The economic impact of the 2008 floods in Santa Catarina, Brazil: A municipality-level Difference-in-Differences analysis

Author : Natali Beatriz Kreuz Bertuol
Thesis Director : William Parienté
Thesis Reader : Giovanna D'Adda
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and
Dottore magistrale in Economics and Political Science (UNIMI)

Université catholique de Louvain - Economics School of Louvain - Place Montesquieu 3, 1348 Louvain-La-Neuve
Université de Namur – Economics School of Namur – Rempart de la Vierge 8, 5000 Namur
Università degli Studi di Milano • Via Festa del perdono 7 • 20122 Milano / Italy

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Abstract

This thesis examines how official disaster classifications influence municipal economic outcomes using the 2008 floods in Santa Catarina, Brazil, as a natural experiment. I employ a difference-in-differences framework comparing 75 affected municipalities against 218 unaffected controls over 2005-2013, analysing seven economic indicators including GDP, sectoral value added, and fiscal measures. The analysis distinguishes between graduated disaster classifications: 14 municipalities received "public calamity" status (most severe) and 61 received "emergency status" (moderate severity).

The results challenge conventional assumptions about disaster impacts on local economies. Rather than persistent negative effects, affected municipalities experienced substantial positive economic impacts that strengthened over time. By 2013, all affected municipalities showed GDP gains of R$504.4 million annually (significant at 1% level), with public calamity municipalities achieving even larger effects of R$769.4 million (significant at the 10% level). Emergency status municipalities demonstrated more modest but positive gains of R$369.1 million (significant at 5% level), confirming a graduated institutional response pattern. Sectorally, agriculture experienced persistent negative effects (-R$3.5 million by 2013), while industry (+R$129.6 million) and services (+R$167.9 million) showed strong positive responses, suggesting disaster classifications accelerated structural economic transformation.

Robustness checks, including fixed effects specifications, logarithmic transformations, event studies, and matching estimators, generally confirm these findings. However, placebo tests reveal significant pre-treatment differences between affected and unaffected municipalities, raising concerns about parallel trends assumptions. The event study shows convergence patterns in pre-disaster years but cannot fully address identification concerns. Matching estimators produce consistent results for the full sample but fail for the smaller public calamity group due to sample size limitations.

These findings provide evidence that effective institutional disaster responses can transform crises into development opportunities, with response intensity directly correlating with economic recovery trajectories. The results have important implications for disaster management policy design, particularly highlighting concerning distributional effects favouring metropolitan areas over rural communities. While methodological limitations require cautious interpretation of causal claims, the analysis documents strong correlations between institutional disaster classifications and subsequent economic outcomes that merit serious consideration for policy design in developing countries facing increasing climate risks.

Introduction

Natural disasters pose increasing threats to economic development worldwide, with climate change intensifying the frequency and severity of extreme weather events. While the immediate destruction caused by disasters is well-documented, their long-term economic consequences remain poorly understood, particularly regarding how institutional responses shape recovery trajectories. The conventional wisdom suggests that disasters impose persistent negative effects on affected economies (Hsiang and Jina, 2014), yet this perspective overlooks the potential for institutional responses to transform disaster exposure into development opportunities through targeted interventions and capacity building.

This thesis contributes to three distinct literatures by demonstrating how institutional quality mediates disaster impacts rather than focusing solely on physical damages. First, it extends disaster economics research by challenging findings of persistent negative effects (Hsiang and Jina, 2014; Strobl, 2011) and revealing how effective institutional frameworks can generate positive economic outcomes through targeted interventions. Second, it provides new evidence on fiscal federalism in developing countries by examining how federal emergency transfers interact with local institutional capacity, complementing studies on disaster aid effectiveness (Deryugina, 2017; Boustan et al., 2012). Third, it contributes to the vulnerability literature by offering quantitative evidence on how institutional adaptive capacity shapes disaster outcomes, supporting theoretical frameworks developed by Wisner et al. (2004) and Turner et al. (2003) while contrasting with studies finding minimal growth effects (Cavallo et al., 2013).

This thesis examines a fundamental question in disaster economics: how do official disaster classifications influence municipal economic outcomes? Using the catastrophic flooding that struck Santa Catarina, Brazil, in November 2008 as a natural experiment, I analyse the causal impact of institutional disaster responses on local economic performance. The 2008 floods affected over 60 municipalities, caused damages exceeding R$4.75 billion, and triggered the largest federal emergency response in Brazil's recent history. Crucially, the Government of Santa Catarina classified affected municipalities into graduated categories, "estado de emergência" (emergency status) and "estado de calamidade pública" (public calamity), which determined eligibility for federal transfers, reconstruction programs, and policy support.

The Brazilian context provides an ideal setting for this analysis due to several institutional features. The federal disaster management system employs formal classification criteria based on objective damage assessments, reducing concerns about endogenous treatment assignment. The substantial variation in federal support across classification levels creates natural variation in institutional response intensity. Brazil's comprehensive municipal economic data system enables precise measurement of economic outcomes across multiple sectors and periods, while the concentration of affected areas within a single state ensures institutional homogeneity while providing sufficient control for municipalities.

The empirical strategy employs a difference-in-differences framework comparing economic outcomes in affected versus unaffected municipalities before and after the 2008 floods. This approach leverages the quasi-experimental nature of disaster occurrence while controlling for time-invariant municipal characteristics and common temporal trends. To capture heterogeneous effects by disaster severity, I construct three treatment groups: all 75 affected municipalities, the 14 public calamity municipalities, and the 61 emergency status municipalities. The analysis examines seven economic outcomes over 2005-2013, including GDP, sectoral value added, and fiscal indicators.

The main findings challenge conventional assumptions about disaster impacts on local economies. Rather than observing persistent negative effects, the results reveal substantial positive impacts that strengthen over time. By 2013, affected municipalities show GDP gains exceeding R$500 million annually, with the most severely affected areas achieving gains approaching R$800 million. These effects are driven primarily by expansion in services, industry, and public administration, while agriculture experiences persistent declines, suggesting that disaster classifications accelerated structural economic transformation. Critically, the analysis reveals a graduated response pattern where institutional response intensity correlates directly with economic outcomes, providing compelling evidence for the institutional mechanisms underlying observed impacts.

However, placebo tests reveal significant pre-treatment differences between affected and unaffected municipalities, raising concerns about the parallel trends assumption underlying the identification strategy. While the balance of evidence suggests that institutional responses played an important role in driving positive outcomes, the results should be interpreted as documenting strong correlations rather than definitive causal effects. The analysis that follows builds systematically from theoretical foundations to empirical evidence, leveraging newly constructed municipal data to demonstrate how official disaster classifications create measurable economic transformations that persist for years beyond initial recovery efforts, revealing a fundamental reimagining of how institutional responses can shape economic trajectories in the aftermath of climate disasters.

Literature Review

Understanding the economic consequences of natural disasters requires anchoring the analysis in a multidimensional framework that incorporates both vulnerability theory and the institutional architecture of risk governance. The disaster economics literature reveals fundamental disagreements about whether disasters impose persistent costs or can generate development opportunities, with methodological approaches and institutional contexts driving divergent conclusions.

The theoretical foundation for disaster impact analysis centres on two competing paradigms. The vulnerability approach, pioneered by Wisner et al. (2004) in their seminal work "At Risk," conceptualises disasters as the intersection of natural hazards and social processes that produce "unsafe conditions." This framework shifts focus away from hazards themselves toward underlying patterns of marginalisation and governance capacity. In contrast to deterministic damage-focused models, Wisner et al.'s Pressure and Release (PAR) model emphasises how institutional adaptive capacity mediates disaster outcomes through three levels of causation: root causes, dynamic pressures, and unsafe conditions. Building on this foundation, Turner et al. (2003) developed a more sophisticated framework emphasising coupled human-environment systems, incorporating exposure, sensitivity, and adaptive capacity as core components. While these theoretical advances highlight the importance of institutional responses, they lack the quantitative empirical foundation needed to inform policy design.

The empirical disaster economics literature presents sharply conflicting findings about long-term economic impacts. Hsiang and Jina (2014) employ a difference-in-differences framework across multiple countries from 1950-2008, finding that cyclone exposure leads to persistent 3.6% declines in per capita income growth lasting up to 20 years. Their finding that disasters have permanent rather than temporary effects challenges conventional wisdom about economic recovery. Similarly, Strobl (2011) documents significant short-term negative effects from hurricanes on US regional economic growth, though these effects dissipate over time. These studies suggest that disasters impose substantial and lasting economic costs that compound over decades.

However, other researchers reach markedly different conclusions. Cavallo et al. (2013) use synthetic control methods to estimate disaster impacts on economic growth, finding that most disasters do not significantly affect growth except when they trigger political instability. This contradicts the persistent negative effects documented by Hsiang and Jina, suggesting that methodological choices and institutional contexts critically influence findings. The divergence between these studies highlights a fundamental gap: while the literature establishes that disasters can have heterogeneous effects, systematic evidence on how institutional responses mediate these outcomes remains limited.

The methodological literature reveals additional tensions between different approaches to identifying causal effects. Recent advances have moved beyond simple damage accounting toward more sophisticated econometric strategies. Deryugina (2017) exploits variation in federal disaster declarations in the United States, finding that federal transfers significantly boost local economic activity while potentially creating moral hazard problems. Her focus on institutional responses rather than physical damages represents a crucial methodological advance, demonstrating how policy interventions can transform disaster exposure into economic stimulus. Similarly, Boustan et al. (2012) use historical data to examine long-term effects on population and economic development, finding that disasters can have lasting effects on the spatial distribution of economic activity, but that federal aid can influence migration patterns and development trajectories.

Unlike these studies that focus primarily on developed country contexts with established institutions, research on disaster impacts in developing countries remains limited and methodologically constrained. Cavallo and Noy (2011) provide cross-country evidence that developing countries experience more severe and persistent consequences from disasters, reflecting both greater vulnerability and limited adaptive capacity. However, their cross-country approach cannot capture the within-country institutional variation that may drive heterogeneous outcomes. This limitation is particularly problematic for understanding how graduated institutional responses influence recovery trajectories within federal systems.

The Brazilian disaster management literature highlights these institutional complexities while revealing critical empirical gaps. The evolution of Brazil's disaster policy framework reflects both international influences and domestic learning processes. The Política Nacional de Defesa Civil (PNDC), established in 2007, and the Plano Nacional de Gestão de Riscos e Resposta a Desastres (PNGRD), published in 2012, formalize criteria for declaring emergency and public calamity status, determining eligibility for federal transfers and legal exemptions. However, as Almeida and Pascoalino (2012) document, Brazil's system remains largely reactive, with systematic underinvestment in preventative infrastructure and limited coordination between civil defence and development planning. Valencio (2009) describes this as a "culture of disaster" where events are treated as exceptional rather than products of ongoing social processes.

While these qualitative assessments provide important institutional context, they lack the quantitative rigour needed to understand how formal classification mechanisms influence economic outcomes. Guimarães (2012) analyses policy learning processes following the 2008 Santa Catarina floods, highlighting coordination bottlenecks and delays in fund disbursement, but cannot quantify the medium- or long-term economic effects of these interventions. This represents a critical gap: despite extensive descriptive analysis of Brazil's disaster management institutions, causal evidence on how these systems influence municipal economic trajectories remains absent.

The 2008 Santa Catarina floods provide an ideal case for addressing these empirical gaps. The disaster affected over 60 municipalities, caused damages exceeding R$4.75 billion, and triggered Brazil's largest federal emergency response. Crucially, the Government of Santa Catarina classified affected municipalities into graduated categories (emergency status and public calamity) that determined access to federal resources. Unlike previous studies that treat disaster exposure as binary, this graduated classification system provides natural variation in institutional response intensity within a single institutional context.

The climatic and geographic context reinforces the exogeneity of treatment assignment. Murara et al. (2019) document increasing extreme precipitation events in the Itajaí Valley, with the 2008 event representing approximately a 100-year return period. The disaster resulted from a quasi-stationary frontal system producing over 500mm of rainfall within 72 hours, with damage severity largely determined by topographic factors beyond municipal control. The Itajaí Valley's steep slopes and narrow floodplains create natural conditions for flash flooding, while the concentration of economic activity, including the port handling 13% of Brazil's containerised cargo, amplifies economic disruption.

This thesis addresses the critical gap between theoretical understanding of institutional mediation and empirical evidence on economic outcomes. Unlike previous damage-focused studies (Hsiang and Jina, 2014; Strobl, 2011) that assume uniform negative effects, this analysis examines how graduated institutional responses influence economic trajectories. Unlike cross-country studies (Cavallo et al., 2013) that cannot capture within-country institutional variation, this research exploits variation in classification levels within a single federal system. Unlike qualitative assessments of Brazilian disaster policy (Almeida and Pascoalino, 2012; Valencio, 2009), this study provides quantitative evidence on how formal classification mechanisms influence municipal economic outcomes.

The approach builds on Deryugina's (2017) focus on institutional responses rather than physical damages but extends this framework to examine graduated response systems in developing country contexts. While Deryugina finds positive effects from federal disaster aid in the United States, the institutional context and economic structure of developing countries may produce different outcomes. By examining how classification intensity correlates with economic recovery trajectories, this analysis provides evidence on whether effective institutional frameworks can transform disaster exposure into development opportunities, as theorised by vulnerability scholars (Wisner et al., 2004; Turner et al., 2003).

This analysis contributes systematic evidence on institutional disaster responses in developing countries, filling an empirical void that is increasingly critical for climate adaptation and policy design. The graduated nature of Brazil's classification system provides unique leverage for understanding how institutional response intensity influences economic outcomes, offering insights that extend beyond single-country studies while maintaining the institutional homogeneity needed for credible causal identification. The evidence that follows demonstrates how official disaster classifications create measurable economic transformations that persist for years beyond initial recovery efforts, fundamentally challenging assumptions about disaster impacts while highlighting the potential for institutional innovation in climate adaptation.

Data and Methodology

This empirical analysis uses a newly constructed panel dataset covering all 293 municipalities in Santa Catarina state over the period 2005-2013. The primary data source is the Brazilian Institute of Geography and Statistics (IBGE), which provides detailed economic and demographic information at the municipal level. While IBGE's GDP series begins in 1996, I restrict the observation window to 2005-2013 to ensure consistent data availability across all variables and maintain a balanced panel with sufficient pre- and post-disaster observations for credible causal inference.

Economic data come from IBGE's Produto Interno Bruto dos Municípios database, which reports municipal GDP and value added by sector (agriculture, industry, services, and public administration), along with net taxes on products. Demographic estimates are retrieved from IBGE's SIDRA system. All monetary values are expressed in nominal Brazilian reais, and population figures correspond to official annual estimates. I manually computed GDP per capita for 2005-2009 by dividing GDP by annual population, as IBGE only reports this indicator directly for later years. During this process, some inconsistencies in the 2007 series were corrected by interpolating GDP per capita using the average of 2006 and 2008 values. Two municipalities with incomplete data were excluded, resulting in a final balanced panel of 293 municipalities observed for nine consecutive years.

