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The other side of chaos COVID-19, federal spending, and local government volatility

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ABSTRACT



We examine the influence of COVID-19 and federal responses to it on budget dynamics of local governments in the US. While it is commonly and implicitly assumed that budgetary difficulty primarily results from deep budget cuts, managing large increases also raises the uncertainty local leaders face. Situated in the logic underpinning Punctuated Equilibrium Theory, we assess the degree of volatility and expansion in local budgets in the wake of the federal response to the pandemic. We use an original dataset of 21,918 changes in local budgets in the state of West Virginia, spanning a decade of spending across 55 counties and 162 sub-categories. Standard measures of change indicate that federal aid provided stability to local budgets, yet new methods we implement reveal more frequent and drastic shifts in spending as well as a positive shift in the value of changes. When assessing counties individually, we report substantial differences in volatility and expansion of budgets between the pre – and post-COVID periods that we show are associated with economic distress. Our findings have implications for the future of local-level budget and expenditure studies and the empirical research on the complexity of policy change in the US, Europe, and elsewhere.

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KEYWORDS Public policy; local government; punctuated equilibrium; governance; agenda setting; Appalachia

Introduction

The COVID-19 pandemic presented local governments across the United States, Europe, and globally with unprecedented fiscal challenges. Rising public health and emergency service expenditures necessitated rapid responses from federal, state, and local levels. In economically constrained regions such as Appalachia in the US, these challenges were compounded by pre-existing vulnerabilities and limited fiscal capacity. This paper seeks to understand how COVID-19 and the subsequent federal relief programmes,

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such as the CARES Act and ARPA, influenced budgetary volatility in local governments in Appalachia, with a specific focus on West Virginia. The study contributes to the broader literature on public budgeting, local-level governance, and Punctuated Equilibrium Theory (PET) by exploring the impacts of sudden fiscal expansions and the ensuing challenges faced by local decision-makers.

In this study, we ask How did the COVID-19 pandemic affect budgetary volatility in local governments? What impacts did federal relief efforts have on the patterns and degree of budget volatility? What can PET teach us about accounting for budget dynamics during sudden fiscal expansions? How did the effects of federal funding vary based on the institutional strength and economic resilience of local governments? And broadly speaking, can federal spending smooth or lessen punctuated spending dynamics at lower levels in the face of disasters, public health emergencies, and other drastic shocks to governing systems?

To address these questions, we use a comprehensive dataset of county expenditures in West Virginia, covering fiscal years 2012–2024. County governments in the state provide critical public services in the state and supplant municipalities as primary administrative units. County functions include mental health, libraries, rail trails, road maintenance, wastewater, public health programmes, law enforcement, and many others. In addition, counties in the US are the locus for several important emergency management and public health services that are necessary below the state level and require more coordination than cities can offer. Our dataset, sourced from the Local Government Division of the WV State Auditor's Office, includes detailed records of expenditures across seven general categories and 223 specific sub-categories. The methodological approach we apply incorporates well-established techniques in the study of PET, such as visual inspections of histograms and calculation of distributional measures like skewness and kurtosis. We further extend our analysis using extreme value methods, fitting a generalised Pareto distribution (GPD) to assess the behaviour of positive expenditure changes in the tails of the distribution. This approach allows us to differentiate between pre – and post-COVID expenditure patterns and explore the impacts of federal interventions on budgetary distributions.

Our analysis reveals both stability and change in expenditure patterns in West Virginia counties during and after the COVID-19 pandemic depending on the measurement approach and level of analysis. First, visual comparison and I-kurtosis scores show that expenditure distributions aggregated across counties exhibited stability between the pre – and post-COVID periods. Our analysis of skew shows that these distributions, particularly among general spending categories, moved rightward following the influx of federal aid. Using our GPD estimation method, we find clearer evidence that federal relief efforts correspond with larger and more frequent spending surges

even in the face of the pressures of the global pandemic. Second, our analysis further shows that budgetary volatility varied notably across individual counties. Economically distressed areas, we show empirically, experienced a marked increase in volatility, revealing that local governments facing constraints on institutions exhibited more significant challenges in managing the influx of federal aid. This highlighted the differential capacity of local governments to respond effectively. Similarly, counties with fewer resources and subsequent limits in administrative capacity exhibited substantial rightward shifts in their expenditure distributions, contributing to patterns with substantially more observations occurring toward the positive end of the distribution.

Taken together, these findings demonstrate that sudden fiscal *expansions*, such as those prompted by the COVID-19 crisis, may lead to shifts in budgetary distributions depending on the measure and level of analysis. The study underscores the importance of factoring in institutional capacity and local economic context when assessing the uneven impact and sustainability of federal relief efforts. Understanding these dynamics offers crucial insights into how local governments navigate periods of unexpected fiscal largesse and the long-term implications for their financial stability. Our findings, we argue, are broadly applicable to systems with federal or national governments beyond the US where large-scale transfers of funds downward are possible, and especially so for those that govern economically distressed areas.

Background: local government budgeting, fiscal volatility, and COVID-19 interventions

In public budgeting and finance, understanding the drivers and impacts of fiscal volatility is crucial, particularly within local governments, where resource constraints and policy mandates significantly shape budgeting outcomes on the ground. We examine the complex factors influencing local government budgeting, focusing on the fiscal volatility experienced by economically constrained regions like Appalachia. We review the foundational challenges of budgeting stability and volatility, and the specific fiscal impacts of the COVID-19 pandemic and subsequent federal interventions directed towards local governments. This highlights the dual challenges local governments face in balancing short-term fiscal needs with long-term financial sustainability, emphasising the role of federal policy structures, and institutional dynamics in shaping these outcomes.

Local government budgets, particularly in economically constrained regions such as Appalachia, offer critical insights into the dynamics of fiscal stability and adaptability to external shocks. Fiscal volatility, characterised by year-to-year fluctuations in revenues and expenditures, poses significant

challenges to maintaining service delivery, engaging in long-term planning, and managing administrative continuity (Deller & Maher, 2005; Maher & Deller, 2007). Traditional approaches, including conservative revenue forecasting, rainy-day funds, and controlled expenditure adjustments, seek to buffer against fiscal uncertainty (Benson & Marks, 2014). However, local fiscal structures often lack flexibility, which can be exacerbated by issues of capacity and geographic scale. First, a ‘flypaper effect’ occurs where federal aid typically becomes earmarked for specific uses, restricting state and local governments’ broader fiscal adaptability (Deller & Maher, 2005). In analysing county revenue structures, Johnston *et al.* (2000) show that state-imposed revenue limits create vulnerabilities, especially in times of crisis. Second, the structural constraints of fiscal federalism hamper local governments’ crisis response capabilities by imposing restrictive conditions on federal funds (López-Santana & Rocco, 2021). Pagano and Johnston (2000) describe this ‘fiscal food chain’ effect, where cities and counties operate at the lower end of resource allocation hierarchies, depending on often inconsistent state and federal funding.

