NATURAL DISASTERS, INSTITUTIONS, ECONOMIC RECOVERY: LONG-TERM EFFECTS OF HURRICANE KATRINA

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ABSTRACT

This study analyzes the effects of Hurricane Katrina on formal and informal institutions in Louisiana, Florida, and Mississippi to provide insights into the recovery trajectories of the states. I use the synthetic control method to construct counterfactual states. I find that the hurricane had large and lingering effects on population and per capita income in all three states, with differing impacts on formal and informal institutions. In Louisiana, the hurricane led to increases in labor market freedom, minimum wage freedom (i.e. deregulation), and property tax freedom (i.e. tax reduction), along with permanent increases in government spending and the government employment. In Florida, it led to decreases in the above three economic freedom indicators, whereas government spending increased. Results for Mississippi indicate a consistent increase in government spending. Moreover, we find that social capital remained robust to the shock in Louisiana, with no pre-treatment fit in Florida and Mississippi.

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INTRODUCTION

Background

Natural disasters' impact on human life and economic performance provides an extensive and multidisciplinary body of research. Conclusions and policy recommendations on how affected areas can best cope and recover from disasters vary considerably. A common explanation for this divergence is the heterogeneity of institutions within societies that undergo disasters (Ostrom 1990). Another critical factor is the nature and extent of the disaster. Both considerations provide a complex theoretical problem with critical real-world implications. Disasters are unavoidable in many respects, and approaches to mitigating harm and providing recovery relief take a variety of forms.

The number of natural disasters is on the rise, with a tenfold increase in the total number of disasters since the 1960's, with poorer communities being hit harder than ever (Bendimerad, 2000; Kahn, 2005). In 2020 alone, over 100 natural disasters struck the United States causing over 250 deaths and $119 billion in damages. Natural disasters shape the world in many ways; from the buildings constructed, to the policies that guide their construction. Economic outcomes, especially changes in GDP per capita provides a useful metric to assess the disruption and recovery of exchange and production within an area impacted by disaster. Other scholars have hinted that institutions are the answer to the question 'why do some countries (and states) recover while others fail to?'.

Problem Statement

This thesis examines the impact of hurricanes on formal and informal institutions. Unlike many other natural disasters, hurricanes are largely predictable (occurring during hurricane season and affecting coastal states in the Southeastern region) and can be quantitatively

categorized according to level.[1] Hurricanes are also among the most detrimental natural disasters on several margins. The Spatial Hazard Events and Losses Database (SHELDUS) finds that eight of the ten costliest natural catastrophes in United States history, including the top six, are hurricanes (2021). Hurricanes also occur frequently. In 2020, six major storms made landfall on the United States (Masters, 2020). The increase in frequency and percentage of category 4 and 5 hurricanes has been well documented (Klotzbach 2015, Klotzbach et al. 2018) and is projected to worsen due to climate change (Grinsted et al. 2013). This makes examining hurricanes specifically fruitful and understanding what is needed for disaster relief policy crucial for contemporary policy and emergency management research.

Coastal states typically impacted by hurricanes also differ considerably in terms of geographic, demographic, and institutional considerations. This heterogeneity makes examining their response to similar natural disasters particularly useful for policy and institutional analysis purposes.

This thesis uses the synthetic control method to study the long-term impacts of disasters on formal and informal institutions. We use several economic freedom indicators from the Fraser Institute as measures of formal institutions. These indicators quantify the level of government restrictions (or lack thereof) on economic activities. The Fraser Institute's economic freedom indicators are indexed variables that can be further disaggregated to create measures for levels of tax freedom, government spending, and labor market freedom. Because the synthetic control method relies on our ability to achieve good pre-treatment fit, we are able to utilize these

[1] Categorizing Hurricanes is done on the Saffir-Simpson Scale, which is based on the maximum sustained wind speed. The scale is distributed as follows: category 1 has winds of 74 to 95 miles per hour; category 2, 96 to 110 mph; category 3, 111 to 129 mph; category 4, 130 to 156 mph; and category 5, anything with above 157 mph winds. Category 3 and above are considered by the National Hurricane Center and Central Pacific Hurricane Center to be "major" hurricanes where electricity and water are likely to become unavailable for weeks and possibly months (2022)

diverse measures to look at which variables provide us with great fit. Measuring informal institutions is trickier; informal institutions are difficult to gauge, but social capital is a commonly used proxy to measure informal institutions (Adler & Kwon, 2002; Aldrich, 2012; Chamlee-Wright & Storr, 2011; Portes, 1998). We use the publicly available data on social capital provided by Hawes (2017). The data compiled by Hawes (2017) measures social capital indices for all U.S. states from 1998 to 2010.

This paper contributes to the growing literature examining how institutional arrangements and designs impact natural disaster recovery. A better understanding of what institutions are in place that lead to better recovery in a post-disaster setting may aid in guiding policy discussion, especially in regions prone to natural disasters. This thesis also compares the damages the disaster did to different economic factors across multiple states and comparing those results.

Summary of Results

In Louisiana I find a significant negative effect on per capita income, population, labor market freedom, minimum wage freedom, property freedom, government spending, and government employment resulting from Katrina.

The Florida synthetic finds a significant deviation for labor market freedom, minimum wage freedom, property tax freedom, and government spending.

Mississippi's synthetic demonstrates comparatively less significances for many outcome variables. However, government spending increased relative to the synthetic at a significant level for a singular time period immediately following the hurricane.

The results strongly suggest that some states are impacted by disaster mo reso than others, via their institutions. There is not a significant deviation between the actual region after a

disaster and the synthetic in some states, suggesting that there are institutions in place that can withstand strong exogenous shocks and decrease economic recovery time.

This paper proceeds as follows. Section 2 reviews literature examining property rights, formal and informal institutions, economic repercussions of natural disaster, and Hurricane Katrina-specific papers. Section 3 outlines our empirical approach and reviews data used in the analysis. Section 4 is the results portion that is broken up in to three parts; one for each state in our investigation. Section 5 is discussion about our findings. Finally, section 6 is concluding remarks.

LITERATURE REVIEW

Disentangling economic and broader institutional considerations into disaster impact is essential to understanding how natural disasters interact with a region. Understanding what occurred within states impacted by Hurricane Katrina specifically warrants further investigation. This section reviews previous on these interrelated subjects.

Property Rights Protecting Institutions

There is a general consensus among economists that secure property rights lead to long-term economic development and better resource allocation (Acemoglu, Johnson and Robinson, 2001; Demsetz, 1970; Kerekes and Williamson, 2008, Feder and Feeny 1991)). Secure property rights reduce the probability of conflict resulting from competition over the control of economic resources by clarifying the bundles of rights endowed to different actors (Demsetz, 1974). By extension, property rights also increase productivity and economic growth, because they provide a more efficient substitute to violence and sets expectations conducive to economic progress (North et al., 2009).

The lesser understood question of how to secure property rights remains contentious. Acemoglu and Johnson (2005) describe property rights protecting institutions as those aimed at constraining the government from engaging in public predation. It is in a state's best interest to increase production and secure rights for the populace because it will lead to more stability and development(Clague et al., 1996). While formal institutions are critical, and comparatively easier to measure (Ballo, 2017). Williamson and Kerekes (2011) find that informal property securing institutions matter more than the formal ones. Similarly, Murtazashvili and Murtazashvili (2016) argue that the security of property comes from customary rules and norms, not formalized legal

institutions. The authors argue formal institutions have very little importance when not backed by customary systems of law that maintain order.

Using the framework developed by Acemoglu and Robinson (2012), we can examine the role of formal and informal institutions in natural disaster recovery in addition to broader development and growth. Societies left bare in the wake of a disaster rely heavily on previous institutional arrangements for recovery. However, post-disaster environments also provide a breeding ground for institutional change for both formal and informal institutions (Yamamura, 2014). Governing bodies, which provide formal institutional structure, are often in search of manners in which to mitigate disasters and stabilize the region. Oftentimes, this results in policy changes that are intended to secure property-rights, and thus strengthen institutions (Liang and Cao, 2015; Smith, Sandler, and Goralnik, 2013). However, formal institutional change provides ineffective or sluggish governance, whereas informal institutions can provide group-specific rules and guidance to address collective action issues (Leeson, 2014, 2014; Leeson & Boettke, 2009; Ostrom, 1990; Rayamajhee and Bohara, 2021).

Economic Impacts of Disasters

Many studies show that disasters lead to increases in per capita income, employment, long-run growth, and even interpersonal connectivity (Barone & Mocetti, 2014; Belasen & Polachek, 2008; Benson, 1997; Kaniasty, 2020; Park & Wang, 2017; Popp, 2006; Skidmore & Toya, 2002). Other studies show that there indeed have been economic losses, and that some have been increasing in the past decades, and the human capital losses are felt for generations (Botzen et al., 2019; Caruso, 2017; Paudel & Ryu, 2018; Shakya et al., 2022). Previous literature finds institutional considerations can mitigate the extent of harm disasters cause but there are studies that show that the economic impact of a disaster is negligible or even has a

positive impact (Barone and Mocetti, 2014; Albala -Bertrand, 1993)[2]. Park and Wang (2017) research the impact that government subsidies have on a region after a natural disaster by comparing the governmental response by China after different disasters and conclude that government support for victims is highly indicative of poverty levels, income, and other economic indicators in their study. The rollout for government aid in response to a disaster is complex, and money is often allocated unevenly and delayed, drastically altering outcomes in the short run (Attary et al., 2020). Longer-term studies on the impact of disasters on institutional quality indicate that economic losses have been increasing in the past decades, and the human capital losses are felt for generations (Botzen, Deschenes, and Sanders, 2019; Caruso, 2017). In examining differing institutional structures within two regions in Italy, Barone and Mocetti (2014) attribute differing recovery periods can be explained by institutional considerations.

This research also suggests that the ramifications of policy changes are of high importance with regards to both economic impact and human capital- a question of formal institutional arrangements. On the other hand, several research papers have found a positive impact of natural disasters in the long-term; Schumpeterian creative destruction theory is the basis for endogenous growth models may explain this growth. Those models predict that in an area impacted by natural disasters, growth may increase following a negative shock because of efforts to rebuild, including higher investments and thus 'productivity effects' leave their mark on the economy for years after (Panwar & Sen, 2020; Berlemann & Wenzel, 2016; Jaramillo, 2009; Noy & Nualsri, 2007; Raddatz, 2009).

[2] There are several potential problems with their methods that may contribute to their findings. The main variable that is not considered in their research is the role that governmental aid plays in economic recovery. The increase in GDP and income caused by federal aid may be responsible for their conclusion that a natural disaster has little effect on economic development in both the long and short run

Disasters and Institutions

Disasters can also affect formal property rights protecting institutions such as those that preserve and validate documentation related ownership and transfer of assets (Rayamajhee, 2020; Rayamajhee & Paniagua, 2021). Clearly defined and enforced property rights are significant contributors to positive economic development (Acemoglu et al., 2005; De Soto, 2001; Libecap, 2003; Norton, 2000). De Vries and Warner (2010) use a case study method to compare the effect of natural disasters on formal property rights, and show that the institutions in place prior to a disaster and the post-disaster policies related to the enforcement of property rights impact economic recovery (de Vries & Warner, 2010).

Disasters can also affect informal institutions(DiGiano & Racelis, 2012; Jessamy & Turner, 2003). Solecki (2015) states that in the wake of the 2012 Hurricane Sandy, there was a "broad-scale strengthening of local social capacity via social media and a variety of informal networks"(91) (Solecki, 2015). DiGiano and Racelis (2012) find, in their study examining effects of Hurricane Dean, strong informal institutions are critical to how "social-ecological systems experience and ultimately respond to severe disturbances" (151). Jessamy and Turner (2003) examine the effects on institutions after a disaster (Hurricane Lenny) and find that informal institutions are bolstered and, like DiGiano and Racelis, recovery is linked to strong informal institutions prior to the disaster.

One of the more relevant papers written on the subject of natural disasters and economic growth is a previously mentioned article titled *Natural disasters, growth and institutions: A tale of two earthquakes* by Barone and Mocetti. The paper by Barone and Mocetti has a similar research question, and along with that, the authors saw fit to examine the problem by using the same method that Abadie has championed, and we followed. The article that they wrote is

dedicated to examining the effect of natural disasters on per capita GDP, which is the initial analysis that we wish to create in our paper. In the synthetic control that they create, there are only seven donor pools used, which is a stark contrast to the pool that we are using, the 50 states minus Louisiana and the other states impacted by Hurricane Katrina.

