Can municipalities weather the weather?

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Abstract: Abnormally warm temperatures predict lower municipal revenues, particularly for areas with few or more concentrated revenue sources or those relying on non-property tax revenues. Municipalities offset revenue shocks with dollar-for-dollar changes in current-year expenditures. Capital expenditures exhibit 2.5 times the sensitivity of operating expenditures, a finding supported via a survey of municipal managers. Revenue concentration and composition strongly predict the effect of temperature on both revenues, capital expenditures and total spending, which municipalities don't appear to manage via intergovernmental transfers or subsequent year's spending. These findings challenge notions of governmental inflexibility, suggesting that municipalities actively manage financial risk.

Keywords: Municipal financing; cash flow shocks; investment; municipal budgeting, climate change

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1. Introduction

How financially resilient are U.S. municipalities to warming temperatures? Despite U.S. municipalities raising and spending over $2 trillion per year to provide essential services like police, fire, utilities, and public works (Berry and Marlowe 2024), *and* mounting evidence on the adverse effects of rising temperatures, there is little empirical evidence on this question. Municipal revenues are well diversified and stem from economic agents with varying sensitivity to warm weather, making both the extent of their exposure to weather-induced financial shocks and how they manage weather-induced shocks empirical questions.[1] For instance, abnormally warm weather may adversely affect the municipal revenues coming from sales and income taxes if it disrupts local businesses, but such variation in weather may not immediately affect property taxes or even be offset by intergovernmental transfers or utility revenues. Moreover, literature on municipalities' financial autonomy and dynamic adjustments to revenue shocks suggests that the manner in which heat-induced municipal revenue shocks translate to expenditure effects is also an important but answered empirical question.[2] Revenues shocks may lead municipalities to reduce current or future operating or capital expenditures, but these effects will be limited to the extent that are managed through balance sheet reductions, debt issuance, or intergovernmental transfers.

In this paper, we provide the first empirical evidence on how annual variation in warm weather affects municipal finances. Specifically, we address three novel and important empirical questions: (1) to what extent are municipal revenues affected by heat variation, (2) what levers do municipalities use to manage warm weather-induced shocks, and (3) is municipal capital investment insulated from short-run non-fundamental revenue shocks.

[1] See Brown, Gustafson, Ivanov (2021), Tran (2023), or Addoum, Gounopoulos, Gustafson, Lewis, and Nguyen (2024) for evidence on how local economies may be disrupted and Addoum, Ng, and Ortiz (2020, 2023) for evidence of how temperature impacts net out across the universe of large firms.
[2] See for example Buettner and Wildasin (2006), Helm and Stuhler (2024), and Mauri (2024).

We identify the effect of abnormal warm temperature on municipal financial outcomes using a panel regression with municipality and state-year fixed effects. The key outcomes of interest are measures of municipal revenues and expenditures, which we obtain for 87,500 municipality-years across 47 states from the Census Bureau's Census of Governments (CoG) as compiled by Pierson, Hand, and Thomson (2015).[3] The average (median) municipality in our local government sample (counties, cities, and towns) earns \$53 (\$3) million in revenues and provides services to 21,000 individuals.

The explanatory variable of interest is standardized versions of the number of cooling degree days (CDDs) in a county-year, where cooling degree days are the number of degree-days above 65 degrees Fahrenheit. CDDs are a well-established metric for economically relevant temperature impacts. For example, CDDs are the foundation for the main temperature-related options contracts traded on the Chicago Mercantile Exchange (see e.g., Purnanandam and Weagley 2016) and have been shown to have substantial economic impacts on outcomes such as migration (Baylis, Bharadwaj, Mullins, and Obradovich, 2025). Our inclusion of municipality fixed effects allows us to the interpret the municipal financing responses to abnormal weather variation. As Dell, Jones, Olken (2014) explain in their survey, this reduced-form approach, which exploits the plausibly random variation in an area's weather over time, has become popular in recent decades and is able to draw plausible inference on the causal effects of weather with relatively few identifying assumptions. In our case, the key identifying assumption is that shifts in relative

[3] The Census Bureau's CoG survey consists of a mail canvass, supplemented by direct data feeds, central collection from state sources, and hand collection from municipal financial statements. The COG occurs every five years (ending in '2' and '7') for all state governments and over 90,000 local governments. We exploit the four most recent CoG surveys in 2007, 2012, 2017, and 2022 for our sample. Pierson et al. (2015) standardize this data in The Government Finance Database.

temperatures of different areas within the same state over time are unrelated to municipal financial outcomes, except through the effect of the weather on these outcomes.

Our first main result is that more abnormally hot temperatures (i.e., more cooling degree days) predict lower municipal revenues. If an already warm month becomes 90 degree-days (or 3 degrees per day) hotter, then our model predicts annual municipal revenues to be approximately 1% lower, or $19 per resident. The relation between abnormal heat and municipal revenues concentrates in the year of the heat event. Other variation in everyday weather (i.e., cold weather, precipitation) fail to provide similar consistent effects on revenue. Municipal revenues are neither affected by the previous years' temperature nor related to future temperature patterns.

The composition of a municipality's revenue is a primary predictor of its sensitivity to temperature. This idea manifests along two dimensions. First, the sensitivity of revenue to temperature attenuates as the number of municipal revenue sources rise or as revenue sources become more dispersed. The predicted revenue-temperature sensitivity is about twice the full sample average for a municipality with four revenue sources (i.e., the 10th percentile of revenue diversity) and approximately zero for a municipality with 17 revenue sources (i.e., the 90th percentile). This result is insensitive to the simultaneous inclusion of interactions between temperature shocks and an area's size or economic conditions. The type of revenues that a municipality relies on also significantly predicts revenue exposure to temperature. The adverse effect of temperature on revenues is largest and most significant for areas relying on non-property tax revenues and virtually non-existent for the hypothetical municipality that exclusively relies on property tax or utilities revenues. Given that non-property tax revenues come from income and business sales, this result is consistent with existing evidence on the negative effect of adverse weather on local business cash flows (see e.g., Brown, Gustafson, and Ivanov, 2021; Tran 2023; Addoum, Gounopoulos, Gustafson, Lewis, and Nguyen, 2024).

We next study the empirical question of how municipal spending and investment responds to everyday variation in heat. Temperature changes may affect operating expenses either directly or through their effect on revenues. The signed impact of direct effects is unclear and will likely vary by expenditure type as temperature variation will differentially affect the cost and benefits of certain operating expenses. For example, while abnormal heat in an Alabaman summer could increase emergency service expenses, these expenses may be offset by lower expected public park attendance, leading to fewer employee staffing hours at these public parks. Given the negative relation between elevated temperature and municipal revenues, a revenue-based effect predicts a negative relation between heat and municipal spending. The extent and timing of this relation depends on complex and dynamic links between municipal revenues and expenditures (see e.g., Buettner and Wildasin, 2006; Helm and Stuhler, 2024) and may be mitigated to the extent that municipalities pre-emptively accumulate cash (see e.g., Gore, 2009).

We find that the effect of temperature shocks on total expenditures is strikingly similar to the corresponding revenue impact. Our findings support the dual conjecture that temperature shocks primarily affect expenditures via their effect on revenue, and municipalities reduce expenditures in real time to in response to moderate non-fundamental revenue shocks. Again, a three-degree warming of everyday temperature in an already hot month predicts a 1% decline in total municipal expenditures. Consistent with municipalities effectively managing revenue shocks in real time via expenditure adjustments, we find that spending is neither affected by the previous years' temperature nor related to future temperature patterns.

We further link temperature's spending effect to its impact on revenues by showing that the distribution of municipal revenues – the number of revenue sources, revenue dispersion, and the revenue type breakdown – are by far the biggest predictors of temperature's impact on municipal expenditures. Moreover, a municipality's reliance on a given revenue source similarly predicts temperature's effect on both municipal revenues and spending. For example, areas that are more reliant on property taxes or utilities compared to non-property taxes exhibit a reduced sensitivity of both municipal revenues and spending. In contrast, after controlling for the composition of municipal revenues, municipality characteristics such as measures urbanity, political leaning, and balanced budgeting provisions have little predictive power with respect to the temperature-spending relationship. These findings offer both intuitive support for the effect of temperature on municipal spending and further suggest that revenue effects are the primary driver of the sensitivity of municipal spending to temperature.

A key difference between municipal operating expenses and their spending on capital investment is that there is arguably no direct relation between the everyday measure of elevated temperature that we employ and long-run capital investment opportunities. Under this assumption, which Brown, Gustafson, and Ivanov (2021) rely on in the case of adverse winter weather and small firms, our setting can shed new light on how insulated municipal capital investment is from short-term non-fundamental changes in revenue. In so doing, we provide perhaps the first evidence on the municipal investment cash flow sensitivity, which has received extensive attention in the corporate finance literature (see e.g., Fazzari, Hubbard, and Petersen, 1988; Erikson and Whited, 2000; Moyen, 2004).

We find that municipal capital investment is more than twice as sensitive to temperature shocks than the average dollar small municipalities spend. In dollar terms, reduced capital expenditures account for about 29% of the CDD-induced reduction in per capita spending even though capital expenditures comprise less than 15% of municipal expenditures. Aside from reduced capital expenditures, the reduction in expenditures persists across a range of expenditure categories. The dollar-for-dollar expenditure adjustment combined with the concentration within capital expenditures mitigates the possibility that our findings primarily reflect elevated temperatures simply lead to event cancellations or facility closures that simultaneously reduce revenues and operating expenses. We expect that such closures do contribute to our findings, but it also appears that municipalities actively manage long-term spending in a manner that sacrifices long-term investments, but indicates financial independence.

We conduct a survey of municipal finance departments, which provides institutional context for several of our findings. Managers report current year capital expenditures to be the most consistently important lever that they use to manage unexpected revenue declines. Interestingly, these investment offsets are most likely to incur simultaneously with a revenue decline, contrasts with prior literature's findings that municipal managers respond to cash shortfalls in subsequent budgeting periods (Costello, Petacchi, and Weber 2017; Helm and Stuhler, 2024). We also inquire about the drivers of fiscal austerity. Managers noted that the fiscal discipline in response to cash shortfalls is in line with what they believe their constituents want, along with requirements to maintain a balanced budget, and concerns regarding financial constraints. We also observe significant variation in municipal governments definition of what constitutes a balanced budget, with most definitions not forcing municipalities to immediately adjust their spending in response to revenue shocks. This survey evidence corroborates our empirical evidence and fills a void in the literature regarding whether and how municipalities respond to unexpected, transitory cash shortfalls (Poterba 1994).

Our study makes several important contributions to the literature. First, we provide robust empirical evidence that abnormal weather shocks affect municipal finances, adding to the growing literature on the impact of exogenous weather shocks on economic activity. While prior work has explored these effects in the context of private firms and industries (e.g., Jin, Li, Lin, and Zhang 2025, Addoum, Ng, and Ortiz-Bobea, 2023, Hong, Li, and Xu, 2019) or broad economic outcomes (e.g. Dell et al. 2009, 2012, and 2014; Burke, Hsiang, and Miguel 2015), our analysis extends this line of inquiry by focusing on a novel setting: municipal governments, which represent a major component of the U.S. economy. Our findings underscore the importance of accounting for local environmental factors when assessing public finance management.

Second, more generally, our study contributes to the literature on how organizations respond to and can isolate themselves from non-fundamental cash-flow shocks (Almeida and Campello, 2007; Dambra 2018; Brown et al. 2021). We find that, unlike common perceptions of bureaucratic inflexibility, municipalities demonstrate surprisingly adaptive financial behaviors when faced with weather-induced revenue shocks, which are short-run and arguably exogenous to municipal fundamentals. The real time expenditure adjustments in response to revenue shocks that we observe differs from studies suggesting that municipalities take several years to stabilize in response to fundamental or permanent shifts in revenue (Holtz-Eakin, Newey, and Rosen, 1989; Buettner and Wildasin, 2006; Helm and Stuhler, 2024), challenging the commonly held notions of governmental inflexibility (Niskanen, 1971) and bureaucratic incentives to maintain current expenditures (Hayes, Razzolini, and Ross, 1998; Wu et al., 2020).

Specifically, we highlight the value of a diversified revenue stream as a tool for mitigating a municipality's exposure to fiscal shocks. Copeland and Ingram (1982) and Gore (2009) argue that having undiversified revenue sources increase credit risk and such firms are more susceptible to adverse revenue shocks. However, extant public policy literature finds largely conflicting evidence on the relation between revenue diversification and budgetary solvency.[4] These studies rely on cross-sectional or lagged panel analyses that cannot credibly identify causal effects (e.g., Hendrick 2002; Carroll 2009). In contrast, we exploit plausibly exogenous weather variation to causally identify how revenue diversity insulates municipalities from negative revenue shocks. Our findings not only reinforce the notion that diversified revenue structures enhance fiscal resilience, but also demonstrate that such diversification enables municipalities to better manage cash flow volatility without relying on intergovernmental transfers or running deficits.

Finally, our study adds to the literature on how local municipalities respond to climate change. The business press and extant literature largely focuses on the financial constraints imposed on municipalities from large natural disasters (Jerch, Kahn, and Lin, 2023) or long-run climate risks such as sea level rise (e.g., Painter, 2020; Goldsmith-Pinkham, Gustafson, Lewis, and Schwert, 2023). Unlike the natural disaster setting, the municipal budget deficits from intertemporal temperature variation are not offset by increased state and Federal aid (Jerch et al., 2023). By establishing a causal relationship between temperature shocks and municipal finances, we underscore the importance of integrating climate-related risks into public sector fiscal management. Our study speaks to the extant climate finance literature by showing local governments appear more resilient to climate change than commonly perceived (e.g., Gillers 2024).

2. Identification Strategy

Our research objective is to explore if and how municipal finance outcomes respond to everyday changes in warm temperatures. Our identification strategy exploits plausibly random

[4] See Jiminez and Afonso (2022) for a comprehensive literature review.

variation in an area's weather in a panel regression over four distinct Census Bureau surveys. Our methods mirror those discussed in Dell, Jones, Olken (2014), which are becoming increasingly popular in studies trying to draw causal inference regarding the effects of weather. Our main empirical specifications take the following form,

$$Y_{mt} = \alpha_{st} + \delta_m + \beta_1 CDD_{mt} + \ Controls + \varepsilon_{mt} \quad (1)$$

where Y_{mt} equals the revenues or expenditures of municipality *m* in year *t*, scaled by the population that they serve. Our baseline analyses employ an ordinary least squares estimator. We find qualitatively similar results using a Poisson maximum likelihood estimator to account as recommended by Cohn, Liu, Wardlaw (2022)

Our main explanatory variables of interest are standardized measures of cooling degree days (CDDs), data on which we obtain from the National Oceanic and Atmospheric Administration (NOAA), supplemented with PRISM Weather Data for years after 2022. CDDs account for the extent of uncomfortable weather over a given period. Specifically, CDD_{mt} counts the number of cooling degree days above 65 degrees Fahrenheit in municipality *m* during year *t*. For example, a single 75-degree day adds ten units to the CDD measure, which are then aggregated over 365 days in year *t*. Because our municipal finance outcomes are observed at the annual level, we intentionally employ an aggregate annual measure of temperature, as opposed to the prevalence of short stints of extreme weather. As Akyapı, Bellon, and Massetti (2025) discuss, this approach aligns closely with studies on the macroeconomic impacts of weather, which either link global temperature to total output or use approaches such as ours that identify off of random changes in temperature (see e.g., Dell, Jones, and Olken 2012; Deryugina and Hsiang 2014; Burke, Hsiang, and Miguel 2015; Kalkuhl and Wenz 2020; Newell, Prest, and Sexton 2021).