The COVID-19 created two simultaneous fiscal challenges for local governments – increased spending for pandemic response and decreased revenues – that tested and sometimes exceeded the limits of typical approaches towards local budgeting. As Benton *et al.* (2020) describe, myriad factors placed local governments in extreme levels of uncertainty: new pressure on costly public health, emergency, and social services, the prospect of stark declines in revenue amidst the economic impacts of the pandemic, and reliance on state policy developments to ensure balanced budgets. The provision of vital services not only put local governments on the ‘frontlines’ of managing pandemic response, but also exposed them to tremendous fiscal pressure (Benton *et al.*, 2020).

The federal government responded to the crisis with relief programmes such as the CARES Act and the American Rescue Plan Act (ARPA), which provided substantial funding but with varying flexibility, compliance, and time horizons for use. The CARES Act (established March 2020 and extended by appropriations legislation in 2021) and the American Rescue Plan (established March 2021) provided an array of funds to state, local, and tribal governments. An advisory report for civic leaders made available in June 2021 by a public accounting firm, contrasts the eligibility of \$150 billion and \$350 made available through the Coronavirus Relief Fund (CRF) and Coronavirus State and Local Fiscal Recovery Funds (SLFRF). Variation in expenditure eligibility (e.g., expenses for compliance with public health measures and medical expenses of public hospitals vs. replacement of lost public revenue, investments in water, sewer, and broadband infrastructure, and funding for natural disaster relief and surface transportation projects) as well as restrictions on payroll costs and qualifications for federal matching requirements

are apparent (REDW, 2021; Dept. of Treasury, n.d.). Outside of the CRF and SLFRF, federal aid was transferred to counties governments through various targeted programmes. These included, for example, the Local Assistance and Tribal Consistency Fund, which provided \$2 billion in FY2022–2023 for eligible counties to use for any purpose and two Emergency Rental Assistance Programs, that provided \$46 billion to states, certain local governments, and tribal governments to provide financial assistance for housing (Dept. of Treasury, n.d.).

In assessing the impact of COVID relief compared to government response to the financial crisis and Great Recession, López-Santana and Rocco (2021) argue that pandemic era funds, while essential, underscored weaknesses in the US fiscal federalism model. By imposing conditions on use that limited local governments' ability to respond effectively, 'familiar political and institutional obstacles' left officials in the lurch (p. 365). Scavo *et al.*'s (2007) concept of 'fend-for-yourself federalism' aptly describes this disconnect, as federal top-down policies fail to address specific local needs.¹ The influx of significant federal funds, across various programmes with varying stipulations (or lack thereof), induces dramatic levels of uncertainty on local decision-makers as they contend with planning for and managing allocations during the turmoil of fiscal pressure noted above. And as Flink (2018) argues, institutional uncertainty around performance has implications for the structure of budgetary change as context and environmental demands affect outcomes.

Pandemic-era fiscal pressures further underscore the difficult trade-offs between immediate needs and long-term investment, which induce further uncertainty among local governments as they balance unclear time horizons. When fiscal austerity forces governments to prioritise spending, decision-makers often sacrifice long-term investments essential for future stability (Breunig & Busemeyer, 2012). Similarly, Breunig and Koski (2018) show that state leaders' decisions can influence fiscal outcomes by prioritising crisis responses over routine expenditures. Other work, however, suggests that local governments with streamlined decision-making processes are better equipped to absorb shocks without experiencing extreme budget shifts (Park & Sapotichne, 2020). These trade-offs highlight the tension in local budgeting, where economic constraints necessitate difficult decisions between social spending and public investments. Rural municipalities, already facing limited fiscal capacity, encountered heightened challenges in adapting to COVID-19-induced economic disruptions (Propheter, 2019).

It is also important to note that federal aid exposed deeper systemic inequities. Deslatte *et al.* (2020) demonstrate that pre-existing disparities in healthcare, housing, and economic resources exacerbated fiscal challenges in disadvantaged communities. Similarly, Pagano and Johnston (2000) emphasise that local governments operate under budgetary constraints

due to state-imposed limits on revenue generation, which restricts their capacity to address these disparities effectively. Propheter (2019) underscores the distinct fiscal limitations faced by rural municipalities, which remain particularly vulnerable in times of crisis, highlighting the importance of adaptable local revenue structures to sustain fiscal health. The issue context, pre-emption at the state level, and the nature of rural areas where resources must spread over extensive geographies with sparse populations all contribute to the difficulties of response and induce tradeoffs among budget priorities.

Punctuated equilibrium and budgetary dynamics

Understanding budgetary volatility in local governments, particularly in response to exogenous shocks like the COVID-19 pandemic, requires a nuanced application of Punctuated Equilibrium Theory. The theory has traditionally been used to explain how policy change is marked by long periods of stability punctuated by bursts of change, with mechanisms underlying these punctuations rooted in the bounded rationality of decision-makers, and at different levels of aggregation, for organisations and systems (Jones & Baumgartner, 2005; Workman *et al.*, 2009). The theory emphasises how the allocation of scarce attention to competing issue priorities and the constraints of institutional friction lead to oscillation and extremes in government outputs such as budgets (Jones & Baumgartner, 2005).

Jones *et al.* (2009) posit that expenditure changes follow a pattern of incremental adjustments punctuated by sudden, significant shifts – a pattern of ‘stick slip’ dynamics found in numerous institutional settings that is so common as to approximate a ‘general law’ of public budgeting. Evidence of these dynamics span numerous countries, continents, and levels of government (see Baumgartner *et al.*, 2009; Breunig, 2006; Bugri, 2024; Cavalieri, 2025; Jennings & John, 2009; Yildirim *et al.*, 2022, among others). Further scholarship explores explanatory factors for variation in punctuated budgetary dynamics, focusing on the nature of regimes and governing conditions (Baumgartner *et al.*, 2017; Jones *et al.*, 2009; Sebök & Berki, 2018) and the complexity of policy areas (Epp & Baumgartner, 2017).