They use per capita GDP as their outcome variable in their regression equation. The predictor variables, or growth determinants that the authors saw fit to use, are; investment/GDP, share of graduates, population density, share VA agriculture, share VA industry, share VA market service, share VA nonmarket service, and overall institutional quality. Using these variables, Barone and Mocetti find that the synthetic closely follows the real area of study, and shows an impact with the shock of a natural disaster.[3] As we can see, there are seemingly contradictory findings across the literature regarding the impact that natural disasters have on economic growth, with some models reporting neutral effects of a natural disaster, and others reporting negative, and even in some cases, positive effects.

Disasters and Institutions

The impact a natural disaster has on institutions is a critical, but comparatively less examined, research area important for this thesis. Some previous research finds disasters increase the strength of informal institutions stemming from comparative ineffectiveness of formal institutions to improve cooperation after a crisis (Diamond, 2011; Harris, 2001; Kuper & Kröpelin, 2006). Conversely, crises can leave communities with less resources, which can incentivize individuals to act selfishly, leading to more conflict and weaker social cohesion and less cohesion (Calo Blanco et al, 2017; JP Henrich & N Henrich, 2007; Tomasello, 2009). Calo

[3] The authors find that economic recovery (i.e. post-disaster gdp per capita) was different in the Southern region as compared to the Northern Italian provinces. In one, gdp per capita increased, while it decreased in the other.

Blanco et al (2017) argue periods of "adversarial environmental conditions" (10) have positive effects on social cohesion, and social cohesion diminishes in periods where disasters are less adverse.

Hurricane Katrina and Institutions

"George Bush doesn't care about black people." This inflammatory statement was made in 2005 by Kanye West on live TV during "A Concert for Hurricane Relief," which was a benefit for supporting Hurricane Katrina victims. The declaration was made regarding the effort, or lack thereof, for dealing with the aftermath of the hurricane, which disproportionately affected lower income individuals and families, as well as minorities. This, compared with how a natural disaster is dealt with in a wealthier, more institutionally sound area, is an appropriate manner in which to set up the paper at hand.

The impact on society from Hurricane Katrina cannot be understated. Less than a week after the disaster, the population declined from approximately 400,000 to near zero, and by mid-2007, nearly half of the evacuees had yet to return, with low-income minority families returning at a slower rate (Frey & Singer, 2006; Paxson & Rouse, 2008; Vigdor, 2008). Vigdor (2008) also predicted that the knock-on effect of Hurricane Katrina will lead to an increase in cost of living, disrupting the pre-Katrina equilibria, and dramatically altering the path of economic development that New Orleans and Louisiana were on. The physical and mental health of survivors of hurricane Katrina have been definitively detrimentally affected in both the short run and long run, with race also playing a role in Katrina-induced mortality, morbidity, and community destruction (Picou, 2012; Sharkey, 2007; Danziger & Danziger, 2006). Serious mental health illnesses increased in prevalence in the wake of the disaster (Galea et al., 2007),

but interestingly, suicidality decreased; this is believed to be a result of the role of post-traumatic personal growth (Kessler et al., 2006).

Setting aside the human toll that Hurricane Katrina took, it was also the most economically disastrous natural disaster in the modern era of the United States, causing $108 Billion in damages, and totaling $85.57 Million in insured property loss in 2020 dollars, over double the next highest, hurricane Sandy (Blake et al., 2011). According to Federal Economic Data, this loss of property sets the region back economically in the following ways. The growth rate of the total gross GDP in Louisiana slowed by 65% in the year following the disaster, the population dropped by over 250 thousand, and per capita income increased by over three thousand dollars (FRED, 2019). According to Deryungina et al. (2018), Katrina had "large and persistent impacts on where people live; small an mostly transitory impacts on wage income, employment, total income, and marriage; and no impact on divorce or fertility," but after a few years, "Katrina victims' incomes fully recover and even surpass that of controls from similar cities that were unaffected by the storm" (Deryugina et al., 2018).

The institutional impact of Hurricane Katrina has been studied on several levels. The effect on the labor market was drastic; evacuees separated from their jobs, had their social networks disrupted, and relocated them to unfamiliar labor markets, drastically affecting the labor market outcome of evacuees (Groen & Polivka, 2008). Similarly, it has been found that counties hit by hurricanes see significant declines in employment and a rise in earnings, with the size of the effect following the magnitude of the earthquake (Belasen & Polachek, 2008). Students in incumbent schools that accepted children that were relocated across the Southeast were not affected on an academic achievement level, and in Louisiana there was little impact as

well, showing that (in accordance with our findings) there was little to no effect on our measure of informal institutions (Imberman et al., 2012).

Formal institutional change includes a variety of implementations, from state-level to federal-level policy decisions. The focus of this paper is on the security of property rights, narrowing in on Hurricane Katrina and the policies that were in place before and after on the county, state, and federal level that influenced economic performance, as well as informal institutions that contribute to property rights security. Formal institutions are more readily altered, with policy changes and laws being enacted or repealed, especially in a time of crisis, as evidenced by the repeal of the Davis-Bacon Act[4]. We also aim to marry the literature on property rights, natural disaster's effect on the economy, and hurricane Katrina research.

A disaster, be it natural or man-made, provides social scientists an excellent opportunity to observe society at its most exposed. Because disasters lay bare the workings of both formal and informal institutions, they provide us with opportunities for a closer examination of the institutions at work (Rayamajhee, 2020). This allows us to investigate whether formal and informal institutions have complementary roles, or one crowds out the other. To understand property-rights-securing institutions in a post-disaster context, we look at several outcome variables that are indicative of different aspects of institutional analysis and draw conclusions based on the commonalities and differences that appear in different states. We use the synthetic control method to analyze post-disaster recovery considering both formal and informal institutions, as well as how they impact property rights. Property rights are directly linked with long-term economic development, and therefore we will be able to make conclusions regarding economic outcomes through our analysis.

[4] The Davis-Bacon Act of 1931 is a federal law that requires public works projects to pay the local prevailing wages to laborers and mechanics.

CONCEPTUAL FRAMEWORK AND CONTRIBUTIONS

Conceptual Framework

Table 1 shows the relationship between formal and informal institutions that we hope to further provide evidence for in this paper.

Table 1

Interaction Between Formal and Informal Property Rights Securing Institutions

		Formal Property Rights Securing Institutions	
		Strong	Weak
Informal Property Rights securing Institutions	Strong	Fast post-disaster recovery	Slow recovery/ Unrest
	Weak	Slow recovery/ Unrest	Poverty trap

Contributions

My research contributes to the existing literature on disasters and institutions by examining the effects of disasters on formal and informal institutions. We use the synthetic control method to analyze how real Louisiana (and Florida and Mississippi) fared after hurricane Katrina relative to the synthetically created counterfactual Louisiana (and Florida and Mississippi) that did not experience the exogenous shock. This method, and others like it that experimental-tangential, are useful to researchers in that they allow for accurately accounting for causality from the variables, and identifying which elements are impacting the outcome of the problem in question (Angrist and Pischke, 2010). The synthetic control method is especially useful in this quest to examine the impact of policies on a state-level, as well as political analysis (Abadie et al. (2010).

METHODOLOGY

Although the synthetic control method is generally used to research the impact of policy implementations, it may also be used in any situation in which a unit, which is part of a larger collection of similar units, is subject to a treatment (Abadie et al., 2010; Furton et al., 2020). This method is appropriate for this paper because it compares a synthetic region to the actual, which received the "treatment" of a natural disaster (Barone & Mocetti, 2014; Cavallo et al., 2013). From this we can calculate the difference between the two regions and compare them.

Comparative studies such as the synthetic control method used in this paper, along with randomized control trials, difference-in-difference (DD), and propensity score matching are frequently used to contrast treated and untreated units of analysis. Each of the aforementioned methods is useful in different cases; the synthetic control, although most commonly used to analyze the impact of a specific policy implementation, is the most appropriate for the research done in this paper. Other instances of utilizing this method unrelated to policy examination are Grier and Maynard, where they assess the economic consequences that the leadership of Hugo Chavez had (Grier & Maynard, 2016). Another example more closely related to the topic at hand is in Coffman and Noy in which the long-term economic consequences of Hurricane Iniki were measured in the state of Hawaii since 1992 (Coffman & Noy, 2012).

A major hinderance to the randomized control trials is the difficulty on creating a double-blind test because of unraveling allocation schedules. This leads to the majority of these types of tests failing the blind test (Schulz, 1995). In addition to that, using randomized control tests here would not be possible due to the task of assigning and administering a natural disaster to a state. Propensity score matching has flaws with accounting for unobservable factors that may be present, as well as the difficulty finding units (states) with comparable statistics and

characteristics. States that do share similar characteristics are more likely to be in the same region and experience similar disaster damage, limiting the scope of analysis for this study. Although these different methodologies have benefits, and are useful in different analyses, they would not fit the goal of this paper as well as synthetic control.

In the discovery process, difference-in-difference was bandied about as a model that would be useful in answering the research question posed in this analysis. Structurally, difference-in-difference and synthetic control methods are similar, however, the key feature lacking in the former is the ability to implement a differential trend. It also compares two existing units, therefore finding an appropriate match for a state that has experienced a natural disaster would most likely be a neighboring state, but, similar to the issues with propensity score matching, it is likely that the neighboring state would also have experienced that disaster, contributing to confounding factors. Difference-in-difference also severely understates the standard errors of the estimate of the "effect" as well, which requires more data and corrections based on "asymptotic approximation of the variance-covariance matrix" to create a more accurate model (Bertrand et al., 2004). Ryan, Burgess, and Dimick also discover that when implemented, the DD method's parallel trend assumption may not hold, and they recommend applying alternative methods (Ryan et al., 2015).

The synthetic control method that is used in this study combines the portions of difference-in-difference and propensity score matching that are most useful, while simultaneously remedying the time-invariant unobservable factors. This method also solves the dilemma of having to choose similar units that have not experienced a treatment by creating a unit that is pieced together with weighted values of a combination of units.

For this study, the synthetic control method allows for the analysis of the impact of a natural disaster on formal and informal institutions by contrasting states that have experienced the effects of Hurricane Katrina (Louisiana, Florida, and Mississippi) with a synthetic creation of those same states where a disaster did not occur. To create this synthetic region, similar states were placed in a donor pool, and a weighted average of those states was used to mimic the pre-treatment trends of the three states. The quality of pre-treatment fit gives us confidence that the post-treatment divergence accurately approximates the impact of the shock. The impact is calculated by overlaying the synthetically constructed states against the actual states where the disaster did strike. The synthetic control method is useful to researchers examining the causal impact of an exogenous change at a state or provincial level, when real counterfactual or comparable control units do not exist (Angrist & Pischke, 2010). By providing an empirically driven process of creating a counterfactual unit where the treatment did not occur, this method allows researchers to tease out the causal impact of a specific policy or political change (Abadie et al., 2010, 2015).

Before creating the synthetic control, we must give a formal description of the method, following Alberto Abadie (Abadie et al., 2010). We have J + 1 regions (in our analysis, states) and, we have the first of such regions as the region exposed to the treatment, in this case, the hurricane. This is i = 1 and the rest of the i's are the remaining donor pool (i = 2, 3, …, J + 1) at time t (t = 1, …, T). Our output variable is y_{it}^0, (e.g. the GDP per capita) of region i and time t. We let T_0 be the number of periods before the hurricane ($1 \leq T_0 < T$). We can assume that the hurricane does not have any effect on the outcome variable before the event, so $y_{it}^0 = y_{it}^1$ for all regions *i* and for all times $t < T_0$. We let $\alpha_0 = y_{it}^1 - y_{it}^0$ be the impact of the hurricane at time $t > T_0$, and we let β_t be an indicator variable that takes the value 1 if i = 1 and $t > T_0$. The observed

outcome variable then, in the region of study may be written as $y_{it}^{1} = y_{it}^{0} + \alpha_t (\beta_t)$. We can infer from this that for $t > T_0$, $\alpha_t = y_{it}^{1} - y_{it}^{0}$ where we must estimate y_{it}^{0}. This allows for us to estimate while considering larger gaps in time, estimating $((\alpha_1 T_{0+1},...,\alpha_1 T)$. For $t > T_0$.

