

Modeling State and Local Governmental Capacity in Managing CDBG-DR Funds: A Structural Equation Modeling (SEM) Approach

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Abstract

This study investigates how state and local governments across the United States mobilize and manage federal CDBG-DR (Community Development Block Grant-Disaster Recovery) resources using quarterly QPR (Quarterly Performance Reports) data on funds obligated, disbursed, and expended in response to 2003-2023 disasters. By constructing average ratios of disbursed-to-obligated and expended-to-disbursed funds, the analysis develops comparable indicators of governmental capacity and fund-management performance across 78 disaster-affected jurisdictions. To examine how these capacity measures shape disaster recovery performance, the study applies both cross-sectional and longitudinal Structural Equation Modeling (SEM) to model latent constructs of governmental capacity and recovery outcomes at the state and local levels.

The cross-sectional SEM results reveal clear differences in administrative capacity across levels of government. State governments consistently demonstrate stronger capacity to move funds from obligation to disbursement and to fully expend obligated amounts, and these capacity indicators show a stable, positive association with recovery outcomes across multiple model specifications. Local governments, by contrast, exhibit lower disbursement capacity and greater variability in administrative processes; their recovery outcomes are more sensitive to expenditure consistency and project-level timeliness. Sensitivity analyses removing highly collinear indicators, such as duration of completion, further show that state-level capacity-outcome relationships remain robust, whereas local-level relationships are more fragile and dependent on operational constraints.

Together, these findings highlight persistent capacity disparities across jurisdictions and underscore the importance of targeted administrative support for local program implementation. As a next step, the study will extend the SEM framework into a longitudinal SEM design to capture how governmental capacity evolves over time, assess whether jurisdictions improve their fund-management efficiency with program experience, and more directly examine dynamic pathways linking administrative capability to long-term disaster recovery performance.

1 Introduction

The effective administration of federal disaster recovery funds is central to advancing equitable and timely community recovery. In the United States, the Community Development Block Grant–Disaster Recovery (CDBG-DR) program has become one of the largest and most flexible sources of long-term recovery assistance following major disaster declarations. Yet despite its national importance, the pace at which grantees – states, counties, cities, and territories – obligate, disburse, and expend CDBG-DR funds varies markedly across jurisdictions and disaster events. Slow or inconsistent financial performance has been repeatedly linked to delayed housing reconstruction, prolonged displacement, uneven economic recovery, and persistent inequities for low-income households and historically marginalized communities (GAO, 2019; HUD OIG, 2021).

A central challenge is that governmental “capacity” in disaster recovery is difficult to measure directly. Previous evaluations often rely on single-period financial indicators or case-based assessments, making it difficult to compare capacity across time, jurisdictions, and disaster contexts. The Quarterly Performance Reports (QPRs) submitted through HUD’s Disaster Recovery Grant Reporting (DRGR) system offer a rare opportunity to construct longitudinal, comparable indicators. These reports consistently document obligated, disbursed, and expended amounts for each grantee and activity, providing rich panel data for assessing financial performance. However, raw financial quantities alone cannot capture the multidimensional nature of administrative capacity, which includes efficiency, timeliness, and internal process management.

To address these issues, this study develops a longitudinal Structural Equation Modeling (SEM) framework to conceptualize, quantify, and compare governmental capacity in managing CDBG-DR funds. Using quarterly data on obligations, disbursements, expenditures, efficiency ratios, and temporal lags, we define capacity as a latent construct that evolves over time and varies across state and local governments responding to different disaster types. The study proceeds by: (1) conducting a descriptive analysis of quarterly fund flows; (2)

constructing operational indicators of financial efficiency and timeliness; and (3) estimating a SEM with latent governmental capacity to evaluate cross-jurisdictional and cross-hazard differences.

This approach advances the literature in three ways. First, it offers a systematic and empirically grounded measurement of administrative capacity using longitudinal financial data, correcting for measurement error, and capturing temporal dynamics. Second, it provides a comparative framework to assess differences between state and local grantees and across disaster contexts. Third, it develops practical diagnostic indicators – ratios and lags – that can be readily incorporated into HUD’s monitoring and technical-assistance processes. Together, these contributions help clarify how administrative capacity shapes financial performance and recovery outcomes, offering new insights for policy reform and institutional support programs.

2 Literature Review

2.1 Context: CDBG-DR administration and performance challenges

CDBG-DR has expanded substantially over the last two decades, distributing billions of dollars following major hurricanes, floods, wildfires, and other disasters. As a block-grant program, it affords grantees considerable flexibility, but this flexibility also introduces substantial administrative burden. Numerous evaluations have documented persistent delays in grant implementation, including slow procurement, environmental reviews, and program startups (GAO, 2019; HUD, 2020). Grantees differ considerably in their experience with federal recovery programs, staffing levels, contracting capacity, and administrative processes – all factors that influence the speed and effectiveness of fund deployment (Zhang & Peacock, 2019; Howell & Elliott, 2019).

HUD requires quarterly reporting through the DRGR/QPR system, which captures obligated, disbursed, and expended amounts by activity and period. These data are widely used by auditors, HUD staff, and researchers to assess financial performance. However, prior analyses generally rely on descriptive summaries or aggregate comparisons rather than modeling the underlying determinants or latent dimensions of administrative capacity.

2.2 Characteristics of disaster recovery administration

In general, three consistent characteristics emerge in the fields of disaster recovery administration. (1) Significant cross-grantee variation: Grantees differ widely in their pace of obligations, disbursements, and expenditures. Prior experience with CDBG-DR or similar programs is often associated with faster deployment (GAO, 2019). (2) Differences between state and local administration: Some studies note that local governments may be more responsive in certain housing programs, whereas states may be more effective in infrastructure or regional projects (Peacock et al., 2022). However, evidence remains mixed due to methodological limitations and inconsistent measures. (3) Administrative processes strongly influence timelines: Delays often stem from procurement rules, environmental reviews, inconsistent staffing, and challenges in coordinating across agencies (Smith & Martin, 2021). Institutional capacity – not only disaster severity – plays a critical role in shaping the speed of recovery.

Despite substantial progress, key gaps persist in the literature: (1) There is a lack of a latent, multidimensional measure of administrative capacity, as no studies integrate multiple performance indicators (obligations, disbursements, expenditures, ratios, and timing lags) into a unified latent construct. (2) Longitudinal and comparative analyses remain limited; instead, most studies rely on static indicators or short time windows, while longitudinal modeling that captures capacity growth, learning effects, or decline over time remains unexplored. (3) There is an urgent need to conduct cross-hazard and cross-jurisdiction comparisons because existing analyses rarely compare performance across disaster types, nor do they consistently evaluate how state and local governments differ in their time-varying capacity. (4) Existing studies exhibit a weak operational linkage between research metrics and management tools. For instance, although QPR data are widely used, there are no established diagnostic indicators for HUD or grantees that link observed financial performance to underlying capacity indicators in a validated way.

2.3 Methods used in prior scholarship

Research on disaster recovery administration has primarily used four methodological approaches. (1) Descriptive and programmatic analyses: HUD and GAO frequently publish summaries highlighting differences in fund utilization rates across grantees (GAO, 2019; HUD, 2020). Academic and think-tank studies also document patterns in program launch times, housing completions, and expenditure trajectories (Enterprise Community Partners, 2024). These analyses reveal substantial variation but do not explain the institutional factors that drive performance. (2) Regression-based and panel analyses: Many public administration and planning studies use regression or panel models to examine how staffing, experience, governance type, or disaster severity influence implementation speed (Pipa, 2020; Gerber & Robinson, 2022). While informative, these models treat financial indicators as observed outcomes without addressing measurement errors or the possibility that capacity itself is a latent construct reflected by multiple correlated indicators.

(3) Case studies and qualitative evaluations: Qualitative studies offer deep insights into administrative processes, identifying barriers such as restrictive procurement rules, complex environmental reviews, and coordination challenges among agencies (Smith & Martin, 2021; Peacock et al., 2022). These studies provide context but are not designed for comparative or longitudinal generalization. (4) Latent-variable and SEM approaches: In disaster studies more broadly, SEM has been used to measure constructs such as preparedness, perceived risk, and institutional resilience (Geddam et al., 2024; Cutter et al., 2019). However, applications of SEM to federal disaster-recovery finance, especially using QPR longitudinal data, remain extremely limited. No existing study develops a latent, time-varying measure of governmental capacity using efficiency ratios and financial timing indicators.

2.4 Research gaps and workflow

In summary, there remains an unaddressed need to use longitudinal modeling and comparative analyses for offering a comprehensive understanding of state and local governmental capacity to manage the flow of obligated, disbursed, and expended CDBG-DR funds, particularly regarding efficiency ratios and timeliness across administrative jurisdictions and disaster events. Therefore, this study directly addresses this gap by constructing a quarterly, latent measure of governmental capacity from QPR data and estimating a longitudinal SEM to evaluate differences across jurisdictions and hazard types. By integrating efficiency ratios, expenditure timing lags, and quarterly variability into a unified analytic framework, the study establishes a rigorous, replicable, and policy-relevant method for understanding administrative capacity in disaster recovery.