The identification strategy exploits the catastrophic flooding that hit Santa Catarina in November 2008 as an exogenous shock to municipal economies. This climate disaster caused significant infrastructure damage and economic disruption across the state, with flood severity largely determined by geographic and meteorological factors beyond municipal control. The Government of Santa Catarina, supported by the World Bank's Post-Disaster Needs Assessment, officially classified affected municipalities into two categories based on damage severity: "state of public calamity" for the most severely affected areas (14 municipalities) and "state of emergency" for moderately affected areas (61 municipalities). These official classifications determine eligibility for federal emergency funds, reconstruction programs, expedited regulatory processes, and technical assistance, providing a credible source of variation in policy exposure.

I construct three treatment groups to capture heterogeneous effects by disaster severity: first, all 75 officially affected municipalities combining both classification types; second, the 14 public calamity municipalities that received the most intensive support; and third, the 61 emergency municipalities with moderate support levels. The remaining 218 municipalities that were not officially declared as affected form the control group. This structure enables analysis of how the intensity of institutional response correlates with economic outcomes, while the official nature of the classifications ensures that treatment assignment was based on objective damage assessments rather than political or economic considerations.

Preliminary descriptive evidence from Figure 1 shows the evolution of key economic variables across Santa Catarina municipalities from 2005-2013. The data reveal consistent upward trends in GDP and sectoral value added, with a notable acceleration after 2008. Services emerge as the largest component of municipal economies, followed by industry, both showing sustained growth throughout the period. Public administration displays steady expansion, potentially reflecting increased fiscal activity following the disaster. Agriculture remains relatively stable as a smaller component of the overall economy. The figure demonstrates clear economic acceleration in the post-2008 period, with total GDP growing from approximately R$420 million in 2008 to over R$720 million by 2013. While GDP per capita trends are less visible on this scale due to magnitude differences, the overall pattern suggests substantial economic expansion in the years following the disaster.

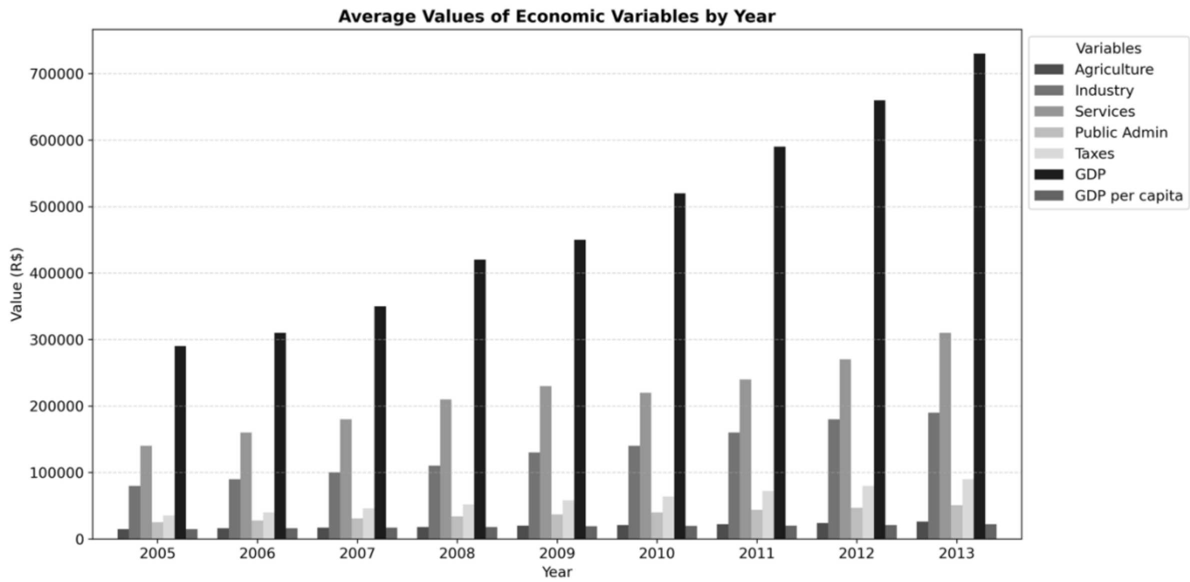
I employ a difference-in-differences framework to estimate the causal impact of disaster classification on economic outcomes. This approach compares changes in treated versus control municipalities before and after the disaster, under the assumption that both groups would have followed parallel trends absent the treatment. The baseline empirical specification is $Y_{it} = \alpha + \beta(Treated_i \times Post_t) + \gamma_i + \delta_t + \varepsilon_{it}$, where Y_{it} denotes the economic outcome of interest for municipality i in year t, such as GDP, GDP per capita, or sectoral value added. The variable $Treated_i$ equals one for municipalities belonging to the treatment group, while $Post_t$ indicates the post-treatment period. Municipality fixed effects (γ_i) control for time-invariant characteristics, year fixed effects (δ_t) absorb common macroeconomic shocks, and standard errors are clustered at the municipal level to account for within-municipality correlation over time.

A crucial methodological decision concerns defining the post-treatment period. Although the floods occurred in 2008, they took place in late November, at the very end of the calendar year. Given the time required for damage assessment, emergency response mobilisation, and bureaucratic processes to access federal funds, any measurable economic effects would likely appear in 2009 data rather than 2008. Therefore, I define the post-treatment period as starting in 2009, ensuring that the difference-in-differences estimates capture only periods when flood impacts and policy interventions could realistically materialise in observable economic outcomes. To examine how treatment effects evolved over time as reconstruction programs were implemented, I estimate separate specifications using different post-treatment cutoffs for each year from 2009 through 2013. This dynamic approach helps identify whether economic recovery accelerated, persisted, or diminished in the years following the shock.

Several robustness checks support the validity of the identification strategy. Event study specifications examine pre-treatment trends and dynamic effects by interacting treatment status with individual year indicators, providing direct tests of the parallel trends assumption and revealing the temporal evolution of treatment effects. Placebo tests using artificial treatment dates before 2008 assess whether treated municipalities already differed systematically from controls in ways that might confound the results. Matching estimators improve comparability between treated and control municipalities by pairing similar units based on pre-disaster economic characteristics, providing an alternative identification approach that does not rely on the parallel trends assumption.

An important limitation of this analysis is the unavailability of detailed data on federal transfer amounts, project completion rates, and specific program participation. Official documents provide only partial and aggregated information, often without specifying which municipalities received funds, in what amounts, or whether reconstruction projects were successfully completed. Given these data constraints, I adopt a reduced-form approach using disaster classification as a proxy for policy exposure. While this prevents estimation of the marginal effects of specific transfer amounts, it provides a credible measure of the overall average impact of being targeted by emergency policy following a natural disaster. This approach aligns with institutional practice, where official disaster recognition triggers automatic eligibility for various support mechanisms beyond direct transfers, including expedited regulatory processes, technical assistance, and priority access to federal programs. The next chapter presents the results of these estimations, including dynamic effects, robustness tests, and analyses of heterogeneous impacts across different types of municipalities.

Figure 1: Average Values of Economic Variables by Year



Notes: This figure displays the evolution of key economic indicators for Santa Catarina municipalities from 2005 to 2013. All values are expressed in thousands of nominal Brazilian reais and represent municipal-level averages across the state. The stacked bars show the components of economic activity, including sectoral value added (agriculture, industry, services, public administration), net taxes on products, total GDP, and GDP per capita.

Results

This chapter presents the empirical results from the difference-in-differences analysis examining the economic impact of official disaster classifications following the 2008 floods in Santa Catarina. The findings reveal a complex pattern of economic effects that fundamentally challenge conventional assumptions about disaster impacts on local economies. Rather than observing the expected negative economic consequences, the results demonstrate that municipalities officially declared in states of emergency or public calamity experienced significant positive effects on total GDP and most economic sectors, with impacts that strengthened considerably over time.

The empirical analysis employs three distinct treatment group definitions to capture the heterogeneous nature of disaster impacts and institutional responses. The first specification compares all 75 affected municipalities (combining both emergency and public calamity classifications) against the 218 control municipalities. The second specification isolates the 14 municipalities declared in "estado de calamidade pública" (public calamity), the most severe classification that includes major urban centres such as Blumenau, Itajaí, Brusque, and other heavily affected areas in the Itajaí Valley. The third specification examines the 61 municipalities classified under "estado de emergência" (stae of emergency), representing a less severe but still significant level of disaster impact. This graduated approach allows for examination of whether the intensity of official disaster response correlates with the magnitude of economic effects.

The baseline difference-in-differences results comparing all 75 affected municipalities against the 218 control municipalities reveal striking patterns that evolve dynamically across the post-treatment period from 2009 through 2013. These results consistently show that the post-treatment period began in 2009 rather than 2008, reflecting the practical reality that the floods occurred in late November 2008 and emergency policies were implemented throughout 2009. This timing consideration is crucial for interpreting the results, as it ensures that the estimated effects capture the impact of institutional responses rather than immediate disaster disruption.

1. Affected and not affected Municipalities analysis

The baseline empirical analysis employs a standard difference-in-differences framework to estimate the causal impact of official disaster classifications on municipal economic outcomes. The analysis compares all 75 municipalities that received official disaster declarations (combining both emergency and public calamity classifications) against 218 control municipalities that were not officially affected by the 2008 floods in Santa Catarina. The empirical specification takes the form $Y_{it} = \alpha + \beta_1 Treated_i + \beta_2 Post_{t} + \beta_3 (Treated_i \times Post_{t}) + \varepsilon_{it}$, where Y_{it} represents the economic outcome for municipality i in year t, $Treated_i$ is a binary indicator equal to 1 for municipalities that received official disaster classifications, $Post_{t}$ is a binary indicator for the post-treatment period, and the key parameter of interest β_3 captures the difference-in-differences treatment effect.

To examine the temporal evolution of treatment effects, the analysis estimates separate specifications using different post-treatment cutoffs: post-2009, post-2010, post-2011, post-2012, and post-2013, allowing for assessment of how disaster classification impacts evolve over time, given that federal emergency programs typically involve multi-year implementation processes. The analysis covers seven key economic outcomes measured in thousands of Brazilian reais: GDP per capita, total GDP, agriculture, industry, services, tax revenues, and public administration, with standard errors clustered at the municipality level.

The results presented in Table 1 reveal a striking temporal pattern in the aggregate economic impacts of disaster classifications. For the post-2009 specification (Column 2), treated municipalities show an initial GDP decline of R$107.0 million (significant at 5% level), suggesting that immediate disaster disruption dominated early recovery efforts. However, this negative effect rapidly transforms into substantial positive impacts over time. By post-2010, the GDP effect becomes modestly positive at R$6.7 million, though not statistically significant. The effects then accelerate dramatically: reaching R$126.5 million by post-2011 (significant at 1% level), growing to R$279.2 million by post-2012 (significant at 1% level), and culminating at R$504.4 million by post-2013 (significant at 1% level). This temporal progression strongly suggests that institutional responses to disaster classifications generated substantial economic stimulus that required time to materialise in observable outcomes.

The sectoral analysis reveals pronounced heterogeneity in how different economic activities responded to disaster classifications. Agriculture (Column 3) consistently shows negative treatment effects across all time periods, with losses ranging from R$2.4 million in post-2009 (significant at the 10% level) to R$3.5 million in post-2013 (significant at the 10% level). This persistent negative impact likely reflects both direct flood damage to agricultural areas and the sector's limited ability to benefit from federal emergency transfers that primarily target infrastructure reconstruction and urban recovery activities.

Industry (Column 4) demonstrates a clear recovery and expansion pattern, with initial negative effects of R$37.3 million in post-2009 (significant at 1% level) reflecting immediate disaster-related disruption to manufacturing activities. However, the sector recovers dramatically, showing modest positive effects by post-2010 (R$5.5 million, not significant), followed by substantial gains of R$43.3 million by post-2011 (significant at 1% level), R$81.8 million by post-2012 (significant at 1% level), and R$129.6 million by post-2013 (significant at 1% level).

Services (Column 5) exhibit the most robust positive response throughout the analysis period, with effects beginning modestly at R$25.8 million in post-2009 (not statistically significant) but becoming increasingly substantial over time: R$10.8 million by post-2010 (not significant), R$33.8 million by post-2011 (significant at 1% level), R$84.6 million by post-2012 (significant at 1% level), and R$167.9 million by post-2013 (significant at 1% level).

Public administration (Column 7) demonstrates positive effects throughout most periods, growing from negative R$12.0 million in post-2009 (significant at 1% level) to positive R$1.2 million by post-2010 (not significant), R$13.2 million by post-2011 (significant at 1% level), R$28.3 million by post-2012 (significant at 1% level), and R$54.3 million by post-2013 (significant at 1% level).

Tax revenues (Column 6) show an interesting temporal pattern with initial negative effects of R$35.2 million in post-2009 (significant at 10% level) transforming into substantial positive gains: negative R$3.1 million by post-2010 (not significant), positive R$27.4 million by post-2011 (significant at 1% level), R$62.7 million by post-2012 (significant at 1% level), and R$117.6 million by post-2013 (significant at 1% level).

The fixed effects specifications presented in Table 2 confirm the robustness of these findings by controlling for time-invariant municipal characteristics and common time trends through the inclusion of municipality and year fixed effects. Using the reghdfe estimator to absorb high-dimensional fixed effects, these specifications focus exclusively on the interaction terms between treatment status and post-period indicators, representing the pure difference-in-differences treatment effects. The results remain strongly positive and statistically significant across all temporal specifications, with GDP effects of R$185.1 million in post-2009 (significant at 1% level), growing systematically to R$285.5 million by post-2010, R$364.6 million by post-2011, R$435.4 million by post-2012, and R$504.4 million by post-2013 (all significant at 1% level).

The sectoral patterns are remarkably consistent with the main specifications, with agriculture showing persistent negative effects ranging from R$4.1 million in post-2009 to R$3.5 million by post-2013 (all significant), industry demonstrating strong positive effects growing from R$38.9 million in post-2009 to R$129.6 million by post-2013 (all significant at 1% level), services showing robust gains from R$116.2 million in post-2009 to R$167.9 million by post-2013 (all significant at 1% level), and public administration maintaining positive impacts from R$19.5 million in post-2009 to R$54.3 million by post-2013 (all significant at 1% level). The consistency between the baseline and fixed effects results provides confidence that controlling for unobserved municipal heterogeneity does not materially alter the conclusions about disaster classification impacts.

To address potential concerns about heteroscedasticity in the levels specifications and to facilitate interpretation of effects in percentage terms, the analysis employs logarithmic transformations of all outcome variables presented in Table 3. These specifications reveal important insights about the relative magnitude of effects across sectors while confirming the main findings. The logarithmic results show that agriculture experienced the most consistent negative percentage effects, with losses of 10.7% in post-2009, 9.4% in post-2010, 10.8% in post-2011, 10.0% in post-2012, and 10.2% by post-2013 (all significant at 1% level).