PET scholarship also extends to sub-national budgeting. At the level of US states, budget distributions also follow the leptokurtic (fat-tailed) model with frequent small changes and rare, but large, adjustments (Breunig & Koski, 2006). Among municipalities, Jordan (2003) shows that while most budget changes are minor, extreme events can trigger major fiscal shifts. Separate studies of cities in the state of Michigan, as well as towns, villages, cities, and counties in Wisconsin, show that local budgets exhibit highly leptokurtic distributions of change (Kovari, 2016; Park & Sapotichne, 2020). In the

comparative context, Mortensen (2005) reveals that local governments in Denmark follow similar patterns.

Despite the growing body of PET scholarship on budgetary patterns, we have not yet sufficiently addressed the unique dynamics introduced when systems face sudden and large-scale fiscal expansions. Instead, existing studies explore how varying degrees of information processing capability, decision-making centralisation, issue complexity, and political factors lead to differences in the extremity of budget distributions. Filling this gap in the literature is critical for understanding how federal interventions in sub-national systems during crises, such as the COVID-19 pandemic, affect budget dynamics.

A key question undergirding our thinking is whether the extreme decision system stress introduced by a major emergency like COVID-19 can be effectively offset by federal spending? Can federal spending lessen the strain of punctuated policy dynamics or does it produce more volatility given the need to allocate new funds under intense fiscal pressure? We believe that large-scale spending initiatives offer a new scenario to apply PET: sudden fiscal largesse that induces decision-making and resource allocation uncertainty, especially in constrained local governments. We contend that the interaction of three factors increases fiscal volatility at the local level: (1) local fiscal structures that lack flexibility, resources, and capacity, (2) spending demands and decreased revenues stemming from crisis that increase fiscal uncertainty, and (3) the influx of federal funds with categorical or time restrictions on use. We presume that large, abrupt infusions of federal aid would create unique patterns of budgetary shifts. Specifically, our first set of hypotheses expect that:

H1A: Volatility: Large infusions of federal funds to local governments will generate more *frequent* and *drastic* changes in expenditure distributions.

H1B: Expansion: Changes in expenditure distributions resulting from large infusions of funds to local governments will be in the *positive* direction.

Here, the pressure to allocate substantial new resources effectively and in accordance with funding guidance² may result in uneven changes across different expenditure categories. This can amplify volatility in subcategories left fallow for long periods more than in general categories, which are catch-alls for suites of priorities. The COVID-19 pandemic illustrates that periods of fiscal largesse can lead to similar punctuated dynamics due to decision-making stress and information overload (Fagan, 2023). As federal funds flow into local budgets, decision-makers must navigate competing priorities and funding restrictions, often with limited administrative capacity. This strain on decision systems can result in shifts that resemble the punctuated changes associated with austerity or veto players, but with different underlying drivers. Fiscal volatility under these circumstances, we argue, differs

from smaller-scale windfalls to budgets such as the revenue generated after the discovery of natural resources or new economic development projects. Crisis-driven federal aid expands local budgets uniquely within the constraints of local governance.

Finally, there is an opportunity to develop PET to account for the uneven impacts of federal spending based on local economic and institutional contexts. Counties with stronger institutions and economic resilience may better absorb federal funds and integrate them into long-term planning. In contrast, those with weaker infrastructure and eroded public institutions stemming from economic distress may experience heightened volatility as they struggle to prioritise spending and manage funds effectively amid environments where trust is exceedingly low (Andersen & Mortensen, 2010; Robinson *et al.*, 2021). We expect that these weaker counties will show greater increases in kurtosis and skewness, indicating more extreme, uneven budgetary changes, especially in larger than expected increases in spending as money chases problems in an environment where government has a hard time gathering information on priorities (Workman *et al.*, 2024). Specifically, counties facing greater economic distress (and related declines in public institutions and services) are likely to show more pronounced positive shifts and fat-tailed distributions, signifying the challenges of managing expanded resources under constraint and uncertainty.

H2: Capacity: In distributions of local expenditures, governments facing economic distress and weak institutional settings will exhibit higher levels of volatility (kurtosis) and expansion (skewness) following an influx of federal funds.

Research design

Our research design uses well-established approaches in the study punctuated equilibrium including ocular inspection of percentage change histograms and calculation of distributional measures of tailed-ness of policy changes pre – and post-COVID. To these traditional approaches, we add two recent and newer ways of thinking about policy change. The first of these innovations is the use of skew. Kurtosis is the fourth moment about the mean and pertains directly to the degree of tailed-ness of policy change distributions. Skew is the third moment, and it offers a depiction of the degree to which distributions shift left or right. Skew taps into some of the intuition of recent studies that concern oscillations or trends in budgetary data (Robinson *et al.*, 2014; Segal & Baumgartner, 2024). While kurtosis speaks to the magnitude of the fat tails, skew speaks to the direction in which these large changes are disproportionately occurring and is particularly useful when assessing the impacts of large-scale funds transfers. The second is estimating parametric fits for a generalised pareto distribution (GPD), which

gives us a fit to the distribution of spending across categories and opens the door to think about parameterising the tails of policy change distributions. Here we use it to compare the excess tails in the distributions for the data pre – and post-COVID and assess volatility in a novel way.

Data

To assess how COVID-19 and federal intervention affected prioritisation and budget volatility, we collect expenditure data for counties in Appalachia, specifically the state of West Virginia (WV). The Appalachian region of the US is home to 26.4 million residents and spans 423 counties from New York state to Mississippi (Appalachian Regional Commission). West Virginia's 1.7 m residents (US Census, 2024) live entirely within its bounds. The state's economy, while historically depressed, relies primarily on energy extraction with recent emphasis on tourism and diverse economic development. West Virginia's 55 county governments are institutionally consistent, each operating with a three or five member elected commission that has legislative and executive authority to establish school boards, hospitals, and engage in general economic and welfare provision set out in state law. County services typically span health and human services, infrastructure, public safety, parks and recreation, and education, and in many localities (especially those that are located in rural areas) are typically the primary entity providing services to residents (NACo, n.d.). We also emphasise that there is a strong political and economic context to understanding budgetary change across counties and that in West Virginia they offer something cities do not. Though special districts are on the horizon, they are not a feature of local politics in the state.