In the synthetic control method, one must find the weighted average of units in a donor pool to create the comparison unit. We represent the artificial unit by a J x 1 vector of weights $W = (w_1, w_2, \ldots, w_{J+1})$, where $0 \leq w_j \leq 1$ for all $j = 2, 3, \ldots, J + 1$ and $w_2 + w_3 + \ldots + w_{J+1} = 1$. W then is equal to our synthetic control. Choosing a value for W such that the characteristics of the synthetic control are most similar to the characteristics of the treated unit is suggested in Abadie et al. (2015). For the set of weights W, that we want to use, we can represent the synthetic control estimator, y_{it}^{n} as $\hat{y}_{1t}^{n} = \sum_{j=2}^{J+1} w_j y_{jt}$, while the control estimator of the synthetic, α_{1t}, is represented by $\hat{\alpha}_{1t} = y_{1t} - \hat{y}_{1t}^{n}$. We fix the weights as ≥ 0 and ≤ 1. Let z be a unit in the donor pool, and say this is the sole unit used for the synthetic control, then we know $w_z = 1$, $w_j = 0 \in j \neq z$, and $\hat{\alpha}_{1t} = y_{1t} - y_{zt}$. z is the index value that will minimize $\|x_1 - x_j\|$ over j for some norm $\|.\|$ for adjacent neighbor estimators.

DATA AND EMPIRICAL STRATEGY

I create a synthetic control state for Louisiana, Florida, and Mississippi to assess the impact of Hurricane Katrina on population, income per capita, and formal and informal institutions. Much of the work that I draw upon for the creation of such a synthetic control is taken from Alberto Abadie and his work with synthetic controls in the Basque country in Spain and further work with California policy (Abadie et al., 2010; Abadie & Gardeazabal, 2003).

The treatment period we are using for this analysis is from 1997 to 2019; eight years of pre-treatment until Hurricane Katrina makes landfall, and thirteen years of post-treatment. Because the impact of disasters does not follow a clear nor consistent pattern, learning what would have happened to Louisiana should Katrina never have happened is important and gives insight for other disasters. The synthetic control method allows for that analysis.

Data

In recent years, there has been a surge of research regarding the impact of natural disasters on economic development (Felbermayr & Gröschl , 2014; Barone & Mocetti, 2014; Raschy, 2008; Kahn, 2005), as well as a growing community of social scientists using quantitative methods to study institutions. These methods, specifically the synthetic control model, are used in here to examine the impact that natural disasters have on the economic growth and development of a region and how different states' institutions mitigate losses, specifically looking at Louisiana, Mississippi, and Florida in the wake of 2005 hurricane Katrina. State-level data was collected for each state for the time period of 1997 to the most recent data available of 2019.

There is a comprehensive data set that goes over disaster statistics that we can use to determine the severity of the disaster, location, and other damage variables, although our focus in this paper is specifically Hurricane Katrina (Spatial Hazard Events and Losses Database for the United States).

This paper focuses specifically on the natural disaster Hurricane Katrina and the state of Louisiana, highlighting specific counties in particular to aid in this process of discovery. The paper *Natural Disasters, Growth, and Institutions: A Tale of Two Earthquakes* by Barone and Mocetti lays the groundwork for our analysis. Many of the variables that we have chosen have been selected based on the conclusions that were presented in their work.

Outcome Variables

To gain insight as to what happened in the wake of the 2005 Hurricane Katrina, we must choose outcome variables that encapsulate the extent of the research question. To address formal institutions, Population, GDP per capita, and variables for freedom were selected[5]. Other variables related to government involvement were included; government spending and government employment. For informal institutions, we use the variable of social capital. The variable for social capital has been created by Hawes for his paper measuring social capital across the 50 states, and then appended to analyze incarceration and racial context (D. Hawes et al., 2013; D. P. Hawes, 2017). Table 2 shows the outcome variables and gives a brief description along with a source. Variables that accurately measure the quality of informal institutions are difficult to find. Although informal institutions are highly context dependent, many empirical studies focusing on disasters use measures for social capital as proxies for informal institutions (Akbar & Aldrich, 2018; Rayamajhee & Bohara, 2021). Informal institutions are, by their very definition, obtuse and hard to define. We use the data on social capital index made publicly available by Hawes, Rocha, and Meier (2013) and Hawes (2017). Their measure of social capital is constructed at the state-level using factor analysis of 22 indicator variables established by Putnam (Putnam, 2000).

[5] The freedom variables are Labor Market, Minimum Wage, Government Employment, and Property Tax Freedom. Gathered from the Fraser Institute Freedom Index

Table 2

Outcome Variables, Description, and Data Sources

Outcome Variable	Description	Source
Population	Number of people legally residing in a state	United States Census Bureau Database
GDP per Capita	Economic output per person	Federal Reserve Economic Database
Labor Market Freedom	On a scale of 1-10, the relative composite score of the freedom in the labor market. A higher score means more freedom in the labor market.	Fraser Economic Institute
Minimum Wage Freedom	On a scale of 1-10 the relative amount of regulation on minimum wages. A high score means less legislation	
Property Tax	On a scale of 1-10 the relative amount of property and other taxes (this excludes income and sales tax revenues). A high score means less taxes	
Government Employment	On a scale of 1-10 the relative amount of government employment. A high score means less government employment	
Government Spending	Billions of dollars in government expenditures	United States Census Bureau Database
Social Capital	"Connections among individuals"	D. P. Hawes 2017

Indicator Variables

For a synthetic control to be a useful tool of analysis, predictor (or indicator) variables must be chosen from several different areas to create a more accurate representation of a synthetic state. The goal with these variables is to obtain a synthetic state that matches the pre-treatment time periods as close as possible. My indicators include population (for all outcome variables except population), construction employees, unemployment rate, per capita GDP (for all outcome variables except per capita GDP), number of business applications, homeownership rate, murder rate, marriage rate, percent of population that is Hispanic, percent of population that is African American, and percent of population that is Asian. Asian, Hispanic, and African American percentages were unavailable for years prior to 2010, so we imputed datapoints. The

backwards interpolation was done by generating an average rate of change for the available data and applying that to the years prior. Visualizations were then created using Stata and occasionally Python and Jupyter libraries. Per capita GDP, Unemployment rate, business applications, and homeownership rate were collected from the Federal Reserve Economic Data (FRED) and the variables population, government spending, marriage rate, and the percentages of Asian, Hispanic, and African American were found in the Census Bureau.

Table 3

Indicator Variables, Description, and Data Sources

Indicator Variable	Description	Source
Population	Number of people legally residing in a state	United States Census Bureau Database
New Housing Units	Total number of building permits for all structure types	United States Bureau of Labor Statistics
Construction Employees	Number of individuals working in the construction field (in thousands)	
Per Capita GDP	Economic output per person	Federal Reserve Economic Database
Unemployment Rate	Percent of population of working age people that are unemployed	
Business Applications	Number of business applications completed in a state	
Homeownership Rate	Percentage of homes that are owner-occupied	
Marriage Rate	Ratio of marriages to the population of a particular region (state)	United States Census Bureau Database
African American %	Percentage of the population that is of African American descent	
Hispanic %	Percentage of the population that is of South or Central American descent	
Asian %	Percentage of the population that is of Asian descent	
Murder Rate	Number of murders divided by the population of a region (state)	Death Penalty Information Center

Disaster Data

I use the threshold established by Cavallo et al. (2013) to determine which states to include in my donor pool to construct synthetic states. The study categorizes a disaster as "major" if it resulted in 99th percentile or higher total fatalities. The 99th percentile cutoff was 233 lives per 1 million inhabitants. The SHELDUS dataset provides a more precise measure of the magnitude of economic loss, quantified in U.S. dollars. We use the same 99th percentile threshold as Cavallo et al. (2013), that is, property damage worth USD 8 Billion or higher. Table 5 lists the ten worst disasters-by-state in the United States during our study period. Note that hurricane Katrina appears three times. We also used this data to determine what states should be eliminated from our analysis and which disaster and states should be assessed further. As shown in Table 5, Texas, New Jersey, and California all have significant disasters strike during our period of analysis, so we cannot include them in the donor pool. We cannot use states that have received the same treatment of the natural disaster in our weighted donor pool, because it would skew the results in the post treatment.

We were interested in hurricane Katrina for several reasons. First, hurricane Katrina had the highest estimated damages due to a hurricane in U.S. history, and therefore we expect to see the most dramatic effect in a post-disaster context (Blake et al., 2011; Oh, 2010). This is important because minor disasters may not be sufficiently large enough to engender institutional change, which is the focus of our study. Second, its damage was spread over several states (all three of which are in the top ranked of severity; see Table 5), and thus provides us with more than a single case to analyze the impact of a major disaster on institutions. Third, despite much attention paid to the economic impacts of hurricane Katrina, its lingering impacts on institutions is meagerly discussed (Boettke et al., 2007; Storr & Haeffele-Balch, 2012). To the best of our

knowledge, no rigorous empirical study exists examining the long-term institutional impacts of hurricane Katrina.

Table 4

Disaster Variables, Description, and Data Sources

Disaster Variable	Description	Source
Property Damage	Total damage done in billions of dollars to property in a region (state)	Spatial Hazard Events and Losses Database
Fatalities	Number of deaths in a region (state) attributed to the disaster	

We gathered the measure of social capital index used in this study from Hawes, Rocha, and Meier (2013) and Hawes (2017)[6]. Social capital includes "tacit knowledge, a collection of networks, an aggregation of reputations, and organizational capital" and thus contributes to the formation of rules in a society and the interactions between individuals (Stiglitz, 2000). It also plays a pivotal role in "furthering development interventions at local levels as well as the nature of interaction between new institutions and older formalised networks" (Chopra, 2002). The social capital index developed by Hawes provides an aggregated social capital measure created using a factor analysis of 22 indicator variables that encapsulate the behavioral components of social capital[7].

[6] Retrieved from the Harvard dataverse repository https://dataverse.harvard.edu/file.xhtml?persistentId=doi:10.7910/DVN/B8NR76/MH03JM&version=1.0

[7] The 22 items included in the index are: *Fraternal order, Religious club, Civic club, Veteran club, Country club, Body of local Government, Voted federal, state, or local election, Wrote to an editor of a magazine or newspaper, Wrote or telephoned a radio or television station, Wrote to an elected official about a matter of public business, Wrote something that has been published, Addressed a public meeting, Visited an elected official to express a point of view, Actively worked for a political party or candidate, Engaged in fund-raising, Voter turnout, NPOs per 1,000 population, Generosity index, Contributed to public television, Public television contributors (composite score), Actively worked as a volunteer (nonpolitical), Took an active part in local civic issue.*

Table 5

Severity of Disasters in the United States

State	Year	GDP (Millions)	Population (census estimate)	Economic Freedom Index Score	Property Damage Adj. (Billions)	Fatalities
Texas	2017	135800.3	28,295,273	7.53	93.3	151
Louisiana	**2005**	12846.2	4,576,628	5.93	70	820
Mississippi	**2005**	6946.3	2,905,943	5.79	33	187
New Jersey	2012	45292.6	8,844,942	5.36	28.2	31
Florida	**2004**	62943.2	17,415,318	7.43	26.7	61
California	2018	182382.5	39,461,588		21.7	132
Texas	2008	95442.7	24,309,039	7.58	19.5	36
Florida	**2005**	68557.6	17,842,038	7.13	16	31
Louisiana	2016	17247.6	4,678,135	6.24	9.76	21
Texas	**2001**	62687.9	21,319,622	7.21	8.07	54

As mentioned above, I use a variation of Abadie's methods that he has brought to light in several of his papers (Abadie et al., 2010; Abadie & Gardeazabal, 2003).

The synthetic control design that Abadie uses focuses on the United States and incorporates a specific treatment, which makes it a good model to base ours off of. This method will be applied to several states that have suffered a "severe" disaster in the past two decades. To determine if a disaster meets the criteria of "severe", the property damage (adjusted) must be above $8 Billion. This threshold was set to encapsulate the ten worst disasters in recent memory, and there is a significant ($2 Billion) gap that follows it. The model begins before a disaster strikes (in this case, the disaster is Hurricane Katrina) and constructs a synthetic control of the region (state) in question that will be compared to the actual region after the shock. Summary Statistics for all outcome and indicator variables are provided in Table 6.