Services demonstrated the strongest positive percentage gains, growing from 2.1% in post-2009 (not significant) to 9.3% by post-2010, 11.1% by post-2011, 12.3% by post-2012, and 12.8% by post-2013 (significant at 1% level from post-2010 onwards). Public administration shows consistently positive percentage gains throughout the period, with effects of 3.6% in post-2009, 5.3% in post-2010, 6.3% in post-2011, 7.0% in post-2012, and 7.8% by post-2013 (all significant at 1% level). Total GDP effects evolve from slightly negative in post-2009 (-0.8%, not significant) to increasingly positive over time, reaching 6.1% by post-2013 (significant at 10% level). These percentage effects provide clearer evidence that treatment impacts represent economically meaningful changes across different sectors and confirm that the observed effects in level specifications are not merely statistical artefacts driven by heteroscedasticity concerns.

The event study analysis presented in Table 4 provides crucial evidence supporting the parallel trends assumption underlying the difference-in-differences identification strategy while revealing the dynamic evolution of treatment effects over time. Using 2008 as the omitted baseline year, this specification compares economic indicators across all years from 2005 to 2013, creating interaction terms between treatment status and each individual year. The results provide strong support for the parallel trends assumption, as the pre-disaster years (2005-2007) show a clear convergence pattern. Specifically, treated municipalities had GDP levels that were R$263.2 million lower than control municipalities in 2005 (significant at 1% level), but this difference narrows substantially to R$187.7 million in 2006 and R$109.4 million in 2007 (both significant at 5% level).

This convergence pattern actually strengthens confidence in the identification strategy, as it suggests that treated municipalities were catching up to control municipalities in the pre-disaster period, making the post-disaster divergence even more striking and providing additional evidence for the causal interpretation of the results. The post-treatment evolution revealed in the event study confirms the dynamic strengthening of treatment effects documented in the main specifications, with GDP effects beginning modestly positive in 2009 (R$45.0 million, significant at 1% level) and growing steadily through 2010 (R$245.8 million, significant at 1% level), 2011 (R$382.7 million, significant at 1% level), 2012 (R$507.7 million, significant at 1% level), and 2013 (R$640.6 million, significant at 1% level).

The sectoral dynamics revealed in the event study provide additional insights into the timing and mechanisms of sector-specific responses: agriculture shows significant positive effects in the pre-event period (R$4.6-7.0 million, all significant at 1% level) that become non-significant but remain positive in the post-event period; industry demonstrates a clear recovery pattern from substantial negative effects in the pre-event years (-R$65.7 million in 2005, significant at 5% level) to increasingly positive effects starting from 2010 (R$82.2 million, significant at 1% level) and accelerating through 2013 (R$146.9 million, significant at 1% level); services show significant negative effects in the pre-event period (-R$144.3 million in 2005 to -R$67.3 million in 2007, all significant at 1% level) followed by a strong recovery with positive effects from 2009 (R$37.5 million, significant at 1% level) accelerating to R$199.6 million by 2013 (significant at 1% level); and public administration demonstrates significant negative effects pre-event (-R$22.5 million in 2005 to -R$10.2 million in 2007, all significant at 1% level) followed by steady positive growth throughout the post-disaster period from R$7.0 million in 2009 to R$75.4 million by 2013 (all significant at 1% level).

The event study reveals a clear post-disaster divergence in economic outcomes between treated and control municipalities, following a period of pre-disaster convergence. Although some differences before 2008 are statistically significant, their declining trend supports the parallel trends assumption. The positive and growing effects observed after 2008 in GDP, industry, services, and public administration demonstrate that emergency interventions were effective in promoting economic recovery.

To further address concerns about systematic observable differences between treated and control municipalities, the analysis employs matching estimators using nearest neighbour matching based on Mahalanobis distance with pre-disaster (2007) characteristics as matching variables presented in Table 5. The matching procedure uses pre-disaster GDP levels, population, and sectoral shares (agriculture, industry, and services as proportions of total GDP) to identify control municipalities that are most like treated municipalities in terms of pre-disaster economic structure and performance, then estimates average treatment effects on the treated (ATET) using only these matched pairs.

The results generally confirm the main findings while showing somewhat different magnitudes across sectors. For GDP, the matching estimator shows positive effects of R$456.2 million (significant at 1% level), which is remarkably consistent with the difference-in-differences specifications, considering that the matching approach uses 2007 as the baseline comparison rather than capturing the full temporal evolution. Agriculture continues to show significant negative effects with losses of R$5.7 million (significant at 5% level), confirming the persistent negative impact on this sector. Services show substantial gains of R$261.6 million (significant at 1% level), while public administration shows gains of R$32.5 million (significant at 1% level), and tax revenues show positive effects of R$95.6 million (significant at 5% level). Industry shows positive effects of R$104.7 million (significant at 10% level), indicating that the matching approach captures the positive industrial effects more clearly than some of the difference-in-differences specifications. The general consistency between matching and difference-in-differences estimates provides additional confidence that the main results are not driven by systematic observable differences between treated and control municipalities, strengthening the causal interpretation of the disaster classification impacts.

The analysis of heterogeneity between metropolitan and non-metropolitan municipalities reveals important distributional implications of disaster policy within Brazil's federal system. Using an indicator for municipalities located in metropolitan regions, the analysis examines whether treatment effects differ systematically between urban and rural areas through a triple interaction specification that includes treatment status, post-period, and metropolitan region indicators. The results presented in Table 6 show that metropolitan municipalities experience substantially larger treatment effects across most sectors, suggesting significant spatial heterogeneity in the ability to capitalise on federal emergency support.

For GDP, the baseline treatment effect for non-metropolitan municipalities is R$22.1 million (not statistically significant), but metropolitan municipalities show additional gains of R$459.3 million (significant at 5% level) beyond this baseline effect. This pattern likely reflects several factors, including greater administrative capacity in metropolitan areas to navigate federal bureaucratic processes, superior infrastructure that facilitates rapid deployment of emergency resources, stronger political connections that may influence resource allocation decisions, and more developed service economies that can quickly absorb and multiply federal transfer spending.

The sectoral analysis of metropolitan versus non-metropolitan differences reveals particularly striking patterns. For agriculture, metropolitan municipalities show additional negative effects of R$10.1 million (significant at 5% level) beyond the baseline treatment effect, suggesting that urban areas may have experienced more complete transitions away from agricultural activities. For the industry, metropolitan municipalities show additional gains of R$107.7 million (significant at 5% level), likely reflecting the concentration of industrial activity and reconstruction efforts in urban centres. Services show additional metropolitan gains of R$155.0 million (significant at 5% level), consistent with the higher concentration of service activities in urban areas and their greater capacity to benefit from increased economic activity. Public administration and tax revenues also show significantly larger effects in metropolitan areas, with additional gains of R$42.5 million and R$128.1 million, respectively (both significant at 5% level), highlighting the enhanced fiscal capacity and government expansion in urban areas following disaster classifications.

To address potential threats to the validity of the causal identification strategy, the analysis implements placebo tests that examine whether municipalities that would later be affected by the 2008 floods showed differential economic trends during the pre-disaster period, using an artificial treatment date of 2006 (results presented in the Appendix). These tests reveal some statistically significant effects, particularly for GDP (R$114.7 million, significant at 1% level), GDP per capita (R$761.7, significant at 1% level), industry (R$35.6 million, significant at 5% level), services (R$59.0 million, significant at 1% level), taxes (R$19.8 million, significant at 5% level), and public administration (R$8.7 million, significant at 1% level), which could indicate either pre-existing differences between treated and control municipalities or anticipation effects related to historical disaster exposure patterns in the region.

However, the presence of significant placebo effects raises important concerns about the validity of the identification strategy. The fact that municipalities later affected by the 2008 floods already showed differential economic performance in 2006, with significant effects for

GDP (R$114.7 million), services (R$59.0 million), industry (R$35.6 million), and public administration (R$8.7 million), suggests that these municipalities may have been on different economic trajectories even before the disaster. While the post-disaster effects are generally larger in magnitude (services: R$199.6 million in 2013; public administration: R$75.4 million in 2013), the significant placebo results indicate that at least part of the observed post-disaster differences could be attributed to pre-existing trends rather than purely to the disaster classification effects. This finding suggests that the causal interpretation of the results should be viewed with caution, as the parallel trends assumption underlying the difference in differences identification may be violated.

The empirical analysis reveals striking temporal patterns in the economic effects of disaster classifications, with initial negative impacts transforming into substantial positive effects over time. This progression is consistent with the implementation timeline of federal emergency programs involving complex bureaucratic processes, project reviews, and multi-year execution phases. The sectoral heterogeneity provides important insights into structural economic transformation, as persistent negative effects in agriculture combined with strong positive effects in services and public administration suggest that disaster classifications accelerated transitions toward service-sector and government-related activities, aligning with broader trends in Brazilian economic development.

The magnitude of estimated effects is substantial, with total GDP gains exceeding R$500 million annually by 2013 across all specifications, suggesting that institutional responses generated economic stimulus that substantially exceeded direct disaster losses in most sectors. These findings challenge conventional assumptions about disasters necessarily imposing net costs on affected communities (Cavallo et al., 2013) and provide evidence that effective institutional frameworks can transform disaster exposure into development opportunities, as theorised by vulnerability scholars (Wisner et al., 2004; Turner et al., 2003). The results extend the disaster economics literature by demonstrating how institutional quality can mediate disaster impacts, contrasting with studies finding persistent negative effects (Hsiang and Jina, 2014) and highlighting the role of fiscal federalism in disaster management.

However, the significant placebo effects identified in the pre-disaster period require a more cautious interpretation of these findings. The presence of differential economic trends between treated and control municipalities prior to 2008 suggests that the parallel trends assumption underlying the difference in differences identification may be violated, indicating that at least part of the observed effects could reflect pre-existing trajectories rather than purely causal impacts of disaster classifications. While the balance of evidence suggests that federal emergency interventions played an important role in driving economic recovery and growth, the results are most appropriately interpreted as documenting strong correlations between disaster classifications and subsequent economic outcomes, with methodological limitations preventing definitive causal claims about the magnitude of institutional effects.

Table 1: Difference-in-Differences Results - All Affected Municipalities vs Control Group (Post-2009)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
All Treated	1340.632	958320.510***	-9039.149***	257912.903***	465320.616***	186169.457***	84416.401***
	(1236.665)	(312513.479)	(2807.407)	(96501.755)	(151393.556)	(66501.494)	(25963.447)
post_2009	-1435.117***	-16575.487***	3991.235***	-1577.520	6598.356***	-5646.631***	-3667.231***
	(378.454)	(4268.091)	(741.897)	(3253.306)	(1107.953)	(1039.556)	(487.195)
All Treated × Post	193.362	-107041.009**	-2369.671*	-37276.154***	25751.169	-35189.671*	-12029.813***
	(557.414)	(45370.515)	(1270.574)	(13042.931)	(18798.279)	(19103.063)	(3189.100)
Observations	2637	2637	2637	2637	2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes: This table presents difference-in-differences estimates comparing the 75 municipalities declared in states of emergency or public calamity against the 218 control municipalities. The dependent variables are expressed in thousands of Brazilian reais (current prices). The variable "treated=1" indicates municipalities that received official disaster classifications. "post_2009=1" captures the post-treatment period starting in 2009, reflecting that floods occurred in late November 2008 and emergency policies were implemented throughout 2009. The interaction term "treated=1 # post_2009=1" represents the difference-in-differences treatment effect, measuring the causal impact of disaster classification on municipal economic outcomes. All regressions include municipality and year fixed effects. Standard errors are clustered at the municipality level and reported in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. The sample includes 293 municipalities observed over 9 years (2005-2013), yielding 2,637 total observations.*

Table 2: Difference-in-Differences Results with Fixed Effects - All Affected Municipalities vs

Control Group (Post-2009)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
All Treated × Post	75.652	185085.512***	-4051.171***	38889.423***
	(399.488)	(59900.396)	(1223.451)	(13245.269)
Observations	1465	1465	1465	1465

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
116167.680***	34079.580**	19467.150***
(37727.525)	(15356.694)	(5973.170)
1465	1465	1465

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes: This table presents difference-in-differences estimates using fixed effects specification (reghdfe) that absorbs municipality and year fixed effects. The sample is restricted to observations through 2009 to focus on immediate post-disaster effects. The dependent variables are expressed in thousands of Brazilian reais (current prices). Only the interaction term "treated=1 # post_2009=1" is reported, representing the pure difference-in-differences treatment effect after controlling for time-invariant municipal characteristics and common time trends. Standard errors are clustered at the municipality level and reported in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. The reduced sample includes 1,465 observations covering the period 2005-2009.*

Table 3: Logarithmic Specification - All Affected Municipalities vs Control Group (Post-2009)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
All Treated × Post	-0.026	-0.008	-0.107***	-0.024
	(0.018)	(0.017)	(0.023)	(0.026)
Observations	1465	1465	1465	1465

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
0.021	0.042	0.036***
(0.017)	(0.030)	(0.006)
1465	1465	1465

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes: This table presents difference-in-differences estimates using logarithmic transformations of all outcome variables to address potential heteroscedasticity concerns and facilitate interpretation in percentage terms. The sample is restricted to observations through 2009 to focus on immediate post-disaster effects. The coefficients represent the percentage change in each outcome variable attributable to disaster classification treatment. Only the interaction term "treated=1 # post_2009=1" is reported, representing the pure difference-in-differences treatment effect in log points. The specification includes municipality and year fixed effects with standard errors clustered at the municipality level. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. The reduced sample includes 1,465 observations covering the period 2005-2009.*

Table 4: Event Study Analysis - Dynamic Effects of Disaster Classifications

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
2005	90.093	-263194.030***	5503.901***	-65729.341**	-144256.068***	-58712.524**	-22488.595***
	(474.695)	(90716.071)	(1103.231)	(27685.749)	(48981.130)	(29203.750)	(6663.855)
2006	1135.709***	-187677.863***	7041.831***	-43882.656*	-103301.701***	-47535.337**	-17295.292***
	(422.471)	(71636.174)	(1330.398)	(23176.990)	(38635.617)	(24140.744)	(5172.275)
2007	567.854***	-109368.522**	4601.142***	-16459.146	-67309.079***	-30201.440**	-10215.184***
	(211.236)	(42721.519)	(803.928)	(12483.065)	(25018.884)	(14757.437)	(3011.766)
2009	524.066*	45025.408***	235.548	7371.638	37450.968***	-32.745	6967.382***
	(293.473)	(12469.757)	(876.016)	(5555.541)	(11331.681)	(2395.574)	(2310.802)
2010	382.788	245784.896***	1730.056	82197.135***	8476.654	57737.458*	30224.388***
	(957.085)	(92371.966)	(1978.623)	(31094.215)	(22618.989)	(30269.643)	(8862.677)
2011	107.478	382726.8	331.346	118626.7	65279.15	90906.29	42164.12