CDDs, our temperature measure of choice, are widely regarded as one of the most economically relevant summary statistics for heat level. CDDs are the foundation for the main temperature-related options contracts traded on the Chicago Mercantile Exchange and commonly used in academic studies (see e.g., Purnanandam and Weagley, 2016; Bae, Jeon, Szaura, and Zurita, 2023) and have been shown to have substantial economic impacts on outcomes such as migration (Baylis, Bharadwaj, Mullins, and Obradovich, 2025).

We also include lagged county-level controls for the unemployment rate, per capita income, and the natural log of the number of business establishments (Dambra, Even-Tov, and Naughton 2023). In addition, we control for municipality-level population to capture size-related differences across our various municipalities. We standardize all independent variables except those relating to the municipalities revenue composition for ease of interpretation. Thus, the baseline CDD coefficient will reflect the effect on the average municipality, or in the case where revenue interactions are included, a hypothetical municipality with all of their revenues derived from non-property taxes.

The inclusion of municipality fixed effects (δ_m) ensures that we identity off of within-municipality variation in temperature. State-year fixed effects (α_{st}) control for time varying climates and local economic conditions, although we show that our main results are qualitatively similar using only year-fixed effects.[5] As Dell, Jones, Olken (2014) discuss, this framework requires few explicit identifying assumptions when identifying the causal effects of abnormal weather. The key identifying assumption is that shifts in relative temperatures of different areas within the same state over time are unrelated to municipal financial outcomes, except through the effect of warm weather on these outcomes.

[5] Technically, we include state-year-month fixed effects to ensure that the comparisons are between municipalities in the same fiscal year end and therefore the same temperature shocks over the fiscal year.

We supplement our main empirical tests with regressions that augment Eq. (1) with lead and lagged CDD measures. The lagged temperature outcomes shed light on the longevity of warm weather's effect on municipal financial outcomes, while the future temperature shocks act as placebo tests that help validate our identifying assumptions. Our non-discrete variables are winsorized at the top and bottom percentile and we cluster our standard errors by county.

3. Data and Descriptive Statistics

3.1 Data Overview

Our data are derived from several sources. For our municipal outcomes and populations, we exploit the Census Bureau's Census of Governments (CoG) as compiled by Pierson, Hand, and Thompson (2015) in The Government Finance Database.[6] The CoG is a comprehensive survey of state and local government financial data for all governments in the United States for fiscal years ending in "2" and "7". The Census Bureau utilizes a combination of (most prominently) direct data feeds of municipalities' accounting systems, survey questionnaires, and data collection from annual financial reports and other Federal agency data to compile the CoG. We restrict our analysis to post-2003 fiscal years (i.e., 2007, 2012, 2017, and 2022) to ensure a consistent reporting approach for CoG revenues and expenses for all municipalities following the full adoption of GASB 34, which significantly altered and standardized municipal financial statements (Baber, Beck, and Koester 2024). The CoG allows for a large cross-sectional panel, covering 22,046 different municipalities across 47 states. Within the CoG data, we analyze county level governments (Unit Type Code = 1) and municipalities (Unit Type Code = 2).[7] Our revenue and

[6] https://my.willamette.edu/site/mba/public-datasets.

[7] According to the Census Bureau, municipal governments are sub-county general purpose governments established to provide general services for a specific population and defined area (Census Bureau 2006). Municipalities includes cities, boroughs, villages, and towns.

expense variables are derived from The Government Finance Database in Pierson et al. (2015) and detailed in Appendix A. We also collect county-level unemployment data from the Bureau of Labor Statistics, county-level personal income per capita from the Bureau of Economic Analysis, and the number of establishments from the Census Bureau's County Business Patterns. We inflation-adjust all dollar-denominated variables to 2022 dollars using the Consumer Price Index (CPI). Finally, we obtain county-month measures of heating degree days from the NOAA Monthly U.S. Climate Divisional Database, and supplement with PRISM Weather Data for years after 2022. Our final sample includes 87,500 municipal-year observations.

3.2 Descriptive Statistics

Panel A of Table 1 presents the descriptive statistics for the full sample. The average total inflation-adjusted revenue for a municipality in our sample is approximately $1,880 per capita, with a standard deviation of $1,770 per capita, underscoring the heterogeneity of our municipal government sample. On a per capita basis, the average municipality in our sample incurs expenses of $1,910 per individual.[8]

[INSERT TABLE 1 HERE]

As a point of reference, the median population in our sample is the City of Weston in Missouri, outside of Kansas City. The City of Weston had revenues of $4.2 million and 13 full-time employees, including its own mayor, Board of Alderman, judicial court, public works department, and police department.[9]

Table 1 shows that the average (and median) municipality in our sample generated revenues from ten different sources. In Figure 1, we decompose municipal revenues and expenses

[8] Expenses according to the Census Bureau format do not follow the traditional accounting expenses as defined by the Governmental Accounting Standards Board (GASB). For instance, capital expenditures are included in the Census Bureau's definition of total expenditures. See Appendix A for more details.
[9] See the City of Weston's website.

into subcomponents. Panel A decomposes revenues into property and non-property taxes, fees, utilities, and intergovernmental transfers. Together, these revenue sources comprise over 90% of municipal revenues in our sample. The largest component of municipal revenues tends to be intergovernmental transfers, followed by property taxes. Fees, utility revenues, and non-property taxes each constitute approximately 15 percent of total revenues.

[INSERT FIGURE 1 HERE]

On the expense side, approximately 10% of spending is in the form of capital investment and more than 25% of spending is in the form of salary.[10] Utilities expenses make up the second largest portion of total costs. Together, the statistics in Figure 1 are qualitatively similar to those discussed in Ross and Peng (2023).

In terms of temperature outcomes, average municipalities in the full sample experience 1,333 cooling degree days annually, with considerable variation across the sample. Again, these represent degree days above 65 degrees for the average municipality's fiscal year.

4. Effect of Warm Weather on Municipal Revenues

Our study investigates the impact of warm weather shocks on municipal financing. *Ex ante*, it is unclear whether and how abnormally warm weather will impact municipal revenues. Extant literature studying the private sector offers mixed evidence as to the effect of varying temperature on retail sales activities and productivity (Addoum et al. 2020, Addoum et al. 2023, Dell et al. 2012, Tran 2023). Although this literature weakly suggests that personal and business income (and the accompanying taxes received by municipalities) will be reduced, Figure 1 shows that non-

[10] Note that the way that salary (code: Z00) is reported in the CoG survey is not mutually exclusive of other expenditures. In other words, the Census Bureau's measure of police expenses cannot be further decomposed into police equipment and police employment expenses (codes: E62 and F62). However, the salary measure will include all salaries from a given municipality.

property tax revenues comprise less than 20% of municipal revenues and abnormal weather shocks may have different effects on similarly important revenue streams derived from fees or utilities.

We begin our empirical analysis by assessing the impact of both cooling degree days on municipal revenues in our full sample. In column 1 of Table 2, we observe a statistically significant negative relationship between cooling degree days (CDDs) and municipal revenues in our OLS model. Since CDD measures are standardized over the full sample, the coefficient in column (1) implies that a one standard deviation (or 853 unit) increase in cooling degree days results in an approximate 8.9% decrease in total revenues, computed by dividing the coefficient of -0.166 by the average scaled revenues of 1.88 in Table 1. An 853-unit shift in CDDs corresponds to the daily average temperature in a hot month becoming 28 degrees hotter. A more intuitive interpretation is that a one standard deviation increase in within-municipality CDDs (or about a 81 unit increase in CDDs) leads to a 0.86% revenue decline. Our results are qualitatively similar using a PPML model in column 2 and when we deploy a simpler fixed effect structure that replaces state-year fixed effects with year fixed effects (untabulated).

[INSERT TABLE 2 HERE]

Although our primary predictions relate to the economic impacts of abnormal heat, column 3 adds controls for other dimension of the weather that may affect municipal revenues as additional control variables. Specifically, we augment Eq. 1 by including explanatory variables that reflect heating degree days (HDDs, the number of heating degree-days below 65 degrees), and annual precipitation including a separate measure for precipitation in months with below freezing average minimum temperatures. We find that these additional control variables are largely insignificant predictors of municipal revenues and have little effect on the estimated relation between CDDs and municipal revenues.

In Figure 2, we delve further into the dimensions of weather that relate to municipal revenues by replicating column 1 of Table 2 after replacing our CDD measure with the weather measure denoted on the x-axis. Here, we further include two measures, Extreme Max Heat and Extreme Cold Precip, which capture the temperatures and precipitation exclusively in the most extreme month of the year. Across all of these weather measures, with the exception of our main CDD measure, we find no evidence of a significant impact on municipal revenues. This null result is especially notable with respect to the precipitation and extreme temperature measures, which have virtually zero-point estimates despite being standardized similarly to our baseline CDD measure. These findings corroborate the economic relevance of CDDs suggested by previous work relative to other annualized dimensions of an area's weather. Thus, we primarily focus most of our remaining analyses on the relation between CDDs and municipal finances.

[INSERT FIGURE 2 HERE]

In column 4 of Table 2, we examine the sensitivity of the CDD-revenue relation to the prevailing climate and the direction of the annual CDD shock. The significantly negative interaction between the typical CDDs in an area and the current year's CDD realization suggests that revenues are more sensitive to abnormal CDDs in areas that are generally hotter. This offers some support for the idea that CDDs are more economically relevant when varied at higher levels, providing a loose tie into evidence on the effects of extreme heat. However, the insignificant relation between the direction of the CDD shock, defined as an indicator for a CDD realization that is higher than the average between 2010 and 2022, suggests that the sign of the CDD shock in a given year has little effect on its revenue impact– revenues drop just as much when CDDs are abnormally high as they rise when CDDS are abnormally low. In sum, the results in column 4 suggest that municipalities with warmer weather climates are most exposed to abnormal heat variation, but conditional on being in a warmer climate municipal revenues symmetrically respond to upside and downside variation in annual CDDs.

The municipality and state-year fixed effects in our specification allow us to interpret the CDD effects we estimate as the effects of "abnormal" CDDs. Specifically, our estimates exploit variation in a municipality's CDDs (relative to other municipalities in the same state-year) across the three years in our sample period.

The key identifying assumption in our analysis is that variation in temperature (in our main specification within state variation in temperature) is unrelated to municipal finance except through its direct effect. A potential violation of this assumption would occur if the variation we identify off of was trending in a manner that correlates with municipal growth. For example, certain regions may be heating up and contracting in population over our 2012-2022 sample period. To alleviate this alternative explanation for our results, we conduct a dynamic analysis in which we regress municipal revenue on the CDDs in the current year as well as CDDs in the previous and future two years. Under our identifying assumptions, we expect future CDDs to have no significant effect on municipal revenues.

Figure 3 presents the dynamic relation between CDDs and municipal revenues, plotting the coefficients obtained by regressing municipal revenue on CDDs in the simultaneous year as well as the two previous and subsequent years using PPML. Figure 3 illustrates that the impact of CDDs on municipal revenues are immediate and limited to the contemporaneous period, as the coefficients of lagged and leading temperature shocks are statistically indistinguishable from zero. These findings help to confirm that municipalities' responses to weather shocks are indeed driven by real-time weather effects rather than regional trends. In addition, the findings suggest that there are limited long-run effects of temperatures on municipal revenues, which suggests that the revenue shocks that we explore are responded to differently than other (perhaps more fundamental) revenue shifts which municipalities adjust dynamically to over the course of several years (see e.g., Buettner and Wildasin, 2006; Costello et al. 2017; Helm and Stuhler, 2024).

[INSERT FIGURE 3 HERE]

4.1 The role of revenue composition

We next study the role of an muni's revenue composition in determining the sensitivity of revenues to temperature. We consider this idea on three dimensions: the number of revenue streams that a municipality has, the dispersion in revenue streams, and the source of its revenues.

Understanding how the revenue-temperature relation varies with the structure of revenues is important as it offers potential avenues for municipalities to mitigate environmental risks as well as more general prescriptions regarding municipal financial stability. Our first prediction is that areas with more revenue sources will be more insulated from temperature shocks on average. We expect that this will happen for two reasons. First, these areas are more likely to be better diversified in their cash generation activities, some of which would be immune to weather variation. Second, more revenue categories likely indicates that municipalities have more flexibility in managing revenue toward their projections. This is consistent with arguments from the prior municipal accounting literature that having undiversified revenue sources increase municipalities credit risk and susceptibility to adverse revenue shocks (Copeland and Ingram 1982; Gore 2009).

Column 1 of Table 3 presents initial results on the relation between the number of non-zero revenue items a municipality in the CoG database and their revenue sensitivity to temperature. We find a highly negative and significant baseline effect of CDDs and a positive offsetting coefficient on the interaction with the number of revenue sources a municipality has. These effects are highly statistically significant with t-statistic magnitudes over six. To put the economic significance in perspective, the median municipality has 10 revenue sources (see Table 1), whereas the 1st (99th) percentile of revenue sources is 1 (are 22). Thus, the predicted CDD-revenue relation for a municipality in the 1st percentile of revenue sources is approximately -0.378, more than double double the full sample estimate in column 1 of Table 2, while the predicted effect attenuates to zero for a municipality with 17 revenue sources. In column 2 of Table 2, we show a qualitatively similar result using a measure of revenue dispersion (i.e., Copeland and Ingram 1982) as opposed to the categorical count measure used in column 1.

[INSERT TABLE 3 HERE]

We next examine how the relation between a municipality's total revenue exposure to CDDs depends on the sources of revenue they rely on. For this analysis, we leave the percent of revenue accruing from non-property taxes as the omitted category (i.e., the 'base' effect). If the predominant driver of the negative CDD-revenue relation reduced local economic activity, as would be consistent with studies such as Brown, Gustafson, and Ivanov (2021), Tran (2023), and Addoum, Gounopoulos, Gustafson, Lewis, and Nguyen (2024) who find that weather can adversely local business sales, we expect this base effect to be negative and larger than the full sample estimate. To the extent that other revenue categories are significantly less affected by CDDs, we expect these interactions to be positive.

Column 3 of Table 3 shows that the effect of CDDs on municipal revenue is most negative to the extent that revenues rely upon non-property taxes. All of the interactions between other revenue sources and CDDs are positive and highly statistically significant. The largest positive coefficients appear on utilities and property taxes, which is intuitive since utilities revenues may actually rise as demand for cooling increases and property taxes are unlikely to be highly sensitive to temperature fluctuations in real time. Comparing the coefficient of -1.449 on the CDD variable with the baseline estimate of -0.166 in Column 1 of Table 2 suggests that municipalities would be approximately nine times as sensitive to CDDs if their revenues came from a single source and were entirely comprised of non-property taxes. Column 4 shows qualitatively similar results as we find in column 3 when we instead utilize revenue dispersion as our main modifying variable.