Table 6

Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
GDP	20005.98	26184.51	1421.8	198836.6
Land Area	69253.08	84719.56	61	570641
Unemployment Rate	5.37	1.94	2.3	13.7
Homeownership Rate	68.15	6.29	39.9	81.3
Business Applications	13269.76	16738.32	936.75	98454.5
Population Density	385.21	1393.69	1.07	11569.66
Construction Employment	131.05	144.68	4.6	933.8
Disaster Fatalities	11.31	30.02	0	820
Marriage Rate	8.04	6.20	4	82.3
Property Damage (Adj. in Billions)	4.9	3.88	0	93.3
Government Spending(B)	53.14	72.15	3.1	622.3
Fraser Economic Freedom	6.01	.93	3.54	8.04
Poverty Rate	12.48	3.43	3.7	25.8
GDP per capita	39147.88	10907.95	19221	83406

RESULTS

I examine the three states affected by hurricane Katrina in 2005: Louisiana, Florida, and Mississippi. For each state affected by the hurricane, I generated synthetic control states that did not experience the hurricane by matching the pre-Katrina trend as closely as possible for all variables of interest: income per capita, population, minimum wage legislation, property tax freedom, government spending, government employment, and social capital. In the three states considered in our analysis, hurricane Katrina led to combined property damage (adjusted for inflation) of over $119 Billion, with more than 1000 fatalities and 200 injuries (SHELDUS). The task of creating synthetic controls is equivalent to that of creating artificial states that did not experience these damages. For some states and some variables, the pre-treatment match was good enough to draw meaningful causal inference, whereas in other cases, this was not feasible. Nonetheless, because I have more than one state to study, I am able to draw meaningful conclusions based on some common findings, even when pre-treatment matches were less than ideal.

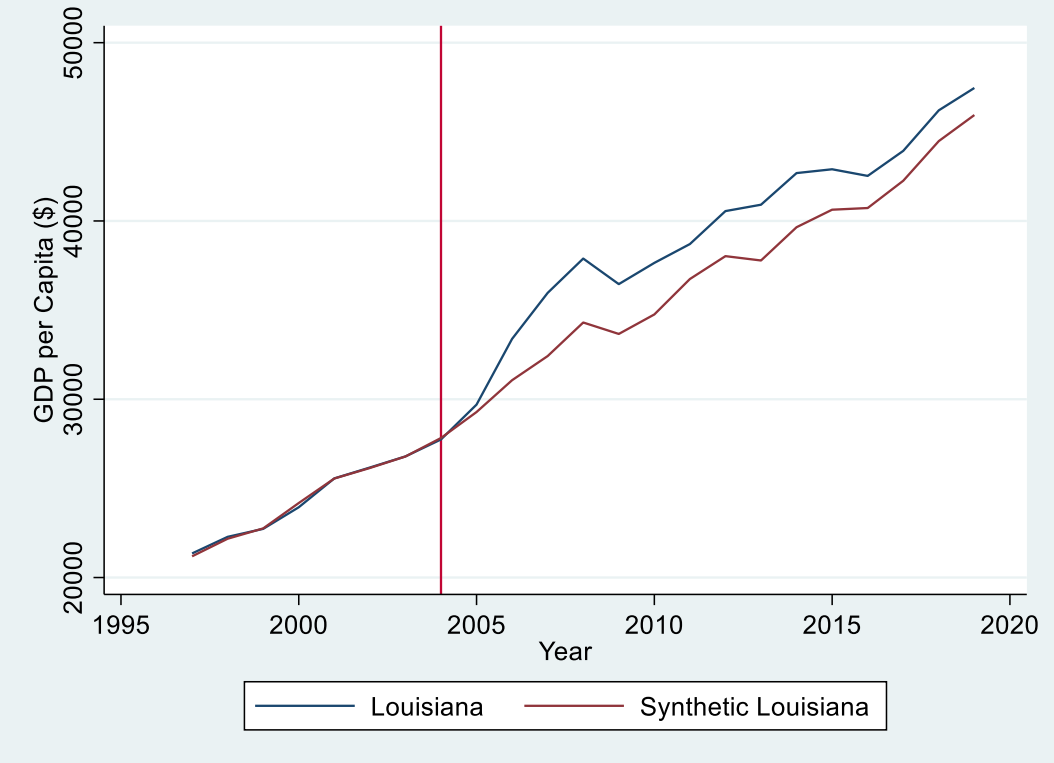
To measure the degree of fit between our determinants and the synthetic counterfactual; during the pre-treatment period, we can look to the RMSPE value. Comparatively smaller RMSPE values indicate that the pre-treatment synthetic state more closely tracks the actual state's outcome variable. This measure is most commonly used as a ratio; in this case, against the standard deviation of the outcome variables. Overall, we see that for nearly all of the outcome variables and states, there is little divergence between the real-world unit and the treatment unit in the pre-treatment period, indicating a well-constructed synthetic counterfactual.

Louisiana

The state that was impacted the most by Hurricane Katrina (in terms of property damage) was Louisiana. This is where we will begin our analysis, because we assume that Louisiana will have the most drastic impacts from the disaster. Visually, we can see that the synthetic counterfactual tracks Louisiana well during the pre-treatment periods and divergence occurs only after the treatment date (2005). The RMSPE for out experiment measures a relatively high RMSPE of 111.73. Treated Louisiana (actual) is an average of 6.58% higher than the synthetic counterfactual during the post-treatment periods. Our results (Figure 1.) show that hurricane Katrina not only was there no decrease in GDP per capita, it may have in fact increased it.

Figure 1

Louisiana Per Capita GDP



To examine whether our results are empirically significant, and not the result of a unique, unobservable factor associated with Louisiana, we compare them to the placebo tests on states

that have not received the treatment. Figure 2 depicts the pseudo-t-stats that result from our placebo tests. The increase in GDP per capita following hurricane Katrina are statistically significant in two of the post-treatment periods. Because the two treatment periods are immediately after the event, this suggests that GDP per capita had a sharp increase due to the disaster, but the effects were not significant beyond that. Figure 3 illustrates the normalized effect of the synthetic control experiment compared to those that were performed on other states.

Figure 2

Louisiana Per Capita GDP Pseudo T-stats

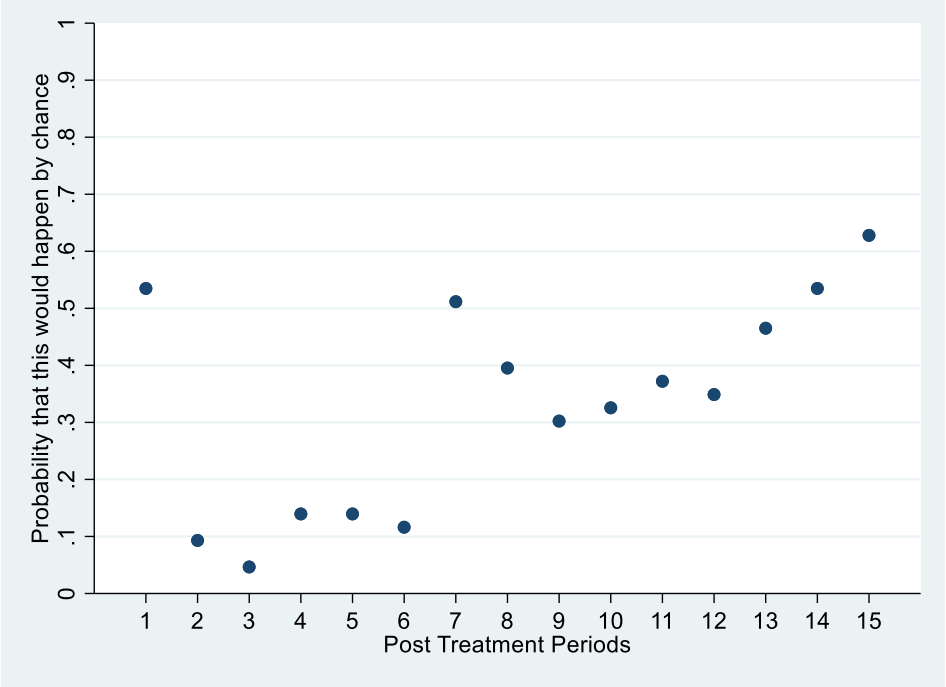
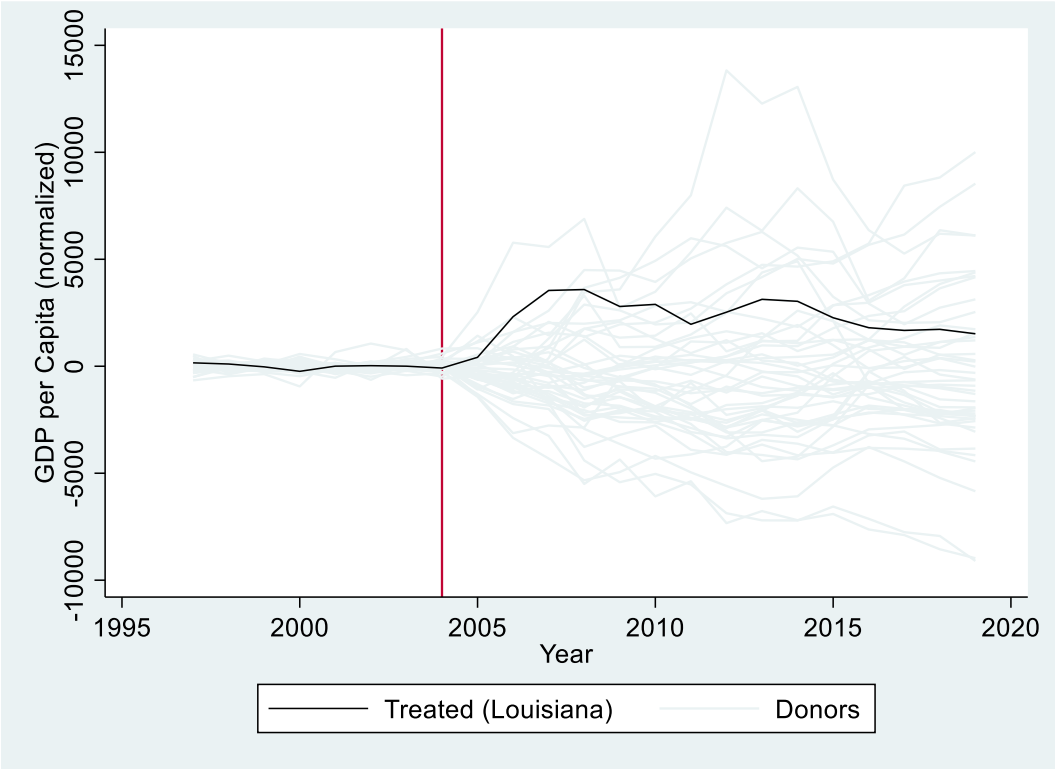


Figure 3

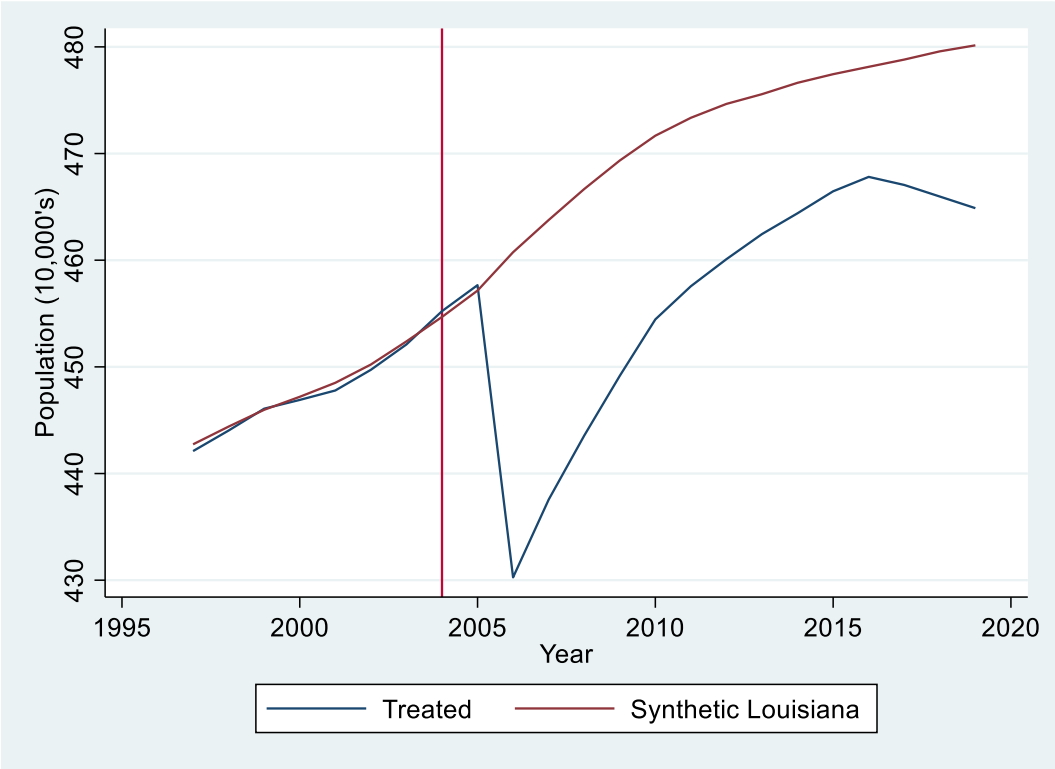
Louisiana per capita GDP Effects (Normalized)



Population also visually shows a strong match in the pre-treatment periods (Figure 4), but an RMSPE value of 3464.46, as well as a sharp divide in post treatment years. After a 0.54% increase in population the previous year (an increase of ~24,000), the population dropped by over 250,000 the following year to just over 4.3 million, and it took half a decade to climb back to above 4.5 million. This is consistent with previous studies examining the effect of hurricane Katrina on population (Paxson & Rouse, 2008). This starkly contrasts to the synthetic counterfactual, which shows a similar increase of roughly 0.5% as the year prior. This decrease is due in large part to the destruction of homes, especially on the coastal cities like New Orleans, causing many people to move.