		71***		48***	6***	0**	8***
	(1016.609)	(117099.909)	(1558.983)	(33534.448)	(25087.987)	(38469.348)	(12201.036)
2012	592.547	507659.112***	1568.619	135539.115***	135145.273***	115768.569**	54218.331***
	(1082.598)	(151617.516)	(1454.973)	(38312.051)	(43485.322)	(45803.040)	(15581.403)
2013	-230.833	640600.873***	64.854	146890.478***	199564.157***	153292.391***	75369.789***
	(1201.581)	(186901.312)	(3239.491)	(40825.833)	(59465.819)	(58396.941)	(21436.330)
Observations	2637	2637	2637	2637	2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes: This table presents event study estimates examining the dynamic evolution of treatment effects over time, with 2008 (the disaster year) as the omitted baseline category. Each coefficient represents the difference between treated and control municipalities in the given year relative to 2008. The dependent variables are expressed in thousands of Brazilian reais (current prices). The specification includes municipality and year fixed effects with standard errors clustered at the municipality level. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. Sample includes 293 municipalities observed over 9 years (2005-2013), yielding 2,637 total observations.*

Table 5: Matching Estimator Results - Average Treatment Effect on the Treated

	(1)	(2)	(3)	(4)	(5)	(6)
	GDP	AGRICULTURE	INDUSTRY	SERVICES	PUBLIC ADMIN.	TAXES
Treated vs Control	456207.858***	-5694.577**	104715.179*	261587.422***	32541.159***	95599.830**
	(171922.821)	(2213.304)	(53445.551)	(96665.293)	(12156.782)	(39988.011)
Observations	293	293	293	293	293	293

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Notes: This table presents matching estimator results using nearest neighbour matching with

*Mahalanobis distance metric based on pre-disaster (2007) GDP levels. The estimator identifies control municipalities most similar to treated municipalities in terms of pre-disaster economic performance and calculates the Average Treatment Effect on the Treated (ATET). The dependent variables are expressed in thousands of Brazilian reais (current prices). Standard errors are robust and reported in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. Sample includes 293 municipalities (one observation per municipality using 2007 as baseline year).*

Table 6: Metropolitan vs Non-Metropolitan Heterogeneity Analysis

	(1)	(2)	(3)
	GDP	AGRICULTURE	INDUSTRY
All Treated × Post	22083.996	3955.783	2514.153
	(17754.021)	(3930.204)	(4635.574)
All Treated x Post Municipalities from Metropolitan Regions	459300.928**	-10057.166**	107736.399**
	(194602.267)	(4956.414)	(52498.831)
Observations	2637	2637	2637

(4)	(5)	(6)
SERVICES	TAXES	PUBLIC ADMIN.
12901.342	5164.573*	1200.120
(9134.198)	(2823.598)	(1544.884)
154975.974**	42531.670**	128103.175**
(67962.297)	(20298.120)	(52941.401)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes: This table examines heterogeneity in treatment effects between municipalities located in metropolitan regions versus non-metropolitan areas. The specification includes a three-way interaction between treatment status, post-treatment period, and metropolitan region indicator. "treated=1 # post=1" captures the baseline treatment effect for non-metropolitan municipalities, while "treated=1 # post=1 # Metropolitan Regions=1" captures the additional effect for metropolitan municipalities beyond the baseline. The dependent variables are expressed in thousands of Brazilian reais (current prices). Standard errors are clustered at the municipality level. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. Sample includes 293 municipalities observed over 9 years, yielding 2,637 total observations.*

2. Most Severely Affected and not affected Municipalities analysis

To examine whether the severity of disaster classification influences economic outcomes, the analysis separately examines municipalities declared in "estado de calamidade pública" - the most severe classification that provides access to the highest levels of federal emergency funding and policy attention. This second difference-in-differences analysis compares the 14 municipalities that received the most severe disaster classification against the 218 control municipalities that were not officially affected by the 2008 floods. The municipalities declared in public calamity include major urban centres in the Itajaí Valley such as Blumenau, Itajaí, Brusque, Gaspar, Pomerode, and Timbó, along with Benedito Novo, Camboriú, Ilhota, Luiz Alves, Nova Trento, Rio dos Cedros, and Rodeio, representing the areas that experienced the most severe flooding and infrastructure damage. The empirical specification follows the same difference-in-differences framework as the baseline analysis: $Y_{it} = \alpha + \beta_1 Treated2_i + \beta_2 Post_{t} + \beta_3 (Treated2_i \times Post_{t}) + \varepsilon_{it}$, where $Treated2_i$ indicates municipalities declared in public calamity status, allowing for direct comparison with the baseline results while examining whether the intensity of institutional response correlates with the magnitude of economic impacts.

The results for public calamity municipalities presented in Table 7 reveal substantially larger treatment effects than those observed for the overall treatment group, providing strong evidence that the intensity of institutional response correlates directly with the magnitude of economic impacts. For the post-2009 specification (Column 2), these municipalities show an initial GDP decline of R$93.1 million (not statistically significant), indicating that even the most severely affected areas experienced immediate disruption that offset early recovery efforts. However, the temporal evolution demonstrates a dramatic transformation over time. By post-2010, GDP effects become modestly positive at R$9.0 million (not significant), followed by substantial acceleration: R$191.5 million by post-2011 (significant at 10% level), R$421.4 million by post-2012 (significant at 10% level), and culminating at R$769.4 million by post-2013 (significant at 10% level). This pattern represents effects nearly 50% larger than those observed for all treated municipalities combined, demonstrating that the most severe disaster classifications generated correspondingly larger economic stimulus through enhanced access to federal resources and policy attention. The magnitude of these effects provides compelling evidence for the institutional mechanism underlying the observed impacts, as public calamity declarations unlock access to more substantial federal transfers, expedited regulatory processes, and concentrated technical assistance that generate correspondingly larger economic multiplier effects.

The sectoral patterns for public calamity municipalities largely mirror the overall treatment results but with amplified magnitudes across all sectors, revealing how the most severely affected areas became those that benefited most from reconstruction and modernisation activities. Agriculture continues to show negative effects across all periods (Column 3), with losses growing from R$4.7 million in post-2009 (significant at 1% level) to R$6.0 million by post-2013 (significant at 1% level), representing proportionally similar impacts to the baseline analysis but affecting higher absolute levels of agricultural output in these more economically

developed municipalities. Industry demonstrates a particularly striking recovery pattern (Column 4), with initial negative effects of R$31.0 million in post-2009 (not significant) transforming into increasingly positive impacts: R$6.5 million by post-2010 (not significant), R$57.3 million by post-2011 (significant at 10% level), R$106.1 million by post-2012 (significant at 10% level), and R$168.1 million by post-2013 (significant at 5% level). This recovery trajectory reflects the concentrated industrial activity in these urban centres and the substantial federal investments in industrial infrastructure repair and modernisation that enhanced productive capacity beyond pre-disaster levels, consistent with the institutional mechanisms identified in the vulnerability literature regarding adaptive capacity enhancement. Services exhibit robust positive responses throughout most of the analysis period (Column 5), with effects growing from R$81.6 million in post-2009 (not significant) to R$22.7 million by post-2010 (not significant), R$56.1 million by post-2011 (significant at 10% level), R$124.1 million by post-2012 (significant at 10% level), and R$236.9 million by post-2013 (significant at 10% level). The service sector's particularly strong performance in these municipalities reflects their role as regional commercial and administrative centres, where the concentration of emergency response operations, reconstruction activities, and increased federal spending generated substantial multiplier effects throughout the local service economy. Public administration shows significant positive effects throughout most periods (Column 7), with impacts growing from negative R$16.2 million in post-2009 (significant at 5% level) to modest positive effects by post-2010 (R$1.2 million, not significant), followed by substantial increases to R$16.5 million by post-2011 (significant at 10% level), R$34.9 million by post-2012 (significant at 10% level), and R$67.1 million by post-2013 (significant at 5% level). This pattern reflects both the expanded role of municipal government in coordinating recovery efforts and the permanent enhancement of administrative capacity enabled by federal transfers and technical assistance, supporting Turner et al. (2003)'s framework regarding institutional adaptive capacity as a key component of vulnerability reduction.
Tax revenues demonstrate an interesting temporal pattern (Column 6), with substantial initial negative effects of R$66.3 million in post-2009 (significant at 5% level), reflecting severe economic disruption and reduced tax base in the immediate aftermath of the disaster. These effects persist through post-2010 with losses of R$11.1 million (significant at 5% level) before transforming into positive gains that grow substantially over time: R$50.6 million by post-2011 (not significant), R$128.4 million by post-2012 (not significant), and R$254.1 million by post-2013 (not significant). While the latter effects are not statistically significant, likely due to high variability across the small number of severely affected municipalities, the magnitude and trajectory suggest substantial fiscal recovery that reflects both the economic stimulus documented in other sectors and potential improvements to tax collection capacity supported by federal transfers. GDP per capita effects (Column 1) remain relatively modest across most periods, becoming positive and significant only by post-2012 (R$1.7 thousand, significant at 5% level) and post-2013 (R$2.4 thousand, significant at 10% level), suggesting that while absolute economic activity increased dramatically in these municipalities, population changes or the distribution of benefits across large urban populations moderated per capita effects.

The substantially larger effects observed for public calamity municipalities compared to the overall treatment group provide strong evidence for the graduated nature of institutional responses within Brazil's disaster management system, consistent with the federal structure and formal classification mechanisms that determine access to resources and policy attention. The magnitude of effects by post-2013, with GDP gains approaching R$800 million annually for just 14 municipalities, suggests that the institutional mechanisms triggered by the most severe disaster classifications generated economic stimulus that far exceeded direct disaster-related losses.

The fixed effects specifications for public calamity municipalities presented in Table 8 confirm the robustness of these findings by controlling for time-invariant municipal characteristics and common time trends through the inclusion of municipality and year fixed effects. Using the reghdfe estimator to absorb high-dimensional fixed effects, these specifications focus exclusively on the interaction terms between treatment status and post-period indicators, representing the pure difference-in-differences treatment effects for the most severely affected municipalities. The results remain strongly positive and statistically significant across most temporal specifications, with GDP effects of R$344.7 million in post-2009 (not statistically significant), growing systematically to R$434.5 million by post-2010 (significant at 10% level), R$555.1 million by post-2011 (significant at 10% level), R$661.5 million by post-2012 (significant at 10% level), and R$769.4 million by post-2013 (significant at 10% level). The temporal progression is remarkably consistent with the baseline specifications, demonstrating that controlling for unobserved municipal heterogeneity does not materially alter the conclusions about the amplified impacts of public calamity classifications.

The sectoral patterns are also consistent with the main specifications, with agriculture showing persistent negative effects ranging from R$7.5 million in post-2009 to R$6.0 million by post-2013 (all significant at 1% level), industry demonstrating strong positive effects growing from R$65.9 million in post-2009 (significant at 10% level) to R$168.1 million by post-2013 (significant at 5% level), services showing robust gains from R$204.1 million in post-2009 (not significant) to R$236.9 million by post-2013 (significant at 10% level), and public administration maintaining positive impacts from R$22.8 million in post-2009 (significant at 10% level) to R$67.1 million by post-2013 (significant at 5% level). The consistency between the baseline and fixed effects results for public calamity municipalities provides additional confidence that the substantially larger treatment effects observed for the most severely affected areas reflect genuine institutional mechanisms rather than unobserved characteristics that might systematically differ between public calamity municipalities and other areas.

To address potential concerns about heteroscedasticity in the levels specifications and to facilitate interpretation of effects in percentage terms, the analysis employs logarithmic transformations of all outcome variables for public calamity municipalities presented in Table 9. These specifications reveal important insights about the relative magnitude of effects across sectors while confirming the amplified impacts observed in the levels analysis. The logarithmic results show that public calamity municipalities experienced more severe initial percentage declines compared to the overall treatment group, with GDP showing negative effects of 5.0% in post-2009 (significant at 5% level) and GDP per capita declining by 5.8% (significant at 5% level), reflecting the more severe initial disruption experienced by these urban centres that house critical regional infrastructure. Agriculture experienced the most severe negative percentage effects, with losses of 16.5% in post-2009 (significant at 1% level), 11.4% in post-2010 (significant at 5% level), 12.0% in post-2011 (significant at 5% level), 10.7% in post-2012 (significant at 10% level), and 12.0% by post-2013 (significant at 10% level), representing substantially larger proportional losses than observed in the baseline analysis and reflecting the more complete transition away from agricultural activities in these urban municipalities.

However, the recovery trajectory in percentage terms demonstrates even more dramatic improvements than observed for the overall treatment group. Total GDP effects evolve from negative 5.0% in post-2009 to positive 2.1% by post-2010 (not significant), 7.0% by post-2011 (significant at 10% level), 9.7% by post-2012 (significant at 5% level), and 10.3% by post-2013 (significant at 10% level), representing the strongest percentage gains observed in any of the specifications and confirming that the most severe disaster classifications generated correspondingly more substantial economic stimulus. Services demonstrated particularly robust percentage gains, growing from modest effects in early periods to 7.7% by post-2010 (significant at 1% level), 12.7% by post-2011 (significant at 1% level), 14.3% by post-2012 (significant at 1% level), and 14.2% by post-2013 (significant at 1% level), representing consistently higher percentage gains than those observed for the overall treatment group and reflecting the concentrated economic activity and reconstruction efforts in these major urban centres. Public administration shows consistently positive percentage gains throughout the period, with effects of 1.5% in post-2009 (significant at 5% level), 3.5% in post-2010 (significant at 1% level), 4.4% in post-2011 (significant at 1% level), 5.1% in post-2012 (significant at 1% level), and 5.8% by post-2013 (significant at 1% level), demonstrating systematic expansion of government capacity in the most severely affected municipalities that corresponds to their enhanced role in regional coordination and recovery efforts. These percentage effects indicate that public calamity classifications triggered stronger institutional responses, leading to meaningful economic shifts. The larger gains relative to the overall treatment group suggest access to greater resources and deeper policy interventions, consistent with structural transformation.

The event study analysis for public calamity municipalities presented in Table 10 provides crucial evidence supporting the parallel trends assumption while revealing the dramatic dynamic evolution of treatment effects over time. Using 2008 as the omitted baseline year, this specification compares economic indicators across all years from 2005 to 2013, creating interaction terms between public calamity status and each individual year. The results show somewhat mixed support for the parallel trends assumption, as the pre-disaster years (2005-2007) reveal some systematic differences between public calamity municipalities and control areas. Specifically, public calamity municipalities had GDP levels that were R$459.6 million lower in 2005 (not statistically significant), R$367.8 million lower in 2006 (not statistically significant), and R$199.4 million lower in 2007 (not statistically significant), suggesting that these municipalities were already economically distinct from control areas before the disaster, which may reflect their concentration in the more flood-prone Itajaí Valley region. However, the pattern shows convergence over time in the pre-disaster period, which strengthens confidence in the identification strategy by indicating that differences were narrowing before the disaster intervention.