3 Data and Research Design

3.1 Data description and sources

The dataset, sourced from the quarterly performance reports (QPR) of HUD's Disaster Recovery Grant Reporting (DRGR) system, covers quarterly obligated, disbursed, and expended CDBG-DR funds across 78 states and local governments (grantees) and 18 disaster events spanning from 2001 to 2023. Each data row represents the set of obligated, disbursed, and expended QPR funds for one disaster recovery program or activity administered by a grantee in response to one disaster event. Notably, obligated QPR funds refer to the amount of federal funding that HUD has formally committed to a grantee for eligible disaster recovery activities, and these funds are reserved but not yet spent. Disbursed QPR funds refer to the amount of money that has been reimbursed or transferred from HUD to the grantee after expenditures are reported and approved, showing the federal government's completed payment to the grantee. Expended QPR funds refer to the portion of obligated funds that the grantee has already spent on approved recovery activities, which reflects actual financial outlays.

Since these QPR fund data are quarterly and program-specific, this study has a panel (time-series cross-sectional) structure. To describe the overall capacity of both state and local governments, we separately calculated the quarterly cumulative values of obligated, disbursed, and expended QRP funds across different disaster recovery programs for each grantee. With the processed dataset, this study focuses on both state-

and county-level data to model and compare state and local governmental capacity in managing CDBG-DR funds. Similarly, to compare and analyze governmental capacity in certain disaster recovery programs, we calculated the quarterly cumulative values of obligated, disbursed, and expended QPR funds for each grantee, separately for housing, administration, infrastructure, and planning programs.

3.2 Indicators of governmental capacity

In this study, state and local governmental capacity in managing CDBG-DR funds cannot be directly observed from the dataset, but it manifests through how efficiently and consistently funds move from obligation, disbursement, to expenditure across time and programs. Therefore, to model state and local governmental capacity, we put forward several possible latent constructs as follows: (1) Administrative/managerial capacity, which can be measured through the ratio of disbursed to obligated funds, the ratio of expended to disbursed funds, and the timeliness (lag) between each stage; (2) Program performance, which can be measured by the speed and completeness of fund expenditure per quarter.

The applications of these latent constructs are reflected in the following ways: (1) using descriptive statistics to describe the overall and program-specific capacity of state and local governments, capture the change over time, and further compare and analyze their differences; (2) incorporating these latent constructs into longitudinal modeling (e.g., SEM) to quantify and compare state and local governmental capacity in disaster recovery, and further analyze possible contributing factors to the performance of state and local governmental capacity.

3.3 Metrics of disaster recovery program outcomes

In this study, disaster recovery program outcomes are characterized by the average duration of completion in months across disaster events, the average percentage of obligated funds fully expended, and the average quarterly-by-quarterly variance of expended funds. Specifically, the duration of completion is equal to the time difference between the start quarter (the quarter when the funds were first obligated) and the end quarter (the earlier one between the current quarter and the quarter when over 95% of obligated funds were fully expended). The percentage of obligated funds fully expended equals the ratio of total expended funds to total obligated funds. The quarterly-by-quarterly variance of expended funds refers to the normalized standard deviation of quarterly expended funds, indicating the smoothness of managing quarterly funds.

3.4 Research design

Based on the processed dataset and capacity indicators, we conducted the following research design to capture state and local governmental capacity to manage CDBG-DR funds:

- To conduct a descriptive analysis of quarterly variations in QPR funds across local and state governments for different disaster events. This includes comparing obligated, expended, and disbursed funds; financial performance among selected states (e.g., California, Florida, Georgia, and Texas); and responses across different disaster events.
- To compute ratios of QPR fund disbursed/obligated and expended/disbursed, as well as lags of time difference between QPR fund obligation and expenditure. This creates latent variables at each time point when modeling quarterly capacity.
- To develop a Structural Equation Modeling (SEM) with latent constructs of governmental capacity to quantify and compare the differences in the capacity of state and local governments in responding to different disaster events over time.

4 Methodology: Structural Equation Modeling

In this study, we use Structural Equation Modeling (SEM) to model and quantify state and local governmental capacity in managing CDBG-DR funds, given longitudinal quarterly data on obligated, disbursed, and

expended amounts across multiple programs. Therefore, the goal is to capture state and local governmental capacity as a latent construct reflected in how funds are allocated and utilized over time.

4.1 Modeling approaches: Cross-sectional vs. longitudinal SEM

Cross-sectional SEM is used to analyze the overall capacity of state or local governments across quarters, specifically creating a latent variable *StateGovCapacity* or *LocalGovCapacity* measured by quarterly average ratios or indicators (the average ratio of disbursed to obligated funds across quarters, the average ratio of expended to disbursed funds across quarters, and the average timeliness across disaster events – an inverse to the duration of completion). The goal is to model relationships between state or local governmental capacity and disaster recovery program outcomes (the average duration of completion in months across disaster events, the average percentage of obligated funds fully expended, and the average quarterly-by-quarterly variance of expended funds). Notably, the duration of completion is equal to the time difference between the start quarter (the quarter when the funds were first obligated) and the end quarter (the earlier one between the current quarter and the quarter when over 95% of obligated funds were fully expended); The percentage of obligated funds fully expended equals to the ratio of total expended funds to total obligated funds; The quarterly-by-quarterly variance of expended funds refers to the normalized standard deviation of quarterly expended funds, indicating smoothness of managing quarterly funds. For cross-sectional SEM, we aggregated each average of these indicators at a grantee level (e.g., each state or local government) across different disaster events and disaster recovery programs. Therefore, it cannot capture the change of state or local governmental capacity to manage CDBG-DR funds over time.

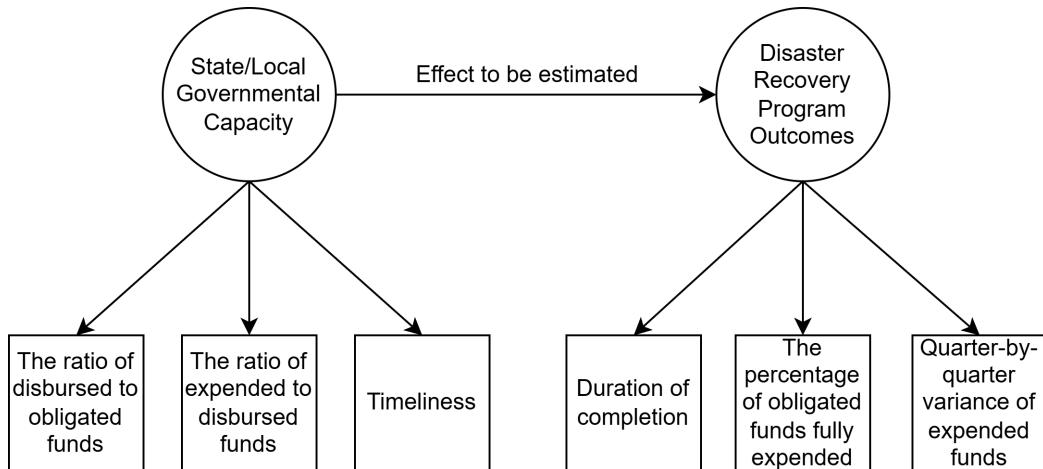


Figure 1: Illustration of the cross-sectional structural equation modeling (SEM) for modeling the relationship between state or local governmental capacity and disaster recovery program outcomes.

In contrast, a longitudinal SEM is developed to investigate how state or local governmental capacity changes over time, specifically measuring each ratio or indicator at multiple quarters and applying these data to the latent growth curve model (LGCM) or autoregressive latent trajectory (ALT) model to quantify and characterize the latent constructs of state or local governmental capacity to manage CDBG-DR funds for disaster recovery. In the modeling process, this study also includes control variables such as population size, disaster magnitude, and administrative staffing to improve SEM performance and add explanatory power of the latent constructs of state or local governmental capacity. Additionally, cross-lagged effects are also incorporated into SEM to examine causality between fund stages and explain the efficiency and timeliness of CDBG-DR funds.

4.2 Experimental design and model evaluation

The SEM approach is implemented in the following ways: (1) to apply quarterly average ratios or indicators and control variables to cross-sectional SEM to evaluate the overall capacity of state or local governmental

capacity; (2) to use quarterly ratios or indicators and control variables to longitudinal SEM to quantify the change of state or local governmental capacity over time; (3) to use multi-group SEM to compare state or local governmental capacity differences across regions, disaster events, and program types (e.g., housing, administration, infrastructure, and planning programs).

To evaluate SEM performance, this study introduces three fit indices, such as Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Akaike Information Criterion (AIC), to assess how well SEM approach captures the data structure and models the relationships between state or local governmental capacity and disaster recovery program outcomes. Specifically, CFI compares the fit of a target model to a null model, with values greater than 0.96 indicating a good fit. RMSEA measures the fit of a model relative to the sample data, with lower values indicating a better fit. AIC refers to an index of relative model fit, with the preferred model being the one with the lowest AIC value.

4.3 Model interpretation

The outcomes of the cross-sectional SEM will output estimates of latent constructs of governmental capacity, which reflect the overall average capacity of state or local governments to manage CDBG-DR funds across quarters. Additionally, we can compare the differences in state or local governmental capacity and further identify and analyze possible contributing factors to the overall governmental capacity differences.