Figure 4

Louisiana Population



To examine whether our results are empirically significant, and not the result of a unique, unobservable factor associated with Louisiana, we compare them to the placebo tests on states that have not received the treatment. Figure 5 shows the pseudo-t-stats that result from the placebo tests. The decrease in population is significant for six years following the disaster, after which the significance decreases. As homes are rebuilt and people move back into the areas devastated by the disaster, the population increases dramatically, and after eight periods post-Katrina there is no statistical significance between the two units. As will be shown below, an influx of migrant workers had a strong impact on the effect of freedom in the labor market, but because many of them were undocumented, they could not be included in the total population count done by the Census Bureau, and thus we may be seeing an exaggerated decline in

population (Olam, 2006). Figure 6 illustrates the normalized effect of the synthetic control experiment compared to those that were performed on other states.

Figure 5

Louisiana Population Pseudo t-stats

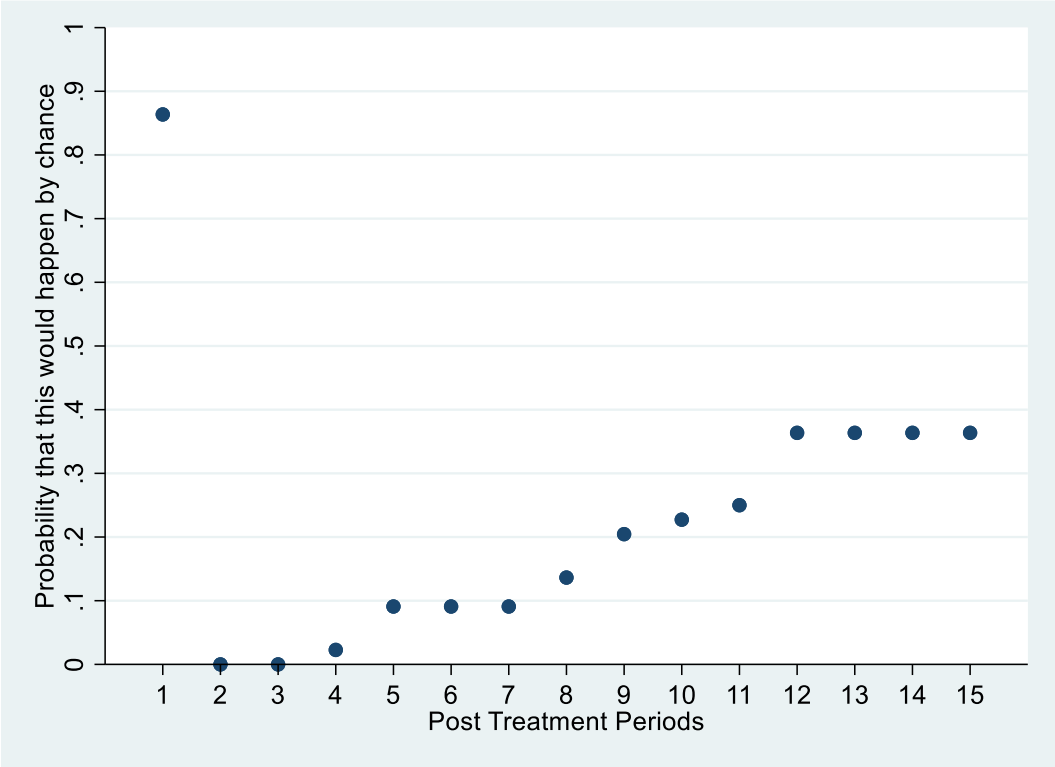
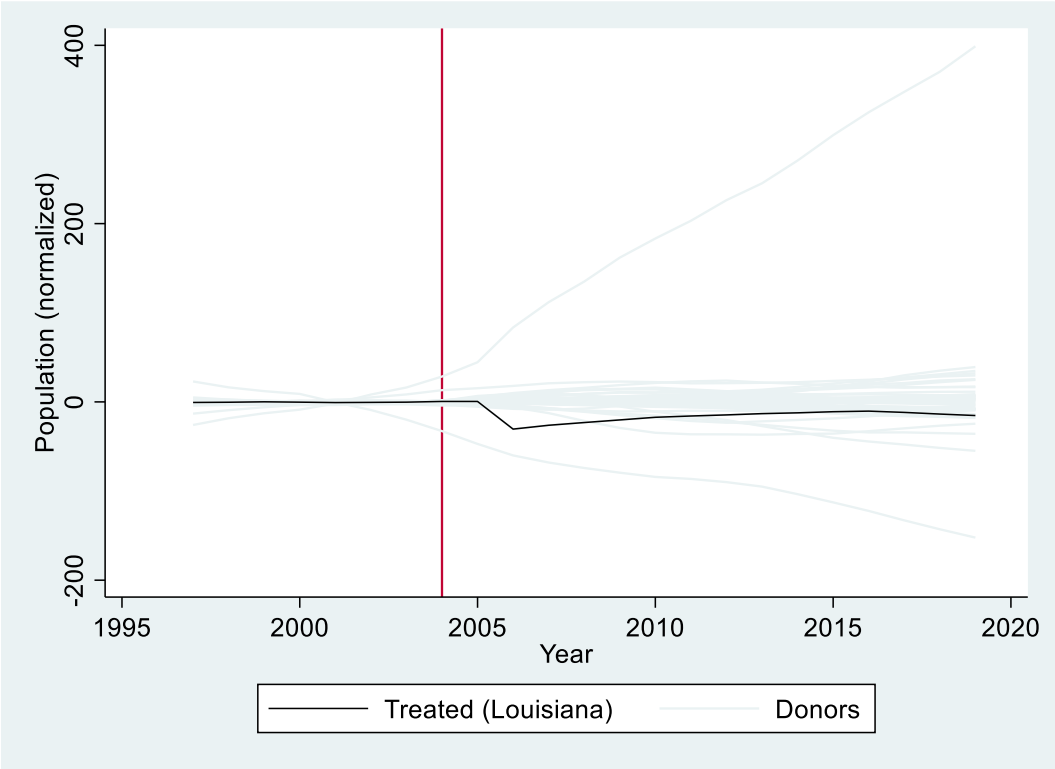


Figure 6

Louisiana Population Effects (Normalized)



We next turn our attention to formal institutions. Our results reveal that the hurricane had significant and notable effects on many indicators of formal institutions. Figure 7, shows visually that we have a strong pre-treatment match between synthetic and actual Louisiana, and a low RMSPE of 0.071. There is a gap between the synthetic and real-world units of nearly a full point, or 17.5 percent of the score prior to the treatment, in Labor Market Freedom for all periods post-disaster. Recall that the measure of Labor Market Freedom that we used is on a scale from 1-10, with 10 being an extremely free labor market, and 1 being a very restricted market. An increase in Labor Market Freedom in this context means that there are less laws regulating the minimum wage, lower union density, and lower government employment. All of these factors help to contribute to higher freedom in the labor market. This reduced wages, leading local workers to search elsewhere for employment, but attracted migrant workers, who were willing to

work for less. The Department of Homeland Security also suspended regulations on employers that dictated that workers provide documentation that proved they were United States citizens or were legally permitted to work in the United States (Olam, 2006). The efflux of residents in search of higher wages can be seen in Figure 1 as a significant decrease in the population. It must be stated, however, that the Davis-Bacon Act was reinstated two months after its repeal, but contracts that had been granted during the suspension were allowed to remain, and wages did not increase.

Figure 7

Louisiana Labor Market Freedom

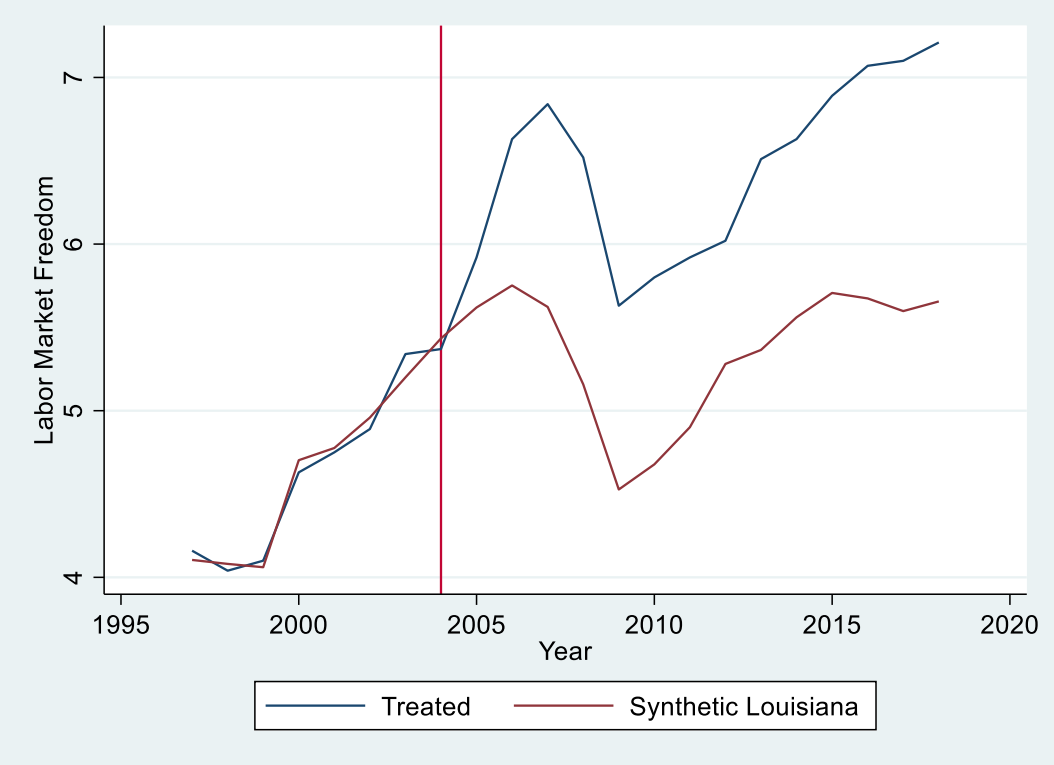


Figure 8 examines the empirical significance of our results using pseudo t-stats. All but three of the post-treatment periods in the placebo test were significant. This suggests that our results are unlikely to be due to chance and are instead a result of the treatment. Figure 9 shows the normalized effects of the natural disaster on Labor Market Freedom.