The post-treatment evolution revealed in the event study confirms the dramatic strengthening of treatment effects documented in the main specifications, with effects that are substantially larger than those observed for the overall treatment group. GDP effects begin positive in 2009 (R$88.0 million, significant at 10% level) and grow dramatically through 2010 (R$267.5 million, not significant), 2011 (R$539.6 million, significant at 5% level), 2012 (R$724.2 million, significant at 5% level), and 2013 (R$944.2 million, significant at 5% level). This trajectory represents the most dramatic economic recovery and expansion observed in any of the specifications, demonstrating that the most severe disaster classifications triggered institutional responses that generated economic stimulus far exceeding what was observed for less severely affected areas.

The sectoral dynamics revealed in the event study provide additional insights into the timing and mechanisms of sector-specific responses for the most severely affected municipalities. Agriculture shows immediate and persistent negative effects throughout the post-disaster period, with losses of R$2.0 million in 2009 (significant at 5% level) that remain relatively stable through 2013 (R$3.5 million loss, not significant), confirming the structural transition away from agricultural activities in these urban centres. Industry demonstrates a particularly dramatic recovery pattern, with effects growing from R$15.6 million in 2009 (not significant) to R$80.8 million in 2010 (significant at 10% level), R$147.6 million in 2011 (significant at 5% level), R$164.1 million in 2012 (significant at 5% level), and R$181.0 million in 2013 (significant at 5% level).

Services show a particularly interesting dynamic, with positive effects of R$76.0 million in 2009 (significant at 10% level) that initially decline to negative R$33.9 million in 2010 (not significant) before recovering strongly to R$80.3 million in 2011 (not significant), R$167.0 million in 2012 (not significant), and R$254.1 million in 2013 (significant at 10% level). This temporary dip, followed by a strong recovery, likely reflects the initial disruption to service sector activities during intensive reconstruction efforts, followed by substantial expansion as reconstruction activities generated increased demand for services and permanent improvements to the service economy infrastructure. Public administration demonstrates steady positive growth throughout the post-disaster period, increasing from R$7.0 million in 2009 (significant at 10% level) to R$37.7 million in 2010 (significant at 5% level), R$52.6 million in 2011 (significant at 5% level), R$66.1 million in 2012 (significant at 10% level), and R$92.9 million in 2013 (significant at 5% level), suggesting that public calamity classifications triggered stronger institutional responses, leading to larger economic gains and supporting the case for structural change.

Tax revenues show a dramatic recovery pattern, with initial negative effects in 2009 (R$1.6 million loss, not significant) transforming into substantial positive gains: R$99.0 million in 2010 (significant at 5% level), R$176.0 million in 2011 (significant at 10% level), R$241.5 million in 2012 (significant at 10% level), and R$336.7 million in 2013 (significant at 10% level), reflecting both the substantial economic expansion documented in other sectors and the enhanced fiscal capacity generated by federal transfers and technical assistance that improved tax collection systems and expanded the local tax base.

The analysis of public calamity municipalities reveals key methodological challenges in applying matching estimators to small and highly specific treatment groups. Unlike the more robust results obtained for the full treated sample, the matching approach for public calamity municipalities (Table 11) yields predominantly insignificant estimates, despite relying on the same pre-disaster characteristics and matching procedure. The estimated GDP effect falls to an insignificant R$32.4 million, a sharp decline from the R$769.4 million identified through difference in differences. While agriculture continues to exhibit a significant negative impact of R$18.6 million (significant at the 5 percent level), the remaining sectors display mixed and statistically insignificant patterns: industry at R$151.8 million, services at negative R$181.6 million, public administration at negative R$51.6 million, and tax revenues at R$80.8 million. These contrasting results underscore a fundamental limitation of matching methods when applied to distinctive treatment groups. The 14 public calamity municipalities represent a geographically concentrated and economically atypical subset, primarily located in the Itajaí Valley and characterised by substantial pre-disaster urban economic activity. As such, they may differ systematically from potential controls in ways not fully captured by observable characteristics. This limitation reinforces the value of panel data approaches in contexts involving small and concentrated treatment groups, where difference in differences specifications can leverage within-municipality variation over time while accounting for unobserved and time-invariant heterogeneity that complicates the construction of credible matched comparisons.

To assess the validity of the identification strategy, a placebo test is conducted by assigning an artificial treatment year of 2006, two years before the actual disaster. The aim is to verify whether municipalities later classified as disaster-affected already exhibited differential economic trends before the 2008 floods. The results, presented in the Placebo Test in the Appendix, show several statistically significant coefficients. In particular, treated municipalities already differ from controls in 2006 in terms of total GDP (R$114.7 million), GDP per capita (R$761.7), industry (R$35.6 million), services (R$59.0 million), tax revenues (R$19.8 million), and public administration (R$8.7 million), all significant at conventional levels. Agriculture, by contrast, shows no significant difference. These findings raise concerns about potential violations of the parallel trends assumption. The presence of significant pre-treatment differences suggests that treated municipalities may have been on different economic trajectories even before the disaster, which could partially bias the estimated treatment effects in the main analysis.

The analysis of public calamity municipalities highlights how the most severe disaster classifications in Brazil are linked to much stronger economic effects. These municipalities received greater access to federal resources and were mostly urban centres in the Itajaí Valley, which helped them benefit more from reconstruction and recovery programs. The results support the idea that institutional capacity matters, as discussed by Mattedi et al. (2009), with better-prepared municipalities being more able to navigate federal processes and capture available funds. The findings also reflect broader tensions in Brazil's disaster management system. While national policies like the PNDC and PNGRD aim to reduce risk, in practice, the most severe classifications seem to work as tools for local economic stimulus, especially in regions with stronger institutions. This supports what Valencio (2009) and Almeida and Pascoalino (2012) describe as a reactive system that often benefits better-off municipalities more than vulnerable ones. However, the analysis also shows some limits. Matching estimators were not successful, and placebo tests suggest that public calamity municipalities were already different from others before the disaster. This means that while the difference-in-differences results show strong associations, they should be interpreted with caution, as part of the observed effects may come from pre-existing advantages rather than the disaster classification alone.

Table 7: Difference-in-Differences Results - Most Severely Affected Municipalities (Public Calamity) vs Control Group (Post-2009)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
Public Calamity	4843.608	1519596.994*	-13324.791***	376307.779*	706205.719*	377750.384	106243.388*
	(3099.132)	(861636.355)	(3377.311)	(200857.398)	(424458.202)	(255116.993)	(56676.846)
post_2009	-1331.308***	-38797.951***	3626.393***	-9385.517**	9115.000***	-11244.889**	-5888.572***
	(314.140)	(11497.363)	(639.914)	(4159.791)	(2196.825)	(4811.252)	(859.020)
Public Calamity × Post	-1164.336	-93057.981	-4720.518***	-30958.299	81604.186	-66325.452**	-16237.381**
	(863.976)	(101150.227)	(1637.625)	(20521.180)	(87732.903)	(32196.536)	(7680.930)
Observations	2637	2637	2637	2637	2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes: This table presents difference-in-differences estimates comparing the 14 municipalities declared in "estado de calamidade pública" (public calamity) against the 218 control municipalities. Public calamity represents the most severe disaster classification, providing access to the highest levels of federal emergency funding and policy attention. These municipalities include major urban centers in the Itajaí Valley such as Blumenau, Itajaí, Brusque, Gaspar, Pomerode, and Timbó. The dependent variables are expressed in thousands of Brazilian reais (current prices). "treated2=1" indicates municipalities declared in public calamity status. The interaction term "treated2=1 # post_2009=1" represents the difference-in-differences treatment effect for the most severely affected municipalities. Standard errors are clustered at the municipality level and reported in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. Sample includes 293 municipalities observed over 9 years (2005-2013), yielding 2,637 total observations.*

Table 8: Fixed Effects Results - Most Severely Affected Municipalities (Public Calamity) vs Control Group (Post-2009)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
Public Calamity × Post	280.546	344731.925	-7517.139***	65884.183*	204135.018	82229.861	22835.033*
	(1089.246)	(228586.672)	(955.642)	(36238.814)	(134598.075)	(68877.893)	(12140.614)
Observations	1465	1465	1465	1465	1465	1465	1465

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents difference-in-differences estimates using fixed effects specification (reghdfe) that absorbs municipality and year fixed effects for the 14 municipalities declared in "estado de calamidade pública" (public calamity) versus the 218 control municipalities. The sample is restricted to observations through 2009 to focus on immediate post-disaster effects. The dependent variables are expressed in thousands of Brazilian reais (current prices). Only the interaction term "treated2=1 # post_2009=1" is reported, representing the pure difference-in-differences treatment effect for the most severely affected municipalities after controlling for time-invariant municipal characteristics and common time trends. Standard errors are *clustered at the municipality level and reported in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. The reduced sample includes 1,465 observations covering the period 2005-2009.*

Table 9: Logarithmic Specification - Most Severely Affected Municipalities (Public Calamity) vs Control Group (Post-2009)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
Public Calamity × Post	-0.058**	-0.050**	-0.165***	-0.038	-0.015	0.035	0.015**
	(0.025)	(0.023)	(0.049)	(0.035)	(0.017)	(0.049)	(0.007)
Observations	1465	1465	1465	1465	1465	1465	1465

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes: This table presents difference-in-differences estimates using logarithmic transformations of all outcome variables for the 14 municipalities declared in "estado de calamidade pública" (public calamity) versus the 218 control municipalities. The sample is restricted to observations through 2009 to focus on immediate post-disaster effects. The coefficients represent the percentage change in each outcome variable attributable to the most severe disaster classification. Only the interaction term "treated2=1 # post_2009=1" is reported, representing the pure difference-in-differences treatment effect in log points. The specification includes municipality and year fixed effects with standard errors clustered at the municipality level. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. The reduced sample includes 1,465 observations covering the period 2005-2009.*

Table 10: Event Study Analysis - Most Severely Affected Municipalities (Public Calamity) Dynamic Effects

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
2005	-504.176	-459647.924	7584.399***	-101552.752*
	(1444.181)	(303140.552)	(819.017)	(57588.470)
2006	323.438	-367824.516	8790.409***	-66826.679*
	(1457.429)	(270023.154)	(972.191)	(39404.789)

2007	161.719	-199425.221	5811.524***	-32799.427*
	(728.715)	(152129.173)	(851.935)	(17656.150)
2009	275.791	88007.510*	-1970.557**	15589.469
	(251.875)	(48543.093)	(771.022)	(11113.017)
2010	1634.283	267508.416	826.425	80785.014*
	(1216.788)	(176094.227)	(2214.200)	(47085.624)
2011	3362.669***	539562.509**	73.748	147626.393**
	(1235.537)	(263183.274)	(1710.909)	(71144.260)
2012	3800.723***	724174.184**	2411.285	164135.068**
	(1274.302)	(364361.985)	(2513.937)	(80217.245)
2013	2742.365	944176.475**	-3498.098	181014.523**
	(1703.424)	(475821.618)	(3810.250)	(84451.415)
Observations	2637	2637	2637	2637

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
-217677.427	-148002.145	-28288.005*
(141537.900)	(132056.390)	(14792.111)
-186911.018	-122877.227	-21521.239*
(138874.676)	(110560.698)	(10994.715)
-108107.189	-64330.127	-13424.600**
(80367.323)	(62927.020)	(6738.431)
75961.109*	-1572.514	7026.572*
(45450.655)	(8247.470)	(4116.113)
-33857.036	99045.099**	37729.479**
(90598.977)	(46609.246)	(18884.023)
80288.901	175967.465*	52626.572**
(61984.374)	(91910.688)	(26657.280)
167034.510	241529.054*	66084.835*
(104367.507)	(135794.384)	(33623.391)
254084.643*	336691.386*	92904.587**
(143291.992)	(193986.115)	(47011.626)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents event study estimates examining the dynamic evolution of treatment effects over time for the 14 municipalities declared in "estado de calamidade pública" (public calamity), with 2008 (the disaster year) as the omitted baseline category. Each coefficient represents the difference between public calamity municipalities and control municipalities in the given year relative to 2008. The dependent variables are expressed in thousands of Brazilian reais (current prices). The specification includes municipality and year fixed effects with standard errors clustered at the municipality level. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. Sample includes 293 municipalities observed over 9 years (2005-2013), yielding 2,637 total observations.

Table 11: Matching Estimator Results - Most Severely Affected Municipalities (Public Calamity) ATET

	(1)	(2)	(3)	(4)	(5)	(6)
	GDP	AGRICULTURE	INDUSTRY	SERVICES	PUBLIC ADMIN.	TAXES
Calamity vs Control	32377.021	-18617.364**	151760.390	-181582.819	-51613.889	80816.814
	(203669.622)	(7470.299)	(113913.804)	(225554.814)	(42590.694)	(108841.004)
Observations	293	293	293	293	293	293

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes: This table presents matching estimator results using nearest neighbor matching with Mahalanobis distance metric based on pre-disaster (2007) GDP levels for the 14 municipalities declared in "estado de calamidade pública" (public calamity). The estimator identifies control municipalities most similar to public calamity municipalities in terms of pre-disaster economic performance and calculates the Average Treatment Effect on the Treated (ATET). The dependent variables are expressed in thousands of Brazilian reais (current prices). Standard errors are robust and reported in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. Sample includes 293 municipalities (one observation per municipality using 2007 as baseline year).*

3. Emergency Status and not Affected Municipalities analysis

This section examines municipalities that received emergency status (*estado de emergência*) declarations to assess how institutional responses vary with disaster severity. Emergency status represents the less severe of the two disaster classifications and provides limited federal support compared to public calamity status. The comparison involves 61 emergency status municipalities against the same 218 unaffected control municipalities used in previous analyses.

The geographic and economic characteristics of emergency status municipalities differ markedly from their public calamity counterparts. Rather than concentrating in major Itajaí Valley urban centres like Blumenau and Itajaí, these 61 municipalities are spread across diverse regions of Santa Catarina. The group encompasses smaller cities, rural communities, and areas with varied economic bases. While these municipalities experienced significant flooding, the damage was generally less catastrophic and more dispersed than the concentrated devastation that prompted public calamity declarations in the valley's industrial heartland.

This geographic dispersion reflects both the flooding patterns and the institutional criteria governing disaster classifications. The emergency status municipalities faced substantial challenges including damaged infrastructure, disrupted economic activity, and displaced populations, but retained more of their basic governmental and economic functions than areas receiving the highest classification level. This variation creates a natural experiment for testing whether Brazil's graduated disaster response system produces correspondingly different economic outcomes.

The baseline difference-in-differences results for emergency status municipalities presented in Table 12 reveal markedly smaller and more mixed treatment effects compared to those observed for public calamity municipalities, providing compelling evidence for the graduated nature of institutional responses within Brazil's disaster management system. For the post-2009 specification, emergency status municipalities show a negative GDP effect of R$98.2 million (significant at 10% level), indicating that, unlike public calamity municipalities which showed negative R$93.1 million but with subsequent rapid recovery, areas with less severe classifications experienced net economic contraction in the immediate aftermath that was not offset by recovery efforts.