In contrast, based on the longitudinal SEM, we can estimate an intercept to describe the baseline capacity of state or local governments and a slope to capture the change in governmental capacity over time. Specifically, baseline capacity (the estimated intercept) describes how capable jurisdictions were at the start, while change rate (the estimated slope) assesses whether they are improving or declining in managing CDBG-DR funds. Additionally, we can also estimate path coefficients to indicate how state or local governmental capacity influences disaster recovery program outcomes, as well as possible contributing factors to governmental capacity and its change over time. With this information, we can answer the following question: “Are some jurisdictions improving in capacity over time while others stagnate?”

5 Results

5.1 Empirical comparison of governmental capacity

The 2017 hurricane season – including major events such as Harvey, Irma, and Maria – along with a series of 2018 disaster events such as windstorms, wildfires, drought, flooding, mudslides, and seismic hazards, caused widespread devastation across the United States. These events resulted in substantial infrastructure damage, economic disruption, and loss of life. States like Florida and Texas were among the most severely affected: Florida faced repeated and destructive storms, including Hurricane Irma in 2017 and additional events in 2018, while Texas endured catastrophic impacts from Hurricane Harvey, one of the costliest natural disasters in U.S. history.

Given the scale and complexity of these disasters, examining how governments manage QPR-reported recovery funds offers valuable and representative insights into their capacity to implement disaster recovery programs. Studying and comparing governmental performance in administering these funds across the 2017 and 2018 events helps illuminate strengths, gaps, and variations in recovery management – critical for improving future disaster readiness and response.

5.1.1 Quarterly average ratios of disbursed/obligated and expended/disbursed funds

Figure 2 illustrates substantial variation in how state and local governments managed QPR funds following the 2017 hurricanes. Florida and California exhibit the strongest overall administrative capacity, maintaining the highest Disbursed/Obligated ratios (~0.48-0.50), while Puerto Rico shows the lowest performance at roughly 0.21, indicating slower movement of obligated funds into active disbursement. Texas – GLO and the Virgin Islands fall in the middle range, though still below California and Florida.

Across all governments, the Expended/Disbursed ratio is consistently high – generally between 0.90 and 1.10 – suggesting that once funds are disbursed, they are effectively expended. Florida and Texas – GLO exceed 1.0 on average, reflecting rapid or catch-up expenditure activity, whereas Missouri and the Virgin Islands fall slightly lower but still retain strong expenditure efficiency. In summary, the major differences lie in governments’ ability to convert obligations into disbursements, while expenditure performance after disbursement remains uniformly strong.

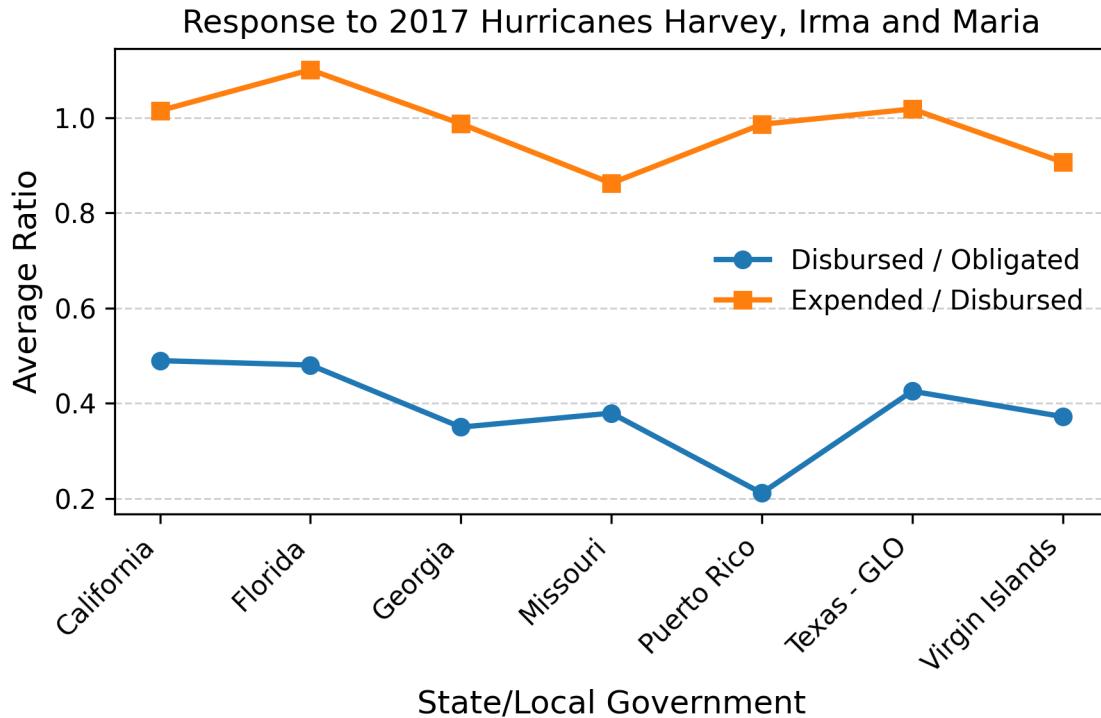


Figure 2: Illustration of quarterly average ratios of disbursed/obligated and expended/disbursed funds across different governments in response to the 2017 Hurricanes.

Figure 3 shows a wide variation in governments’ ability to move funds through the disaster recovery pipeline in 2018. Disbursed/Obligated ratios are generally low, with most governments disbursing less than half of what they obligate. Performance ranges from very limited disbursement in Hawaii County, American Samoa, and California (around 0.1–0.2) to relatively strong performance in North Carolina – NCORR, Wisconsin, and the “rogco” jurisdiction, which approaches or exceeds 0.6-1.0.

In contrast, Expended/Disbursed ratios remain consistently high across governments, indicating that once funds are disbursed, they are efficiently spent. Values hover near or above 1.0 for most jurisdictions, with particularly high ratios in Alaska and rogco (near 2.0), suggesting rapid expenditure relative to disbursement. Overall, governments differ substantially in their ability to convert obligations into disbursements, while their expenditure efficiency after disbursement remains uniformly strong.

Across both years, governments consistently show high Expended/Disbursed ratios, meaning that once funds are released, they are spent efficiently. The key difference lies in Disbursed/Obligated performance: 2017 governments – especially Florida and California – generally disbursed a larger share of obligated funds, while many 2018 governments had much lower disbursement levels, with only a few (e.g., NCORR, rogco) performing strongly. Overall, the main capacity gap in both years is slow disbursement, not expenditure efficiency.

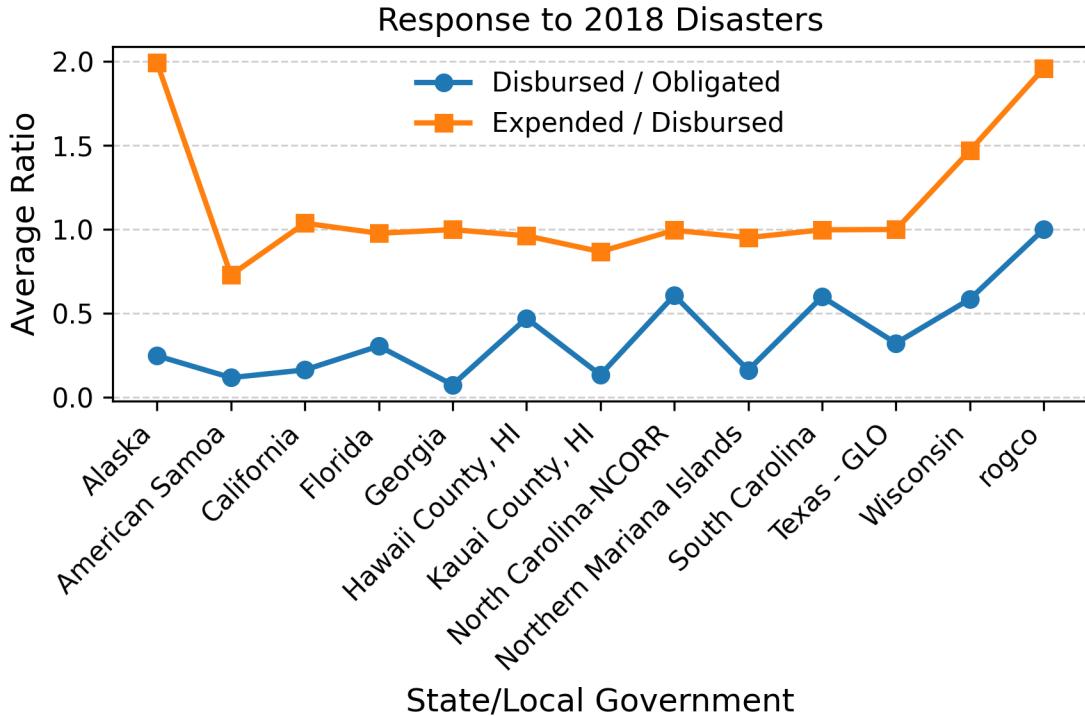


Figure 3: Illustration of quarterly average ratios of disbursed/obligated and expended/disbursed funds across different governments in response to the 2018 disasters.

