. Altogether, these results exemplify how sensitive are OLS estimates to the econometric specification.

The 2SLS estimates at Panel B, on the other hand, are less sensitive to the presence of controls and state-fixed effects. This reduced variability observed in the 2SLS estimates 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 short-term borrowing. The implied effect from this model suggests that an increase of cash reserves equivalent to one percentage point of discretionary revenues leads to an increase in short-term borrowing between 0.09 and 0.20 percentage points of discretionary revenues.

Table 2: Effect of Cash Reserves on Short Term Debt Issuance

	(1)	(2)	(3)	(4)
Panel A: OLS Estimates				
Cash Reserves (% DR) $\hat{\delta}$	–0.1464***	–0.0766*	0.0657*	0.0757*
	(0.0285)	(0.0386)	(0.0361)	(0.0374)
Panel B: 2SLS IV Estimates				
Cash Reserves (% DR) $\hat{\delta}$	0.1904	0.0936	0.2047*	0.2074**
	(0.1502)	(0.0941)	(0.1052)	(0.0982)
First Stage: Budget Error $\hat{\beta}$	1.5273**	2.0203***	1.6578***	1.6357***
	(0.5613)	(0.5678)	(0.4193)	(0.4221)
Cragg-Donald F statistic	7.4055	12.6596	15.6315	15.0154
Mean of Dep Var	0.0690	0.0690	0.0690	0.0690
Observations	596	596	596	596
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: *$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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 7 in the Appendix replicates the coefficients at Table 2 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.

6.2 Credit Quality and Borrowing Costs

Pecking order theory posits organizations prefer internal over external financing to avoid the adverse selection problem prevalent in financial markets (Myers, 1984). Borrowing costs are the mechanism through which these incentives operate. 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, this theory posits governments' incentives to manage cash flows using cash reserves (internal financing) rather than short-term debt increase along with the borrowing costs they face. At the same time, governments also face incentives to accumulate slack for credit quality maintenance (Marlowe, 2011). This implies that governments with low cash reserves might use short-term debt over financial slack to manage cash flows when both are available. Therefore, there are arguments to hypothesize there is some heterogeneity in the effect of cash on short-term borrowing driven by differences in credit quality.

For this analysis, I first estimate the empirical model at Equation 9 using borrowing costs on short-term debt as the dependent variable. I use loan-level data that comes from the public debt registrar of all the outstanding loans by state and

local governments held by the Ministry of Finance.[13] Table 3 describes the results of replicating the baseline analysis on the sample of short-term loans issued by state governments. The dependent variable for these regressions is the Total Interest Cost (TIC) observed by short-term loans (less than 12 months). It should be noted that according to the Fiscal Discipline Law, short-term loans can only be used for cash-flow management purposes and they cannot be secured/collateralized. Therefore, in this case, TIC provides a direct measurement of market perceptions of governments' liquidity risks.

Since the dependent variable is expressed in percentage points, to improve estimation precision and instrument strength, for this specification I use as an instrumental variable the timing error as the percentage point difference between the observed transfer and the budgeted one (see right panel at Figure 2), as opposed to being scaled by historical discretionary revenues as in the previous results. Results in Table 3 show a large and significant negative relationship between cash reserves and borrowing costs. Estimates from the preferred IV specification point towards an effect of 5.89 percentage points on state borrowing costs. Considering the average TIC on the sample was 8.95%, these coefficients imply a 65.8% reduction in short-term borrowing costs for an increase in cash holdings equivalent to 1 percentage point of discretionary revenues.

These estimates provide suggestive evidence of the role that cash holdings play in determining borrowing costs. Lenders (banks) seem to reward governments with larger cash holdings with lower liquidity risk premiums. Therefore, the opportunity cost of external financing (borrowing) should be lower for well-capitalized governments, relative to the one potentially observed by governments with lower cash reserves.

The results from the last regression underline the relevance of borrowing costs shaping the incentives toward external financing. To examine the heterogeneity on the effect of cash holdings on short-term debt liabilities I estimate $\hat{\delta}$ from Equation 9 within each credit rating group. Hence, each coefficient is estimated using variation

[13]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.

Table 3: Effect of Cash Reserves on Borrowing Costs (Only Short-Term)

	(1)	(2)	(3)	(4)
Panel A: OLS Estimates				
Cash Reserves (% DR) $\hat{\delta}$	–0.0261	–0.0299	–0.0899**	–0.0537***
	(0.0174)	(0.0224)	(0.0386)	(0.0156)
Panel B: 2SLS IV Estimates				
Cash Reserves (% DR) $\hat{\delta}$	–0.3138	–0.2164*	–1.7221	–0.4603
	(0.2359)	(0.1235)	(22.4606)	(1.1026)
Cragg-Donald F stat	2.4625	7.2082	0.0054	0.1457
Mean of Dep Var	0.0738	0.0738	0.0739	0.0739
Observations	139	139	138	138
Controls	No	Yes	No	Yes
State FE	No	No	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
budget_error	–0.8891	–1.5158***	–0.0477	–0.2443
	(0.5666)	(0.5646)	(0.6465)	(0.6370)