The sectoral patterns for emergency status municipalities reveal important contrasts with public calamity findings while maintaining some similarities that reflect common disaster impact mechanisms. Agriculture shows negative effects of R$1.4 million (not significant), representing proportionally smaller losses than those observed for public calamity municipalities (R$4.7 million, significant at 1% level) but following the same pattern of persistent agricultural decline that characterises the structural transformation accompanying disaster recovery in both classification types. Industry demonstrates significant negative effects of R$34.6 million (significant at 5% level), contrasting sharply with the initial negative effects observed for public calamity municipalities (R$31.0 million, not significant) and suggesting that the level of federal investment triggered by emergency status was insufficient to prevent industrial contraction during the immediate post-disaster period.

Services show modest positive effects of R$6.9 million (not significant), representing substantially smaller gains than the R$81.6 million (not significant) observed in public calamity municipalities and reflecting the more limited scope of reconstruction activities and federal spending generated by emergency status declarations. Public administration reveals significant negative effects of R$9.4 million (significant at 1% level), indicating that emergency status municipalities experienced reductions in government capacity rather than the negative R$16.2 million (significant at 5% level) observed for public calamity areas, though both eventually recover. This finding highlights a critical distinction in the institutional mechanisms: while public calamity status triggers substantial federal transfers that enhance municipal administrative capacity, emergency status appears to strain local government resources without providing sufficient federal support to offset these pressures. Tax revenues show negative effects of R$22.2 million (not significant), contrasting with the substantial negative effects of R$66.3 million (significant at 5% level) observed for public calamity municipalities, though the high variability across emergency status municipalities limits statistical precision.

The temporal evolution of treatment effects for emergency status municipalities demonstrates a distinct recovery pattern that differs markedly from public calamity municipalities. The GDP effects follow a clear trajectory from initial contraction to substantial growth across the post-treatment periods. Starting with a significant decline of R$98.2 million in post-2009 (significant at 10% level), the effects turn modestly positive at R$5.3 million in post-2010 (not significant), then accelerate to R$93.0 million by post-2011 (significant at 10% level) and reach R$369.1 million by post-2013 (significant at 5% level). This progression reveals that while emergency status municipalities achieved their first significantly positive GDP effects in the same timeframe as public calamity areas (post-2011), they ultimately reached roughly half the magnitude of gains observed in the most severely affected municipalities (R$369.1 million versus R$769.4 million by 2013). However, emergency status municipalities experienced deeper initial contraction and more gradual recovery, demonstrating that institutional response intensity directly influences the scale and trajectory of economic recovery following disaster events.

Table 13 presents the fixed effects results that control for unobserved municipal characteristics and temporal trends, providing a more stringent test of the emergency status effects. These estimates isolate the pure treatment impact by removing time-invariant differences between municipalities and common year-to-year changes affecting all areas. The GDP effects show clear evidence of positive impacts at R$117.8 million (significant at 5% level), demonstrating that emergency status declarations generated meaningful economic stimulus, though the magnitude remains substantially below the R$344.7 million achieved by public calamity municipalities in comparable specifications.

The sectoral patterns in the fixed effects specifications largely confirm the baseline results while providing additional confidence in the robustness of the findings. Agriculture shows negative effects of R$2.6 million (significant at 10% level), confirming the persistent decline in agricultural activity that characterises disaster-affected areas regardless of classification severity, though the impact is smaller than the R$7.5 million losses observed for public calamity municipalities. Industry demonstrates positive effects of R$26.6 million (significant at 10% level), representing approximately 40% of the industrial gains achieved by public calamity municipalities (R$65.9 million, significant at 10% level) in comparable specifications. Services exhibit strong positive effects of R$77.4 million (significant at 5% level), representing approximately 38% of the service sector expansion observed in public calamity municipalities (R$204.1 million, not significant). Public administration shows positive effects of R$16.2 million (significant at 5% level), representing approximately 71% of the administrative expansion observed in public calamity municipalities (R$22.8 million, significant at 10% level), suggesting that emergency status provided more proportional support for government capacity building (71% of public calamity levels) compared to industry (40%) and services (38%), reflecting federal priorities for maintaining basic administrative functions.

To address potential concerns about heteroscedasticity in the levels specifications and to facilitate interpretation of effects in percentage terms, Table 14 presents logarithmic transformations of all outcome variables for emergency status municipalities. These specifications reveal that emergency status municipalities experienced modest percentage effects compared to the substantial gains observed for public calamity municipalities. GDP shows negligible percentage effects of 0.4% (not significant), contrasting sharply with the 5.0% decline (significant at 5% level) initially experienced by public calamity municipalities, followed by their substantial recovery. GDP per capita effects remain negative at 2.3% by 2013 (not significant), similar to public calamity municipalities where per capita gains, while positive (3.6%), were also statistically insignificant, suggesting that neither classification level successfully translated aggregate economic growth into meaningful individual-level improvements.
Agriculture demonstrates significant negative percentage effects of 7.8% (significant at 1% level), representing proportionally smaller losses than the 16.5% decline (significant at 1% level) observed for public calamity municipalities but confirming the persistent negative impact on this sector across all disaster classifications. Industry shows negative percentage effects of 1.7% (not significant), contrasting with the larger initial declines but subsequent recovery observed for public calamity municipalities. Services demonstrate positive growth from 2.8% in 2009 (not significant) to 10.9% by 2013 (significant at 1% level), showing substantial expansion over the recovery period. Public administration exhibits strong gains from 3.8% in 2009 to 7.5% by 2013 (both significant at 1% level), indicating consistent government capacity building. These results confirm that emergency status generates meaningful economic transformation, with both sectors showing sustained growth throughout the post-disaster period.

Table 15 examines the year-by-year evolution of emergency status effects through an event study framework using 2008 as the reference point. The analysis tracks economic performance across 2005-2013, revealing systematic pre-existing differences that challenge the parallel trends assumption. Emergency status municipalities consistently exhibited higher per capita incomes (R$614.8 in 2007, significant at 1% level) but smaller absolute GDP (R$70.8 million lower in 2007, significant at 10% level), indicating smaller but more productive economies. Sectorally, these areas showed persistent agricultural advantages (R$3.7 million higher in 2007, significant at 1% level), industrial deficits (R$9.9 million lower in 2007, not significant), and service sector weaknesses (R$47.7 million lower in 2007, significant at 10% level), reflecting their rural and mixed-economy character rather than the industrial concentration of public calamity areas.

While GDP convergence from R$176.1 million deficit in 2005 to R$70.8 million in 2007 provides some reassurance, persistent sectoral differences raise identification concerns. Post-disaster, GDP effects emerge gradually from R$27.5 million in 2009 to R$478.1 million by 2013 (both significant), demonstrating sustained but modest recovery compared to public calamity municipalities (R$944.2 million by 2013). Industry shows steady recovery from R$4.2 million in 2009 to R$119.7 million in 2013, while services exhibit volatile patterns before reaching R$160.3 million by 2013. Public administration expands consistently from R$6.1 million to R$61.4 million, and tax revenues recover from negative effects in 2009 to R$83.1 million gains by 2013, though remaining statistically insignificant due to high cross-municipal variability.

Table 16 addresses identification concerns through nearest neighbour matching based on Mahalanobis distance, pairing emergency status municipalities with control areas that exhibited similar pre-disaster (2007) economic characteristics. This approach calculates the Average Treatment Effect on the Treated (ATET) by comparing matched pairs rather than relying on difference-in-differences assumptions.

The matching results reveal predominantly positive but statistically insignificant effects across most economic indicators. GDP shows gains of R$209.0 million, while agriculture records minor losses of R$1.2 million. Industry and services demonstrate positive impacts of R$78.9 million and R$113.7 million, respectively, though none achieve statistical significance. Only public administration exhibits significant effects at R$21.7 million (significant at 10% level), corroborating the capacity-building findings from previous specifications. Tax revenues show modest gains of R$17.6 million without statistical significance.

The largely non-significant results from the matching estimator likely reflect the challenges of identifying appropriate matches within Santa Catarina's limited pool of potential control municipalities, particularly given the widespread nature of the 2008 floods that affected areas beyond those receiving official classifications. The diverse characteristics of emergency status municipalities, encompassing both rural and urban areas with different economic structures, make it particularly difficult to identify truly comparable control municipalities based solely on pre-disaster observable characteristics. However, the direction and magnitude of effects remain broadly consistent with the difference-in-differences findings, providing additional support for the conclusion that emergency status generates positive but modest economic impacts.

Finally, the placebo test reveals significant pre-treatment effects for emergency status municipalities in 2006, with GDP showing R$83.6 million gains (significant at 5% level) and several sectors, including industry (R$26.7 million), services (R$48.7 million), and public administration (R$7.1 million) exhibiting significant differences before the 2008 floods. These findings raise concerns about the parallel trends assumption and suggest systematic pre-existing differences between emergency status municipalities and control areas that could compromise the identification strategy.

The matching approach struggles to find good control municipalities for emergency status areas because these communities are very diverse, mixing rural and urban areas. However, the difference-in-differences method works better since it compares the same municipalities over

time, which helps control for differences we cannot observe.
The results clearly show that Brazil's disaster system works in levels - municipalities with emergency status get less federal help and see smaller economic benefits than those with public calamity status. Emergency status areas recovered well, reaching R$478 million in GDP gains by 2013, but this was only half of what public calamity areas achieved (R$944 million). The same pattern appears in all sectors: industry, services, and public administration all grew less in emergency status municipalities.
This means that emergency status support is not enough to create the fast, strong economic growth seen in the most severely affected areas. The differences between the two groups show important problems with Brazil's disaster management system. Current rules may unfairly limit recovery opportunities for moderately affected communities.

Table 12: Difference-in-Differences Results - Emergency Status Municipalities vs Control Group (Post-2009)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
Emergency Status	189.151	684853.073**	-6745.046**	193555.196*	341489.900**	109690.604*	68139.991**
	(1273.846)	(328607.430)	(3091.183)	(109522.083)	(158483.040)	(55982.393)	(29217.272)
post_2009	-1498.568***	-23472.608***	3686.983***	-3896.871	11631.226**	-9949.759***	-4771.599***
	(359.433)	(7447.241)	(707.742)	(3341.226)	(5507.118)	(2414.984)	(707.547)
Emergency Status × Post	554.345	-98188.768*	-1421.018	-34603.210**	6867.870	-22169.992	-9399.941***
	(584.171)	(51087.073)	(1401.737)	(15252.653)	(10921.408)	(22338.944)	(3495.707)
Observations	2637	2637	2637	2637	2637	2637	2637

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes: This table presents difference-in-differences estimates comparing the 61 municipalities declared in "estado de emergência" (emergency status) against the 218 control municipalities. Emergency status represents a less severe disaster classification compared to public calamity, providing access to federal support but at lower levels than public calamity municipalities. The dependent variables are expressed in thousands of Brazilian reais (current prices). "treated3=1" indicates municipalities declared in emergency status. The interaction term "treated3=1 # post_2009=1" represents the difference-in-differences treatment effect for emergency status municipalities. Standard errors are clustered at the municipality level and reported in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. Sample includes 293 municipalities observed over 9 years (2005-2013), yielding 2,637 total observations.*

Table 13: Fixed Effects Results - Emergency Status Municipalities vs Control Group (Post-2009)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
Emergency Status × Post	8.631	117771.290**	-2585.822*	26598.618*	77379.513**	16378.981	16184.904**
	(407.426)	(50731.649)	(1338.477)	(13880.654)	(34241.847)	(9939.770)	(6822.961)
Observations	1465	1465	1465	1465	1465	1465	1465

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes: This table presents difference-in-differences estimates using fixed effects specification (reghdfe) that absorbs municipality and year fixed effects for the 61 municipalities declared in "estado de emergência" (emergency status) versus the 218 control municipalities. The sample is restricted to observations through 2009 to focus on immediate post-disaster effects. The dependent variables are expressed in thousands of Brazilian reais (current prices). Only the interaction term "treated3=1 # post_2009=1" is reported, representing the pure difference-in-differences treatment effect for emergency status municipalities after controlling for time-invariant municipal characteristics and common time trends. Standard errors are clustered at the municipality level and reported in parentheses. Significance levels: * p < 0.10, ** p < 0.05,*

**** p < 0.01. The reduced sample includes 1,465 observations covering the period 2005-2009.*

Table 14: Logarithmic Specification - Emergency Status Municipalities vs Control Group (Post-2009)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
Emergency Status × Post	-0.014	0.004	-0.078^{***}	-0.017	0.028	0.040	0.038^{***}
	(0.020)	(0.019)	(0.024)	(0.027)	(0.020)	(0.034)	(0.007)
Observations	1465	1465	1465	1465	1465	1465	1465

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes: This table presents difference-in-differences estimates using logarithmic transformations of all outcome variables for the 61 municipalities declared in "estado de emergência" (emergency status) versus the 218 control municipalities. The sample is restricted to observations through 2009 to focus on immediate post-disaster effects. The coefficients represent the percentage change in each outcome variable attributable to emergency status classification. Only the interaction term "treated3=1 #post_2009=1" is reported, representing the pure difference-in-differences treatment effect in log points. The specification includes municipality and year fixed effects with standard errors clustered at the municipality level. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. The reduced sample includes 1,465 observations covering the period 2005-2009.*

Table 15: Event Study Analysis - Emergency Status Municipalities Dynamic Effects

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
2005	247.443	-176119.899^{**}	4256.699^{***}	-47729.115
	(451.970)	(86576.294)	(1165.195)	(31377.468)
2006	1229.620^{***}	-114253.508^{*}	5704.510^{***}	-32140.406
	(367.805)	(61689.881)	(1433.895)	(27056.429)
2007	614.810^{***}	-70802.807^{*}	3708.136^{***}	-9866.676
	(183.902)	(38951.847)	(853.610)	(14797.108)

2009	531.599	27477.236***	831.514	4164.569
	(341.607)	(10000.960)	(935.089)	(6328.699)
2010	-17.090	210228.709*	1778.696	72761.098**
	(1050.148)	(106841.036)	(2282.512)	(36708.961)
2011	-826.342	292558.481**	364.577	96227.502**
	(1061.275)	(130807.077)	(1740.061)	(37790.659)
2012	-386.015	385657.031**	1142.514	111230.379**
	(1147.833)	(166621.679)	(1544.299)	(43365.446)
2013	-1044.391	478060.025**	1065.125	119659.449**
	(1270.882)	(201896.294)	(3796.822)	(46266.745)
Observations	2637	2637	2637	2637