5.1.2 Quarterly variations in QPR funds across state governments

Based on the findings from 5.1.1, we selected the four common states – California, Florida, Georgia, and Texas – to further compare and analyze QPR-reported quarterly obligated, disbursed, and expended funds in response to both the 2017 Hurricanes and 2018 disasters, offering a more comprehensive understanding of the overall capacity of different state governments to manage QPR funds.

2017 Hurricanes Harvey, Irma, and Maria

The quarterly QPR data reveal distinct funding trajectories across California, Florida, Georgia, and Texas after the 2017 hurricane season, reflecting differences in disaster severity, federal allocation size, and state administrative capacity, as shown in Figure 4.

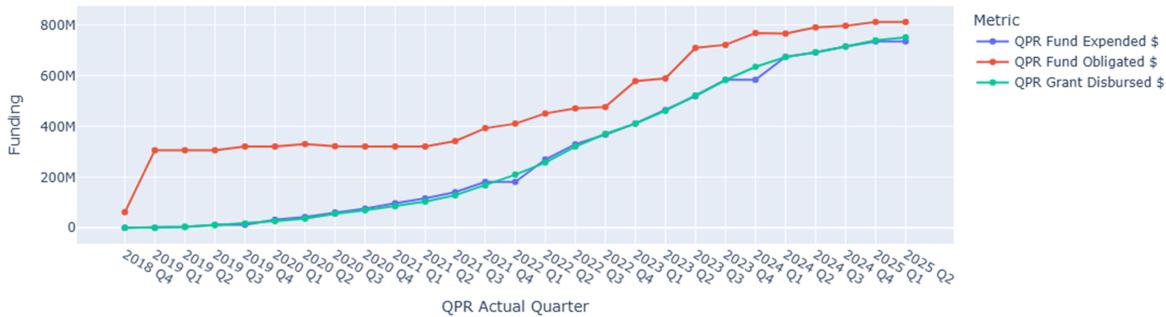
Scale of allocation and initial obligations: Texas and Florida – both heavily impacted by major hurricanes – show the largest and fastest increases in obligated funds, highlighting the scale of damages and the urgency of federal support. For instance, Texas experienced an immediate surge to more than \$4.5 billion in obligations by late 2018, driven by the extensive destruction caused by Hurricane Harvey. Florida recorded a substantial but smaller increase, with obligations exceeding \$300 million early in the recovery period, reflecting the widespread impacts of Hurricane Irma. In contrast, California and Georgia, which received smaller CDBG-DR allocations tied to unmet needs and indirect impacts, show slower, more incremental obligation patterns. Georgia's obligations grow steadily over several years, while California's mid-cycle increase reflects later-awarded mitigation-oriented funds that required program setup before ramping up.

Pace of expenditures and disbursements: Differences in expenditure and disbursement trajectories illustrate how each state structured its programs and sequenced its recovery activities. Texas shows the most sustained and linear upward trend, with expenditures surpassing \$4 billion by 2025 – consistent with long-term housing reconstruction, buyouts, and large infrastructure projects. Florida displays a similar pattern on a smaller scale, driven by ongoing statewide housing recovery initiatives. California records moderate expenditure

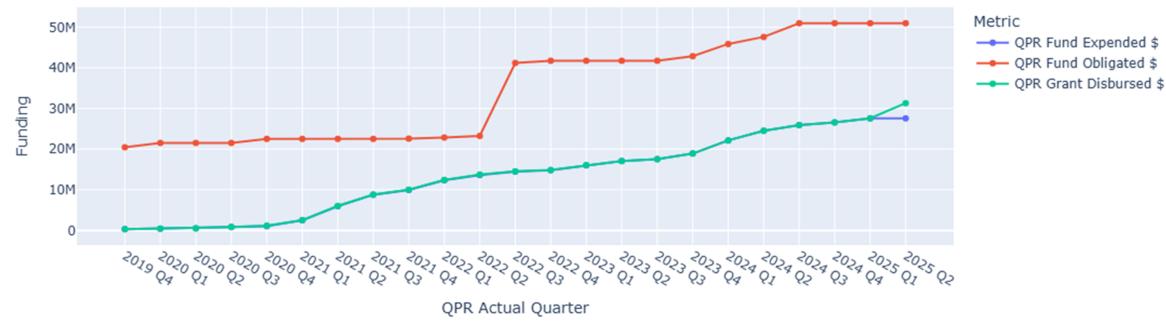
Quarterly Performance Reports: California



Quarterly Performance Reports: Florida



Quarterly Performance Reports: Georgia



Quarterly Performance Reports: Texas - GLO

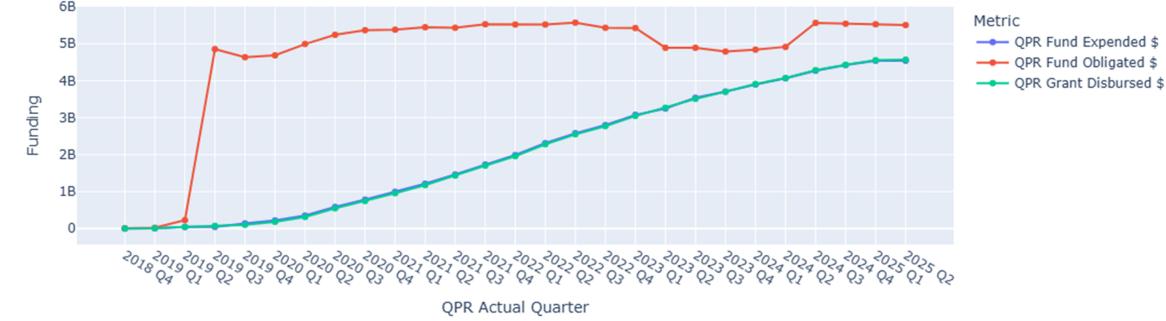


Figure 4: Quarterly variations of QPR funds obligated, disbursed, and expended in California, Florida, Georgia, and Texas in response to the 2017 Hurricane. ¹⁰

growth associated with housing, utility resilience, and mitigation programs. Georgia maintains the smallest but steadily increasing expenditures, reflecting consistent execution within a limited funding envelope.

Relationship between obligations, expenditures, and disbursements: Across all states, expenditures and disbursements move closely together, indicating effective conversion of obligated funds into active projects. However, timing and magnitude differ: Texas shows the largest early gap between obligations and expenditures, aligning with rapid obligation of major program budgets followed by multiyear construction cycles. Florida demonstrates a closer alignment between obligations and expenditures, suggesting more incremental spending and shorter project timelines. California and Georgia display smaller but proportionate spending patterns, consistent with narrower and more targeted program scopes.

Overall, the four-state comparison shows how disaster severity, allocation size, and program design shape financial trajectories in the QPR system. Specifically, Texas emerges as the most rapid and largest allocator of funds, reflecting unprecedented hurricane impacts. Florida follows as a major, though more moderate, recovery case. California and Georgia represent smaller, targeted recovery programs that progressed steadily across the reporting period. Together, these patterns highlight the need to align federal recovery allocations with actual disaster impacts and illustrate the varied administrative timelines states require to translate obligations into measurable recovery outcomes.

2018 Disasters

The quarterly QPR data show how California, Florida, Georgia, and Texas – GLO managed CDBG-DR funds allocated for the 2018 disaster recovery programs, as shown in Figure 5. The trajectories illustrate differences in allocation size, pace of program rollout, and administrative capacity.

Scale of allocation and initial obligations: Obligation levels vary considerably across the four states, reflecting differences in the scale of 2018 disaster impacts and federal allocations. For instance, California shows the largest and most rapid growth in obligations, rising sharply to nearly \$1 billion by late 2024, driven by substantial allocations for wildfire recovery and mitigation. Florida records significant obligations as well, increasing to over \$700 million, reflecting extensive impacts from Hurricanes Michael and other 2018 storms. Georgia exhibits a much smaller obligation footprint, gradually rising to just above \$40 million, consistent with a more limited set of affected areas. Texas – GLO demonstrates moderate but steady obligation growth, reaching approximately \$65 million, corresponding to targeted programs addressing localized 2018 flood and storm damage.

Pace of expenditures and disbursements: The expenditure and disbursement trajectories indicate how each state translated obligated funds into active project spending. Specifically, California shows a steady and gradual rise in both expenditures and disbursements, reflecting multi-year wildfire and mitigation projects that required extended planning before full implementation. Florida demonstrates a stronger and more consistent increase in spending, with expenditures closely tracking obligations – indicative of large-scale housing and infrastructure recovery programs rolling out steadily. Georgia shows modest but continuous growth in expenditures and disbursements, signaling stable progress within a relatively small program. Texas – GLO shows accelerated spending beginning in 2023, with disbursements and expenditures rising in parallel, reflecting the ramp-up of targeted recovery activities.

Relationship between obligations, expenditures, and disbursements: Patterns across the four states highlight varying administrative timelines and program structures. California demonstrates a widening gap between obligations and expenditures after 2023, consistent with the long lead time typical of mitigation and wildfire resilience projects. Florida shows the closest alignment among the three metrics, reflecting incremental obligation practices and relatively rapid conversion of funds into active spending. Georgia maintains proportionate relationships across all metrics, consistent with a narrow program scope and steady implementation pace. Texas – GLO shows an initial lag between obligations and expenditures, followed by stronger convergence as spending accelerates in 2023-2024.