One plausible alternative explanation for our results in Table 3 is that we are only capturing a size effect, as larger communities may also be able to offset quasi-random variation in revenue declines due to abnormally warm weather. In column 1 of Appendix Table 1, we show that the significant attenuation of the CDD-revenue relation in response to growing revenue sources is virtually identical even after controlling for an area's population. Columns of Appendix Table 1 further bolsters the idea that the CDD-revenue relation is unrelated to local economic conditions, whether the area is urban, or the area's political leaning. For example, both the baseline CDD effect and the interaction between CDDs and the number of revenue sources in an area are of similar magnitude to their corresponding estimates in Tables 2 and 3. Columns 3 and 4 of Appendix Table 1 include additional interactions between CDDs, various expense compositions, and revenue compositions. The attenuating effect of revenue sources on the CDD-revenue relation remains similar in this alternative specification.

Overall, our evidence in Tables 2 and 3 suggests that increased CDDs predict a revenue decline that concentrates in municipalities with concentrated revenue and those that rely most heavily on non-property tax revenue sources.

5. Effect of Temperature on Municipal Spending

We next study how municipal spending responds to warm temperature shocks. Temperature changes may affect operating expenses either directly or through their effect on revenues, but the magnitude and direction of these effects are *ex-ante* unclear and will likely vary by expenditure type. As we show in Figure 1, municipal operating expenses are spread across many categories with approximately 20% being utilities and between 10% and 15% being dedicated to police and safety, utilities, administrative expenses, and park and highway spending. Apart from utilities expenditures, municipalities have discretion over all these spending categories in the sense that hot temperature cannot cause them to change. However, elevated temperatures may change the cost and benefits of certain operating expenses, such as salaries or park operations.

Given the negative relation between elevated temperature and municipal revenues, a revenue-based effect predicts a negative relation between heat and municipal spending, but the extent and timing of this relation is an empirical question. For instance, the immediate expenditure impact of revenue shocks may be muted because municipalities with volatile revenues pre-emptively accumulate cash to manage revenues shocks (see e.g., Gore, 2009) or view municipal expenditures, such as salaries, as fixed costs (Wu, Young, Yu, and Hsu 2020). The expenditure impact of revenue changes may also be spread over several years (see e.g., Buettner and Wildasin, 2006; Helm and Stuhler, 2024), unless municipalities prioritize a balanced budget in real time. That being said, prior literature finds that traditional tax increases and expense reductions occur with a lag in response to operating deficits (e.g., Costello, Petacchi, and Weber 2017).

We explore this empirical question in Table 4. The estimates in column (1) indicate a significant negative relation between CDDs and municipal spending. The magnitude of the coefficient is remarkably similar to the revenue effect we document in Table 2, suggesting that municipalities reduce spending approximately dollar-for-dollar in response to a temperature-induced revenue change. The coefficient of -0.181 indicates that an increase in temperature by 81 degree days (a one standard deviation increase in within-municipality CDDs and about a 2.8-degree warming of every day in an already warm month) lowers total spending by 1%, or about

$19 per resident.[11] Column 2 shows that our inferences are largely unchanged when we utilize a PPML model.

[INSERT TABLE 4 HERE]

Similar to our revenue results in Table 2, we find little evidence that non-CDD dimensions of the weather meaningfully affect municipal spending. Column 3 suggests that alternative weather shocks such as abnormal colder weather and abnormal precipitation do not appear to have a meaningful effect on total municipal expenditures. Moreover, our single regression plots in Figure 4 show that abnormally warm weather is the only weather variable that has a meaningful impact on municipal total expenditures.

[INSERT FIGURE 4 HERE]

The expenditure response also mirrors the revenue response in terms of how the CDD effect varies by the prevailing climate and specifics of the CDD shock. Like column 4 of Table 2, column 4 of Table 4 shows that the relation between CDDs and total expenditure concentrates in geographical areas with warmer temperatures. Moreover, we again find asymmetric response to CDD shocks whether they mean a less of drop below average or more of a rise above average. This is consistent with municipalities being on margins whereby small cash shortfalls and windfalls map analogously into municipal spending.

In Figure 5, we augment Eq. (1) by including lead and lag *Cooling Degree Days* and we plot the coefficients to study the dynamic effect of temperature on municipal spending. Similar to our revenue results, we only find the relation between total expenditures and abnormal cooling degree days in the concurrent period. These results further support our argument that our results

[11] These figures are computed as follows. First, we divide the within municipality standard deviation of CDDs of 81 by the sample wide standard deviation of 835 with which the variable is standardized to get 0.097. We then take 1 minus 0.097 times the exponential of the coefficient estimate.

are not an artifact of trends in local economies, as the relation between municipal financing and weather only holds in the contemporaneous period.

[INSERT FIGURE 5 HERE]

This real-time management of municipal spending is consistent with local governments imposing fiscal austerity in response to temperature-induced revenue variation. To the extent that this is indeed going on, our results indicate that on the margin municipal spending may be less sticky than previously suggested (Wu et al. 2020). Interestingly, our results are more consistent with how private sector firms manage their expenditures in the face of non-fundamental negative cash flow shocks (e.g., Rauh 2006; Bakke and Whited, 2012; Lamont 2012).[12]

5.1 The role of revenue composition

Figure 5 provides striking support for the idea that the primary way that CDDs affect municipal spending is through their effect on revenues, as the CDD effect on revenues and expenditures move in lockstep. To the extent that CDDs do indeed influence municipal spending via their effect on revenues, we expect an area's revenue composition and dispersion to moderate the effect of CDDs on municipal spending. If instead CDDs effect on spending arises via direct effects or non-revenue channels, then we expect no significant relation between municipality's revenue source reliance and the CDD-expenditure relation. We test this conjecture in Table 5 using specifications identical to those used in the context of municipal revenues in Table 3.

[INSERT TABLE 5 HERE]

The estimates in Tables 3 and 5 are remarkably similar. Column 1 of Table 5 shows that the baseline negative relation between CDDs and municipal spending attenuates as the number of

[12] In Section 6 of the manuscript, we supplement our empirical results with evidence from a field survey of municipal managers. Among other things, we probe municipal managers on the dials in which they reduce expenditures and the reasons why they respond to revenue shortfalls by reducing expenditures.

revenue sources an area rises, with a t-statistic on the interaction of over 6. In column 2 of Table 5, we find similar evidence that as revenue dispersion increases the relation between CDDs and total expenses attenuates. In columns 3 and 4, we again utilize the percent of revenue accruing from non-property taxes as the omitted category (i.e., the 'base' effect) and include interactions between areas' revenue breakdown and CDDs. As in Table 3, we find the baseline CDD effect to be highly negatively significant and the interactions to be all positive and significant. Notably, the magnitude of the CDD-revenue type interactions observed in Table 3 also closely tracks the corresponding effect on expenditures in Table 5. The revenue component breakdown in columns 3 and 4 further suggest that an elevated reliance on property taxes leads to the most significant attenuation of CDDs financial impact, with reliance on utilities having the next largest coefficient.

Appendix Table 2 further shows that our revenue source findings are insensitive to interacting CDDs with an area's economic conditions, size, urbanity, political leaning, or expense composition. Our findings offer two key pieces of evidence that support expenditures being primarily impacted by CDDs through their effect on revenues. First, there is a persistent similarity between the revenue and expenditure impacts across specifications. Second, the source, composition, and dispersion of municipal revenues influence CDDs effect on spending.

5.2. A Concentration in Municipal Capital Investment

The striking similarity between the effect of temperature on municipal revenues and expenses is consistent with the expense effects being driven at least in part by the direct effect of temperature on municipal revenues. For instance, consider a municipality-operated concession stand in a park. In days with excessive heat, there may be lower attendance at a park. The decline in attendance leads to lower municipality revenues from concession sales, lower employee expenditures, and lower inventory costs on these days. This matching between revenues and expenses in the private sector is extensively studied in the accounting literature (i.e., Dichev and Tang 2008), and thus our results could be construed as mechanical. In this section, we abstract from direct expenditures and focus on capital outlays.

The key difference between municipal current operating expenses and their spending on capital investment is that there is arguably no direct relation between the everyday measure of elevated temperature that we employ and long-run capital investment opportunities. Indeed, existing literature such as Brown, Gustafson, and Ivanov (2021), assumes that routine variation in winter weather is a shock to private sector cash flows, but does not otherwise affect investment opportunities. Under this assumption, our setting can not only shed new light on the relation between temperature fluctuations and municipal capital investment, but also the more general question of how insulated municipal capital investment is from short-term non-fundamental changes in revenue. We explore this question in Table 6, deploying municipal capital expenditures as our outcome variable.

Table 6 finds strong evidence that municipalities also reduce capital expenditures in response to abnormally warm weather. Specifically, the coefficient on CDDs when capital expenditures in the outcome variable is -0.053 in column 1 of Table 6 using OLS. To compare the economic effects of CDDs on capital expenditures to total expenditures in percentage terms, we turn to the PPML model in column 2. We observe that the coefficient on CDDs in column 2 of Table 6 in the capital expenditures column is more than double the size of the corresponding effect on total expenditures in column 2 of Table 4. Column 3 of Table 6 incorporates other weather variation. Similar to our other analyses, we fail to find a meaningful relation using precipitation and abnormal cold weather. Finally, column 4 of Table 6 shows that, similar to the general expenditures effect, our results appear concentrated in U.S. areas with warmer geographical climates.

[INSERT TABLE 6 HERE]

Figure 6 illustrates the outsized effect of CDDs on capital expenditures, relative to other expenditure types. The solid line presents the dynamic effect of CDDs on capital expenditures (along with the corresponding 95% confidence interval), while the dashed line presents the same for non-capital spending (i.e., total expenditures minus capital expenditures). Both expenditure series exhibit qualitatively similar patterns whereby (1) the most negative and most statistically significant estimate corresponds to the current year's CDDs, (2) future CDDs exhibit no significant relation or any observable trends, and (3) there is no evidence of significant long-run effects.

[INSERT FIGURE 6 HERE]

In Table 7, we explore whether our capital expenditure results are equally sensitive to variation in revenue source, dispersion, and composition. Column 1 of Table 7 shows that that, as municipalities have different revenue sources, the effects of abnormally warm temperatures on capital investment abate. Similarly, column 2 of Table 7 shows that revenue dispersion offsets the effects of CDDs of capital expenditures. Column 3 and 4 include additional interactions composed of municipalities' revenue compositions. The base effect of CDDs in columns 3 and 4 can be interpreted as the effects of CDDs on a municipality with one revenue source, non-property based taxes. Columns 3 and 4 provide similar evidence: as a municipality's revenue sources expand beyond non-property taxes (i.e., fees revenues, utilities…etc.), the effect that CDDs have on capital expenditures decline. Appendix Table 3 shows that urbanity and political slant do not appear to modify the relation between CDDs and capital expenditures. We interpret our collective results in Section 5.2 as new evidence towards investment cash flow sensitivity in the public sector.

[INSERT TABLE 7 HERE]

Tables 6 and 7 show that capital outlays are an important dial that municipal managers adjust when faced with a revenue shortfall driven by extreme heat. In Table 8, we examine whether hot temperature fluctuations affect other types of municipal expenditures. In column 1 of Table 8, we start with *Salary Expenses*, which constitute the largest discretionary component of local municipal expenditures.[13] We find some evidence that governments respond to negative weather shocks by reducing personnel costs, as the coefficient on *Salary Expenses* is negative and marginally statistically significant. Across columns 2 through 6, we observe negative relations between CDDs and spending on health and welfare, parks and highways, police and safety, utilities, and administrative expenses, but only police-related expenses and administrative-related expenses are reliably statistically significant (with t-statistics above 2). Table 8 shows that in addition to the disproportionate decline in capital spending, CDDs lead municipalities to cut back on a variety of other spending categories that directly affect the extent of their public good's provision.

[INSERT TABLE 8 HERE]

5.3 The role of regulatory constraints

Our results thus far suggest that municipalities face frictions that allow CDD-induced revenue shocks to affect spending and investment, similar to the way that financially constrained firms are known to exhibit investment-cash flow sensitivity. In this section, we examine the extent to which regulatory frictions contribute to the observed relation between CDDs and municipal revenues, spending, and investment. We do so via replicating our main results with additional

[13] Our sample size for column 2 is slightly smaller for *Salary Expenses* given the data availability of the Census Bureau's CoG code "*Z00*".

interactions between CDDs and various types of regulatory constraints that may affect the way municipalities pass revenues through to expenditures.

We start by conducting analyses similar to those in Tables 2 – 7 whereby we interact CDD with variables capturing the restrictiveness of balanced budget provisions in a particular state (Kido et al. 2017). Since we standardize our measures of balanced budget exposure, the continued significance of the baseline CDD measure in top row of Appendix Table 4 indicates that our main results persist for municipalities with average balanced budget restrictions. The predominantly insignificant interactions between CDDs and our balanced budget measures offer little evidence that municipal managers respond differently to abnormally warm weather conditions in terms of raising additional municipal revenue or reducing expenditures, conditional on operating in a state with more restrictive balanced budgeting rules.

In Appendix Table 5, we examine whether other features of the regulatory environment relate to the sensitivity of municipal finances to warm weather. Specifically, we study the role of statewide tax and expenditure limitations and bankruptcy restrictions. Columns 1 through 3 of Appendix Table 5 exploit the Tax and Expenditure Limits Severity Index from Wen, Xu, Kim, and Warner (2020). Although the relation between CDDs and municipal finances remains robust after the inclusion of interactions between CDDs and restrictive limits on its ability to raise taxes and spending, we do find that these regulatory frictions lead CDDs to trigger larger revenue and capital investment declines. These results are intuitive in that the municipality may be less able to offset the heat-induced revenue shortfall with additional taxes and thus must reduce expenses more precipitously to adjust their financial position.

Columns 4 through 6 of Appendix Table 5 examine whether state Chapter 9 bankruptcy laws, which capture the extent to which states assist local governments in financial stress, influence the municipal financing-CDD relation (Basu, Beck, Gore, and Rich 2025). Although these regulatory frictions have been shown to increase municipal bond yields. (Gao, Lee, and Murphy 2019), we find little evidence that Chapter 9 access influences the way municipal finances respond to CDD shocks. Overall, the findings in Section 5.3 suggest that differences in state regulatory environments have little influence over a municipality's financial response to heat induced revenue shocks.