For our analytical purposes, West Virginia is the only state in Appalachia to have implemented a standardised, publicly available system of local budgeting with both current and historical data accessible. Many counties, both within and outside Appalachia, report budgets sporadically on individual webpages in inconsistent or unstandardised formats (e.g., those in Pennsylvania³ and Texas⁴), while other states (e.g., California⁵) publish compiled county expenditures across a limited number of general categories. West Virginia is unique not only for its high level of data availability, but also in its implementation of a standardised sub-category classification scheme that supports the distributional analysis we implement here. The economic depression and institutional context of local government in the Appalachian region, and West Virginia in particular, also provides analytical leverage to study the hypotheses we note above.

The US Census Bureau's Census of Governments is a perennial source of data on revenues and expenditures in local governments. However, we opt for data collected from the Local Government Division of the WV State

Auditor's Office. These data are more complete, detailed and represent the entire population of local expenditures for the state. We collect data for all 55 counties in the state at the general and sub-category levels. These data are available in digital format on the State Auditor's Office's Local Government Division website – the revenue and expenditure tables, stored in PDF format, date back to fiscal year (FY) 2012.⁶ Our data cover FY 2012–2024, with updates for FY 2025 underway. For each county, we collected the PDFs manually and transferred the data to CSV files via a macro deployed by the authors and research assistants.

Once these data were collected, we manually ensured compatibility and comparability across time and space. Following Jones *et al.* (2009), we developed a crosswalk, adjusting the budget documents to ensure the general and sub-categories were comparable across all years and counties. The budget documents contain expenditures from seven general categories (e.g., capital projects, culture and recreation, general government, public safety) and 223 specific sub-categories. The highest grossing spending sub-categories include county commissions, courthouses, sheriff and law enforcement, buildings, regional jails, and ambulance authority, among others.

To construct the overall data infrastructure, we parse and append each budget file for county expenditures as reported to the Auditor. Expenditure data in WV is provided in four variables, including a revised expenditure category, reconciling various tensions in the original reported data, and information on the state's coal severance tax revenues – an important source of revenue in the state for counties during our study period. We use the revised general plus revised coal fund as our primary variable of interest and restrict the study to all of the 162 sub-categories with data sufficient to analyse (Johnston *et al.*, 2000; Pagano & Johnston, 2000).⁷ For counties in the data, this yields 2,358 sub-category panels with percentage changes across FY 2012–2024 ($N = 21,918$ percentage changes). Because our data must be comparable across time and space, we adjust for inflation using the GDP-based deflator the St. Louis Federal Reserve Bank provides. We use the FY 2017 deflator for October of each FY. With data that is reliable and comparable across space among counties and over time within each county's spending, we can construct the typical measures of expenditure punctuations identified in the literature that inform current measurement debates in the study of punctuated equilibrium.

Methodological approach

Extreme value analysis is a collection of statistical techniques that focus on analysing significant departures from the median within probability distributions. This approach is particularly relevant in fields such as disaster management and insurance, where researchers aim to assess the likelihood of

extreme events occurring at the tails of a distribution. In our study, we first engage in standard visual and empirical measurement of expenditure distributions common to PET using l-kurtosis scores. When then innovate in two ways: first, by assessing shifts in skew as a measure of rightward expansion stemming from the influx of federal aid; and second, by using the generalized Pareto distribution (GPD) along with a peak-over-threshold method (Leadbetter, 1991) to evaluate the probabilities associated with extreme instances of expenditure changes. With this method, the analyst begins by selecting a threshold based on their understanding of the data or deriving it empirically from a metric that reflects the central tendency of the skewed distribution. For our analysis, we determine the threshold by setting it at the median of the expenditure change distributions related to county fiscal policy, which serves as the basis for modelling the excess peaks.⁸

We follow Workman *et al.* (2024) in using maximum likelihood estimation to fit the GPD to the distribution of county expenditures in sub-categories. In the context of a peaks-over-threshold framework, the log-likelihood function for the GPD is expressed as follows:

$$\ell(\sigma, \xi|y_i) = \mu * \log(\sigma) - \left(1 + \frac{1}{\xi}\right) \sum_{i=1}^{\mu} \log\left(1 + \frac{\xi y_i}{\sigma}\right)$$

In this equation, the sub-category expenditures (y_i) are modelled as a GPD that is conditional on the scale parameter σ and the shape parameter ξ . The shape parameter is crucial, as it influences the tail characteristics of the GPD. For the purposes of this analysis, variations in the shape parameter help identify differences in tail behaviour based on pre versus post COVID eras. Furthermore, the equation incorporates the parameter μ , which accounts for the number of excess peaks identified in relation to our threshold estimation.

After implementing this GPD approach to study the tails of pooled spending, we engage in analysis of county-level distributions. We compare measures of kurtosis and skew to assess how variation in the economic and institutional constraints across counties shape the effects of federal aid. We end by modelling pre – and post-COVID differences in these measures as a function of economic distress among counties.

Findings

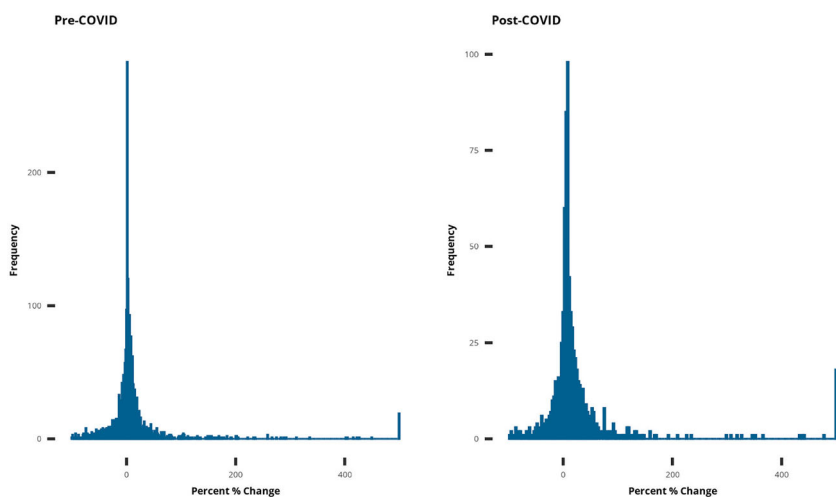
Our findings relate well to the mountain of literature in PET noting the punctuated nature of budgetary policy change. Our accounting of this phenomena in counties in Appalachia adds some context that provides a basis for advancing theoretical development. They pertain to the constraints decision systems face, the nature of social and economic fabric in these places, and the

bipolar role of federal spending in stabilising spending for some localities and exacerbating difficulties in others.