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 = Year FE. Standard errors clustered by state. Significance level: *$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

from states belonging to each of the following rating groupings: i) AAA and AA, ii) A, and iii) BBB, BB, and below. I chose this specific grouping to improve the reliability of the estimates as the sample size on AAA and AA independently are not large enough to provide enough variation. First, Table 8 in the Appendix shows the descriptive statistics of the main variables for each rating group. Lower-rated governments observe larger levels of short-term debt liabilities and lower levels of cash reserves. Furthermore, they are also characterized by larger fiscal deficits. At first sight, these factors suggest governments' incentives to manage cash-flows through short-term borrowing increase as credit quality decreases.

Table **??** replicates the baseline results on subsets of the analytical sample partitioned by credit rating. Results from this exercise provide suggestive evidence that the effect of cash reserves on short-term liabilities is larger for lower-rated governments, relative to governments with higher credit quality. Coefficient estimates at Panel A (OLS) imply that, after controlling for state-fixed effects, the effect that holding cash has on short-term debt liabilities increases as credit quality falls. While large standard errors and relatively low Cragg-Donald statistics limit the reliability of estimates at Panel B, they also add to the evidence of larger effects on lower-

Table 4: Effect of Cash Reserves on Short Term Debt Issuance

	(1)	(2)	(3)	(4)
Panel A: OLS Estimates				
AAA,AA	–0.0021	–0.0261	0.0153	0.0101
	(0.0159)	(0.0187)	(0.0190)	(0.0152)
A	–0.1670**	–0.1059	0.0784	0.1080*
	(0.0700)	(0.0742)	(0.0750)	(0.0596)
BBB,BB,NR	–0.1764***	–0.1553***	0.1072*	0.1566**
	(0.0228)	(0.0380)	(0.0534)	(0.0658)
Panel B: IV Estimates				
AAA,AA	0.0108	0.0004	0.2133***	0.2898***
	(0.0232)	(0.0116)	(0.0519)	(0.0828)
A	0.0020	0.0893	0.1073	0.1304
	(0.1879)	(0.1653)	(0.1244)	(0.0826)
BBB,BB,NR	0.3171	0.1836	3.3030	2.3001
	(0.4508)	(0.3322)	(7.9612)	(2.2128)
Cragg-Donald F stat: AAA,AA	3.1225	3.1282	38.2809	25.3695
Cragg-Donald F stat: A	4.3431	4.7550	6.2652	6.0910
Cragg-Donald F stat: BBB,BB,NR	1.9234	2.7849	0.1820	1.0942
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: *$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

rated governments. For issuers rated BBB, BB, and below, the coefficient estimate implies an increase in short-term borrowing equivalent to 2.49 percentage points of discretionary revenues, upon an increase in cash holdings equivalent to one percent of discretionary revenues. For higher-rated governments (AAA and AA), in contrast, this coefficient is estimated ad 0.25 percentage points.

The general direction of the results persists in each rating group: IV estimates suggest a larger effect than OLS results, and downward bias in the coefficients is attenuated after including the vector of control variables and state fixed effects. Results from these models provide evidence of heterogeneity driven by credit quality. It should be noted, however, that IV estimates suggest heterogeneity driven by credit quality is larger than the one found by OLS coefficients. Altogether, these results suggest government's incentives to hoard cash decrease as their credit rating rises, aligning with the results at Marlowe (2011).

These results underline that governments with limited access to financial markets (lower-rated governments) might rely more on short-term debt as a cash flow management tool. This intuition 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). However, this theory posits that preferences over cash financing are driven by the extent to which information asymmetries in financial markets lead to higher borrowing costs (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).

7 Robustness Check: Heckman Selection Model

Scholars often 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.

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). For this estimation, I use the same instrumental variable (FGP timing errors as a percentage of discretionary revenues) 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 **??** 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

Table 5: Heckman Selection Model: Short Term Borrowing and Cash Reserves

	(1)	(2)	(3)	(4)
Panel A: Second Stage (Outcome Model)				
Cash Reserves (% DR)	–0.1690***	–0.1042*	0.0152	0.0385
	(0.0529)	(0.0570)	(0.0549)	(0.1278)
Panel B: First Stage (Selection Model)				
Budget Error (% DR)	–2.6477	–2.6477	–2.6477	–2.6477
	(2.6885)	(2.6885)	(2.6885)	(2.6885)
Mean of Dep Var	0.0687	0.0687	0.0687	0.0687
Observations	599	599	599	599
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 (2) 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 by state. Significance level: *$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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.

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 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.[14] 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.

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

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.

[14] 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.