Figure 8

Louisiana Labor Market Freedom Pseudo t-stats

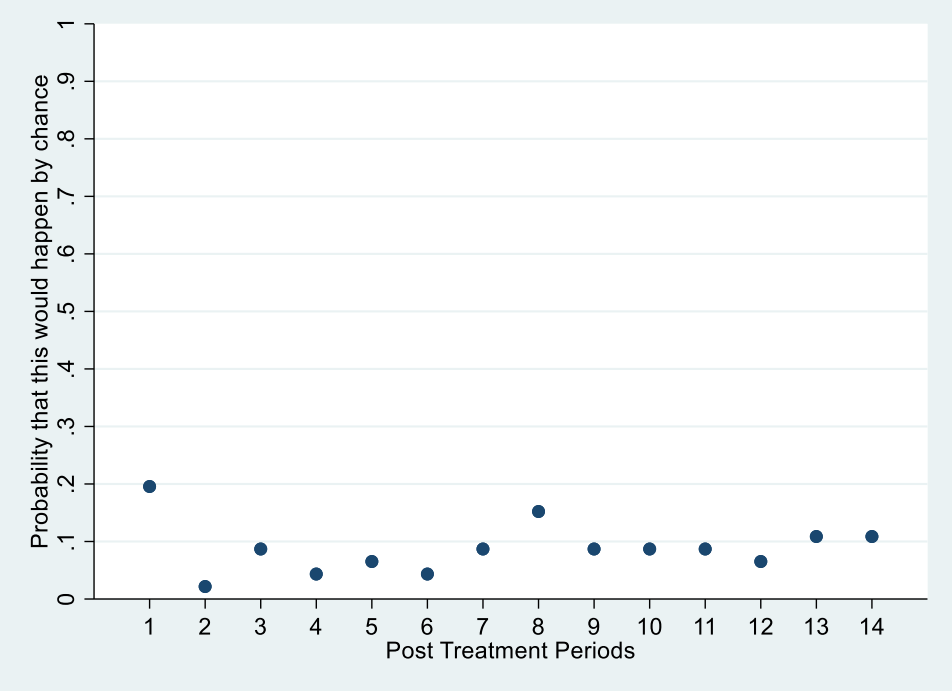
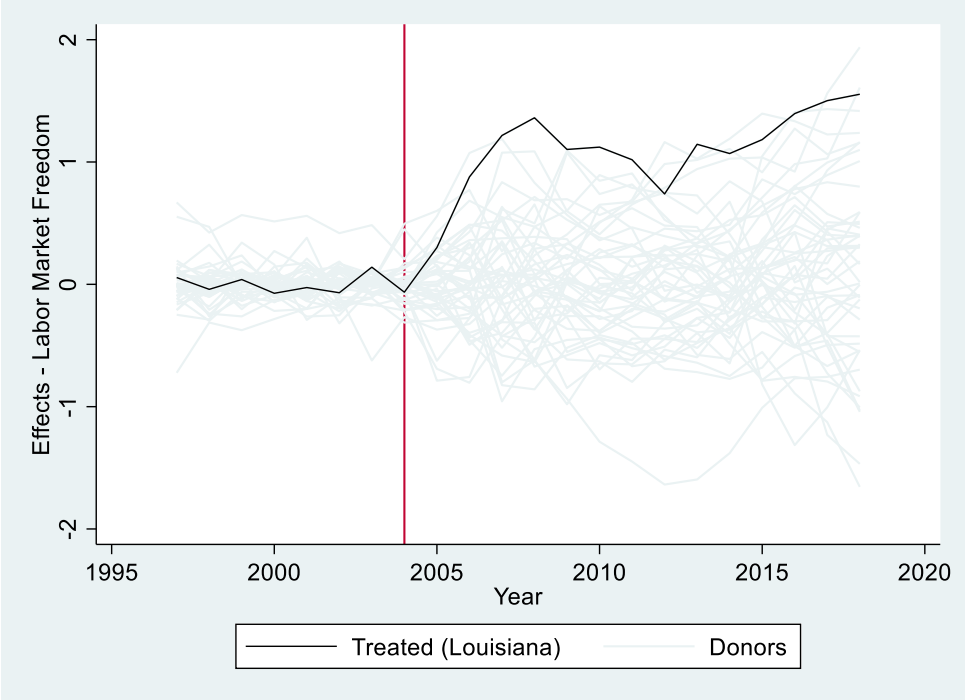


Figure 9

Louisiana Labor Market Freedom Effects (Normalized)



We next look at two variables that also measure the level of strength of formal institutions; Property Tax Freedom and Minimum Wage Freedom. Both have strong pre-treatment matches with their counterfactuals visually (Figure 10) and low RMSPE's (0.053, and 0.051 respectfully). In Figure 10, we see that there is a real-world increase compared to the synthetic unit for both outcome variables. Property Tax freedom increased compared to the counterfactual by an average of 5.41% in the post-treatment years. Minimum Wage Freedom had an average increase of 17.43% relative to the counterfactual. We must examine whether these results are empirically significant, and thus turn back to the placebo tests to show the pseudo t-stats. Figure 11 shows the pseudo t-stats for both Property Tax and Labor Market freedom. Four post treatment periods are significant for Property Tax freedom, and eight periods are significant for Minimum Wage Freedom, suggesting that we are more confident in assuming that the disaster caused the increase in minimum wage freedom than the increase in property tax freedom.

Figure 10

Louisiana Property Tax and Minimum Wage Freedom

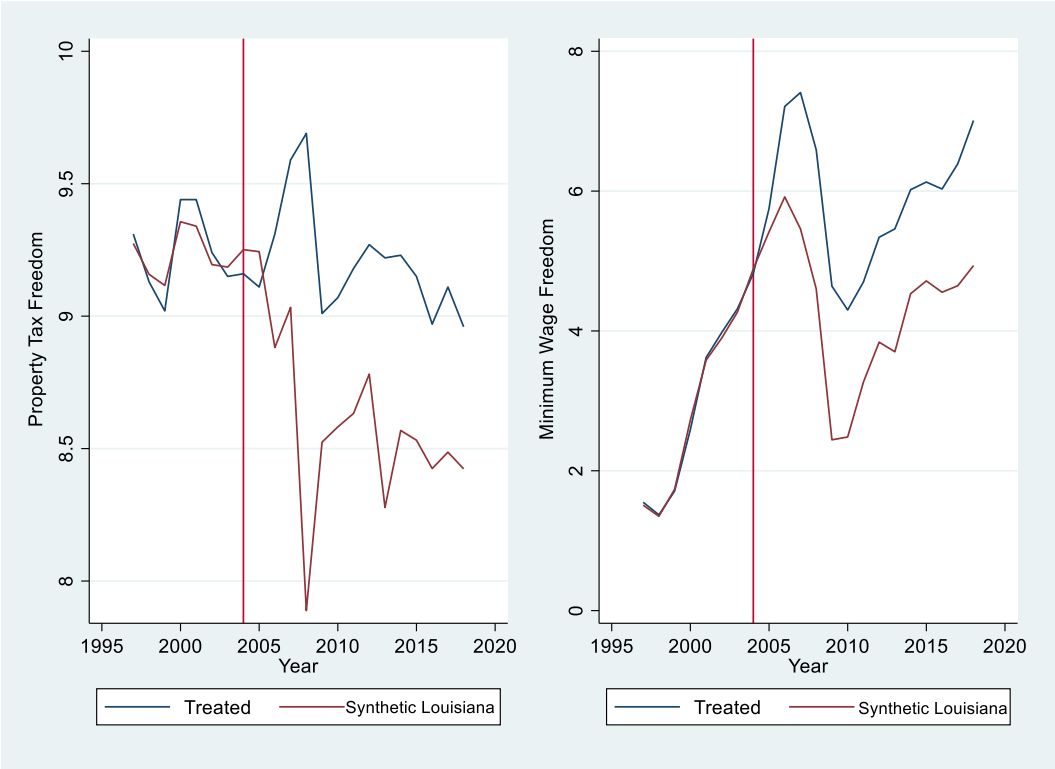


Figure 11

Louisiana Property Tax and Minimum Wage Freedom Pseudo t-stats

We ran a synthetic control model on the total Economic Freedom index score as well and found no significant deviation from the real world to the synthetic. Although this result may seem to contradict our previous findings, it may be due to an increase in government activity and spending, and how that is interpreted through the Fraser index. Figure 12 shows that there is a visually close pre-treatment counterfactual to actual government spending with a low RMSPE of 0.568. Figure 13 shows the pseudo t-stats generated from placebo tests; we do not get significant results from this model. We cannot conclude that hurricane Katrina had anything to do with the increase in government spending that occurred after 2005. The increase in government spending was likely to happen regardless of the hurricane touching down. There is an increase in government spending overall, however, which aids in explaining the lack of a result for total economic freedom.

Figure 12

Louisiana Government Spending

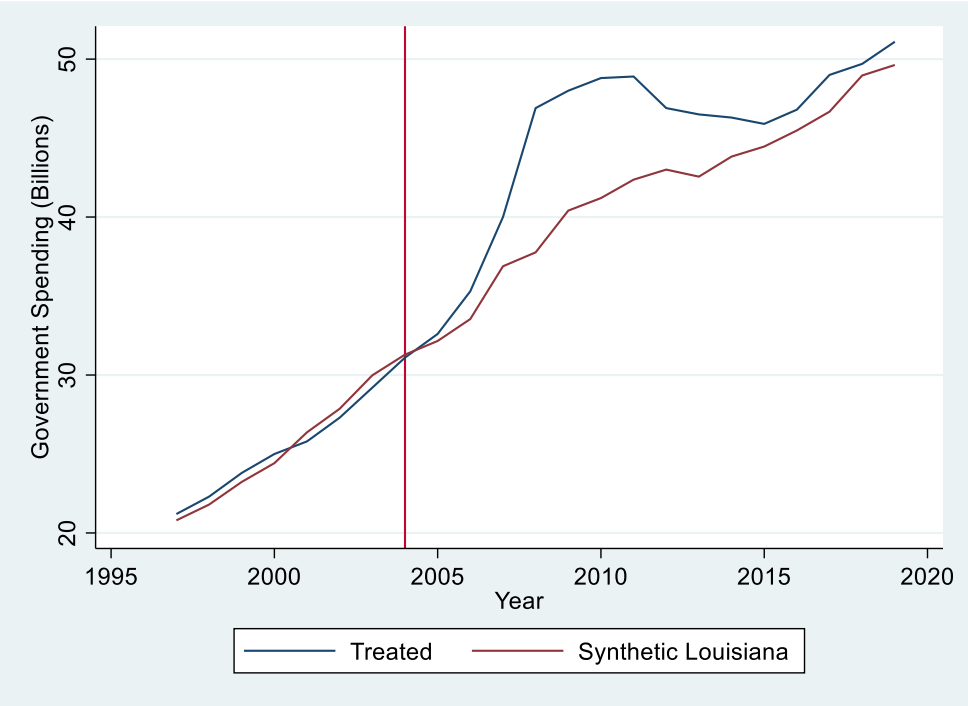
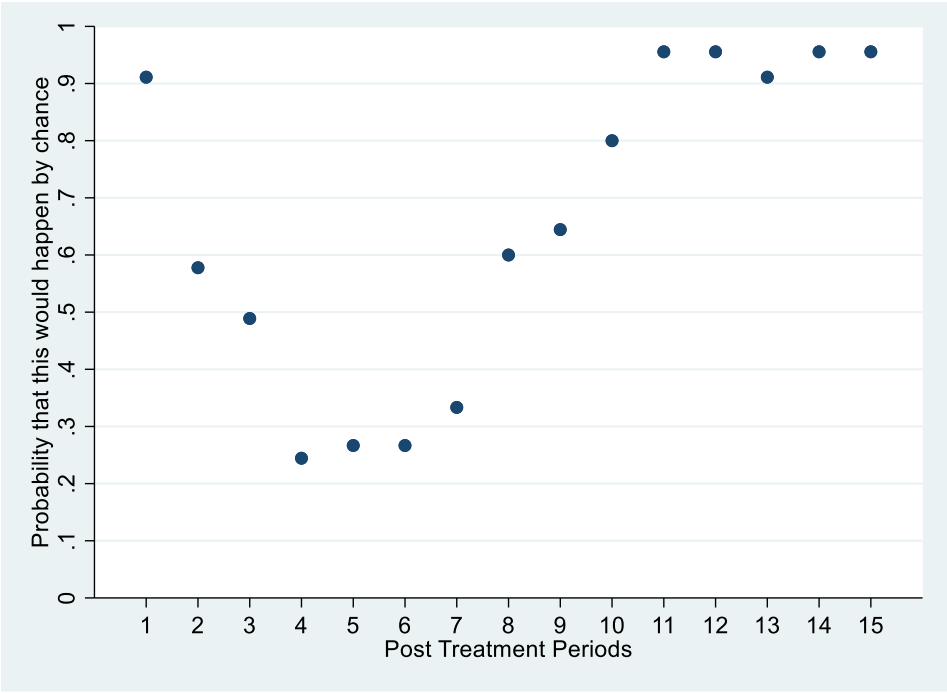


Figure 13

Louisiana Government Spending Pseudo t-stats



There are more conflicting forces at work that contribute to the lack of a significant result for total economic freedom, including the increase in freedom related to the decrease in taxation, the increase in freedom due to the relaxing of minimum wage rules and regulations, along with lower government employment; higher government employment freedom. Visually, we can see that the synthetic counterfactual does not track as well as previous models, but it is a close fit, with slight divergence in earlier pre-treatment periods. The RMSPE value is 0.070. Government employment freedom increased by nearly 3 points in Fraser's analysis relative to the treated unit, meaning that actual government employment decreased significantly a decade after the disaster. The increase in government employment freedom in the real-world Louisiana increases in significance over time as shown in Figure 15. This contradicts the theory that government expands as much as possible if an opportunity arises. This may be due to the long time period of our analysis, and there seems to be a larger divergence starting after the 2008 crisis, which we did not account for in our model. If the divergence were due to the natural disaster, we would expect to see a significant difference between real and synthetic sooner than 10 periods after the event, thus concluding that we cannot make any strong causal inferences based on hurricane Katrina and government employment.