Overall, the four-state comparison demonstrates how differences in disaster scale and program design shaped QPR-reported financial management: California shows the largest and most rapid obligation growth, driven by severe wildfire impacts and significant mitigation investments. Florida represents a major, steadily progressing recovery program with strong alignment between obligations and expenditures. Georgia reflects a small



Figure 5: Quarterly variations of QPR funds obligated, disbursed, and expended in California, Florida, Georgia, and Texas in response to the 2018 disasters

but consistently executed program with proportional spending. Texas – GLO shows a targeted program that gained momentum over time as expenditures increased. Together, these patterns highlight the varied administrative trajectories states follow as they move from federal allocations to on-the-ground recovery outcomes for 2018 disaster events.

5.1.3 Latent constructs of state governmental capacity for 2017 & 2018 disaster recovery programs

Following the SEM structure illustrated in Figure 1, the model incorporating three measures of governmental capacity and three indicators of disaster recovery outcomes – based on data from seven state governments responding to the 2017 Hurricanes Harvey, Irma, and Maria – exhibited poor model fit, as shown in Figure 6. The goodness-of-fit statistics ($CFI = 0.1808$, $RMSEA = 2.1299$, $AIC = -38.5003$) indicate that the specified relationships do not adequately reflect the underlying data structure. Although the estimated paths suggest that higher governmental capacity may be associated with improved recovery outcomes, these results are not reliable. The primary limitation is the extremely small sample size, which introduces substantial estimation uncertainty and constrains the model's ability to generate stable and interpretable parameter estimates.

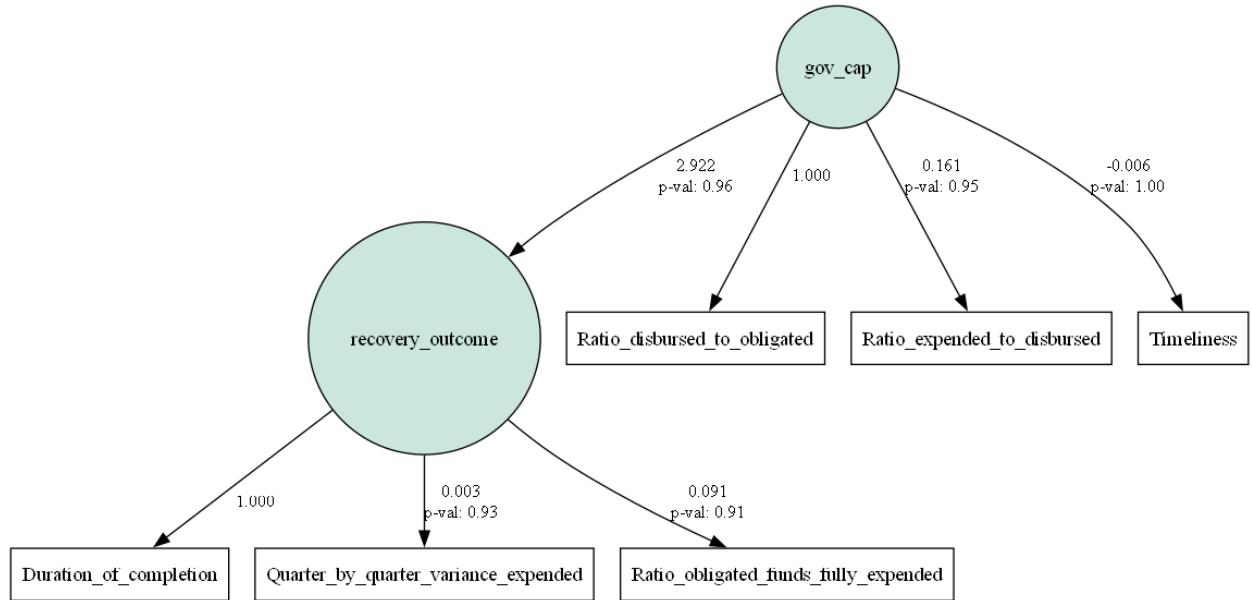


Figure 6: Illustration of SEM outputs of state governmental capacity to manage QPR funds for 2017 Hurricanes Harvey, Irma, and Maria.

As shown in Figure 7, the SEM estimated using data from thirteen state/local governments responding to the 2018 disasters demonstrates a comparatively better statistical fit. The goodness-of-fit indices ($CFI = 0.6201$, $RMSEA = 0.6705$, $AIC = 18.1289$) suggest that the model captures part of the underlying data structure, although it still falls short of conventional thresholds for acceptable fit. Notably, several path coefficients indicate that greater governmental capacity is associated with poorer recovery outcomes – an unexpected result that contradicts theory and practical experience. This counterintuitive pattern is largely attributable to methodological limitations, including the small sample size and the combination of state and local governments within a single model, both of which introduce substantial estimation uncertainty and hinder the generation of stable, meaningful parameter estimates.

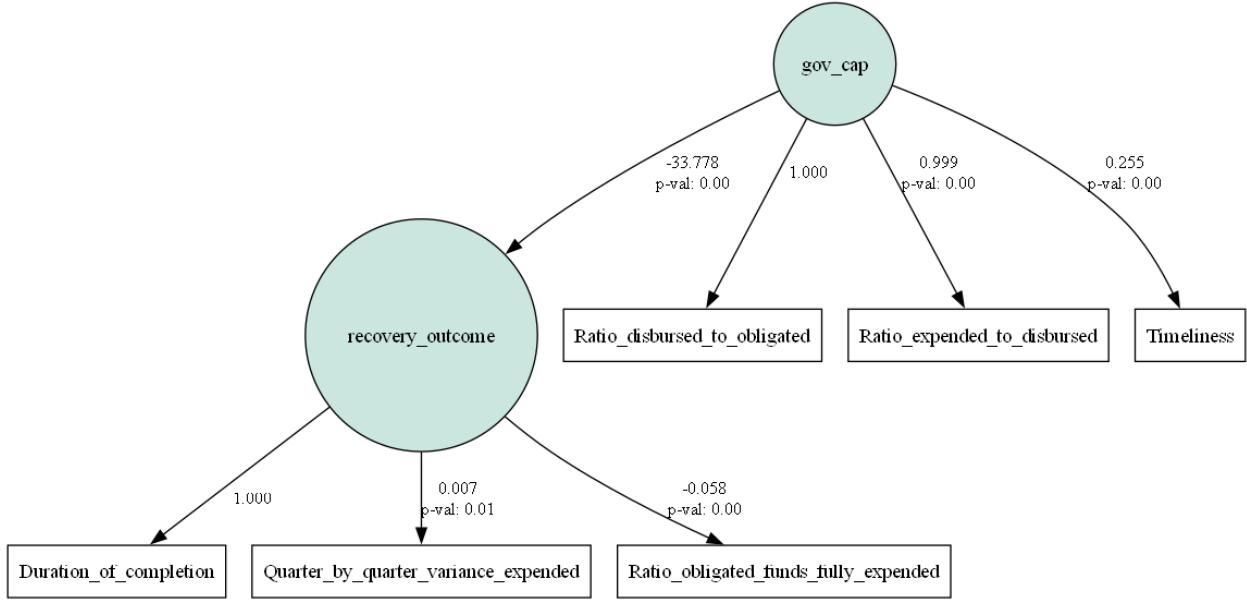


Figure 7: Illustration of SEM outputs of state governmental capacity to manage QPR funds for 2018 Disasters.

5.2 Comparison of overall capacity of state/local governments

5.2.1 Measurements of governmental capacity: Average ratios of QPR fund disbursed/obligated and expended/disbursed

State government:

Figure 8 summarizes how state governments managed QPR funds across disaster events from 2003-2023 using two key indicators of administrative capacity. The Disbursed/Obligated ratio is generally low and clustered between 0.2 and 0.7 for most states, indicating that many governments disburse only a portion of obligated funds each quarter, with wide variation in their ability to convert obligations into actionable spending. In contrast, the Expended/Disbursed ratio is consistently high – typically between 0.8 and 1.5 – showing that once funds are disbursed, most states are effective at expending them. A few extreme values, such as Mississippi’s unusually high expenditure ratio, reflect irregular reporting or one-time spending spikes rather than sustained performance. Overall, the figure demonstrates that the primary capacity challenge for state governments lies in timely disbursement, while their expenditure efficiency after disbursement remains strong across nearly all jurisdictions.

Local government:

Figure 9 presents two key indicators of local governmental capacity in managing QPR funds across disaster events from 2003-2023. Overall, local governments exhibit low and tightly clustered Disbursed/Obligated ratios, typically below 0.5, indicating that most jurisdictions disburse only a modest share of obligated funds each quarter. In contrast, Expended/Disbursed ratios are consistently high, generally falling between 0.8 and 1.5, suggesting strong expenditure efficiency once funds are disbursed. Several extreme spikes – for example in Detroit (MI) and San Marcos (TX) – reflect irregular reporting or one-time expenditure surges rather than sustained performance patterns.