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

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

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

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

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: [15]

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

where:

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

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

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

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

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

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

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

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.

9.1 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 ($R_{ds} < 0$)[16].

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.

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

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.

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

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

[16] 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.

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.

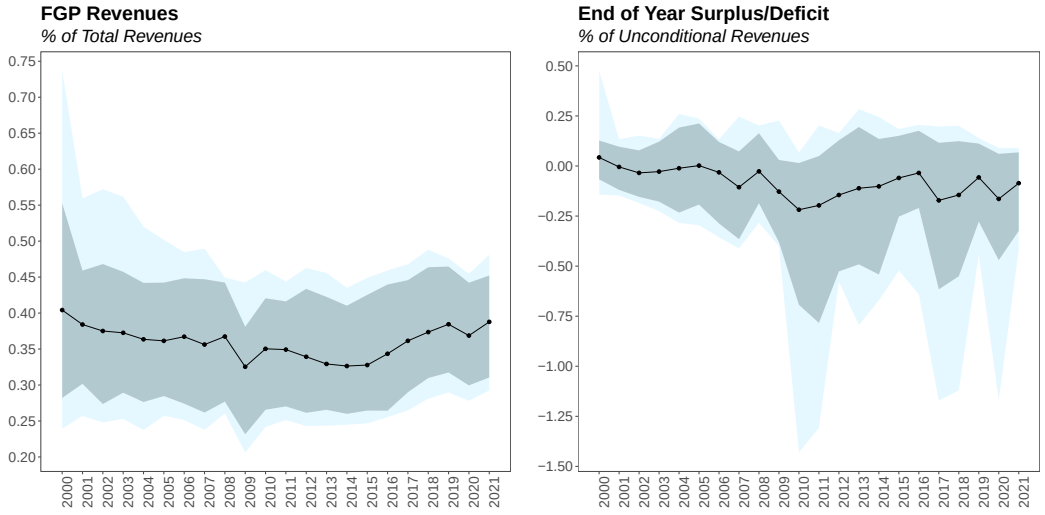
10 Appendix

Table 6: 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

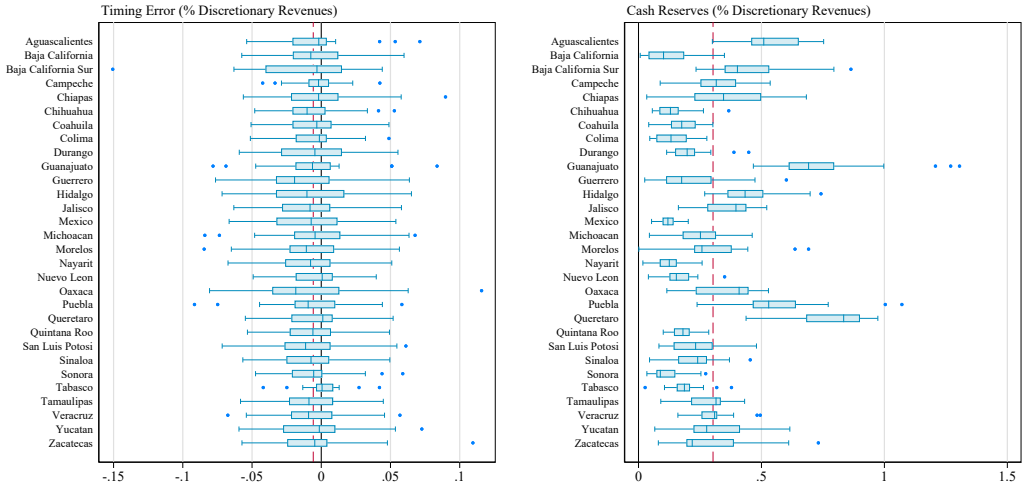
Notes: This table shows the descriptive statistics on the shares/allocations of the FGP each state observed between 2000 and 2021. Shares are computed as the proportion of each state FGP allocation represents out of the total FGP.

Figure 3: State Governments Exposure to Liquidity Shocks



Notes: The graph on the left shows the percentage of FGP revenues with respect to total fiscal revenues for all states across time. The solid black line represents the average in the sample. Dark-shaded area covers show quantiles between 5% and 95%, while light-shaded area quantiles 1% to 99% (excluding outliers). End-of-year balance defined as the difference between total revenues (earmarked transfers + unconditional transfers + own source revenues) and total expenditures (payroll + operating expenses + IG transfers + capital outlays + debt service). In average, 36% of fiscal revenues come from the General Participation Fund. At the same time, the average government experiences a deficit equivalent to 8% of their unconditional revenues in a given fiscal year.

Figure 4: Budget Error and Cash Reserves by State Government (2018-2022)



Notes: These panels show the distribution of the forecasting mistake and cash reserves for each state government during the period of analysis. The red dashed line shows the mean of the variable in the pooled sample.

Table 7: 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 8: 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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