Figure 14

Louisiana Government Employment

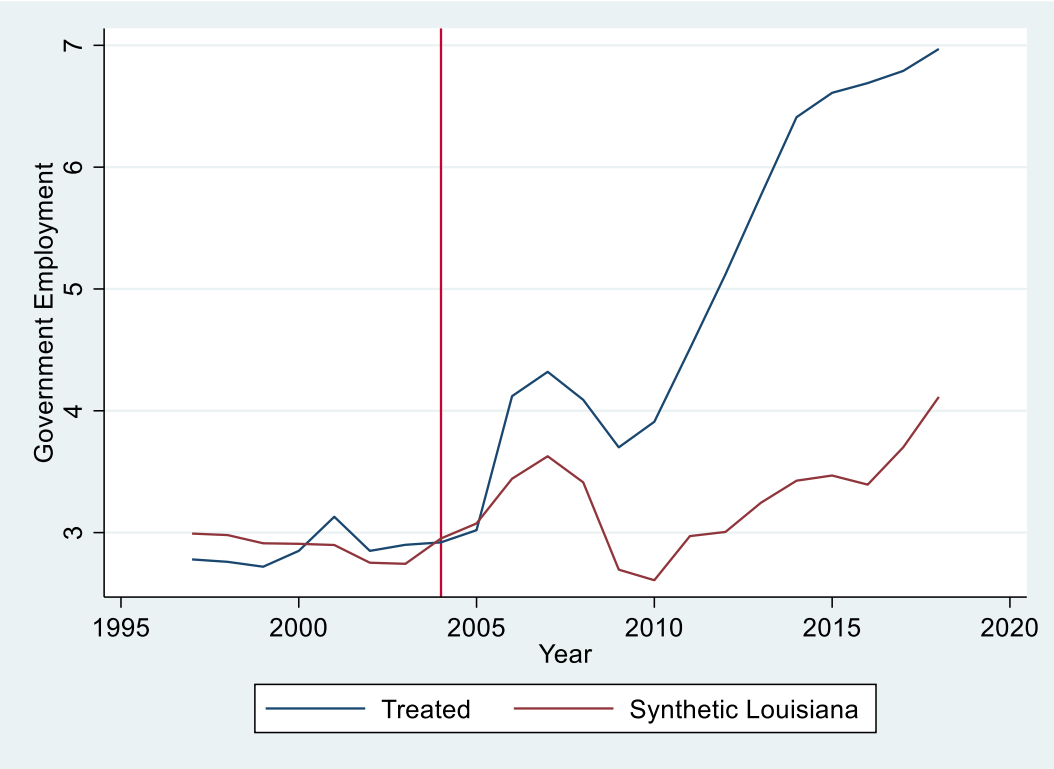
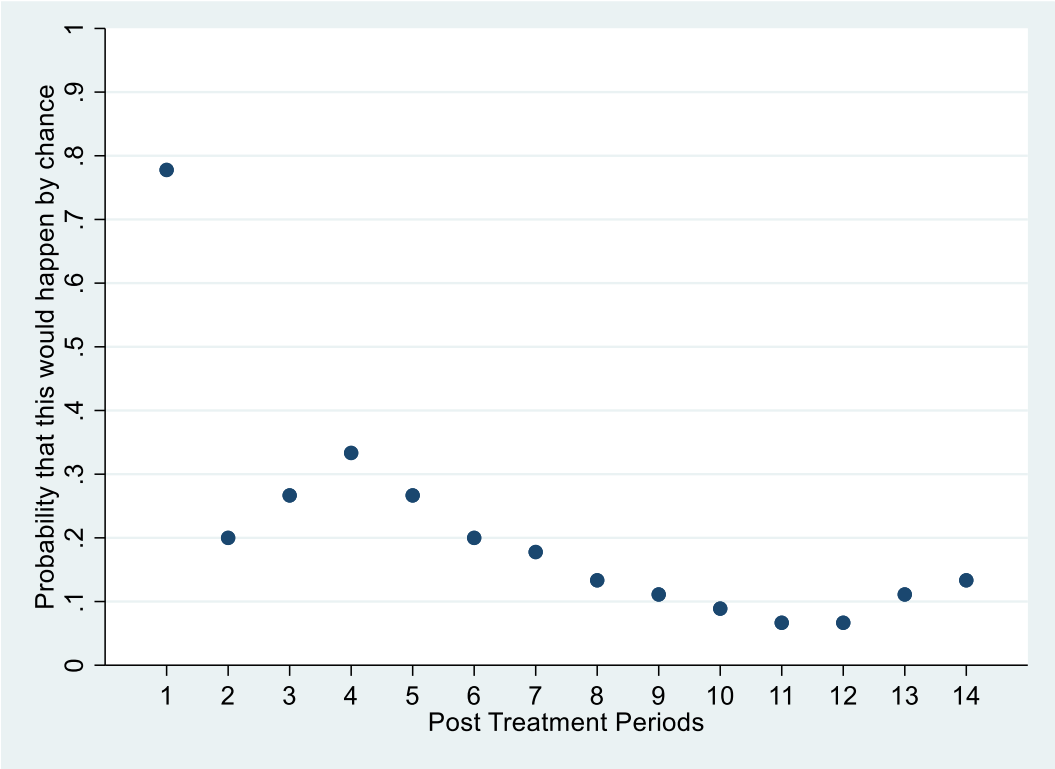


Figure 15

Louisiana Government Employment Pseudo t-stats

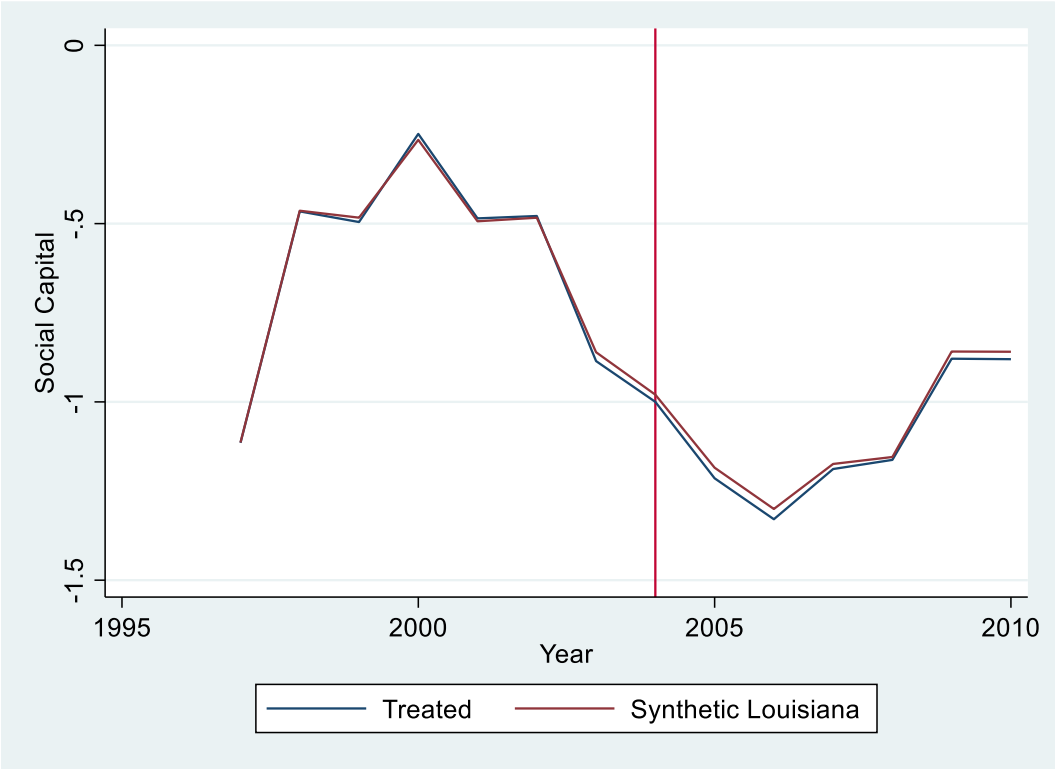


The outcome variable that represents informal institutions, Social Capital, is shown in Figure 17. Visually, there is very little deviation during both the pre-treatment and post treatment periods; the RMSPE value is 0.013. We find that there is no significant deviation between the synthetic Louisiana and real-world Louisiana in the time period we analyzed. The data for social capital was only available for the time period 1997 to 2011, which means the fit is not as strong as some of our other models. That being said, we see nearly no change between real and synthetic in a post-disaster setting, meaning that we cannot conclude that informal institutions were impacted by Hurricane Katrina in our analysis.[8]

[8] See Appendix 2 for Robustness checks on all significant results for every state

Figure 16

Louisiana Social Capital



Florida

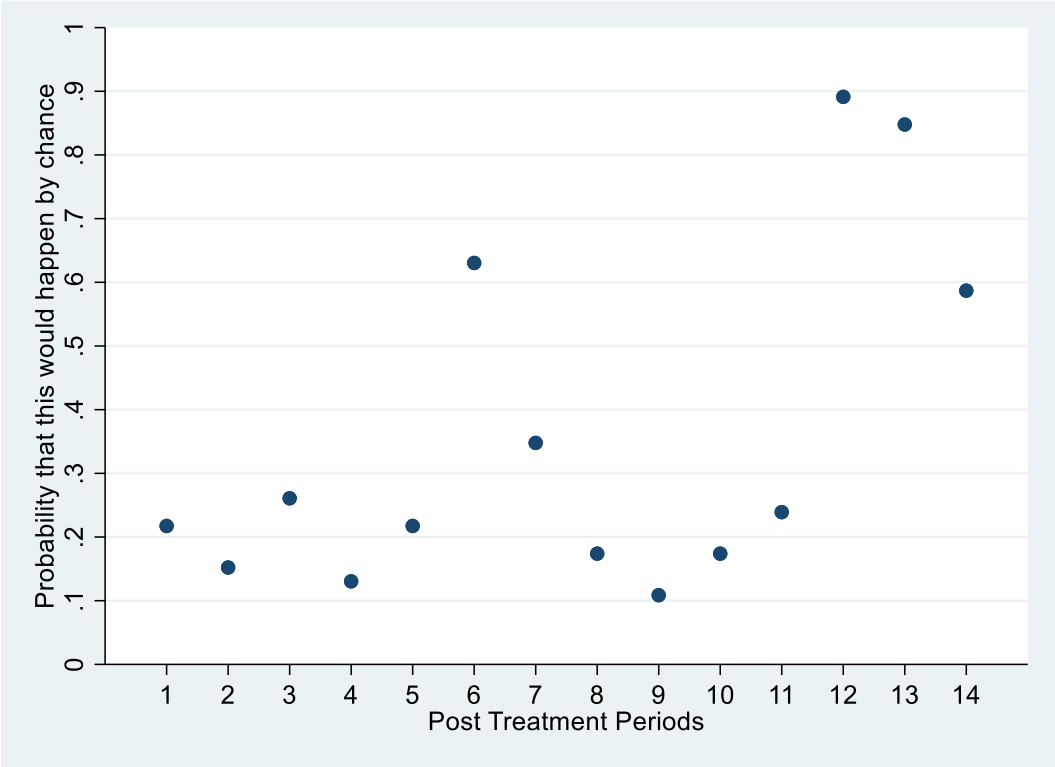
The economic outcome variables show that the impact of Hurricane Katrina was not as severe as that of Louisiana. There were not significant effects on either GDP per capita or Population. The Effect Summary Table for Florida shows the outcome variables and the direction of the effect, as well as if it was significant during 2 or more of the post-treatment periods in the models we ran.

Our outcome variables representing formal institutions were slightly more illuminating. Labor market freedom was not significant in any of the post treatment periods (Figure 18). To examine whether our results are empirically significant, and not the result of a unique, unobservable factor associated with Florida, we compare them to the placebo tests on states that have not received the treatment. Figure 19 depicts the pseudo-t-stats that result from our placebo

tests. We cannot conclude that any deviation in labor market freedom in the wake of hurricane Katrina can be attributed to the disaster.