Typically, analysts think of the largesse of spending programmes as good for local budget volatility, depending on the configuration of institutional constraints of these programmes. In theorising about budgetary change, our analysis allows us to examine a unique dynamic depending on levels of category aggregation that country-wide studies rarely confront. Our results speak to how expansions of federal spending may, depending on measurement approaches, induce volatility. This may cause problems for prioritisation, and present challenges for decision-makers usually only envisioned in moments of austerity and a shrinking pie.

COVID and county expenditure volatility

Figure 1 below displays histograms of percentage changes to county expenditures. We do not necessarily need the usual distributional measures to say that these are very punctuated or leptokurtic. We have binned all percentage changes over 1,000 percent at 1,000 and plot varying y-axis scales for visualisation purposes.⁹ To assess how the pre and post COVID period compares, we break the data into the period prior to fiscal year 2021 (FY 2012–2020) and the period after (FY2021–2023). For context, the fiscal year in West Virginia begins July 1st. So, fiscal year (FY) 2021 begins 1 July 2020, just after the Trump administration had signed the first relief legislation of what would be six efforts over the next two years. In our dataset, we note that more than 25



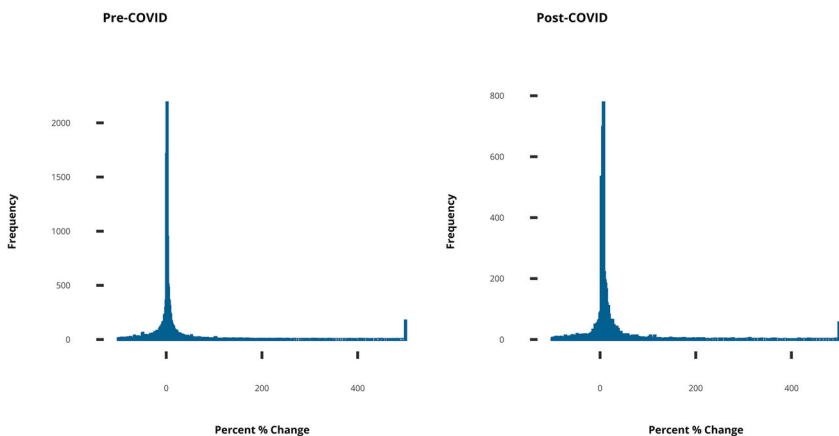
Source: Compiled by the authors from data provided by the WV State Auditor. Bins calculated using the Freedman-Diaconis Rule.

Figure 1. County general category expenditure distributions.

sub-categories have direct relevance to these programmes given the nature of the public health and economic emergency resulting from COVID.¹⁰

To the subjective eye, the figure shows two important features of the post-COVID period. The first is that the post-COVID period histogram seemingly has stronger ‘shoulders’, defined roughly as observations occurring on either side of central peaks, than the pre-COVID period. This is important because it is synonymous with relatively moderate, more adaptable percentage changes. The second is that the distribution visibly shifts right in the post-COVID period. Large, positive percentage changes are relatively more frequent – expansions of spending beyond what we would expect by default. This shows up in the peak for percentages in the ‘1000’ bin as well as those between there and the centre compared to the pre-COVID period. These features provide no preliminary support H1A regarding volatility (as shoulders indicate adaptability) and preliminary support for H1B regarding skew – though our empirical comparisons below allow more robust assessment.

Figure 2 displays the same information for county expenditure sub-categories, with varying y-axes for visualisation purposes. Federal programmes figure in local expenditure volatility disproportionately depending on levels of category aggregation. Theoretically, decision-makers face trade-offs in levels. The first decisions are about how much to allocate across major priorities like Capital Projects or Public Safety. These larger priorities conceal more nuanced decisions about specific sub-categories. In our data, there are sub-categories that, in any given year, may be unfunded – this is more likely under scarcity. Federal spending, and especially federal spending targeted directly at local governments, allows funding of specific sub-categories that may not normally be possible.



Source: Compiled by the authors from data provided by the WV State Auditor. Bins calculated using the Freedman-Diaconis Rule.

Figure 2. County sub-category expenditure distributions.

Figure 2 shows that, again, expenditure sub-categories are incredibly punctuated, with peaked centres and fat tails, especially on their positive sides. Importantly, these distributions highlight the dynamic we mention above where sub-categories appear much more punctuated than do general categories. Many of these specific sub-categories face resource scarcity most of the time. Simultaneously, federal spending on a grand scale allows funds to flow to these sub-categories, making their change distributions appear more leptokurtic. Table 1 displays the distributional measures associated with these figures and both confirm this general view of the data as punctuated and hints at why we see the shifts.

Table 1 displays the calculated l-skew and l-kurtosis of the county expenditure change distributions graphed above. We use l-moments for these calculations as they are more robust in smaller samples we typically deal with in the study of public policy (Breunig & Koski, 2006; Hosking, 1990). We also include a calculation for the Gini coefficient as a proposed alternative from recent literature (Kaplaner & Steinebach, 2022).

In assessing the values for l-kurtosis in the pre – and post-COVID periods, pooled county spending remains roughly similar in terms of its degree of tailed-ness compared across periods and for both general and sub-categories of expenditure. Though the temporal features of our data are limited, the Gini coefficients also point to largely unchanged volatility in the general categories but display much less sub-category volatility in the post-COVID period. We think this lies in part with the explanation above. Sub-category bins that are usually sporadically funded are more consistently funded in the wake of the federal programmes addressing COVID and its fallout. We would not expect this consistency to last beyond the life cycle of many of these programmes. ARPA funds, President Biden’s first legislation addressing COVID relief, was to be encumbered by 31 December 2024, and spent by the end of 2025. Gini coefficients are uniquely positioned to capture this temporal dimension of PET.

Importantly, our empirical results thus far provide no clear support for H1A, which expects increased volatility: while strong shoulders appear visible in post-COVID histograms, l-kurtosis scores are similar and trend toward more stability in the post-COVID periods when analysing pooled changes among both general categories and sub-categories.