Compared with state governments, local governments show even lower disbursement capacity but similarly strong expenditure performance. This contrast highlights a systematic pattern: both state and local governments are effective at spending funds after disbursement, but local jurisdictions face greater challenges in moving obligated dollars into active use, likely due to more limited administrative resources, staffing, and program management capacity.

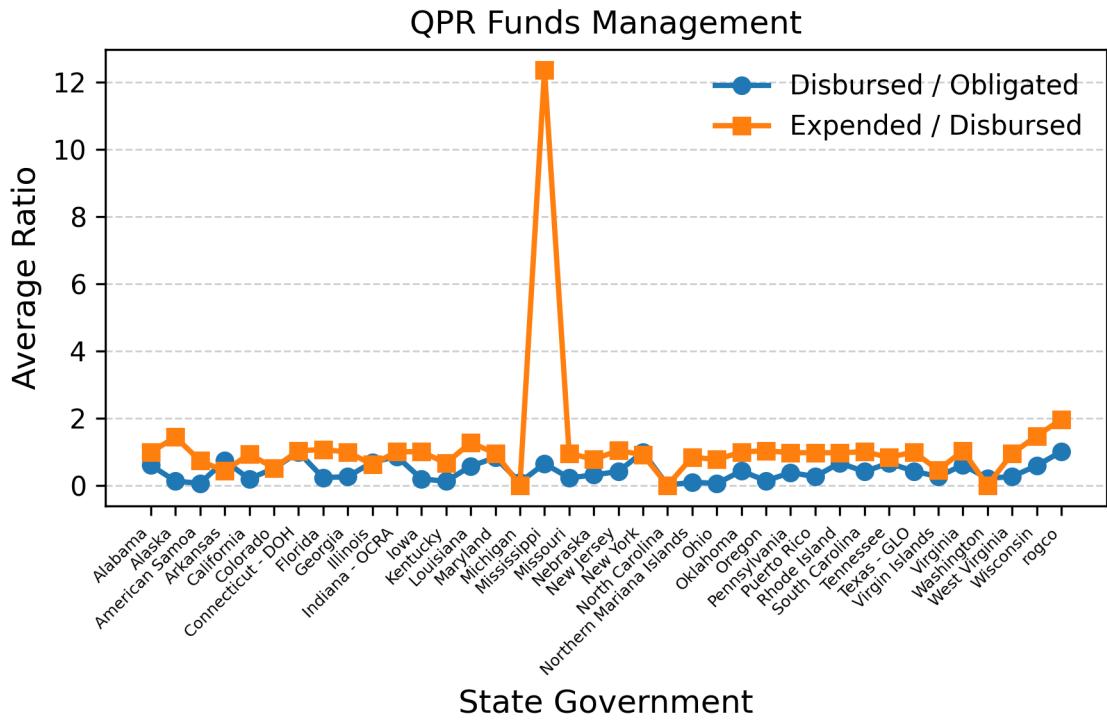


Figure 8: Illustration of quarterly average ratios of disbursed/obligated and expended/disbursed funds across different state governments and 2003-2023 disaster events.

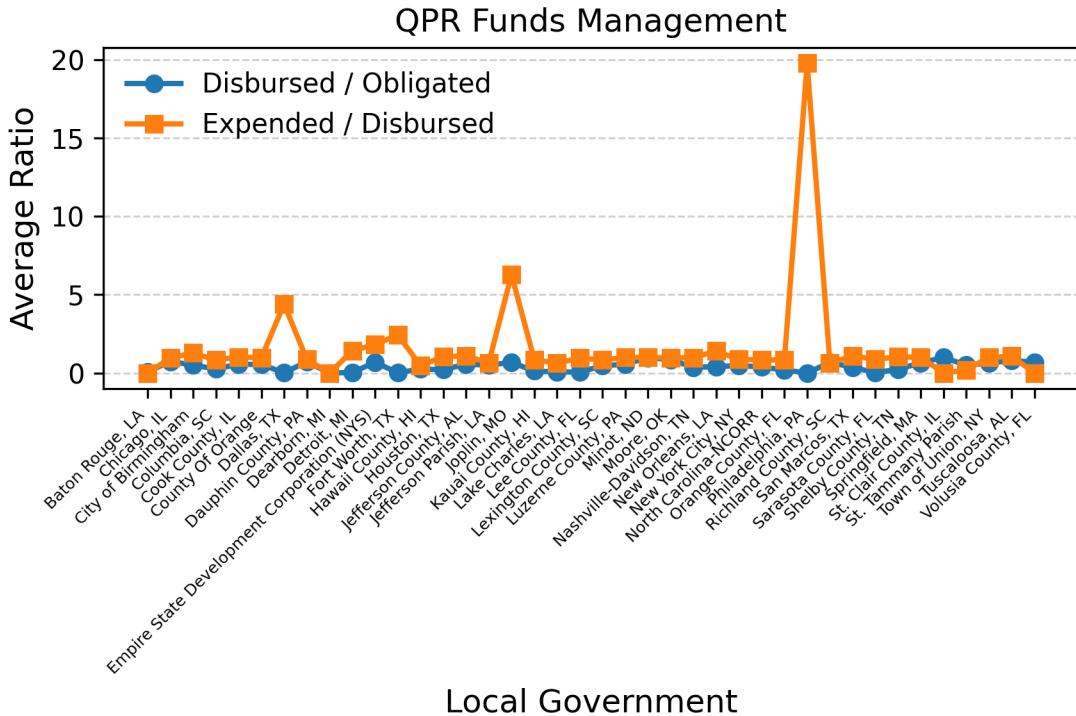


Figure 9: Illustration of quarterly average ratios of disbursed/obligated and expended/disbursed funds across different local governments and 2003-2023 disaster events.

5.2.2 Latent constructs of governmental capacity: Cross-sectional SEM

State government:

As shown in Figure 10, the SEM estimated using data from 38 state governments responding to disasters between 2003 and 2023 demonstrates a considerably stronger model fit compared with earlier models. The goodness-of-fit indices ($CFI = 0.8602$, $RMSEA = 0.3141$, $AIC = 24.0418$) indicate that the specified relationships capture much of the underlying data structure and meaningfully reflect how state governments manage QPR funds.

The path estimates reveal a positive and statistically significant relationship between state governmental capacity and overall recovery outcomes ($\beta = 71.024$, $p = 0.01$). This suggests that states with stronger administrative capacity – measured through their ability to disburse, expend, and timely process QPR funds – tend to achieve more favorable recovery performance. Although not all individual capacity indicators load equally onto the latent construct (e.g., timeliness and expended/disbursed show weaker contributions), the model still identifies a coherent underlying dimension of administrative effectiveness.

On the outcome side, the latent recovery construct is shaped by multiple program performance indicators, including duration of completion, quarter-to-quarter expenditure stability, and the share of fully expended obligated funds. The significant loading on the latter ($\beta = 0.017$, $p = 0.00$) indicates that effective and full expenditure of obligated funds is a key driver of stronger recovery outcomes.

Taken together, the SEM supports the interpretation that states with higher capacity – those able to move funds efficiently through the stages of obligation, disbursement, and expenditure – tend to implement recovery programs more effectively. Although some relationships remain modest or statistically weak, the overall model suggests that administrative capacity is an important structural determinant of disaster recovery performance at the state level.

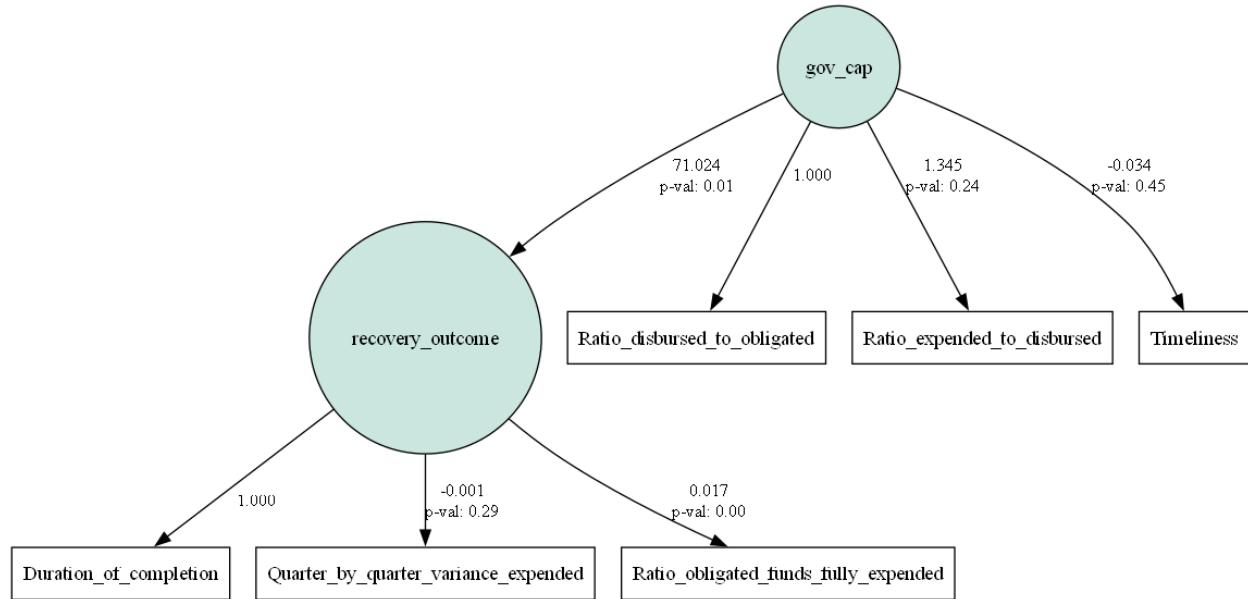


Figure 10: Illustration of SEM outputs of state governmental capacity to manage QPR funds across 2003-2023 disaster events.