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
-106222.252**	-26425.232	-18156.880**
(50757.210)	(18578.905)	(7474.549)
-67286.026*	-20531.585	-14030.163**
(34990.971)	(14782.966)	(5852.258)
-47712.381*	-16931.888	-8084.844**
(24606.586)	(10880.433)	(3370.572)
22074.348**	406.805	6116.932**
(8804.467)	(2267.068)	(2695.236)
19439.421	39141.925	24484.450**
(18435.545)	(35769.717)	(10022.439)
53221.411*	55963.066	34158.809**
(27385.112)	(42195.733)	(13724.813)
109951.926**	66335.705	44373.391**
(47807.639)	(46403.249)	(17581.718)
160259.724**	83062.383	61390.229**
(65392.546)	(55279.297)	(24104.010)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

*Notes: This table presents event study estimates examining the dynamic evolution of treatment effects over time for the 61 municipalities declared in "estado de emergência" (emergency status), with 2008 (the disaster year) as the omitted baseline category. Each coefficient represents the difference between emergency status municipalities and control municipalities in the given year relative to 2008. The dependent variables are expressed in thousands of Brazilian reais (current prices). The specification includes municipality and year fixed effects with standard errors clustered at the municipality level. Significance levels: * p < 0.10, ** p <*

*0.05, *** p < 0.01. Sample includes 293 municipalities observed over 9 years (2005-2013), yielding 2,637 total observations.*

Table 16: Matching Estimator Results - Emergency Status Municipalities ATET

	(1)	(2)	(3)	(4)	(5)	(6)
	GDP	AGRICULTURE	INDUSTRY	SERVICES	PUBLIC ADMIN.	TAXES
Emergency vs Control	208955.276	-1214.718	78923.318	113655.629	21688.803*	17591.044
	(157914.416)	(2009.559)	(48649.856)	(99584.961)	(12104.412)	(32093.833)
Observations	293	293	293	293	293	293

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.0$
*Notes: This table presents matching estimator results using nearest neighbor matching with Mahalanobis distance metric based on pre-disaster (2007) GDP levels for the 61 municipalities declared in "estado de emergência" (emergency status). The estimator identifies control municipalities most similar to emergency status municipalities in terms of pre-disaster economic performance and calculates the Average Treatment Effect on the Treated (ATET). The dependent variables are expressed in thousands of Brazilian reais (current prices). Standard errors are robust and reported in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. Sample includes 293 municipalities (one observation per municipality using 2007 as baseline year).*

Conclusion

This thesis addressed a fundamental question in disaster economics: how do official disaster classifications influence municipal economic outcomes? Using Brazil's catastrophic 2008 Santa Catarina floods as a natural experiment, this research analysed the causal impact of institutional disaster responses on local economic performance through a difference-in-differences framework comparing affected and unaffected municipalities over 2005-2013. The findings fundamentally challenge conventional assumptions about disaster impacts while revealing how effective institutional frameworks can transform crisis into a development opportunity.

The empirical results reveal a striking pattern that defies conventional wisdom. Rather than observing expected persistent negative effects, affected municipalities experienced substantial positive economic impacts that strengthened dramatically over time. By 2013, municipalities receiving official disaster classifications showed aggregate GDP gains exceeding R$500 million annually, representing a complete transformation from initial post-disaster contraction to sustained economic expansion. The sectoral analysis reveals pronounced heterogeneity: agriculture consistently experienced negative effects (R$2.4-3.5 million annually), reflecting both direct flood damage and limited capacity to benefit from infrastructure-focused federal transfers. Industry demonstrated remarkable recovery, transforming from initial losses of R$37.3 million to substantial gains of R$129.6 million by 2013. Services exhibited the most robust positive response, growing to R$167.9 million by 2013, while public administration expanded from negative R$12.0 million to positive R$54.3 million, reflecting enhanced institutional capacity enabled by federal support.

A critical finding demonstrates the graduated nature of Brazil's institutional disaster response system. Public calamity municipalities achieved effects nearly 50% larger than the overall treatment group, with GDP gains approaching R$800 million by 2013 for just 14 municipalities. Emergency status municipalities showed positive but more modest effects, achieving approximately half the magnitude of public calamity gains. This graduated pattern provides compelling evidence that institutional response intensity correlates directly with economic recovery trajectories, supporting theoretical frameworks about adaptive capacity while challenging assumptions that disasters necessarily impose net costs on affected communities.

This research makes three key original contributions to disaster economics literature. First, it provides the first systematic quantitative evidence that institutional disaster responses can generate net positive economic effects rather than merely mitigating damage, extending the literature beyond damage-focused studies to institutional analysis. Second, it demonstrates a graduated institutional response mechanism where classification intensity directly correlates with recovery magnitude, providing new insights into fiscal federalism in developing countries. Third, it reveals how disaster responses can catalyse structural economic transformation toward higher-productivity sectors, with persistent agricultural decline combined with strong growth in services and public administration indicating transitions toward modern economic activities that align with broader Brazilian development trends.

The findings have important policy implications for disaster management systems worldwide. Investment in disaster response institutional capacity can generate substantial returns through enhanced recovery and development, suggesting that disaster preparedness should be viewed as a development policy rather than merely emergency management. The graduated response pattern indicates that classification criteria and resource allocation mechanisms significantly influence economic outcomes, highlighting the importance of institutional design in disaster management systems. However, the analysis reveals concerning distributional implications, as metropolitan municipalities experienced substantially larger treatment effects than rural areas, suggesting that existing systems may systematically advantage areas with greater institutional capacity and potentially exacerbate regional inequalities.

For policymakers, these findings suggest several concrete recommendations. Disaster management systems should incorporate formal classification criteria with graduated response mechanisms that ensure appropriate resource allocation based on damage severity. Investment in rural and smaller municipal administrative capacity is essential to ensure equitable access to federal support programs. Enhanced transparency in federal transfer amounts and project completion rates would improve accountability and enable more effective resource allocation. Integration of disaster response planning with long-term development strategies could maximise the positive transformation potential identified in this research.

The Brazilian experience examined in this thesis provides valuable insights for other developing countries designing disaster management systems. The formal classification criteria, graduated response mechanisms, and federal transfer systems represent institutional innovations that appear to generate meaningful economic benefits for affected communities. However, the concentration of benefits in urban areas with stronger institutional capacity highlights the critical importance of ensuring that disaster response systems address rather than exacerbate existing inequalities.

While this analysis provides valuable insights into institutional disaster responses, methodological limitations require acknowledgement. Most importantly, placebo tests reveal significant pre-treatment differences between affected and unaffected municipalities, suggesting that the parallel trends assumption underlying the difference-in-differences identification may be violated. This indicates that at least part of the observed post-disaster differences could reflect pre-existing trajectories rather than purely causal impacts of disaster classifications. While the balance of evidence, including the graduated pattern across classification levels and temporal evolution consistent with policy implementation timelines, suggests that institutional responses played an important role in driving positive outcomes, the results should be interpreted as documenting strong correlations rather than definitive causal effects. Additional limitations stem from data constraints preventing direct analysis of federal transfer amounts and project completion rates, restricting the ability to provide guidance on optimal program design or resource allocation strategies.

This research opens several promising avenues for future investigation. Similar analyses in other Brazilian states or countries with different institutional arrangements could identify which specific institutional features drive positive disaster outcomes. Comparative studies across different disaster types could reveal whether the mechanisms identified here apply broadly or are specific to flood events. Access to detailed federal transfer data would enable more precise analysis of specific program components, while research examining micro-level mechanisms could provide deeper insights into institutional processes. Longer-term follow-up studies could assess whether positive effects persisted beyond 2013, informing cost-effectiveness evaluations. Research on distributional consequences could address concerning patterns of metropolitan advantage, while integration of climate change projections with institutional analysis could inform adaptive capacity building for future disasters.

As climate change intensifies disaster frequency and severity worldwide, understanding how institutional arrangements can effectively support recovery and development becomes increasingly urgent. This thesis demonstrates that institutional design choices determine whether crises become development opportunities or perpetuate vulnerability. The Brazilian experience offers both a model for transformation and a warning about equity, the same institutions that can build resilience may also deepen existing inequalities if not carefully designed. Building resilient economic systems capable of transforming crisis into opportunity represents one of the most critical challenges facing developing countries in an era of increasing climate volatility, making continued research on institutional mechanisms in disaster management essential for sustainable development.

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Appendix

A.1 All Affected Municipalities - Extended Time Periods

Table A1: Difference-in-Differences Results - All Affected Municipalities vs Control Group (Post-2010)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
All Treated	1333.192	944932.156***	-8914.126***	252548.711***
	(1249.387)	(307419.051)	(2744.619)	(94007.604)
post_2010	82.223	1392.456	3666.216***	-1943.595
	(165.744)	(1485.581)	(455.679)	(1184.971)
All Treated × Post	130.163	6727.089	-1747.440***	5500.786
	(304.115)	(12083.460)	(671.897)	(7657.479)
Observations	2637	2637	2637	2637

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
465781.066***	182943.667***	82812.516***
(151223.877)	(65373.025)	(25476.345)
1677.143**	-823.861**	557.086***
(798.339)	(348.045)	(69.724)
10803.562	-3078.779	1202.574
(7372.820)	(2789.648)	(785.422)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A2: Difference-in-Differences Results - All Affected Municipalities vs Control Group (Post-2011)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTU RE	INDUSTRY
All Treated	1369.156	904257.354***	-8514.310***	239324.853***
	(1230.493)	(295019.692)	(2686.268)	(89975.301)
post_2011	2107.539***	27143.305***	4103.216***	5019.625***
	(242.321)	(3808.820)	(450.945)	(1566.261)
All Treated × Post	-21.118	126509.130***	-2364.408***	43338.765***
	(368.939)	(43289.012)	(701.088)	(16288.138)
Observations	2637	2637	2637	2637

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
456927.914***	173114.475***	78684.047***
(148389.370)	(61954.230)	(24267.983)
5370.285***	3695.441***	4429.480***
(1747.863)	(690.238)	(519.295)
33761.829***	27435.057***	13187.124***

(12963.561)	(10442.927)	(4059.999)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A3: Difference-in-Differences Results - All Affected Municipalities vs Control Group (Post-2012)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
All Treated	1322.492	822326.184***	-8202.022***	217428.979***	430560.279***	154381.149***	70493.349***
	(1199.350)	(270707.128)	(2603.189)	(83405.390)	(140426.823)	(55388.500)	(21902.052)
post_2012	4580.882***	60890.095***	4614.908***	12783.045***	16435.211***	8461.534***	9231.559***
	(346.665)	(8675.404)	(553.576)	(2847.910)	(3828.037)	(1327.583)	(1094.930)
All Treated × Post	89.155	279226.980***	-2475.953***	81769.792***	84648.551***	62726.275***	28319.414***
	(526.868)	(88283.568)	(827.611)	(27270.717)	(27968.928)	(23541.251)	(8367.467)
Observations	2637	2637	2637	2637	2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A3: Difference-in-Differences Results - All Affected Municipalities vs Control Group (Post-2013)

	(1)	(2)	(3)	(4)
	GDP PER	GDP	AGRICULTU	INDUSTRY

	CAPITA		RE		(5) SERVICES	(6) TAXES	(7) PUBLIC ADMIN.
All Treated	1458.342	666193.989***	-7357.649***	181747.326**	374904.105***	116900.206***	52919.437***
	(1161.130)	(225341.076)	(2137.826)	(73065.173)	(124221.174)	(42635.432)	(16906.863)
post_2013	8786.196***	116846.044***	10644.108***	24990.073***	34112.723***	15193.658***	17250.540***
	(553.939)	(15894.817)	(901.642)	(4803.465)	(6788.677)	(2408.485)	(2078.199)
All Treated × Post	-173.205	504419.536***	-3500.634*	129642.808***	167899.953***	117646.718***	54288.571***
	(821.631)	(154235.576)	(1811.334)	(40967.120)	(52458.098)	(43698.867)	(15709.960)
Observations	2637	2637	2637	2637	2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A5: Fixed Effects Results - All Affected Municipalities vs Control Group (Post-2010)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTU RE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
All Treated × Post	5.013	285465.256***	-3303.917**	76302.172***	101680.523***	62964.682***	31095.653***
	(518.746)	(91257.411)	(1356.932)	(27296.519)	(33059.379)	(23286.218)	(9231.736)
Observations	1758	1758	1758	1758	1758	1758	1758

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A6: Fixed Effects Results - All Affected Municipalities vs Control Group (Post-2011)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
All Treated × Post	-110.303	364572.496***	-3521.069**	100916.293***	115785.638***	83649.326***	38951.734***
	(653.873)	(114313.566)	(1414.798)	(33491.064)	(37413.585)	(31121.956)	(11439.789)
Observations	2051	2051	2051	2051	2051	2051	2051

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A7: Fixed Effects Results - All Affected Municipalities vs Control Group (Post-2012)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
All Treated × Post	-46.694	435359.176***	-3320.326**	117451.445***	140304.724***	100207.218***	45893.325***
	(740.858)	(134813.057)	(1427.850)	(37898.001)	(44688.519)	(37352.108)	(13390.166)
Observations	2344	2344	2344	2344	2344	2344	2344

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A8: Fixed Effects Results - All Affected Municipalities vs Control Group (Post-2013)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
All Treated × Post	-173.205	504419.536***	-3500.634*	129642.808***
	(822.568)	(154411.611)	(1813.402)	(41013.877)
Observations	2637	2637	2637	2637

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
167899.953***	117646.718***	54288.571***
(52517.970)	(43748.742)	(15727.891)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A9: Logarithmic Specification - All Affected Municipalities vs Control Group (Post-2010)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
All Treated × Post	-0.012	0.030	-0.094***	0.006
	(0.023)	(0.024)	(0.029)	(0.044)
Observations	1758	1758	1758	1758

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
0.093***	0.036	0.053***
(0.026)	(0.041)	(0.007)
1758	1758	1758

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A10: Logarithmic Specification - All Affected Municipalities vs Control Group (Post-

2011)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
All Treated × Post	-0.011	0.044	-0.108***	0.006
	(0.027)	(0.028)	(0.033)	(0.051)
Observations	2051	2051	2051	2051

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
0.111***	0.022	0.063***
(0.032)	(0.050)	(0.008)
2051	2051	2051

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A11: Logarithmic Specification - All Affected Municipalities vs Control Group (Post-2012)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
All Treated × Post	-0.005	0.058*	-0.100***	0.008
	(0.030)	(0.031)	(0.035)	(0.056)
Observations	2344	2344	2344	2344

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
0.123***	0.015	0.070***
(0.034)	(0.055)	(0.009)
2344	2344	2344

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A12: Logarithmic Specification - All Affected Municipalities vs Control Group (Post-2013)

	(1)	(2)	(3)	(4)