Table 1. Distributional measures of county expenditure changes.

Metric	General categories		Sub-categories	
	Pre-COVID	Post-COVID	Pre-COVID	Post-COVID
L-Kurtosis	0.53	0.52	0.58	0.57
Gini Coefficient	0.71	0.70	0.75	0.68
L-Skewness	0.35	0.48	0.39	0.41

Source: Compiled by the authors from data provided by the WV State Auditor’s Office.

In [Table 1](#), the l-skewness also speaks to the general picture in the histograms and allows us to examine our second primary hypothesis. Whether for general categories or sub-categories, distributions of change shifted right in the post-COVID period. The tailed-ness of the distributions became more positively skewed. These pooled measures hint at the power of the federal programmes meant to address COVID to stabilise resulting volatility, but also to fill bins with funds that would not usually have them.¹¹ This result supports our expectation in H1B, that expenditure distributions would shift rightward following influxes of federal aid. This finding is most prevalent at the general category level (0.35 pre-COVID compared to 0.48 post-COVID).

Next, we estimate GPD fits to county expenditure categories to further test our hypothesis on budget volatility. Because we were interested in raw spending, we use the spending for each category here and not the percentage change distributions. The GPD fits are an excellent way to assess PET in cases where the variables of interest fall on the positive side of zero. Here, a category could plausibly have no spending but could not have negative spending for a given FY. In fitting the GPD to the county expenditures, we used the revised general expenditures plus the coal severance tax expenditures. In WV, these are vital components of the budgets for counties and used for everything from social services to capital projects.

In the formulation reported in [Table 2](#), we get a scale parameter and a shape parameter. The scale parameter pertains to the variance in the distributions of spending – larger scale parameters mean greater variance in spending across categories. The table shows this greater variance during the post-COVID era amid federal spending for both general categories and sub-categories. The shape parameter for the GPD directly models the positive tail of the expenditure distributions. For general and sub-categories, the shape parameter increases as we move from the pre-COVID period to the post-COVID period. This means the positive tail of county expenditures grows and receives more density in its far reaches. Counties during this time were certainly spending more and in greater relative quantities out of necessity, but the nature of the federal response both mitigated against

Table 2. GPD fits to county expenditures.

Parameter	General categories		Sub-categories	
	Pre-COVID	Post-COVID	Pre-COVID	Post-COVID
Scale	1,131,805.81	1,616,093.51	318,395.80	392,598.96
SE (Scale)	741.51	1482.98	371.09	742.15
Shape	0.84	0.87	0.46	0.54
SE (Shape)	0.04	0.07	0.01	0.02
-logLik	34,121.61	12,877.04	113,366.64	47,231.63
BIC	68,258.61	25,767.48	226,751.27	94,479.46

Source: Model results from GPD fits using fevd package in R.

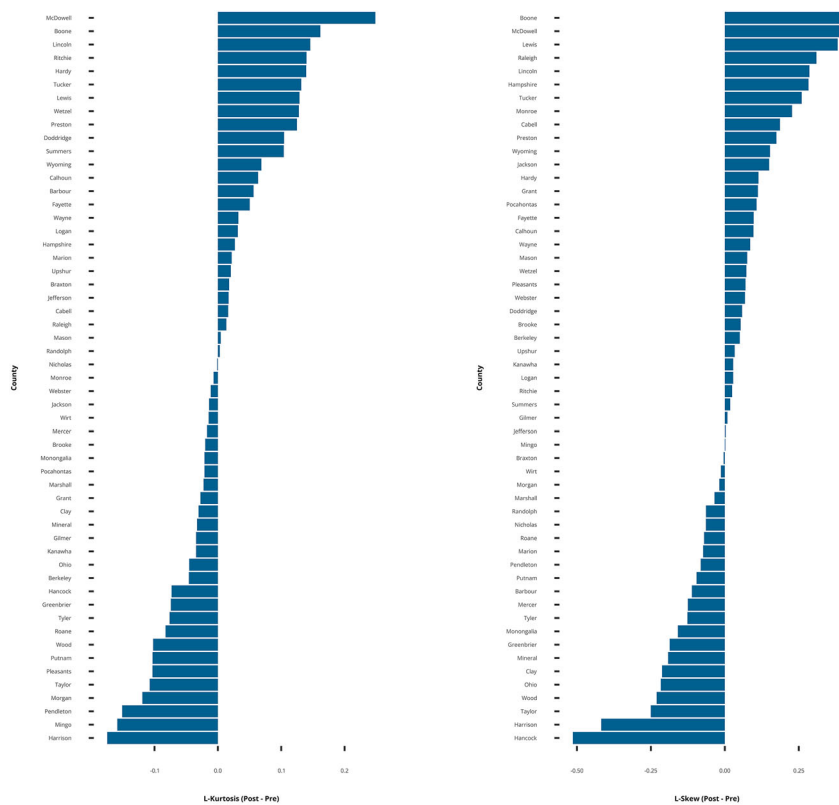


Figure 3. Change in county distributional measures pre-post COVID.

cuts and allowed growth in the far reaches of spending in these distributions. Considering volatility through the lens of GPD fit provides support for H1A at the aggregate level.

We now turn to our second hypothesis, which expects that county-level differences in both volatility and expansion will vary according to the institutional demands placed on governments by economic distress. As shown in Figure 3, we calculate the l-kurtosis and l-skew for each county pre – and post-COVID. On the left the figure plots the post-COVID minus the pre-COVID l-kurtosis, meaning counties at the top of the figure display increased expenditure volatility post-COVID, while those at the bottom display decreased expenditure volatility. Counties at the top in Figure 3 are those generally facing more economic distress and weakened public institutions and services. For these counties, COVID and federal responses to COVID were destabilising for obvious, but very different reasons. Collectively, those at the bottom experience less disjointedness in expenditures. For these counties, who were better positioned to deal with COVID at the