Local government:

As shown in Figure 11, the SEM estimated using data from 40 local governments responding to disasters between 2003 and 2023 demonstrates a moderately strong model fit. The goodness-of-fit indices ($CFI = 0.7847$, $RMSEA = 0.3027$, $AIC = 24.1708$) indicate that the specified relationships capture much of the underlying data structure, though not as robustly as the state-level model.

The estimated paths suggest that local governmental capacity has a positive and statistically significant effect on disaster recovery outcomes ($\beta = 223.685$, $p = 0.00$). This indicates that local jurisdictions with greater administrative capacity – measured through fund disbursement, expenditure patterns, and timeliness – tend to achieve better program performance. Among the observed indicators, timeliness loads strongly and significantly onto local capacity, suggesting that procedural efficiency plays a more central role for local governments than for state governments. At the same time, the expended/disbursed ratio shows a weaker contribution, reflecting the high expenditure efficiency observed across most local jurisdictions and therefore offering less discriminatory power in measuring capacity.

On the recovery side, the latent recovery outcome variable is shaped by indicators such as duration of completion, quarter-to-quarter expenditure stability, and the proportion of fully expended obligated funds, with the latter showing a significant positive loading ($\beta = 0.008$, $p = 0.00$). This suggests that local governments demonstrating consistent follow-through in spending obligated funds tend to achieve stronger recovery outcomes.

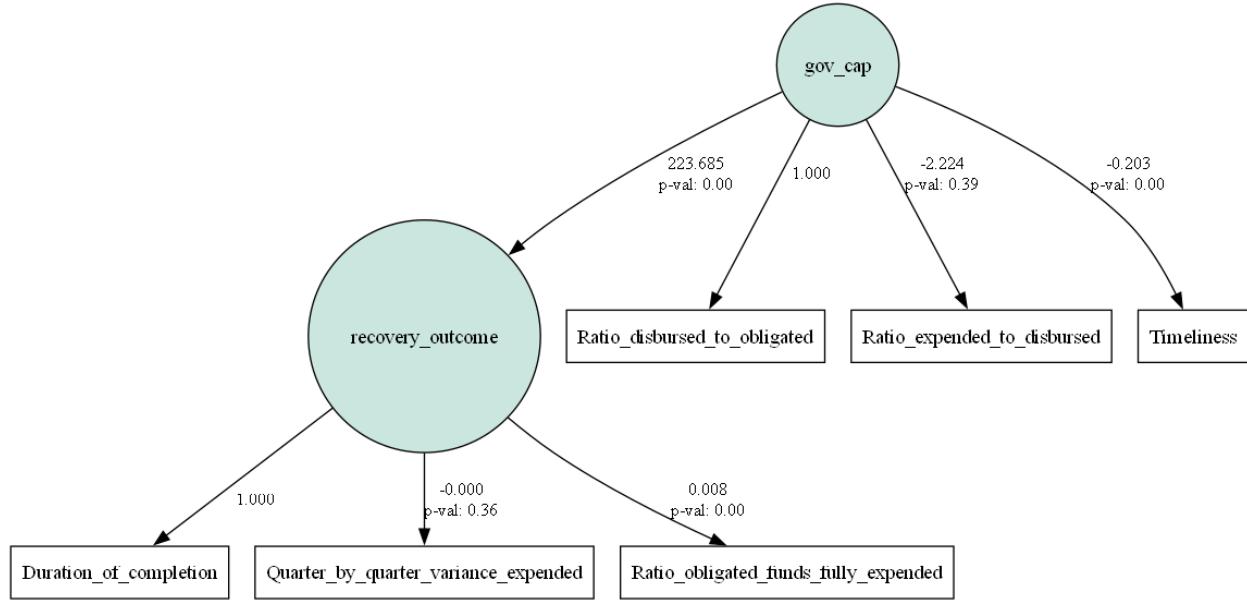


Figure 11: Illustration of SEM outputs of local governmental capacity to manage QPR funds across 2003-2023 disaster events.

When compared with the state-level SEM, two differences emerge clearly. First, the magnitude of the capacity effect is substantially larger for local governments, implying that variations in administrative capability play an even more decisive role at the local level, where staffing, expertise, and program management resources are often more constrained. Second, state models exhibit more balanced contributions across capacity indicators, whereas the local model places greater weight on timeliness and procedural efficiency – core bottlenecks in local program implementation.

Overall, the SEM results indicate that while both state and local governments benefit from higher administrative capacity, the sensitivity of recovery outcomes to capacity constraints is greater at the local level. This highlights the importance of sustained technical assistance, staffing support, and administrative investment for local governments managing complex, long-term federal recovery programs.

5.2.3 Latent constructs of governmental capacity: Cross-sectional SEM without duration of completion

Because timeliness, an indicator of governmental capacity, is strongly correlated with duration of completion, an outcome measure, we removed duration of completion from the SEM to reduce multicollinearity and improve the robustness of the model. This adjustment allows for a clearer separation between the latent

constructs of capacity and recovery performance, and it also serves as a sensitivity test for the stability of the state- and local-level results.

State government:

As shown in Figure 12, the revised SEM – estimated using data from 38 state governments responding to disasters between 2003 and 2023 – exhibits improved model fit. The goodness-of-fit indices ($CFI = 0.8470$, $RMSEA = 0.2531$, $AIC = 21.2906$) indicate that the simplified structure captures most of the underlying data patterns and performs better than the full model that included duration of completion.

Importantly, the path estimates reveal that state governmental capacity continues to have a positive and statistically significant effect on recovery outcomes even after removing the completion-time measure. The disbursed/obligated ratio remains the strongest contributor to the capacity construct and significantly predicts better recovery performance ($\beta = 1.235$, $p = 0.01$). This underscores that, for state governments, the ability to convert obligated funds into disbursed funds is a critical driver of overall program success. Other measures – such as expended/disbursed and timeliness – still load onto the capacity construct, but with weaker influence, reflecting less variation across states in later stages of fund expenditure.

Comparing the SEM results with and without duration of completion highlights several meaningful differences. In the original model, duration of completion played a substantial role in defining recovery outcomes, and its strong correlation with timeliness risked overstating the influence of administrative speed. In the revised model, recovery outcomes are driven primarily by expenditure consistency and the proportion of obligated funds fully expended, both of which remain conceptually and empirically distinct from capacity indicators. The persistence of significant relationships in the reduced model shows that state-level capacity effects are stable and not dependent on the inclusion of project completion times.

Overall, the sensitivity analysis demonstrates that state governmental capacity is strongly tied to financial throughput rather than project duration, and that removing duration of completion strengthens the clarity and reliability of the model. This contrasts with local governments – where recovery performance is more dependent on timeliness and completion speed – highlighting a fundamental difference in how administrative capacity shapes outcomes across levels of government.

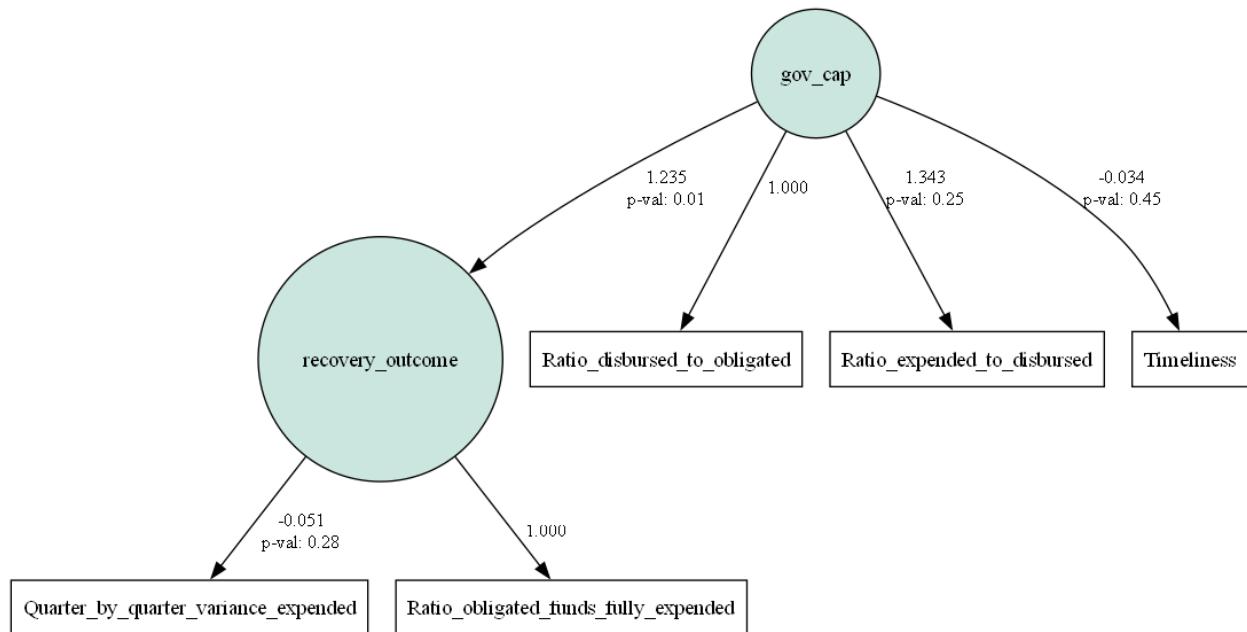


Figure 12: Illustration of SEM outputs of state governmental capacity to manage QPR funds across 2003-2023 disaster events.