6. Municipal Manager Survey

Our empirical evidence above provides several new insights to the municipal finance literature. We find that abnormally warm weather reduces municipal revenues; municipalities with diverse revenue sources can mitigate these negative effects, municipalities appear to adjust their expenses downward in real time to offset adverse revenue shocks, and in particular reduce capital outlays. We supplement this empirical evidence by conducting a field survey of municipal finance managers. Utilizing our sample, we searched the websites for contact information for the head of the municipalities finance department.[14] From our sample, we randomly ordered our municipalities sample and collected contact information from municipal websites for 200 managers (of which 184 had legitimate email addresses). We then emailed a Google survey to these managers through Google forms regarding the operational responses to cash windfalls.[15] Thirteen managers responded to our survey, resulted in a participation rate of 7.1%. Appendix B shows the survey questions and response to our municipal finance managers.

Panel A shows that our responses included managers from varied municipal sizes ranging from small municipalities (populations < 1,000) to large municipalities (populations > 100,000).

[14] The title of such positions varied across municipalities (e.g., Treasurer, Finance Director, Town Clerk, Finance Officer, Town Administrator). If a finance-related role was not found, we collected contract information from the City Administrator, City Manager, or Mayor.
[15] We sent initially sent our survey on 4/28/2025, with a follow up request on 5/8/2025.

First, we note in Panel B that approximately one-quarter (23.1%) of our municipal managers experienced significant deviations in their revenue receipts versus their budgeted revenues in at least one of the past four years. Another 30.8% experienced significant deviation from budgeting revenues in 10% to 25% of reporting years. Breaking down the deviations by revenue categories, Panel C shows that non-property taxes and fees comprised the most common deviation from revenue expectations, which intergovernmental transfers having the least variation from revenue expectations.

In Panel D, we inquire of municipal managers how they modify their expenditures and capital outlays to manage an unexpected revenue shortfall. Managers note that their current year capital expenditures to be the most consistently important lever that they use to manage unexpected revenue declines as 69.2% of respondents note that this is very important and 23.2% of respondents note that this is the most important. Interestingly, these investment offsets are most likely to incur simultaneously with a revenue decline as less than half of respondents noted that future capital expenditures are useful mechanism to respond to a cash shortfall. These findings corroborate our empirical evidence in Figure 6 and Table 7 that capital expenditures are more sensitive to the unexpected revenue declines due to abnormally warm weather. Further this evidence contrasts with prior literature's findings that municipal managers respond to cash shortfalls in subsequent budgeting periods (Costello, Petacchi, and Weber 2017; Helm and Stuhler, 2024). The second most common response to mitigating revenue shortfalls was to draw on cash reserves, credit lines, or issue debt (61.5% of respondents noted that this was very important). This municipal manager response is consistent prior empirical evidence that municipalities with higher revenue uncertainty retain more cash (Gore 2009).

Next, in Panel E, we inquire of managers as to what drives their fiscal austerity. Managers noted that the fiscal discipline in response to cash shortfalls is in line with what they believe their constituents want (100% believe this is very important)), along with requirements to maintain a balanced budget (83.3% believe that is very important), and concerns regarding financial constraints (75% believe that is very important). We also were interested in further understanding what constitutes a balanced budget for municipal managers. In Panel F, we document significant variation in responses as to municipal governments' definitions of a balanced budget. The majority of respondents noted that a balanced budget implies that their municipality will not project spending above project receipts (58.3%), and half our respondents noted that cash expenditures cannot be less than cash receipts plus net cash reserves. Another 16.7% of respondents noted that they are not subject to balanced budget requirements. While balance budgets to appear binding on firm behavior (Costello et al. 2017), the utilization of cash balances to offset revenue shortfalls (Gore 2009) and our survey evidence confirms that managers have tools at their exposure beyond expenditure reductions. Our survey question asks municipal managers how frequently do they believe that weather contributes to revenue shortfalls. While only 7.7% perceive weather as regularly driving weather shortfalls, 38.5% acknowledge there have been years when weather has affected revenue.

7. Conclusion

Using a large cross-sectional panel across four Census Bureau surveys, we find robust and consistent evidence that municipalities incur revenue declines in response to abnormally warm weather. These effects are larger for municipalities relying on few revenue streams or revenue streams with a high percentage of non-property tax revenues. Municipalities exhibit financial flexibility, fully offsetting the revenue declines in real time by reducing capital expenditures and other expenditures. We supplement our empirical evidence with field surveys which corroborate how managers adjust their capital budgeting in real time in response do unexpected revenue shortfalls.

Our first contribution is to provide novel evidence that municipal revenues are significantly affected by variation in temperature, with warm weather negatively predicting revenues. This result, which is not ex-ante obvious due to the many dimension of municipal revenues adds municipalities to the list of economic agents whose cash flows are significantly impacted by the weather (see e.g., Addoum, Ng, and Ortiz-Bobea, 2023; Tran, 2023; Dell et al. 2014).

Our second contribution arises from the somewhat surprising result that municipal expenditures move in lockstep with the revenue decline, suggesting that municipal spending responses to short-run non-fundamental weather shocks occur quickly and are predominantly driven by revenue changes not direct effects of temperature on spending. This takeaway becomes particularly clear from our finding that the type of revenues municipalities rely on is a key predictor of CDDs effect on both municipal revenue *and* spending. In particular municipalities' revenue reliance better predicts CDDs effect on spending compared to their spending breakdown. These findings highlight the flexible manner with which municipalities manage their financial resources when faced with short-run non-fundamental shocks and contrast with longer-run dynamic responses to fundamental or permanent revenue shock (see e.g., Buettner and Wildasin 2006, Helm and Stuhler 2024).

Finally, our study provides the first evidence on the sensitivity of municipal investment to revenue shocks. Our findings indicate that short-run revenue shocks lead municipalities to forgo long-term investment in a manner that is broadly consistent with the behavior of financially constrained firms (Fazzari, Hubbard, and Petersen, 1988; Moyen, 2004; Brown, Fazzari, and Petersen, 20098). In fact, municipal capital spending is more than twice as sensitive as operating costs to temperature shocks. Thus, while municipalities are self-sufficient and able to manage temperature shocks, it comes at the cost of long-term investment projects.

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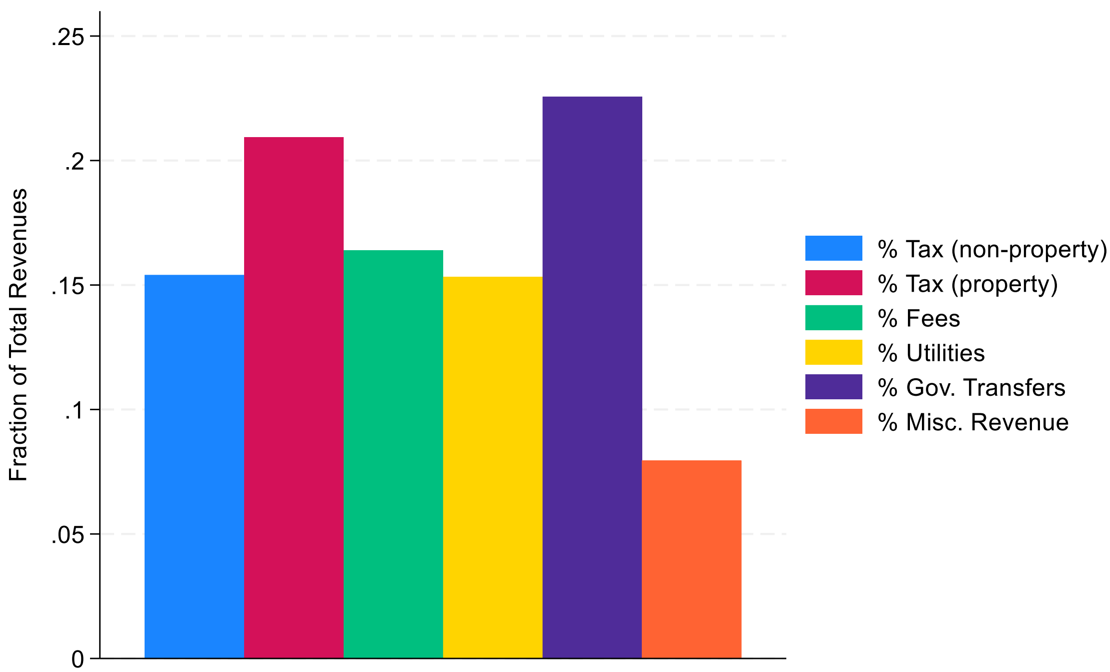
Figure 1: Municipal Revenue & Expenditure Breakdown

This figure decomposes municipal revenues (Panel A) and expenditures (Panel B) by type. The y-axis reflects the fraction of revenues or expenditures contained within each category.

Panel A: Revenue Breakdown



Panel B: Expenditure Breakdown

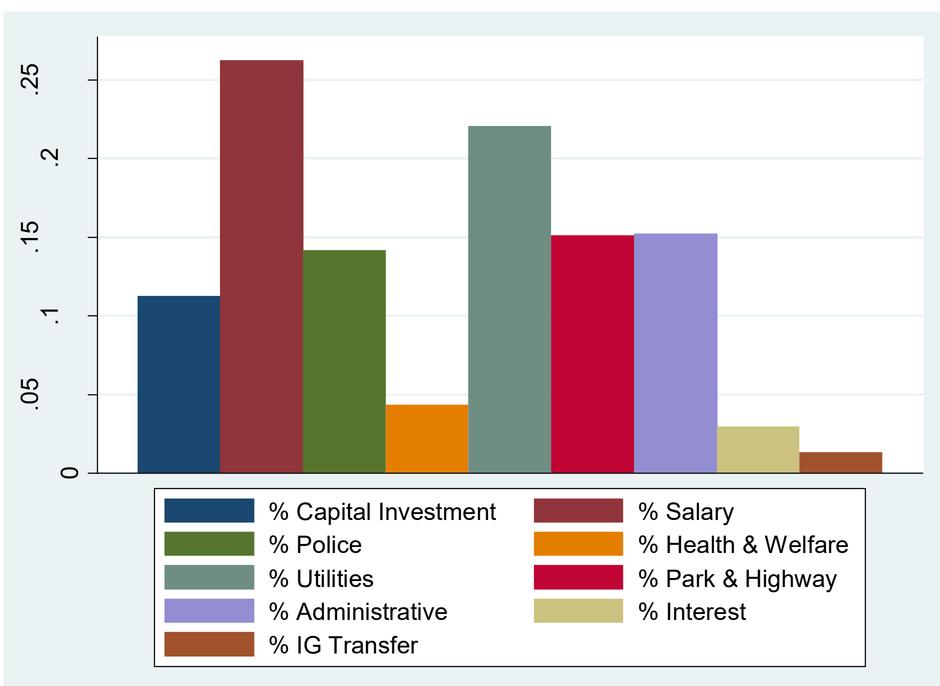


Figure 2: Revenue Impact of CDDs versus other dimensions of municipal weather

This figure examines the municipal revenue impact of various dimensions of the weather. Each point on the figure represents a coefficient estimate (coupled with its 95% confidence interval based on standard errors clustered at the county level) from a model identical to that in column 1 of Table 2 replacing our "Hot days" measure with the weather measure denoted on the x-axis. Thus, the coefficient on "Hot days" precisely replicates the result in column 1 of Table 2. *Cold Days*, is defined as heating degree days (i.e., degree-days below 65 degrees Fahrenheit. *Precip* is the total precipitation during the year, while *Cold Preci*p only sums precipitation during months with average minimum temperatures below freezing. *Extreme Max Heat* measures the average temperature during the hottest month of the year, while *Extreme Cold Precip* captures maximum monthly level of cold precipitation during the year.

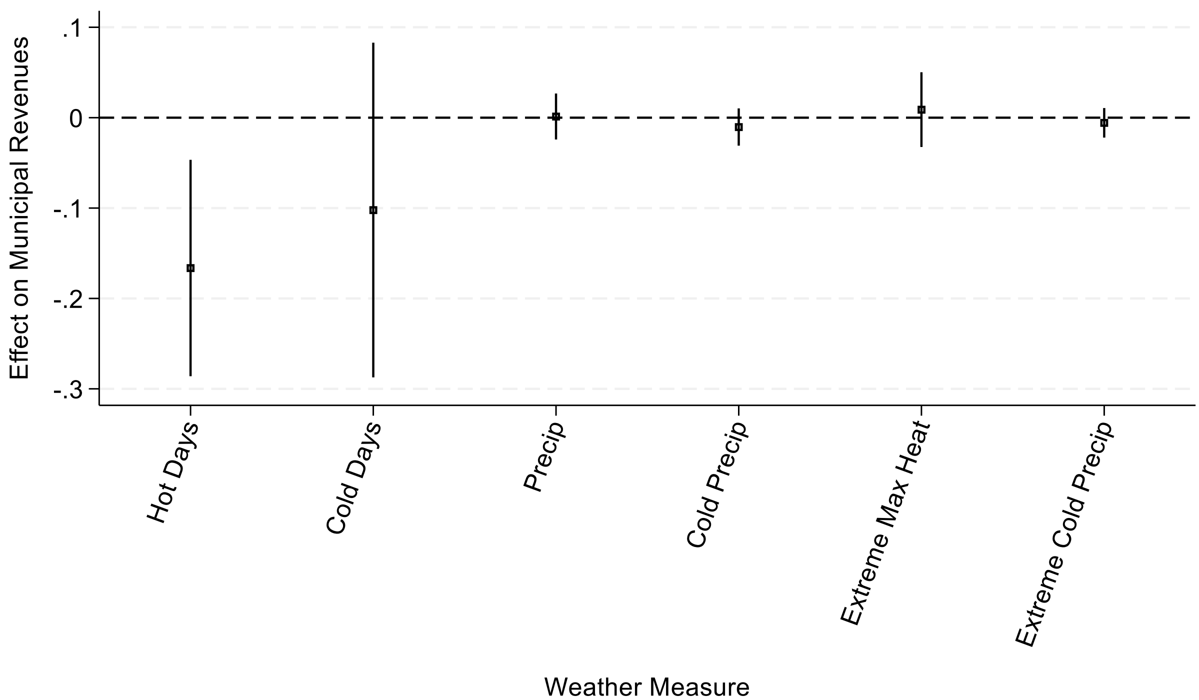


Figure 3: Dynamic Effect of Temperature on Municipal Revenues

This figure plots the estimated coefficients of contemporaneous, lead, and lagged annual cooling degree days (i.e., the number of degree days above 65 degrees Fahrenheit) on municipal revenues scaled by population. The estimates derive from a Poisson maximum likelihood regression model with municipality and state-year fixed effects and county level controls for the unemployment rate, per capita income, and the number of business establishments. We obtain municipal finance information from the Census Bureau's Census of Governments and temperature information from NOAA Monthly U.S. Climate Divisional Database. Error bars represent 95 percent confidence intervals based on standard errors clustered at the county level.