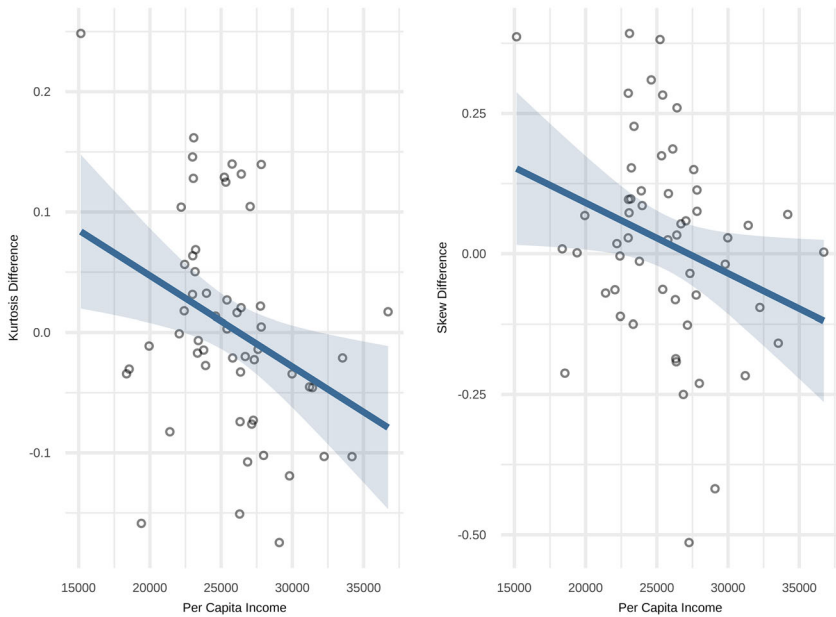


Figure 4. Kurtosis and county per capita income.

outset, federal programmes also fell on political and social institutions less eroded by the economic distress characteristic of much of Appalachia.

Moving to the right side of [Figure 3](#), it displays the same difference but for l-skew. Note that many more counties shifted positively in skew than for kurtosis. This is expected given the necessities wrought by COVID and the federal response. At the upper reaches of l-skew, counties known to be most affected by the erosion of public services and institutions evidence the largest rightward shifts and of greater magnitude in the tails of the distribution. [Figure 3](#) foreshadows what we learn about budgetary politics falling unevenly at subnational levels depending on the quality of public institutions and the nature of economic and social upheaval (e.g., McDowell County, for instance, has no clean drinking water as of the writing of this research) (Andersen & Mortensen, 2010). While federal relief is a welcome sight, and more so under times of such extreme duress, influxes of resources, like austerity, introduces tremendous problems of prioritisation.

To test this logic empirically, we draw on economic estimates from the US Census American Community Survey. In [Figure 4](#), we plot per capita income (2020), as a proxy measure of economic distress and constraints on institutions, by the differences in both kurtosis and skew (pre – vs. post-COVID) at the county level. Both sides of the plot show that lower per capita income is associated with increasing differences in each measure comparing pre – and post-COVID. An OLS regression model indicates that these are

statistically significant relationships ($p = 0.011$ and $p = 0.043$, see Appendix A). Aligning with H2, these results suggest that economic austerity forces tradeoffs directly and works through cuts selectively or broadly. Expansions of federal resources to local governments place extreme stress on collective decision-making and prioritisation, with visible effects for constrained institutions in terms of both volatility and positive expansion.

Discussion

In sum, we find mixed evidence that COVID, and responses to it, made budgets more volatile. Using standard measures of l-kurtosis to test our first hypothesis, we show that pandemic related aid may have contributed to more stability in the aggregate distribution of county budgets. We also report sharp annual decreases in l-kurtosis after 2021 when taking averages across counties. By implementing a novel approach to modelling the right side of expenditure distributions, however, we document increases in the tail behaviour that indicate more frequent and drastic shifts in spending. This analysis provides empirical support more in line with our hypothesis. When considering the skew of expenditure distributions, we noted pronounced positive shift in changes at the general category level and modest shifts among sub-category expenditures. At the individual county level, our second hypothesis expects that differences between pre – and post-COVID periods will vary and relate to economic distress and the institutional constraints that result. We find support for this expectation, showing that increasing economic distress is associated with higher levels of both volatility and rightward expansion.

On the one hand, we expected to witness greatly increased expenditure punctuation in the wake of COVID-19, especially for geographically constrained localities at the bottom of the federal ladder in the US. PET has always offered good theoretical reasons to suspect that large federal distributive spending initiatives are potentially destabilising. While government austerity generally, and especially amid large emergencies, forces the types of tradeoffs that make priorities interdependent and a complex system leading to punctuated policymaking (Breunig & Busemeyer, 2012), the nature of large spending expansions themselves strain decision and policy systems. Absent tradeoffs, the scale of the issue and urgency with which public systems had to react strained attention limits of governing institutions. Our results suggest that the story is more nuanced, and depends on how one measures and models volatility.

This strain and the resulting punctuated budgetary politics that results affect all systems but fall unevenly on those more vulnerable and less well-resourced from the start. Economic distress, along with eroded public institutions and decision systems, and social erosion, especially of trust in these

systems and processes, all fuel the sort of budget and expenditure volatility we witness at the level of individual counties. The costs are real. As these systems rush to address the problem and spend money that must sunset, federal priorities for the public health response are blunted. Our study also points to the need to be thorough in accounting for the vertical nature of budgeting. One way in which PET can be expanded is in understanding how expenditures or budgetary allocations cascade over budgetary decision systems. This occurs in two layers – one across layers of government associated with a federal system and the other a public finance and administration layer associated with budget categories and how flexible a given system may be.

Conclusion

In this study, we set out to examine how local level expenditures might be affected by an extreme public health shock like COVID-19 and the federal government's attendant efforts to mitigate the public health disaster through relief programmes like the CARES Act or ARPA. From our view, our theories of public policy shed a lot of insight on the former. Massive, exogenous disasters strain all governments, local governments more so, and force the types of tradeoffs that lead to the dynamics of punctuated equilibrium. We see less discussion of what happens when policy and decision systems are strained in periods of largesse, and our work points to the unevenness in information processing associated with distressed areas where public institutions and services have eroded. Considering this, we think PET has much to teach us about understanding these very practical issues on the ground, and especially in federal systems. We suspect such dynamics routinely occur in areas prone to natural disaster.

We argue that the largest increases in federal spending in recent memory brought on by COVID offer an excellent opportunity to understand distributive politics through the lens of PET. Such analysis allows us to explore the prospects of deeper theoretical development on how government expansions and spending influence the punctuated dynamics of budgetary politics. Our findings broadly help us understand how institutions and decision systems influence the trajectory of local budgetary dynamics. We believe our hypotheses on volatility, expansion, and capacity apply beyond the case of one US state. Where local fiscal structures lack flexibility and new spending demands or decreased revenues develop, influxes of national funds are likely to contribute to increasingly volatile and positive shifts in budgets. Federal or national systems with variation in economic context and institutional context among sub-national governments are likely to exhibit similar patterns to those we uncover here. We think the approach we take here provides context for comparing and assessing local government policy dynamics in the US, Europe, and elsewhere, especially between federal systems and those more centralised. In

comparison, both the nature of federalism and the path taken to respond to crisis (massive spending versus austerity) offer leverage on these comparisons and resulting public policy changes.