Local government:

As shown in Figure 13, the SEM estimated using data from 40 local governments – after removing duration of completion from the recovery outcome construct – produces a moderately improved statistical fit. The goodness-of-fit indices ($CFI = 0.5295$, $RMSEA = 0.6601$, $AIC = 18.4010$) indicate that although the model does not meet conventional fit thresholds, it captures a meaningful portion of the underlying data structure and performs worse than the full model that included duration of completion. Removing this indicator helps reduce multicollinearity with timeliness, one of the capacity measures, and increases the interpretability of the local-level SEM results.

The path coefficients reveal a nuanced relationship between local governmental capacity and disaster recovery outcomes. Local capacity, defined by disbursement efficiency, expenditure efficiency, and timeliness, shows a statistically significant and positive association with recovery performance through the ratio of disbursed to obligated funds ($= 1.199$, $p = 0.00$). This reinforces that local jurisdictions with stronger administrative ability to move funds early in the grant cycle tend to achieve better program outcomes. However, the expended-to-disbursed ratio and timeliness show weaker or marginal contributions to the capacity construct ($p = 0.14$ and $p = 0.05$), reflecting wide variability in local administrative processes and the greater operational constraints faced by local governments.

On the recovery side, indicators such as quarter-to-quarter expenditure stability and the share of fully expended obligated funds remain central to defining recovery outcomes, with the latter demonstrating a strong and stable loading across model specifications. This suggests that consistent follow-through in spending obligated funds is a primary marker of successful local recovery performance.

Comparing the SEM results with vs. without duration of completion highlights an important shift: In the full model, duration of completion strongly influenced the recovery construct, and its high correlation with timeliness risked inflating the apparent role of administrative speed. In the reduced model, the influence of timeliness weakens, indicating that local recovery outcomes are shaped more by how effectively funds are expended, rather than by project-completion timelines alone.

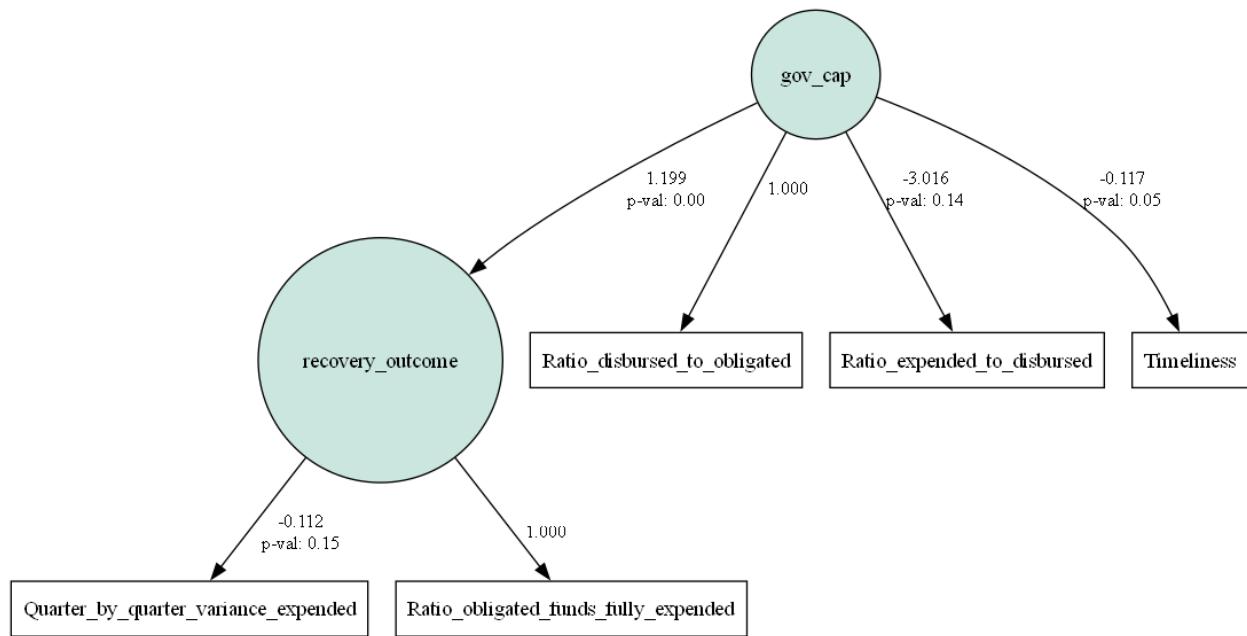


Figure 13: Illustration of SEM outputs of local governmental capacity to manage QPR funds across 2003-2023 disaster events.

When contrasted with state-level SEM results, additional differences emerge. State governments show a stronger and more stable relationship between capacity and recovery outcomes, even after removing duration of completion. State capacity is driven largely by financial throughput – especially disbursement efficiency – and the effects remain significant and consistent across sensitivity tests. By contrast, local governments

exhibit greater sensitivity to model specification: their capacity-outcome relationship is more fragile and heavily shaped by variability in timeliness and expenditure behavior.

Overall, the SEM results indicate that while both state and local governments benefit from stronger administrative capacity, local governments face greater operational constraints and exhibit less stable capacity-outcome relationships when project duration is removed. This underscores the need for targeted administrative support at the local level, where limited staffing and procedural complexity can pose persistent barriers to effective disaster recovery program management.

5.3 Evolution of state/local governmental capacity: Longitudinal SEM

6 Discussion

7 Conclusions

This study developed a Structural Equation Modeling (SEM) framework to measure and quantify governmental capacity as a latent construct. Use the model to compare differences in capacity across local and state governments, identify potential structural or contextual factors driving these differences, and offer evidence-based recommendations to improve governmental capacity for future climate-related risks and disasters.

8 References

- Cutter, S. L., Ash, K. D., & Emrich, C. T. (2019). Urban–rural differences in disaster resilience. *Annals of the American Association of Geographers*, 109(5), 1237–1252. <https://doi.org/10.1080/24694452.2018.1535887>
- Enterprise Community Partners. (2024). *Federal recovery funds temper rent increases after disaster*. Enterprise Community Partners. <https://enterprisecommunity.org>
- Geddam, S. M., Garg, P., & Tyagi, A. (2024). Enhancing disaster management effectiveness: A structural equation modeling approach. *International Journal of Disaster Risk Reduction*, 99, 104123. <https://doi.org/10.1016/j.ijdrr.2023.104123>
- Gerber, B. J., & Robinson, S. E. (2022). Local government capacity and disaster resilience: The role of institutional arrangements and administrative resources. *Public Administration Review*, 82(2), 340–352. <https://doi.org/10.1111/puar.13449>
- Howell, J., & Elliott, J. R. (2019). As disaster costs rise, so does inequality: Social disparities in spending after Hurricane Harvey. *Social Problems*, 66(3), 448–467. <https://doi.org/10.1093/socpro/spy016>
- HUD. (2020). *CDBG-DR: Performance measurement and reporting guidance*. U.S. Department of Housing and Urban Development.
- HUD Office of Inspector General. (2021). *HUD did not adequately oversee Community Development Block Grant–Disaster Recovery grantees*. Office of Inspector General, U.S. Department of Housing and Urban Development.
- Pipa, A. (2020). *Reforming disaster recovery funding: A framework for an effective and equitable federal approach*. Brookings Institution.
- Peacock, W. G., Van Zandt, S., & Zhang, Y. (2022). Inequitable housing recovery? Evidence from disaster housing assistance programs in the United States. *Natural Hazards Review*, 23(4), 04022029. [https://doi.org/10.1061/\(ASCE\)NH.1527-6996.0000562](https://doi.org/10.1061/(ASCE)NH.1527-6996.0000562)
- Smith, G., & Martin, A. (2021). Barriers to post-disaster housing recovery: Procurement, permitting, and administrative constraints. *Journal of the American Planning Association*, 87(3), 345–359. <https://doi.org/10.1080/01944363.2020.1857071>

U.S. Government Accountability Office. (2019). *Disaster recovery: Better monitoring of CDBG-DR grants is needed to ensure program effectiveness* (GAO-19-232). U.S. Government Accountability Office.

Zhang, Y., & Peacock, W. G. (2019). Planning for post-disaster recovery and reconstruction. In H. Rodríguez, A. Trainor, & E. L. Quarantelli (Eds.), *Handbook of disaster research* (2nd ed., pp. 373–393). Springer.
https://doi.org/10.1007/978-3-319-63254-4_20