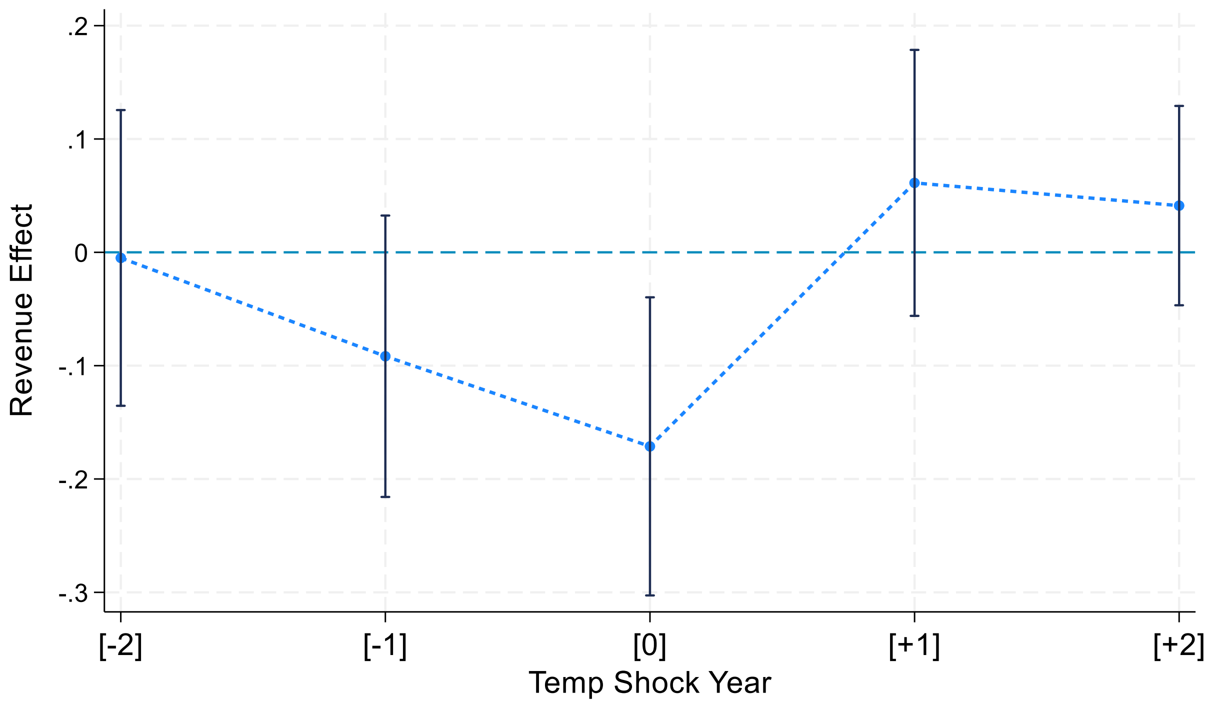


Figure 4: Expenditures Impact of CDDs versus other dimension of municipal weather

Thie figure examines the municipal expenditure impact of various dimensions of the weather. Each point on the figure represents a coefficient estimate (coupled with its 95% confidence interval based on standard errors clustered at the county level) from a model identical to that in column 1 of Table 4 replacing our "Hot days" measure with the weather measure denoted on the x-axis. Thus, the coefficient on "Hot days" precisely replicates the result in column 1 of Table 4. *Cold Days*, is defined as heating degree days (i.e., degree-days below 65 degrees Fahrenheit. *Precip* is the total precipitation during the year, while *Cold Preci*p only sums precipitation during months with average minimum temperatures below freezing. *Extreme Max Heat* measures the average temperature during the hottest month of the year, while *Extreme Cold Precip* captures maximum monthly level of cold precipitation during the year.

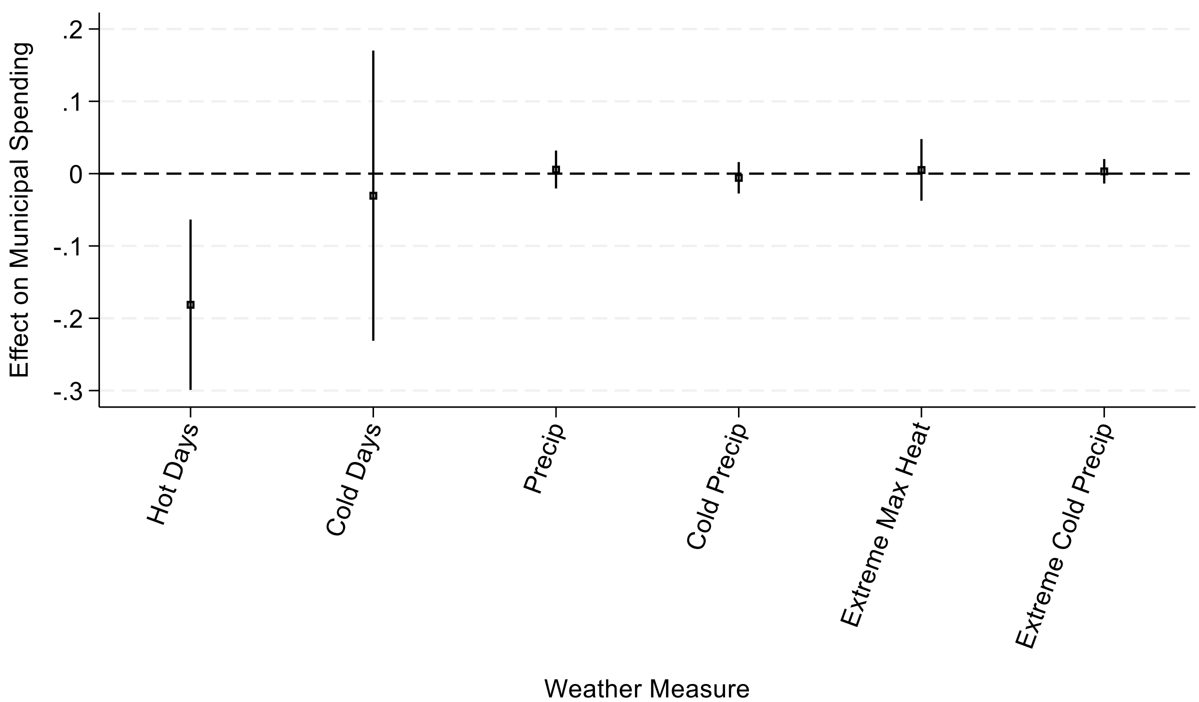


Figure 5: Dynamic Effect of Temperature on Municipal Spending

This figure plots the estimated coefficients of contemporaneous, lead, and lagged annual cooling degree days (i.e., the number of degree days above 65 degrees Fahrenheit) on municipal expenditures scaled by population. The estimates derive from a Poisson maximum likelihood regression model with municipality and state-year fixed effects and county level controls for the unemployment rate, per capita income, and the number of business establishments. We obtain municipal finance information from the Census Bureau's Census of Governments and temperature information from NOAA Monthly U.S. Climate Divisional Database. Error bars represent 95 percent confidence intervals based on standard errors clustered at the county level.

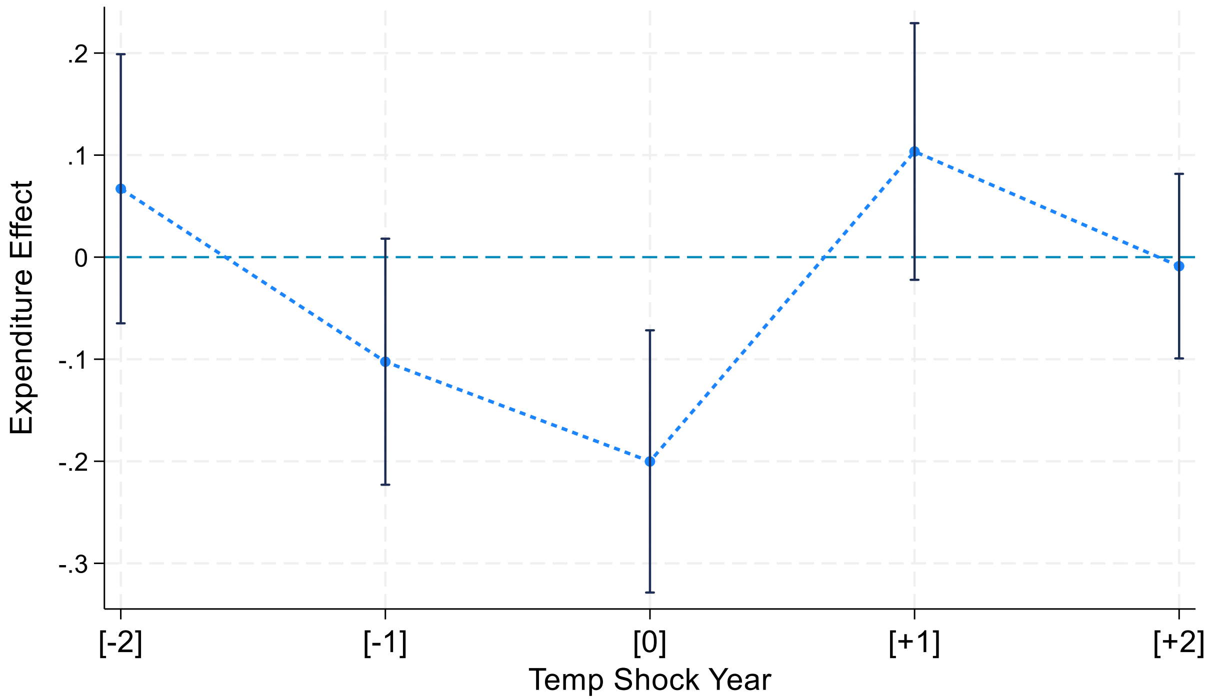


Figure 6: Dynamic Effect of Temperature on Municipal Capital Expenditures

This figure plots the estimated coefficients of contemporaneous, lead, and lagged annual cooling degree days (i.e., the number of degree days above 65 degrees Fahrenheit) on municipal capital investment and non-capital expenses, each scaled by population. The estimates derive from a Poisson maximum likelihood regression model with municipality and state-year fixed effects and county level controls for the unemployment rate, per capita income, and the number of business establishments. We obtain municipal finance information from the Census Bureau's Census of Governments and temperature information from NOAA Monthly U.S. Climate Divisional Database. Error bars represent 95 percent confidence intervals based on standard errors clustered at the county level.

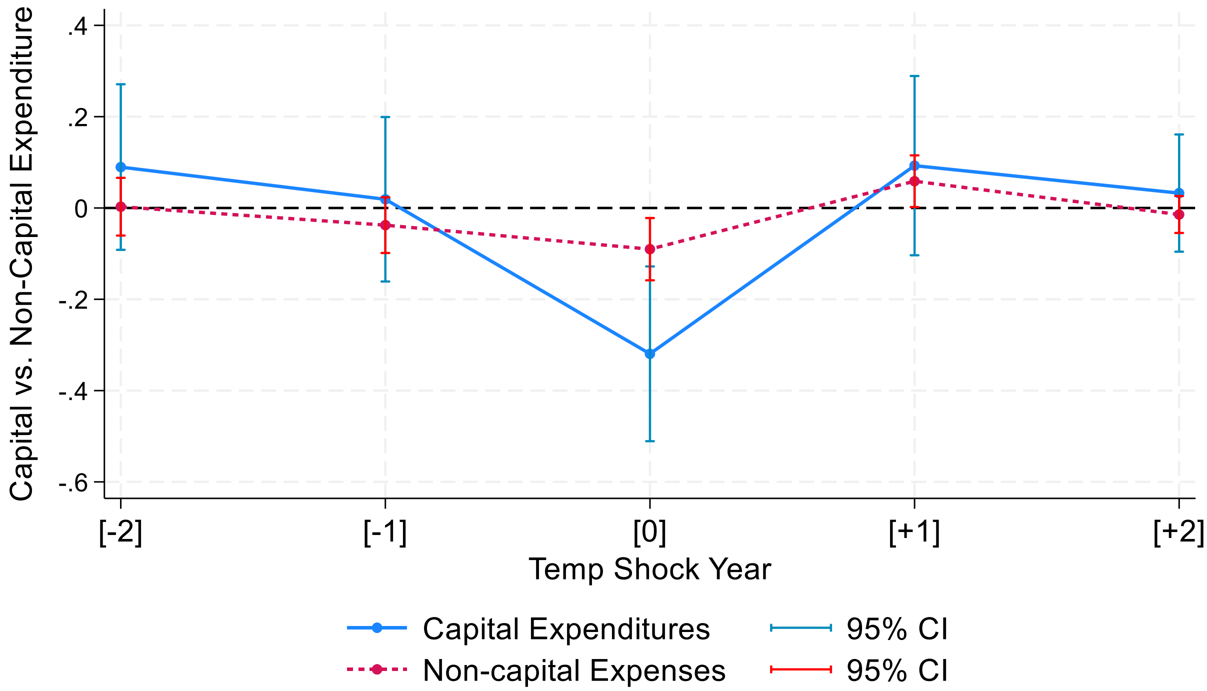


Table 1: Descriptive Statistics

This table presents descriptive statistics for the variables used in our analysis. The sample contains 87,500 municipality-years, where the years correspond to the three most recent Census Bureau's Census of Governments (CoG) in 2007, 2012, 2017, and 2022. Appendix A provides detailed variable definitions along with data sources.