Finally, we note that our approach to assessing the tails of the distribution of expenditures warrants further exploration. Whether using a GPD, or other more flexible distributions, similar approaches offer the prospective bringing PET more into normal regression and statistical modelling. These distributions are designed to account for shape, precisely the element central to PET's depiction of policy change. Future work would do well to develop parameterizations of distributional shape so that many of the conceptual elements we measure can be assessed regarding the tails of distributions while controlling for other features of the systems.

Notes

1. We note that counties in West Virginia are not able to take on debt exceeding 5 per cent of taxable property, outside of state-approved general bond for development or other programmes (NACo, n.d.).
2. For example, see the US Department of Treasury's guidance on allocation of Coronavirus State and Local Fiscal Recovery Funds under ARPA, p. 4: <https://home.treasury.gov/system/files/136/SLFRF-Compliance-and-Reporting-Guidance.pdf>.
3. See York County, Pennsylvania: <https://yorkcountypa.gov/319/County-Budgets>
4. See Travis County, Texas: <https://www.traviscountytx.gov/planning-budget>.
5. See California State Comptroller's Office: <https://counties.bythenumbers.sco.ca.gov/#/year/default>
6. See West Virginia State Auditor's Office: <https://www.wvsao.gov/LocalGovernment/Default>
7. For inclusion, sub-categories needed to have at least one instance of two observations occurring in consecutive years for at least one county government, such that we could calculate year-year percentage changes. We include all possible data in our analysis and make no substantive inclusion or exclusion decisions. Those excluded sub-categories range in scope and span the general categories of capital planning, administration, infrastructure, services, and grants. For example, health and sanitation funding for dental clinics, capital projects for sheriff-jails, and general government expenditures on parking.
8. We note for the reader that we did conduct empirical simulations out to the \$2M value and observed changes in the log-likelihood. The resulting likelihoods levelled out quickly, offering no great power over our substantively informed median threshold.
9. We identify several such instructive cases with percentage changes above 1000, which we bin for visualisation purposes. For example, in Calhoun County, spending for the local health department moved from an inflation adjusted level of \$1,127-\$1,519 (FY2012-FY2020) to \$29,720 in FY2021, a change of 1,855 per cent, before returning lower in FY2022. In Beckley County general capital projects expenditures varies widely from year to year, jumping from \$7,133 in FY2013 to \$92,542 in FY2015 (a change of 1,197 per cent). In Cabell County, spending on buildings had a one-year increase from \$177,712 in

FY2020 to \$2.2m in FY2021 (a change of 1,142 per cent). Spending in the capital projects category allocated to emergency services in Doddridge County, for example, moves from \$6,507 in FY2012 to \$80,913 in FY2013 (a change of 1,143 per cent). Parks and recreation expenditures in Taylor County, begin FY2012 at \$2,702 yet increase to \$48,411 in FY2014 (a change of 1627 per cent), and then incrementally adjust through FY2022 to \$66,638. While many of the extremely large percentage changes in our data are related to transfers, reimbursements, grants, buildings, and capital expenditures, others are substantive. For example, emergency service expenditures in the public safety category in Fayette County shift from \$934-\$967 in FY2012-FY2014 to \$1.45m in FY2015 (a change of 14,948 per cent) and represent a significant shift in priority among local government in the county.

10. These include sub-categories such as: local health department, local emergency planning, hospital, ambulance, emergency services, other health programmes, mental health, public transit, public safety, rapid response, social services, housing authority, homeless shelter, fire department, airports, communications centre, promotion of tourism, among others.
11. We also assess temporal volatility as an additional window into the effects of federal aid. Appendix Figure A1 plots average county l-kurtosis over time. L-kurtosis was considerably higher from FY 2015–2020 and dropped precipitously thereafter. Distributional tails became leaner as federal relief shifted distributions away from more extreme decreases and spurred increases across a broader range of spending categories. This pattern is in the inverse direction expected by H1A.

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Data availability

These data are publicly available from the West Virginia State Auditor's Office Local Government Division.

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Appendix A: Additional Analysis

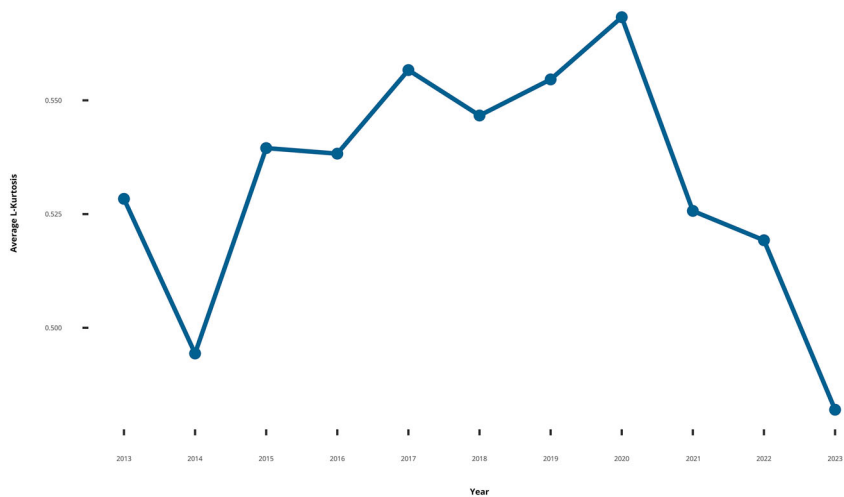


Figure A1. Volatility over time: average county I-kurtosis by year.

Table A1. Estimation results of per capita income regression on differences in kurtosis and skewness, by county (OLS).

	Kurtosis difference	Skewness difference
(Intercept)	19.796** (7.396)	34.219* (15.721)
Per Capita Income	−0.001* (0.000)	−0.001* (0.001)
Obs.	55	55
R ²	0.116	0.075

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; Kurtosis and Skew $\times 100$ for presentation purposes.