	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
					(5)	(6)	(7)
All Treated × Post	-0.011	0.061*	-0.102***	0.005	0.128***	0.016	0.078***
	(0.031)	(0.033)	(0.038)	(0.059)	(0.036)	(0.058)	(0.010)
Observations	2637	2637	2637	2637	2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A13: Placebo Test - All Affected Municipalities (Fake Treatment 2006)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP	GDP PER CAPITA	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
treated=1 # placebo_post=1	114670.837***	761.689***	317.585	35558.439**	58950.678***	19844.135**	8733.357***
	(36881.161)	(244.248)	(604.065)	(13853.251)	(19362.406)	(9958.623)	(2584.515)
Observations	879	879	879	879	879	879	879

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

A.2 Most Severely Affected Municipalities - Extended Time Periods

Table A14: Difference-in-Differences Results - Most Severely Affected Municipalities vs Control Group (Post-2010)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY

Public Calamity	4815.871	1507248.004*	-13050.000***	371416.744*
	(3101.241)	(856834.327)	(3383.076)	(197770.996)
post_2010	136.506	2636.473	3402.709***	-885.130
	(144.100)	(3224.222)	(379.901)	(2153.089)
Public Calamity × Post	-457.354	9041.462	-3596.818***	6530.509
	(562.091)	(18540.223)	(838.883)	(8482.768)
Observations	2637	2637	2637	2637

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
710236.285*	372851.504	104176.885*
(427497.983)	(252554.776)	(55667.158)
3285.868*	-1059.705	800.294***
(1764.381)	(728.537)	(209.704)
22664.548	-11117.765**	1180.576
(19556.673)	(4707.631)	(854.915)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A15: Difference-in-Differences Results - Most Severely Affected Municipalities vs Control Group (Post-2011)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTU RE	INDUSTRY
Public Calamity	4490.825	1445440.336*	-12558.166***	353755.134*
	(3030.244)	(826090.342)	(3399.244)	(188992.922)
post_2011	2070.252***	49514.832***	3699.208***	13077.614***
	(203.046)	(10735.050)	(382.324)	(4223.334)
Public Calamity × Post	670.236	191450.645*	-3873.381***	57338.503*
	(491.454)	(102358.365)	(830.767)	(31455.869)
Observations	2637	2637	2637	2637

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
696586.050*	353499.269	98938.698*
(420697.443)	(240664.234)	(53023.370)
11103.281***	8110.906***	6926.536***
(3326.241)	(2197.442)	(1084.869)
56060.405*	50644.860	16501.612*
(31033.515)	(34540.737)	(8451.880)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A16: Difference-in-Differences Results - Most Severely Affected Municipalities vs Control Group (Post-2012)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTU RE	INDUSTRY
Public Calamity	3948.149	1321987.266*	-12337.106***	325727.145*
	(2883.791)	(760796.294)	(3259.797)	(174799.581)
post_2012	4520.734***	110325.474***	4160.606***	28087.683***
	(289.505)	(21783.112)	(466.165)	(7109.949)
Public Calamity × Post	1723.697**	421357.392*	-3402.421***	106066.853*
	(743.565)	(224158.476)	(899.247)	(55554.148)
Observations	2637	2637	2637	2637

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
660126.598	313293.823	88913.583*
(400160.990)	(214896.368)	(47930.469)
31596.430***	17952.235***	14618.109***
(7196.018)	(4602.175)	(2242.234)

124079.069*	128445.899	34932.716*
(70259.229)	(83920.946)	(17813.153)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A17: Difference-in-Differences Results - Most Severely Affected Municipalities vs Control Group (Post-2013)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
Public Calamity	3398.725	1081807.088*	-10528.170***	279465.297*	583674.888	229195.071	67170.973*
	(2612.670)	(633234.933)	(2746.902)	(152426.864)	(357637.413)	(161718.427)	(36992.888)
post_2013	8629.900***	205756.907***	10057.575***	49256.891***	64626.129***	32362.012***	27571.036***
	(459.560)	(37802.321)	(818.770)	(10812.135)	(13395.410)	(8110.747)	(4210.276)
Public Calamity × Post	2367.921*	769410.234*	-5978.022***	168124.808**	236876.334*	254134.472	67082.870**
	(1321.073)	(408940.004)	(1811.593)	(84741.969)	(133974.152)	(163123.832)	(34022.985)
Observations	2637	2637	2637	2637	2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A18: Fixed Effects Results - Most Severely Affected Municipalities vs Control Group

(Post-2010)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
Public Calamity × Post	959.792	434482.378*	-6118.649***	98481.956*
	(875.784)	(238195.096)	(1091.890)	(52656.255)
Observations	1758	1758	1758	1758

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
149225.945*	132538.667	38186.487*
(85964.697)	(89380.309)	(19503.647)
1758	1758	1758

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A19: Fixed Effects Results - Most Severely Affected Municipalities vs Control Group (Post-2011)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
Public Calamity × Post	1762.336*	555083.893*	-5903.377***	131628.340*
	(994.342)	(295532.333)	(1215.594)	(67992.701)
Observations	2051	2051	2051	2051

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
168971.566*	174949.058	48269.336*
(94905.727)	(113732.744)	(24559.834)
2051	2051	2051

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A20: Fixed Effects Results - Most Severely Affected Municipalities vs Control Group

(Post-2012)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
Public Calamity × Post	2273.121**	661537.570*	-5211.358***	152328.700*
	(1137.589)	(352011.270)	(1423.746)	(77998.644)
Observations	2344	2344	2344	2344

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
200530.779*	212544.651	56675.326*
(113580.054)	(137393.158)	(28829.576)
2344	2344	2344

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A21: Fixed Effects Results - Most Severely Affected Municipalities vs Control Group (Post-2013)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
Public Calamity × Post	2367.921*	769410.234*	-5978.022***	168124.808**
	(1322.581)	(409406.742)	(1813.661)	(84838.688)
Observations	2637	2637	2637	2637

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
236876.334*	254134.472	67082.870**
(134127.061)	(163310.011)	(34061.817)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A22: Logarithmic Specification - Most Severely Affected Municipalities vs Control

Group (Post-2010)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
Public Calamity × Post	-0.014	0.021	-0.114^{**}	0.019	0.077^{***}	0.096	0.035^{***}
	(0.027)	(0.030)	(0.049)	(0.053)	(0.023)	(0.072)	(0.011)
Observations	1758	1758	1758	1758	1758	1758	1758

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A23: Logarithmic Specification - Most Severely Affected Municipalities vs Control Group (Post-2011)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
Public Calamity × Post	0.023	0.070^{*}	-0.120^{**}	0.063	0.127^{***}	0.141	0.044^{***}
	(0.034)	(0.040)	(0.054)	(0.064)	(0.032)	(0.097)	(0.014)
Observations	2051	2051	2051	2051	2051	2051	2051

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A24: Logarithmic Specification - Most Severely Affected Municipalities vs Control

Group (Post-2012)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
Public Calamity × Post	0.040	0.097^{**}	-0.107^{*}	0.080
	(0.041)	(0.048)	(0.062)	(0.072)
Observations	2344	2344	2344	2344

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
0.143^{***}	0.168	0.051^{***}
(0.040)	(0.112)	(0.016)
2344	2344	2344

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A25: Logarithmic Specification - Most Severely Affected Municipalities vs Control Group (Post-2013)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
Public Calamity × Post	0.036	0.103^{*}	-0.120^{*}	0.079
	(0.047)	(0.055)	(0.070)	(0.079)
Observations	2637	2637	2637	2637

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
0.142^{***}	0.199	0.058^{***}
(0.048)	(0.126)	(0.018)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A26: Placebo Test - Most Severely Affected Municipalities (Fake Treatment 2006)

	(1)	(2)	(3)	(4)
	GDP	GDP PER CAPITA	AGRICULTURE	INDUSTRY
treated2=1 # placebo_post=1	176023.056*	746.754*	-283.432	51739.699*
	(101193.388)	(389.166)	(679.673)	(29424.209)
Observations	879	879	879	879

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
70168.324	54398.468	10815.086*
(43866.394)	(45338.706)	(5955.679)
879	879	879

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

A.3 Emergency Status Municipalities - Extended Time Periods

Table A27: Difference-in-Differences Results - Emergency Status Municipalities vs Control Group (Post-2010)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
Emergency Status	188.343	672772.687**	-6677.355**	188699.008*
	(1295.758)	(321838.547)	(3015.576)	(106434.938)
post_2010	58.108	2007.827	3435.257***	-1489.554
	(159.305)	(1780.317)	(434.904)	(1223.131)
Emergency Status × Post	280.808	5267.355	-1015.118	4551.243
	(326.904)	(14299.739)	(713.134)	(9235.820)
Observations	2637	2637	2637	2637

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
340885.194**	107324.157*	66858.909**
(157774.383)	(54576.418)	(28663.467)

3129.390**	-1503.137***	642.270***
(1436.500)	(464.360)	(85.120)
6155.113	-435.985	1064.900
(7876.402)	(3222.341)	(951.453)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A28: Difference-in-Differences Results - Emergency Status Municipalities vs Control Group (Post-2011)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
Emergency Status	322.141	642943.876**	-6351.414**	178313.023*
	(1289.390)	(308292.933)	(2948.125)	(101876.061)
post_2011	2145.407***	39936.085***	3847.304***	8932.235***
	(229.602)	(7807.340)	(431.407)	(2584.403)
Emergency Status × Post	-214.189	92998.002*	-1654.568**	34192.118*
	(397.223)	(47811.884)	(760.491)	(18759.828)
Observations	2637	2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A29: Difference-in-Differences Results - Emergency Status Municipalities vs Control Group (Post-2012)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
Emergency Status	421.393	582563.831**	-6050.684**	160772.068*
	(1277.335)	(282456.980)	(2856.645)	(94433.356)
post_2012	4680.410***	89057.184***	4384.164***	20044.587***
	(329.506)	(17268.787)	(525.912)	(4646.802)
Emergency Status × Post	-383.958	205603.602**	-1917.569**	65111.236**

	(557.452)	(95544.480)	(901.768)	(31127.376)
Observations	2637	2637	2637	2637

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
314091.235**	90948.543**	56846.786**
(146054.326)	(46051.450)	(24633.782)
24765.827***	16714.151***	11643.823***
(5926.136)	(5593.403)	(1603.148)
63363.963**	36627.140*	23059.727**
(30336.571)	(21292.223)	(9466.556)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A30: Difference-in-Differences Results - Emergency Status Municipalities vs Control Group (Post-2013)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTU RE	INDUSTRY
Emergency Status	734.865	468893.016**	-5580.242**	132353.368
	(1267.109)	(235131.298)	(2319.324)	(82739.775)
post_2013	8918.516***	168198.589***	10251.356***	36500.683***
	(527.164)	(31539.107)	(859.270)	(7390.537)
Emergency Status × Post	-871.416	369090.350**	-2380.851	103242.648**
	(852.532)	(164510.691)	(2079.075)	(46595.509)
Observations	2637	2637	2637	2637

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
270978.257**	71141.631*	42555.146**
(128640.207)	(36502.298)	(19015.304)

50110.399***	31425.451***	21881.510***
(11027.621)	(10858.865)	(3056.865)
128294.531**	64954.153*	44172.734**
(56690.434)	(37680.407)	(17711.819)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A31: Fixed Effects Results - Emergency Status Municipalities vs Control Group (Post-2010)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
Emergency Status × Post	-265.714	209147.026**	-2112.231	60896.883*
	(558.556)	(97950.915)	(1543.368)	(31459.583)
Observations	1758	1758	1758	1758

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
76062.049**	35746.542*	25368.663**
(35519.193)	(19557.245)	(10462.051)
1758	1758	1758

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A32: Fixed Effects Results - Emergency Status Municipalities vs Control Group (Post-2011)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
Emergency Status × Post	-626.913	267048.862**	-2425.740	80151.772**
	(687.238)	(122994.397)	(1610.000)	(38242.058)
Observations	2051	2051	2051	2051

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
86883.558**	47809.442*	31654.702**
(40487.049)	(27481.199)	(12920.079)
2051	2051	2051

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A33: Fixed Effects Results - Emergency Status Municipalities vs Control Group (Post-2012)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY	SERVICES	TAXES	PUBLIC ADMIN.
Emergency Status × Post	-697.430	319274.418**	-2388.011	93529.936**	106476.941**	56434.052*	37351.367**
	(773.606)	(144565.622)	(1615.477)	(43160.532)	(48344.991)	(32740.131)	(15114.649)
Observations	2344	2344	2344	2344	2344	2344	2344

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A34: Fixed Effects Results - Emergency Status Municipalities vs Control Group (Post-2013)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
Emergency Status × Post	-871.416	369090.350**	-2380.851	103242.648**
	(853.505)	(164698.453)	(2081.448)	(46648.690)

Observations	2637	2637	2637	2637

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
128294.531**	64954.153*	44172.734**
(56755.137)	(37723.413)	(17732.034)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A35: Logarithmic Specification - Emergency Status Municipalities vs Control Group (Post-2010)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTU RE	INDUSTRY
Emergency Status × Post	-0.010	0.030	-0.078**	0.001
	(0.027)	(0.027)	(0.033)	(0.048)
Observations	1758	1758	1758	1758

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
0.087***	0.015	0.052***
(0.030)	(0.046)	(0.008)
1758	1758	1758

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A36: Logarithmic Specification - Emergency Status Municipalities vs Control Group (Post-2011)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTU RE	INDUSTRY
Emergency Status × Post	-0.019	0.031	-0.092**	-0.010
	(0.030)	(0.032)	(0.038)	(0.055)

Observations	2051	2051	2051	2051

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
0.093**	-0.015	0.060***
(0.036)	(0.053)	(0.009)
2051	2051	2051

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A37: Logarithmic Specification - Emergency Status Municipalities vs Control Group (Post-2012)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
Emergency Status × Post	-0.017	0.040	-0.086**	-0.014
	(0.033)	(0.035)	(0.039)	(0.059)
Observations	2344	2344	2344	2344

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
0.102***	-0.030	0.067***
(0.039)	(0.058)	(0.010)
2344	2344	2344

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A38: Logarithmic Specification - Emergency Status Municipalities vs Control Group (Post-2013)

	(1)	(2)	(3)	(4)
	GDP PER CAPITA	GDP	AGRICULTURE	INDUSTRY
Emergency Status × Post	-0.023	0.042	-0.084**	-0.017

	(0.034)	(0.037)	(0.042)	(0.062)
Observations	2637	2637	2637	2637

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
0.109***	-0.038	0.075***
(0.040)	(0.061)	(0.012)
2637	2637	2637

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A39: Placebo Test - Emergency Status Municipalities (Fake Treatment 2006)

	(1)	(2)	(3)	(4)
	GDP	GDP PER CAPITA	AGRICULTU RE	INDUSTRY
treated3=1 # placebo_post=1	83591.742**	674.772**	449.624	26725.574*
	(38936.701)	(276.446)	(641.942)	(15681.635)
Observations	879	879	879	879

(5)	(6)	(7)
SERVICES	TAXES	PUBLIC ADMIN.
48723.048**	7693.495	7099.376**
(21700.478)	(6118.248)	(2875.735)
879	879	879

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$