	Mean	Stan. Dev.	Median	p99	p1
Total Revenue	1.88	1.77	1.38	11.27	0.10
Total Expenses	1.91	1.80	1.42	11.16	0.03
Capital Expenditure	0.28	0.56	0.09	3.64	0.00
Revenue Sources	10.40	4.80	10.00	22.00	1.00
Revenue Dispersion	0.66	0.18	0.71	0.88	0.00
Cooling Degree Days	1,333.16	853.62	1,128.00	4,019.00	66.00
Population	21,434	140,063	1,691	338,018	37
Income per capita	49,417	12,418	46,988	94,699	29,735
Unemployment	6.20	2.52	5.60	14.20	2.40
Establishments	6,757	22,250	920	104,022	53

Table 2: Temperature Shocks and Municipal Revenues

This table presents output from estimating panel regressions using municipality and state-year fixed effects. Columns 1, 3, and 4 employ an OLS regression, while column 2 employs a Poisson maximum likelihood model. The dependent variable is municipal revenues scaled by municipal population. CDDs are Cooling Degree Days and are standardized measures of the number of degree days above (below) 65 degrees Fahrenheit in the year over which the dependent variable is measured. All models include county level controls for the unemployment rate, per capita income, and the number of business establishments. Column 3 further controls for HDDs (i.e., degree days below 65 degrees Fahrenheit), and two separate annual precipitation measures. In column (4) we add an interaction between CDDs and the average CDD level for a municipality over our sample period as well as an interaction between CDDS and whether the observed CDDs in a year represents a positive CDD realization relative to the average CDD level between 2010 and 2022. Appendix A provides detailed variable definitions along with data sources. Standard errors clustered at the county level are shown in parentheses. Statistical significance is indicated as follows: ***: p<0.01, **: p<0.05, *: p<0.1.*

	(1)	(2)	(3)	(4)
	Total Revenue	Total Revenue	Total Revenue	Total Revenue
CDDs	-0.166***	-0.106***	-0.188***	-0.060
	(-2.72)	(-3.29)	(-3.03)	(-0.80)
CDDs X Average CDDs				-0.095**
				(-2.14)
CDDs X Positive CDD Shock				-0.006
				(-0.40)
Income per capita	0.089***	0.034***	0.088***	0.088***
	(4.45)	(3.85)	(4.37)	(4.40)
Ln(Pop.)	-2.115***	-1.049***	-2.116***	-2.116***
	(-15.07)	(-15.23)	(-15.06)	(-15.08)
Unemployment	0.013	0.001	0.014	0.013
	(0.94)	(0.11)	(0.97)	(0.94)
Ln(Estabs)	0.866***	0.413***	0.874***	0.893***
	(5.02)	(5.31)	(5.08)	(5.17)
HDDs			-0.163*	
			(-1.69)	
Precipitation			-0.003	
			(-0.23)	
Cold Precipitation			-0.008	
			(-0.75)	
Positive CDD Shock				0.001
				(0.04)
Model	OLS	Poisson	OLS	OLS
State-Year-Month FE	Y	Y	Y	Y
Muni FE	Y	Y	Y	Y
Mean Dependent	1.88	1.88	1.88	1.88
Adjusted (Pseudo) R^2	0.75	0.30	0.75	0.75
Observations	87,500	87,500	87,493	87,500

Table 3: The Role of Revenue Composition

This table presents output from estimating panel regressions using OLS and municipality and state-year fixed effects. The dependent variable is Total Revenues, scaled by municipal population. CDDs are Cooling Degree Days and are standardized measures of the number of degree days above 65 degrees Fahrenheit in the year over which the dependent variable is measured. Columns 1 and 3 interact CDDs with the number of non-zero revenue sources in a municipality, while columns 2 and 4 interact CDDs with a revenue dispersion measure computed as the inverse of a Herfindahl concentration measures across revenue sources. In columns 3 and 4, we further interact CDDs with the percentage of municipal revenue arising from the indicated sources. The excluded revenue category is non-property taxes, meaning that the baseline CDD coefficient approximates the effect of CDDs on revenue if all revenue were generated from non-property taxes. All models include county level controls for all interacted variables as well as unemployment rate, per capita income, population, and the number of business establishments. Appendix A provides detailed variable definitions along with data sources. Standard errors clustered at the county level are shown in parentheses. Statistical significance is indicated as follows: ***: p<0.01, **: p<0.05, *: p<0.1.*

	(1) Total Revenue	(2) Total Revenue	(3) Total Revenue	(4) Total Revenue
CDDs	-0.402***	-0.408***	-1.449***	-1.552***
	(-5.62)	(-5.30)	(-12.78)	(-11.11)
CDDs X Rev. Sources	0.024***		0.030***	
	(6.20)		(7.54)	
CDDs X Rev. Dispersion		0.367***		0.499***
		(4.48)		(5.43)
Rev. Sources	0.096***		0.092***	
	(25.66)		(23.88)	
Rev. Dispersion		-0.571***		-0.899***
		(-6.08)		(-9.44)
CDDs X % Utilities			1.313***	1.349***
			(8.81)	(8.37)
CDDs X % Tax (property)			1.551***	1.771***
			(11.21)	(11.61)
CDDs X % Fee			1.024***	1.152***
			(7.50)	(8.51)
CDDs X % Gov. Transfers			0.986***	0.991***
			(9.27)	(9.00)
CDDs X % Other			1.058***	1.007***
			(8.88)	(8.36)
Model	OLS	OLS	OLS	OLS
Controls	Y	Y	Y	Y
State-Year-Month FE	Y	Y	Y	Y
Muni FE	Y	Y	Y	Y
Mean Dependent	1.88	1.88	1.88	1.88
Adjusted R^2	0.76	0.75	0.79	0.77
Observations	87,500	87,500	87,500	87,500

Table 4: Temperature Shocks and Municipal Spending

This table presents output from estimating panel regressions using municipality and state-year fixed effects. Columns 1, 3, and 4 employ an OLS regression, while column 2 employs a Poisson maximum likelihood model. The dependent variable is municipal expenditures scaled by municipal population. CDDs are Cooling Degree Days and are standardized measures of the number of degree days above (below) 65 degrees Fahrenheit in the year over which the dependent variable is measured. All models include county level controls for the unemployment rate, per capita income, and the number of business establishments. Column 3 further controls for HDDs (i.e., degree days below 65 degrees Fahrenheit), and two separate annual precipitation measures. In column 4 we add an interaction between CDDs and the average CDD level for a municipality over our sample period as well as an interaction between CDDS and whether the observed CDDs in a year represents a positive CDD realization relative to the average CDD level between 2010 and 2022. Appendix A provides detailed variable definitions along with data sources. Standard errors clustered at the county level are shown in parentheses. Statistical significance is indicated as follows: ***: p<0.01, **: p<0.05, *: p<0.1.*

	(1) Total Expenditures	(2) Total Expenditures	(3) Total Expenditures	(4) Total Expenditures
CDDs	-0.181***	-0.110***	-0.193***	-0.099
	(-3.02)	(-3.35)	(-3.17)	(-1.25)
CDDs X Average CDDs				-0.083*
				(-1.80)
CDDs X Positive CDD Shock				0.002
				(0.14)
Income per capita	0.075***	0.032***	0.074***	0.074***
	(3.76)	(3.60)	(3.71)	(3.71)
Ln(Pop.)	-2.115***	-1.089***	-2.116***	-2.115***
	(-13.89)	(-14.39)	(-13.88)	(-13.89)
Unemployment	0.006	0.002	0.007	0.006
	(0.45)	(0.22)	(0.46)	(0.44)
Ln(Estabs)	0.964***	0.476***	0.969***	0.984***
	(5.44)	(5.96)	(5.48)	(5.53)
HDDs			-0.097	
			(-0.93)	
Precipitation			0.000	
			(0.00)	
Cold Precipitation			-0.005	
			(-0.43)	
Positive CDD Shock				-0.003
				(-0.15)
Model	OLS	Poisson	OLS	OLS
State-Year-Month FE	Y	Y	Y	Y
Muni FE	Y	Y	Y	Y
Mean Dependent	1.91	1.91	1.91	1.91
Adjusted (Pseudo) R^2	0.72	0.30	0.72	0.72
Observations	87,500	87,500	87,493	87,500

Table 5: Revenue Composition affects Expenditure Response

This table presents output from estimating panel regressions using OLS and municipality and state-year fixed effects. The dependent variable is Total Expenditures, scaled by municipal population. CDDs are Cooling Degree Days and are standardized measures of the number of degree days above 65 degrees Fahrenheit in the year over which the dependent variable is measured. Columns 1 and 3 interact CDDs with the number of non-zero revenue sources in a municipality, while columns 2 and 4 interact CDDs with a revenue dispersion measure computed as the inverse of a Herfindahl concentration measures across revenue sources. In columns 3 and 4 we further interact CDDs with the percentage of municipal revenue arising from the indicated sources. The excluded revenue category is non-property taxes, meaning that the baseline CDD coefficient approximates the effect of CDDs on revenue if all revenue were generated from non-property taxes. All models include county level controls for all interacted variables as well as unemployment rate, per capita income, population, and the number of business establishments. Appendix A provides detailed variable definitions along with data sources. Standard errors clustered at the county level are shown in parentheses. Statistical significance is indicated as follows: ***: p<0.01, **: p<0.05, *: p<0.1.*

	(1) Total Expenditures	(2) Total Expenditures	(3) Total Expenditures	(4) Total Expenditures
CDDs	-0.439***	-0.327***	-1.074***	-1.070***
	(-6.32)	(-4.57)	(-10.69)	(-8.77)
CDDs X Rev. Sources	0.026***		0.029***	
	(6.74)		(7.31)	
CDDs X Rev. Dispersion		0.225***		0.321***
		(3.23)		(3.97)
Rev. Sources	0.099***		0.097***	
	(25.87)		(24.96)	
Rev. Dispersion		0.049		-0.226***
		(0.66)		(-2.79)
CDDs X % Utilities			0.811***	0.863***
			(5.86)	(5.70)
CDDs X % Tax (property)			1.125***	1.303***
			(9.38)	(9.79)
CDDs X % Fee			0.704***	0.859***
			(5.59)	(6.56)
CDDs X % Gov. Transfers			0.355***	0.364***
			(3.83)	(3.68)
CDDs X % Other			0.605***	0.611***
			(5.67)	(5.50)
Model	OLS	OLS	OLS	OLS
Controls	Y	Y	Y	Y
State-Year-Month FE	Y	Y	Y	Y
Muni FE	Y	Y	Y	Y
Mean Dependent	1.88	1.88	1.88	1.88
Adjusted R^2	0.76	0.75	0.79	0.77
Observations	87,500	87,500	87,500	87,500

Table 6: Temperature Shocks and Municipal Capital Expenditures

This table presents output from estimating panel regressions using municipality and state-year fixed effects. Columns 1, 3, and 4 employ an OLS regression, while column 2 employs a Poisson maximum likelihood model. The dependent variable is municipal capital expenditures (i.e., capex), scaled by municipal population. CDDs are Cooling Degree Days and are standardized measures of the number of degree days above (below) 65 degrees Fahrenheit in the year over which the dependent variable is measured. All models include county level controls for the unemployment rate, per capita income, and the number of business establishments. Column 3 further controls for HDDs (i.e., degree days below 65 degrees Fahrenheit), and two separate annual precipitation measures. In column 4, we add an interaction between CDDs and the average CDD level for a municipality over our sample period as well as an interaction between CDDS and whether the observed CDDs in a year represents a positive CDD realization relative to the average CDD level between 2010 and 2022. Appendix A provides detailed variable definitions along with data sources. Standard errors clustered at the county level are shown in parentheses. Statistical significance is indicated as follows: ***: p<0.01, **: p<0.05, *: p<0.1.*

	(1) *Capital Expenditures*	(2) *Capital Expenditures*	(3) *Capital Expenditures*	(4) *Capital Expenditures*
CDDs	-0.053**	-0.264***	-0.060***	-0.018
	(-2.36)	(-2.99)	(-2.58)	(-0.51)
CDDs X Average CDDs				-0.053***
				(-2.89)
CDDs X Positive CDD Shock				0.008
				(1.19)
Income per capita	0.023***	0.080***	0.022***	0.022***
	(2.71)	(3.07)	(2.67)	(2.65)
Ln(Pop.)	-0.407***	-1.084***	-0.407***	-0.406***
	(-6.04)	(-6.93)	(-6.03)	(-6.03)
Unemployment	-0.001	0.000	-0.001	-0.002
	(-0.22)	(0.02)	(-0.20)	(-0.25)
Ln(Estabs)	0.256***	0.825***	0.259***	0.265***
	(3.91)	(3.97)	(3.96)	(4.04)
HDDs			-0.047	
			(-0.86)	
Precipitation			-0.003	
			(-0.43)	
Cold Precipitation			0.000	
			(0.01)	
Positive CDD Shock				-0.000
				(-0.01)
Model	OLS	Poisson	OLS	OLS
State-Year-Month FE	Y	Y	Y	Y
Muni FE	Y	Y	Y	Y
Mean Dependent	0.28	0.31	0.28	0.28
Adjusted (Pseudo) R^2	0.32	0.27	0.32	0.32
Observations	87,500	79,040	87,493	87,500

Table 7: Revenue Composition affects Capital Spending Response

This table presents output from estimating panel regressions using OLS and municipality and state-year fixed effects. The dependent variable is municipal capital expenditures (i.e., capex), scaled by municipal population. CDDs are Cooling Degree Days and are standardized measures of the number of degree days above 65 degrees Fahrenheit in the year over which the dependent variable is measured. Columns 1 and 3 interact CDDs with the number of non-zero revenue sources in a municipality, while columns 2 and 4 interact CDDs with a revenue dispersion measure computed as the inverse of a Herfindahl concentration measures across revenue sources. In columns 3 and 4 we further interact CDDs with the percentage of municipal revenue arising from the indicated sources. The excluded revenue category is non-property taxes, meaning that the baseline CDD coefficient approximates the effect of CDDs on revenue if all revenue were generated from non-property taxes. All models include county level controls for all interacted variables as well as unemployment rate, per capita income, population, and the number of business establishments. Appendix A provides detailed variable definitions along with data sources. Standard errors clustered at the county level are shown in parentheses. Statistical significance is indicated as follows: ***: p<0.01, **: p<0.05, *: p<0.1.*

	(1) *Capital Expenditures*	(2) *Capital Expenditures*	(3) *Capital Expenditures*	(4) *Capital Expenditures*
CDDs	-0.071***	-0.077***	-0.280***	-0.306***
	(-2.90)	(-3.04)	(-7.92)	(-7.77)
CDDs X Rev. Sources	0.002*		0.002**	
	(1.83)		(2.27)	
CDDs X Rev. Dispersion		0.038*		0.051**
		(1.86)		(2.12)
Rev. Sources	0.018***		0.022***	
	(14.20)		(17.24)	
Rev. Dispersion		0.040		-0.006
		(1.62)		(-0.21)
CDDs X % Utilities			0.367***	0.378***
			(8.80)	(8.80)
CDDs X % Tax (property)			0.368***	0.404***
			(8.91)	(9.36)
CDDs X % Fee			0.297***	0.320***
			(7.04)	(7.43)
CDDs X % Gov. Transfers			0.015	0.020
			(0.44)	(0.57)
CDDs X % Other			0.194***	0.192***
			(4.87)	(4.77)
Model	OLS	OLS	OLS	OLS
Controls	Y	Y	Y	Y
State-Year-Month FE	Y	Y	Y	Y
Muni FE	Y	Y	Y	Y
Mean Dependent	0.28	0.28	0.28	0.28
Adjusted R^2	0.32	0.32	0.38	0.37
Observations	87,500	87,500	87,500	87,500

Table 8: Temperature Shocks and Municipal Expenditures

This table presents output from estimating OLS panel regressions using municipality and state-year fixed effects. The dependent variable is the expenditure category listed at the top of the table, scaled by municipal population. In column 1, we set salary expenditures to missing for municipalities that do not report this line item. CDDs are Cooling Degree Days and are standardized measures of the number of degree days above 65 degrees Fahrenheit in the year over which the dependent variable is measured. All models include county level controls for the unemployment rate, per capita income, and the number of business establishments. Appendix A provides detailed variable definitions along with data sources. Standard errors clustered at the county level are shown in parentheses. Statistical significance is indicated as follows: ***: p<0.01, **: p<0.05, *: p<0.1.*

	(1) Salary Expenses	(2) Health/ Welfare Expenses	(3) Park / Highway Expenses	(4) Police Expenses	(5) Utilities Expenses	(6) Admin Staff and Educ. Expenses
CDDs	-0.027*	-0.018*	-0.021*	-0.022**	-0.018	-0.031**
	(-1.88)	(-1.80)	(-1.68)	(-2.28)	(-0.80)	(-2.50)
Income per capita	0.014***	0.008**	0.012**	0.001	0.022***	0.002
	(3.02)	(2.04)	(2.51)	(0.46)	(2.89)	(0.73)
Ln(Pop.)	-0.402***	-0.071**	-0.282***	-0.193***	-0.510***	-0.333***
	(-15.08)	(-2.46)	(-8.48)	(-9.16)	(-9.93)	(-11.54)
Unemployment	0.000	0.001	-0.003	0.001	0.004	0.004
	(0.07)	(0.33)	(-0.99)	(0.61)	(0.64)	(1.37)
Ln(Estabs)	0.151***	0.045*	0.142***	0.091***	0.214***	0.106***
	(4.27)	(1.83)	(4.35)	(4.05)	(3.52)	(3.66)
Model	OLS	OLS	OLS	OLS	OLS	OLS
State-Year-Month FE	Y	Y	Y	Y	Y	Y
Muni FE	Y	Y	Y	Y	Y	Y
Mean Dependent	0.44	0.11	0.28	0.25	0.49	0.25
Adjusted R^2	0.79	0.77	0.58	0.77	0.67	0.82
Observations	68,461	87,500	87,500	87,500	87,500	87,500

Appendix A: Variable Definitions

Variable	Description	Source
<u>Outcome Variables</u>		
Total Revenue	Total CPI-adjusted municipal revenue (Total_Revenue) scaled by the municipal's population (Population). Revenue is defined by the Census Bureau as all amounts of money received by a government from external sources (i.e., those originating from "outside the government"), net of refunds and other correcting transactions, proceeds from issuance of debt, the sale of investments, agency or private trust transactions, and intragovernmental transfers.	Census Bureau's CoG/The Government Finance Database (TGFD)
% Tax (non-property)	Total CPI-adjusted municipal taxes (Total_Taxes) less property taxes (Property_Tax) scaled by CPI-adjusted Total_Revenue.	Census Bureau's CoG/TGFD
% Tax (property)	Total CPI-adjusted municipal property (Property_Tax) taxes scaled by CPI-adjusted Total_Revenue. Property taxes are defined by the Census Bureau as taxes imposed on ownership of property and measured by its value. This variable is set to zero when missing or negative.	Census Bureau's CoG/TGFD
% Fee	Total CPI-adjusted municipal charges (Tot_Chgs_and_Misc_Rev) less miscellaneous general revenues (Misc_General_Revenue) scaled by CPI-adjusted Total_Revenue. This variable is set to zero when missing or negative. Municipal charges include fees, maintenance assessments, and other reimbursements for current services; rents and sales derived from commodities or services furnished incident to the performance of particular functions; gross income of commercial enterprises; and the like.	Census Bureau's CoG/TGFD
% Utilities	Total CPI-adjusted utility charges (Total_Utility_Revenue) scaled by CPI-adjusted Total_Revenue. This variable is set to zero when missing or negative. Utility revenues are gross receipts from sale of utility commodities or services to the public or other governments by publicly-owned and controlled utilities.	Census Bureau's CoG/TGFD
% Other	Total CPI-adjusted miscellaneous scaled by CPI-adjusted Total_Revenue. Miscellaneous revenues are the difference between *Total Revenues* and (Total_Taxes*, Fee Revenues, Utility Revenues, and Intergov. Revenues*). This variable is set to zero when missing or negative.	Census Bureau's CoG/TGFD
% Gov. Transfers	Total CPI-adjusted intergovernmental revenues (Total_IG_Revenue) scaled by CPI-adjusted Total_Revenue. This variable is set to zero when missing or negative. The intergovernmental revenue category consists of amounts received from other governments, whether for use in performing specific activities, for general financial assistance, or as a share of tax proceeds.	Census Bureau's CoG/TGFD

Variable	Description	Source
Total Expenditures	Total CPI-adjusted municipal expenditures (Total_Expenditures) scaled by the municipal's population (Population). Expenses include all amounts of money paid out by a government during its fiscal year – net of recoveries and other correcting transactions – other than for retirement of debt, purchase of investment securities, extension of loans, and agency or private trust transactions.	Census Bureau's CoG/TGFD
Capital Expenditures	Total CPI-adjusted capital outlays (Total_Capital_Outlays) scaled by the municipal's population (Population). Capital outlays consist of expenditures for purchase or construction, by contract or government employee, construction of buildings and other improvements; for purchase of land, equipment, and existing structures; and for payments on capital leases.	Census Bureau's CoG/TGFD
Health Welfare Expenses	Total CPI-adjusted health and welfare expenses (Health_Direct_Expend, Total_Hospital_Dir_Exp, Own_Hospital_Total_Exp, Hosp_Other_Direct_Exp, Public_Welf_Direct_Exp, Tot_Assist___Subsidies, Hous___Com_Direct_Exp, Prot_Insp_Direct_Exp) scaled by the municipal's population (Population). This variable is set to zero when missing or negative.	Census Bureau's CoG/TGFD
Park / Highway Expenses	Total CPI-adjusted transportation and park expenses (Parks___Rec_Direct_Exp, Natural_Res_Direct_Exp, Total_Highways_Dir_Exp, Parking_Direct_Expend, Air_Trans_Direct_Expend) scaled by the municipal's population (Population). This variable is set to zero when missing or negative.	Census Bureau's CoG/TGFD
Police Expenses	Total CPI-adjusted public safety expenses (Police_Prot_Direct_Exp, Correct_Direct_Exp, fire_prot_direct_exp) scaled by the municipal's population (Population). This variable is set to zero when missing or negative.	Census Bureau's CoG/TGFD
Utilities Expenses	Total CPI-adjusted utilities expenses (Total_Util_Total_Exp, Sewerage_Direct_Expend) less utilities interest expense (Total_Util_Inter_Exp) scaled by the municipal's population (Population). This variable is set to zero when missing or negative.	Census Bureau's CoG/TGFD
Admin. Expenses	Total CPI-adjusted administrative expenses (CEN_STAFF_DIRECT_EXP, fin_admin_direct_exp, judicial_direct_expend, Libraries_Direct_Exp) scaled by the municipal's population (Population). This variable is set to zero when missing or negative.	Census Bureau's CoG/TGFD
IG Transfer Expenses	Total CPI-adjusted intergovernmental expenditures (Total_IG_Expenditure) scaled by the municipal's population (Population). This variable is set to zero when missing or negative.	Census Bureau's CoG/TGFD
Salary Expenses	Total CPI-adjusted *non-zero* salaries and wages (Total_Salaries___Wages) scaled by the municipal's population (Population**).**	Census Bureau's CoG/TGFD

Variable	Description	Source
Weather Variables		
CDDs	The number of degree days above 65 degrees Fahrenheit in the municipality's county during a given fiscal year. For example, if the temperature were 75 degrees every day for a year, this value would be (75-65)*365 = 3,650.	NOAA Supplemented with PRISM post-2022
Average CDDs	The average within-municipality CDD value during our sample period.	NOAA Supplemented with PRISM post-2022
HDDs	The number of degree days below 65 degrees Fahrenheit in the municipality's county during a given fiscal year. For example, if the temperature were 55 degrees every day for a year, this value would be (65-55)*365 = 3,650.	NOAA Supplemented with PRISM post-2022
Precipitation	The total precipitation in the municipality's county during a given fiscal year.	PRISM
Cold Precipitation	The total precipitation in the municipality's county during a given fiscal year that occurs during months with an average minimum daily temperature below freezing.	PRISM
Modifiers and Controls		
Rev. Sources	The count of revenue categories > 0 for a given municipality. The revenue categories comprise of the following variables in The Government Financial Database: Property_Tax, Total_Gen_Sales_Tax, Alcoholic_Beverage, Tax Amusement_Tax, Insurance_Premium_Tax, Motor_Fuels_Tax, Pari_mutuels_Tax, Public_Utility_Tax, Tobacco_Tax, Other_Select_Sales_Tax, Alcoholic_Beverage_Lic, Amusement_License, Corporation_License, Hunting___Fishing_License, Motor_Vehicle_License, Motor_Veh_Oper_License, Public_Utility_License Occup_and_Bus_Lic_NEC, Other_License_Taxes, Individual_Income_Tax, Corp_Net_Income_Tax, Death_and_Gift_Tax, Docum_and_Stock_Tr_Tax, Severance_Tax Taxes_NEC, Chg_Air_Transportation, Chg_Misc_Com_Activ, Chg_Elem_Ed_Sch_Lunch, Chg_Elem_Ed_Tuition, Chg_Elem_Ed_NEC, Chg_Total_High_Ed, Chg_Hospitals, Chg_Regular_Highways, Chg_Toll_Highways, Chg_Housing___Comm_Dev, Chg_Total_Nat_Res, Chg_Parking, Chg_Parks___Recreation, Chg_Sewerage, Chg_Solid_Waste_Mgmt, Chg_Water_Transport, Chg_All_Other_NEC, Special_Assessments, Prop_Sale_Other Interest_Revenue, Fines_and_Forfeits, Rents_and_Royalties	Census Bureau's CoG/TGFD

Variable	Description	Source
	Net_Lottery_Revenue Misc, General_Rev_NEC, Liquor_Stores_Revenue, Water_Utility_Revenue, Electric_Utility_Rev, Gas_Utility_Rev, Transit_Utility_Rev, Emp_Ret_Total_Ctrib, Emp_Ret_Loc_To_Loc_Sys, Emp_Ret_Sta_To_Sta_Ctr, Emp_Ret_Int_Rev, Unemp_Payroll_Tax, Unemp_Int_Revenue, and Unemp,Federal_Advances	
Rev. Dispersion	A measure of revenue concentration using 1 - Herfindahl Index based on the *Rev. Sources* categories.	Census Bureau's CoG/TGFD
Deficit Ind.	An indicator variable equal to 1 when Total_Expenditure exceeds Total_Revenue and equal to zero otherwise.	Census Bureau's CoG/TGFD
Balanced Budget	An indicator variable equal to 1 when executed budget at year-end required to be balanced a for State government, and equal to zero otherwise.	The National Association of State Budget Officers (2021), Table 9
Balanced Budget Score	A count variable in increasing levels of balanced budget restrictiveness contingent upon: (1) whether an executed budget at year-end required to be balanced a for state government, (2) whether a state legislature is required to pass a balanced budget, (3) whether a budget signed by the governor is required to balanced, and (4) whether the executed budget at year-end is required to be balanced.	The National Association of State Budget Officers (2021), Table 9
TEL Index	A rank variable capturing the intensity of limits on a municipalities ability to raise taxes or increase spending as imposed by their state.	Wen, Xu, Kim, and Warner (2020)
Chapter 9	An indicator variable equal to 1 when a municipality has unconditional access to Chapter 9 bankruptcy within a state, and equal to zero otherwise.	Gao, Lee, and Murphy (2019)
Metro Area	An indicator for a municipality in an area with a rural-urban continuum code of less than four as of 2013.	U.S. Department of Agriculture.
Democrat Area	An indicator for a municipality located in a state with above the median Democratic vote share (of 40.6%) in the 2012 presidential election.	MIT Election Data & Science Lab
Income per Capita	Personal income per capita in a municipality's county measured as of July 1st of the previous non-overlapping year.	Bureau of Economic Analysis [CAINC1]

Variable	Description	Source
Ln(Pop.)	The natural log of 1 plus a municipality's population. Population refers to a concentration of individuals for which the municipality provides services.	Census Bureau's CoG/TGFD
Ln(Estabs)	The natural log of 1+ the number of business establishments in a municipality's county measured in March of the previous non-overlapping year.	Census Bureau's CBP
Unemployment	The average monthly unemployment rate in a municipality's county measured in December of the previous non-overlapping year.	Bureau of Labor Statistics (LAUS)

Appendix B: Survey of Municipal Finance Managers

The appendix below provides the questions and answers to our survey to 184 municipal finance managers distributed on 4/28/2025 (follow-up email on 5/8/2025). Panels A – G present our survey questions with the number responses in parentheses.

Panel A: What is the approximate population of your municipality (N=13)?

Response	Less than 1,000	1,000 to 3,000	3,000 to 10,000	10,000 to 25,000	Over 100,000
# Responses	3	3	3	3	1
% of Respondents	23.1%	23.1%	23.1%	23.1%	7.7%

Panel B: How often do municipal revenues significantly deviate from expectations in a manner that affects municipal spending? (N = 13).

Response	Less than one in ten years	10% to 25% of Years	25 to 50% of years	Almost every year
# Responses	6	4	1	2
% of Respondents	46.2%	30.8%	7.7%	15.4%

Panel C: How often do the following revenue categories significantly deviate from your budgeted projection due to unpredictable factors?

State N/A if your municipality does not rely on a given revenue source (N=13).

Revenue Category	Always/Usually	Sometimes	Rarely/Never	Not Applicable
Property Taxes	7.7%	30.7%	53.8%	7.7%
Non-Property Taxes	7.7%	46.2%	38.4%	7.7%
Fees	7.7%	46.2%	46.2%	0.0%
Utilities	0.0%	46.2%	30.7%	23.1%
Intergov. Transfers	0.0%	30.7%	61.5%	7.7%

Panel D: How important are the following mechanisms for adjusting to unexpected revenue changes? (N=13).

Expenditure Adjustment (N=13)	Very Important	Somewhat Important	Not Important
Current year capital expenditures	69.2%	23.1%	7.7%
Cash reserves, credit lines, or debt issuances	61.5%	23.1%	15.4%
Current year non-salary spending	46.2%	53.8%	0.0%
Next year operating spending	46.2%	46.2%	7.7%
Next year capital expenditures	46.2%	30.8%	23.1%
Current year salary spending	23.1%	61.5%	15.4%

Panel E: How important are the following forces in explaining why your county responds to a cash shortfall by adjusting expenditures (N =12)?

Explanation	Very Important	Somewhat Important	Not Important
We believe that scaling spending to revenues is what our constituents want.	100.0%	0.0%	0.0%
Requirements to maintain a balanced budget.	83.3%	8.3%	8.3%
Financial constraints (we do not have cash flows available to pay for certain expenditures).	75.0%	25.0%	0.0%
We believe that fiscal austerity is important.	58.3%	25.0%	16.7%
We do not want to borrow money (or draw from cash reserves).	41.7%	58.3%	0.0%

Panel F: What does your municipality consider to be a "balanced budget"? Check all that apply (N = 12).

Explanation	% Respondent Selection
We do not project spending above our projected receipts	58.3%
Cash expenditures are less than cash receipts + cash reserves and debt issuances at the end of the year	50.0%
Cash expenditures are less than cash receipts at the end of the year	25.0%
We do not project spending above our projected receipts + cash reserves	16.7%
We are not restricted to a balanced budget provision	16.7%

Panel G: Do you believe that weather contributes to revenue shortfalls (N = 13) ?

Response	Yes, Regularly	There have been years when weather has affected a small portion of revenue	Sometimes, but I cannot imagine the effect is large	It has never come to my mind
# Responses	1	5	3	4
% of Respondents	7.7%	38.5%	23.1%	30.8%

Appendix Table 1: Robust role of revenue concentration in explaining CDDs Revenue Impact

This table presents output from estimating OLS panel regressions with using municipality and state-year fixed effects. The dependent variable is Total Revenue, scaled by municipal population. CDDs are Cooling Degree Days and are standardized measures of the number of degree days above 65 degrees Fahrenheit in the year over which the dependent variable is measured. All columns interact CDDS with the number of non-zero revenue sources a municipality lists as well as the natural log of municipal population. Columns 2 and 4 add interactions between CDDs and the local economic controls variables used throughout our analyses. The added CDD interactions in columns 2 and 4 are with: *Metro Area* is an indicator for areas defined as having a rural-metro code of 3 or less in 2013, and *Democrat Area* is the percentage of Democratic votes in the 2012 Presidential election. Finally, columns 3 and 4 further interact CDDS with the percentage of municipal revenues and expenditures arising from different sources. The revenue splits are the same as in Table 3 of the paper, while the expenditure decomposition includes interactions with: the number expenditure sources, the % spent on police, the % spent on health and welfare, the % spent on utilities, the percent spent on capex, the % spent on parks and recreation, and the % spent on highways. All models include county level controls for all interacted variables as well as unemployment rate, per capita income, and the number of business establishments. Appendix A provides detailed variable definitions along with data sources. Standard errors clustered at the county level are shown in parentheses. Statistical significance is indicated as follows: ***: p<0.01, **: p<0.05, *: p<0.1.*

	(1) Total Revenue	(2) Total Revenue	(3) Total Revenue	(4) Total Revenue
CDDs	-0.423***	-0.295**	-1.463***	-1.516***
	(-5.82)	(-2.31)	(-12.51)	(-9.20)
CDDs X Rev. Sources	0.029***	0.029***	0.022***	0.022***
	(6.73)	(6.71)	(6.67)	(6.65)
Rev. Sources	0.095***	0.095***	0.059***	0.059***
	(25.40)	(25.41)	(17.41)	(17.43)
CDDs X Ln(Population)	-0.218***	-0.218***	-0.265***	-0.278***
	(-7.33)	(-7.21)	(-7.83)	(-8.00)
CDDs X Unemployment		-0.000		-0.002
		(-0.12)		(-0.66)
CDDs X Income per capita		-0.000		-0.000
		(-0.74)		(-0.33)
CDDs X Ln(Estabs)		-0.018		0.004
		(-0.97)		(0.21)
CDDs X Metro Area		0.108**		0.092*
		(2.18)		(1.93)
CDDs X Democrat Area		-0.021		0.036
		(-0.12)		(0.21)
Model	OLS	OLS	OLS	OLS
Baseline Controls	Y	Y	Y	Y
Rev. Category Controls	N	N	Y	Y
Exp. Category Controls	N	N	Y	Y
State-Year-Month FE	Y	Y	Y	Y
Muni FE	Y	Y	Y	Y
Mean Dependent	1.88	1.88	1.88	1.88
Pseudo R-squared	0.76	0.76	0.80	0.80
Observations	87,500	87,500	87,500	87,500

Appendix Table 2: Robust role of revenue concentration in explaining CDDs Spending Impact

This table presents output from estimating OLS panel regressions with using municipality and state-year fixed effects. The dependent variable is Total Expenditures, scaled by municipal population. CDDs are Cooling Degree Days and are standardized measures of the number of degree days above 65 degrees Fahrenheit in the year over which the dependent variable is measured. All columns interact CDDS with the number of non-zero revenue sources a municipality lists as well as the natural log of municipal population. Columns 2 and 4 add interactions between CDDs and the local economic controls variables used throughout our analyses. The added CDD interactions in columns 2 and 4 are with: *Metro Area* is an indicator for areas defined as having a rural-metro code of 3 or less in 2013, and *Democrat Area* is the percentage of Democratic votes in the 2012 Presidential election. Finally, columns 3 and 4 further interact CDDS with the percentage of municipal revenues and expenditures arising from different sources. The revenue splits are the same as in Table 3 of the paper, while the expenditure decomposition includes interactions with: the number expenditure sources, the % spent on police, the % spent on health and welfare, the % spent on utilities, the percent spent on capex, the % spent on parks and recreation, and the % spent on highways. All models include county level controls for all interacted variables as well as unemployment rate, per capita income, and the number of business establishments. Appendix A provides detailed variable definitions along with data sources. Standard errors clustered at the county level are shown in parentheses. Statistical significance is indicated as follows: ***: p<0.01, **: p<0.05, *: p<0.1.*

	(1) Total Expenditures	(2) Total Expenditures	(3) Total Expenditures	(4) Total Expenditures
CDDs	-0.461***	-0.351***	-1.055***	-1.024***
	(-6.51)	(-2.84)	(-10.48)	(-7.02)
CDDs X Rev. Sources	0.031***	0.031***	0.017***	0.017***
	(7.29)	(7.27)	(5.35)	(5.34)
Rev. Sources	0.097***	0.098***	0.043***	0.043***
	(25.65)	(25.66)	(12.79)	(12.80)
CDDs X Ln(Population)	-0.224***	-0.225***	-0.271***	-0.277***
	(-7.52)	(-7.51)	(-8.33)	(-8.42)
CDDs X Unemployment		-0.002		-0.002
		(-0.53)		(-0.79)
CDDs X Income per capita		-0.000		-0.000
		(-0.80)		(-0.68)
CDDs X Ln(Estabs)		-0.014		-0.007
		(-0.75)		(-0.41)
CDDs X Metro Area		0.087*		0.086*
		(1.75)		(1.83)
CDDs X Democrat Area		0.004		0.069
		(0.02)		(0.42)
Model	OLS	OLS	OLS	OLS
Baseline Controls	Y	Y	Y	Y
Rev. Category Controls	N	N	Y	Y
Exp. Category Controls	N	N	Y	Y
State-Year-Month FE	Y	Y	Y	Y
Muni FE	Y	Y	Y	Y
Mean Dependent	1.91	1.91	1.91	1.91
Pseudo R-squared	0.74	0.74	0.79	0.79
Observations	87,500	87,500	87,500	87,500

Appendix Table 3: Robust role of revenue concentration in explaining CDDs Capital Spending Impact

This table presents output from estimating OLS panel regressions with using municipality and state-year fixed effects. The dependent variable is total capital spending (i.e., capex), scaled by municipal population. CDDs are Cooling Degree Days and are standardized measures of the number of degree days above 65 degrees Fahrenheit in the year over which the dependent variable is measured. All columns interact CDDS with the number of non-zero revenue sources a municipality lists as well as the natural log of municipal population. Columns 2 and 4 add interactions between CDDs and the local economic controls variables used throughout our analyses. The added CDD interactions in columns 2 and 4 are with: *Metro Area* is an indicator for areas defined as having a rural-metro code of 3 or less in 2013, and *Democrat Area* is the percentage of Democratic votes in the 2012 Presidential election. Finally, columns 3 and 4 further interact CDDS with the percentage of municipal revenues and expenditures arising from different sources. The revenue splits are the same as in Table 3 of the paper, while the expenditure decomposition includes interactions with: the number expenditure sources, the % spent on police, the % spent on health and welfare, the % spent on utilities, the percent spent on capex, the % spent on parks and recreation, and the % spent on highways. All models include county level controls for all interacted variables as well as unemployment rate, per capita income, and the number of business establishments. Appendix A provides detailed variable definitions along with data sources. Standard errors clustered at the county level are shown in parentheses. Statistical significance is indicated as follows: ***: p<0.01, **: p<0.05, *: p<0.1.*

	(1) Capital Expenditures	(2) Capital Expenditures	(3) Capital Expenditures	(4) Capital Expenditures
CDDs	-0.075***	0.029	-0.195***	-0.175***
	(-3.04)	(0.58)	(-6.44)	(-4.06)
CDDs X Rev. Sources	0.003**	0.003**	0.003***	0.003***
	(2.37)	(2.36)	(2.85)	(2.83)
Rev. Sources	0.018***	0.018***	0.005***	0.005***
	(13.92)	(13.93)	(3.81)	(3.80)
CDDs X Ln(Population)	-0.039***	-0.033***	-0.039***	-0.040***
	(-3.49)	(-2.88)	(-4.30)	(-4.20)
CDDs X Unemployment		-0.002		-0.001
		(-1.31)		(-1.53)
CDDs X Income per capita		-0.000*		-0.000
		(-1.81)		(-1.46)
CDDs X Ln(Estabs)		-0.010		-0.003
		(-1.31)		(-0.57)
CDDs X Metro Area		0.010		0.017
		(0.48)		(1.20)
CDDs X Democrat Area		0.031		0.063
		(0.41)		(1.22)
Model	OLS	OLS	OLS	OLS
Baseline Controls	Y	Y	Y	Y
Rev. Category Controls	N	N	Y	Y
Exp. Category Controls	N	N	Y	Y
State-Year-Month FE	Y	Y	Y	Y
Muni FE	Y	Y	Y	Y
Mean Dependent	0.28	0.28	0.28	0.28
Pseudo R-squared	0.32	0.32	0.73	0.73
Observations	87,500	87,500	87,500	87,500

Appendix Table 4: The Limited Role of Balanced Budget Requirements

This table presents output from estimating OLS panel regressions, comparable to those in Column 1 of Tables 2 through 7, with an added interaction between CDDs and the extent of balanced budget rules faced by the municipality. CDDs are Cooling Degree Days and are standardized measures of the number of degree days above 65 degrees Fahrenheit in the year over which the dependent variable is measured. The dependent variable is total revenues, expenditures, or capital spending across the six columns in both panels. *Balanced Budget* is an indicator variable equal to 1 when executed budget at year-end required to be balanced a for State government, and equal to zero otherwise. *Balanced Budget Score* is a count variable in increasing levels of balanced budget restrictiveness contingent upon: (1) whether an executed budget at year-end required to be balanced a for state government, (2) whether a state legislature is required to pass a balanced budget, (3) whether a budget signed by the governor is required to balanced, and (4) whether the executed budget at year-end is required to be balanced. The difference between Panels A and B is that Panel B further includes an interaction between CDDS and the number of non-zero revenue sources a municipality lists. All models include county level controls for all interacted variables as well as unemployment rate, per capita income, and the number of business establishments. Appendix A provides detailed variable definitions along with data sources. Standard errors clustered at the county level are shown in parentheses. Statistical significance is indicated as follows: ***: p<0.01, **: p<0.05, *: p<0.1.*

Panel A: Replicating Tables 2, 4, and 6 with Balanced Budget Interactions

	(1) Total Revenue	(2) Total Expenses	(3) Capital Outlays	(4) Total Revenue	(5) Total Expenses	(6) Capital Outlays
CDDs	-0.150**	-0.145**	-0.042*	-0.164***	-0.183***	-0.052**
	(-2.54)	(-2.42)	(-1.65)	(-2.69)	(-3.05)	(-2.28)
CDDs X Balanced Budget	-0.053	-0.119*	-0.035			
	(-0.87)	(-1.84)	(-1.10)			
CDDs X Balanced Budget Score				0.035	-0.036	0.024
				(0.57)	(-0.56)	(0.91)
Adjusted R-squared	0.75	0.72	0.32	0.75	0.72	0.32
Observations	87,500	87,500	87,500	87,500	87,500	87,500

Panel B: Replicating Tables 3, 5, and 7 with Balanced Budget Interactions

	(1) Total Revenue	(2) Total Expenses	(3) Capital Outlays	(4) Total Revenue	(5) Total Expenses	(6) Capital Outlays
CDDs	-0.393***	-0.411***	-0.061**	-0.399***	-0.440***	-0.069***
	(-5.51)	(-5.73)	(-2.16)	(-5.57)	(-6.31)	(-2.81)
CDDs X Balanced Budget	-0.029	-0.093	-0.033			
	(-0.48)	(-1.44)	(-1.03)			
CDDs X Balanced Budget Score				0.058	-0.012	0.029
				(0.98)	(-0.20)	(1.10)
CDDs X Rev. Sources	0.024***	0.026***	0.002*	0.024***	0.026***	0.002*
	(6.19)	(6.72)	(1.80)	(6.20)	(6.75)	(1.82)
Adjusted R-squared	0.76	0.74	0.32	0.76	0.74	0.32
Observations	87,500	87,500	87,500	87,500	87,500	87,500

Appendix Table 5: The Role of Tax and Expenditure Limitations (TELs) and Chapter 9 Bankruptcy Rules

This table presents output from estimating OLS panel regressions, comparable to those in Column 1 of Tables 2 through 7, with an added interaction between CDDs and the extent of TELs and Chapter 9 rules faced by the municipality. CDDs are Cooling Degree Days and are standardized measures of the number of degree days above 65 degrees Fahrenheit in the year over which the dependent variable is measured. The dependent variable is total revenues, expenditures, or capital spending across the six columns in both panels. In columns 1 – 3, *TEL Index* is a rank variable capturing the intensity of limits on a municipalities ability to raise taxes or increase spending as imposed by their state. In columns 4 – 6, *Chapter 9* is equal to an indicator variable equal to 1 when a municipality has unconditional access to Chapter 9 bankruptcy within a state, and equal to zero otherwise. The difference between Panels A and B is that Panel B further includes an interaction between CDDS and the number of non-zero revenue sources a municipality lists. All models include county level controls for all interacted variables as well as unemployment rate, per capita income, and the number of business establishments. Appendix A provides detailed variable definitions along with data sources. Standard errors clustered at the county level are shown in parentheses. Statistical significance is indicated as follows: ***: p<0.01, **: p<0.05, *: p<0.1.*

Panel A: Replicating Tables 2, 4, and 6 with Balanced Budget Interactions

	(1) Total Revenue	(2) Total Expenses	(3) Capital Outlays	(4) Total Revenue	(5) Total Expenses	(6) Capital Outlays
CDDs	-0.125**	-0.151***	-0.037	-0.154***	-0.170***	-0.046*
	(-2.17)	(-2.59)	(-1.49)	(-2.59)	(-2.79)	(-1.81)
CDDs X TEL Index	-0.094*	-0.070	-0.037*			
	(-1.66)	(-1.26)	(-1.79)			
CDDs X Chapter 9				-0.028	-0.025	-0.015
				(-0.49)	(-0.44)	(-0.71)
Adjusted R-squared	0.75	0.72	0.32	0.75	0.72	0.32
Observations	87,500	87,500	87,500	87,500	87,500	87,500

Panel B: Replicating Tables 3, 5, and 7 with Balanced Budget Interactions

	(1) Total Revenue	(2) Total Expenses	(3) Capital Outlays	(4) Total Revenue	(5) Total Expenses	(6) Capital Outlays
CDDs	-0.357***	-0.405***	-0.054**	-0.394***	-0.434***	-0.064**
	(-5.18)	(-5.92)	(-2.03)	(-5.58)	(-6.04)	(-2.32)
CDDs X TEL Index	-0.104*	-0.080	-0.039*			
	(-1.93)	(-1.53)	(-1.89)			
CDDs X Chapter 9				-0.017	-0.013	-0.015
				(-0.32)	(-0.25)	(-0.70)

CDDs X Rev. Sources	0.024***	0.026***	0.002*	0.024***	0.026***	0.002*
	(6.21)	(6.74)	(1.83)	(6.20)	(6.74)	(1.81)
Adjusted R-squared	0.76	0.74	0.32	0.76	0.74	0.32
Observations	87,500	87,500	87,500	87,500	87,500	87,500