Figure 17

Florida Labor Market Freedom Pseudo t-stats



Our other measures of formal institutions, Property Tax freedom and Minimum Wage freedom, both decreased after the treatment relative to the counterfactual Florida. In Figure 19, we can see visually, there is a strong match during the pre-treatment periods between treated Florida and the counterfactual; the RMSPE value is 0.069. Property tax freedom reaches a peak difference of 50% in the wake of hurricane Katrina. The synthetic counterfactual held relatively steady at 4, but the treated Florida decreased by nearly 2 full points (50%). Figure 20 shows the pseudo t-stats during the post treatment periods. Because all but three of the post treatment periods are significant, we can conclude that, in the years directly following the disaster, the decrease in property tax freedom can be attributed to Katrina.

Figure 18

Florida Property Tax Freedom

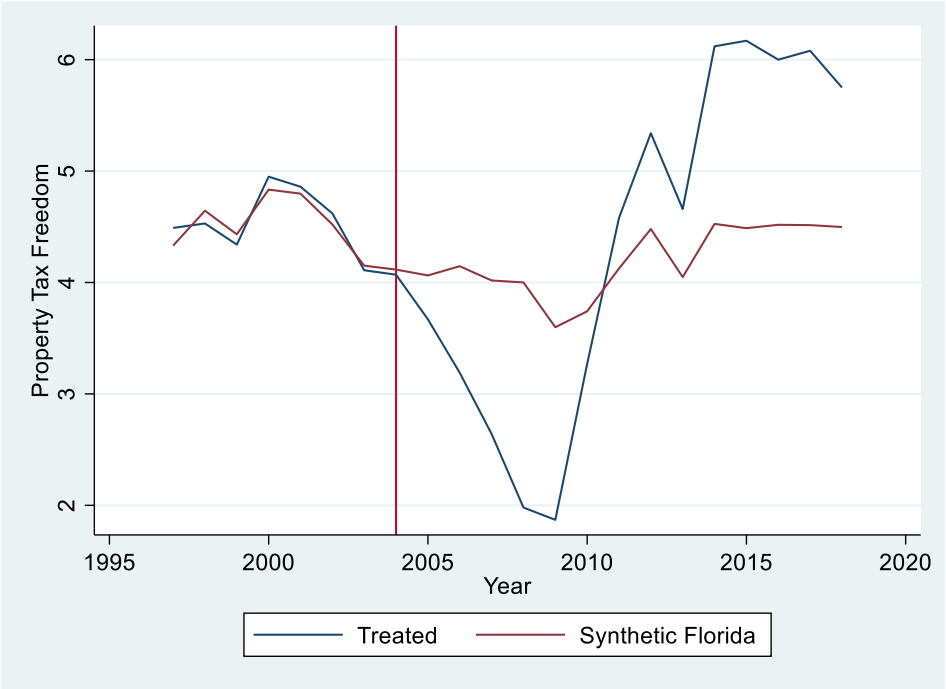
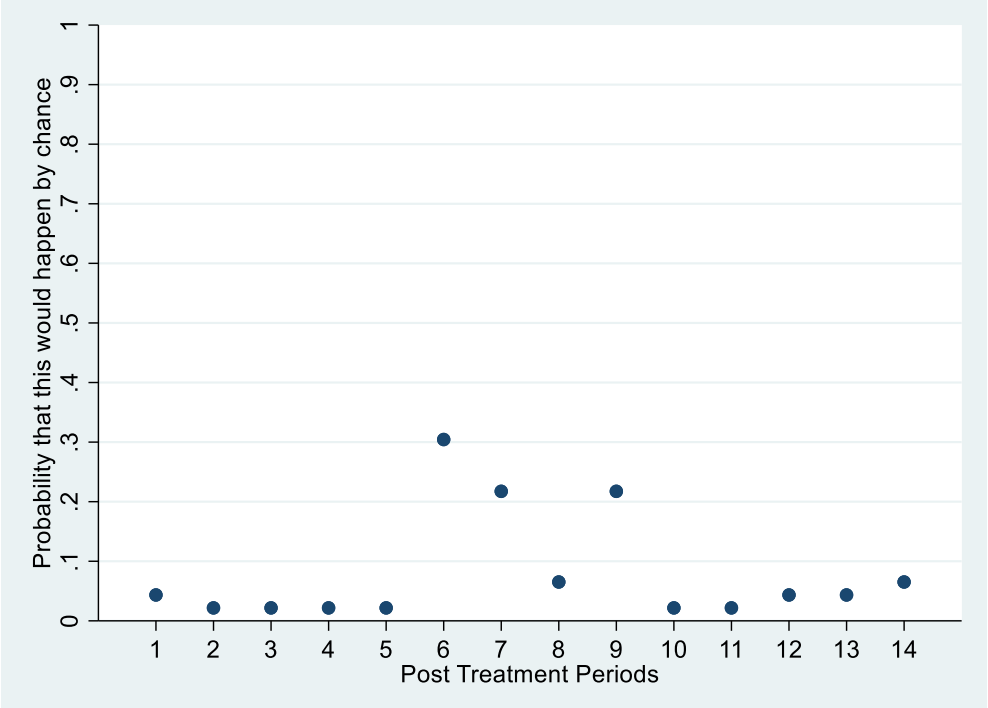


Figure 19

Florida Property Tax Freedom Pseudo t-stats



We could not create a synthetic counterfactual for minimum wage legislation that closely followed the treated Florida. There was a visible gap between the two that meant that we cannot explain any change in the post treatment periods as being caused by the hurricane.

In the aftermath of Katrina (as well as the severe hurricane season the year prior that saw four hurricanes make landfall in the span of six weeks (Florida Health, 2005)) we can see that government spending in Florida increased by over $10 million (Figure 21). Visually, the synthetic counterfactual and the treated Florida are closely aligned in the pre-treatment periods; the RMSPE value is 1.18. To examine whether our results are empirically significant, and not the result of a unique, unobservable factor associated with Louisiana, we compare them to the placebo tests on states that have not received the treatment. Figure 22 shows the pseudo t-stats. For three periods following the treatment, the difference is significant, after which it loses significance. This suggests that the state of Florida did not continue to increase spending after the initial aid.

Figure 20

Florida Government Spending

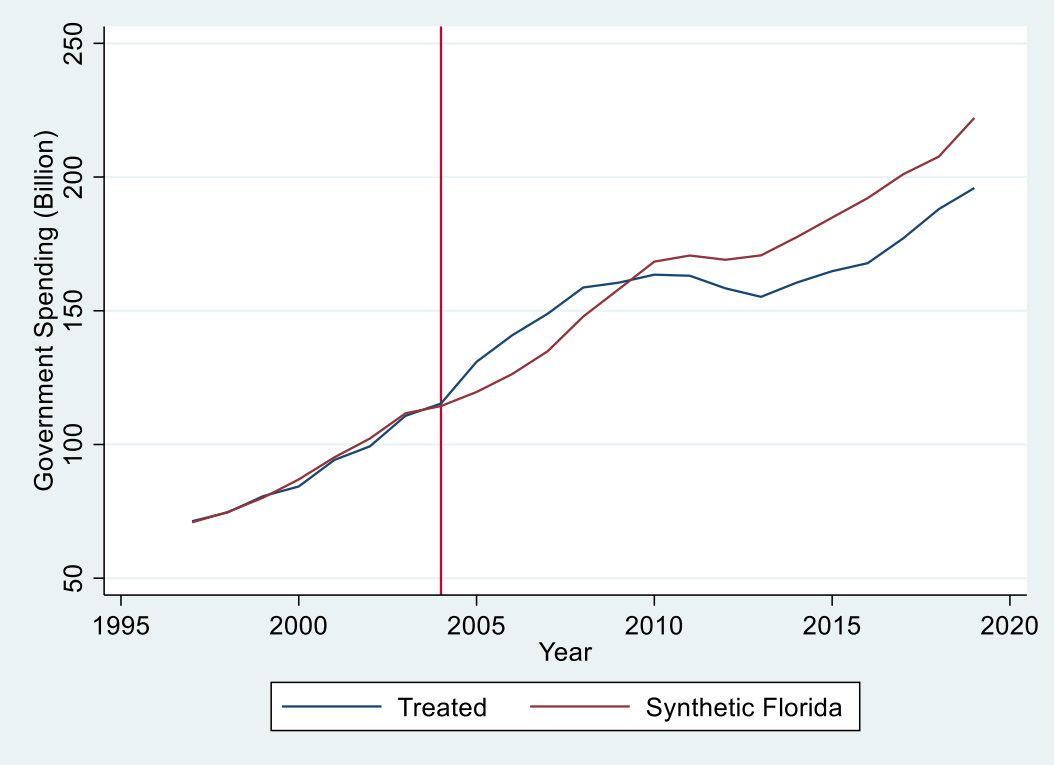
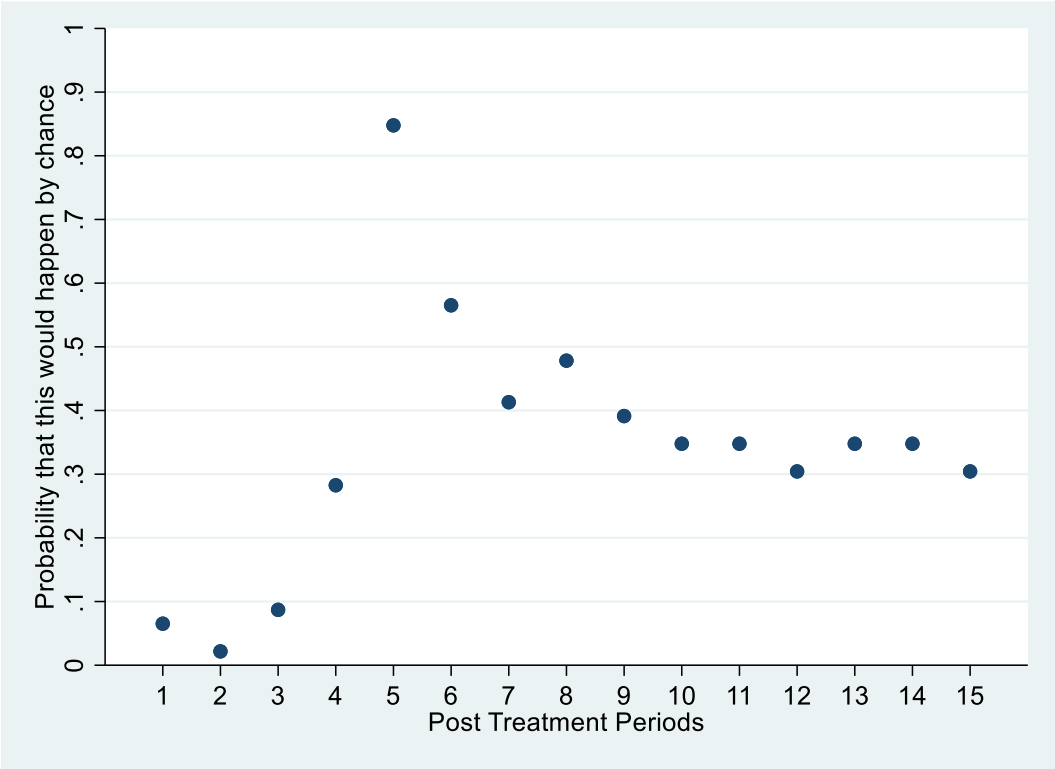


Figure 21

Florida Government Spending Pseudo t-stats



We were unable to produce a pre-treatment match for government employment or social capital, and thus cannot conclude that hurricane Katrina had any significant impact on either outcome variable. The Florida results; the majority of which are less drastic than Louisiana; suggest that the institutions present in the state were less impacted than in Louisiana. This was to be expected, as the damages in Louisiana were greater than that of Florida. The following section details the effects on Mississippi, which had the least property damage according to SHELDUS.

Mississippi

In Mississippi, as the figures below demonstrate, there are very few successful models with a strong pre-treatment match. The majority of the graphs do not have a good fit, and if they do, the effect is minimal and insignificant. There appears to be no drastic effects in regards to

freedom of the region, economic impact, and social capital, with the single result that had any significance being government spending (Figure 22). Visually, there is a strong match between the synthetic counterfactual and the treated Mississippi; the RMSPE value is 0.132. In the post treatment periods, there is an increase in government spending with a maximum divergence of 13.16%. To test whether our results are empirically significant, we ran obtained pseudo t-stats (Figure 23). We find that only a single post treatment period is statistically significant, and therefore cannot conclude that hurricane Katrina was the cause of this increase in government spending.

Figure 22

Mississippi Government Spending

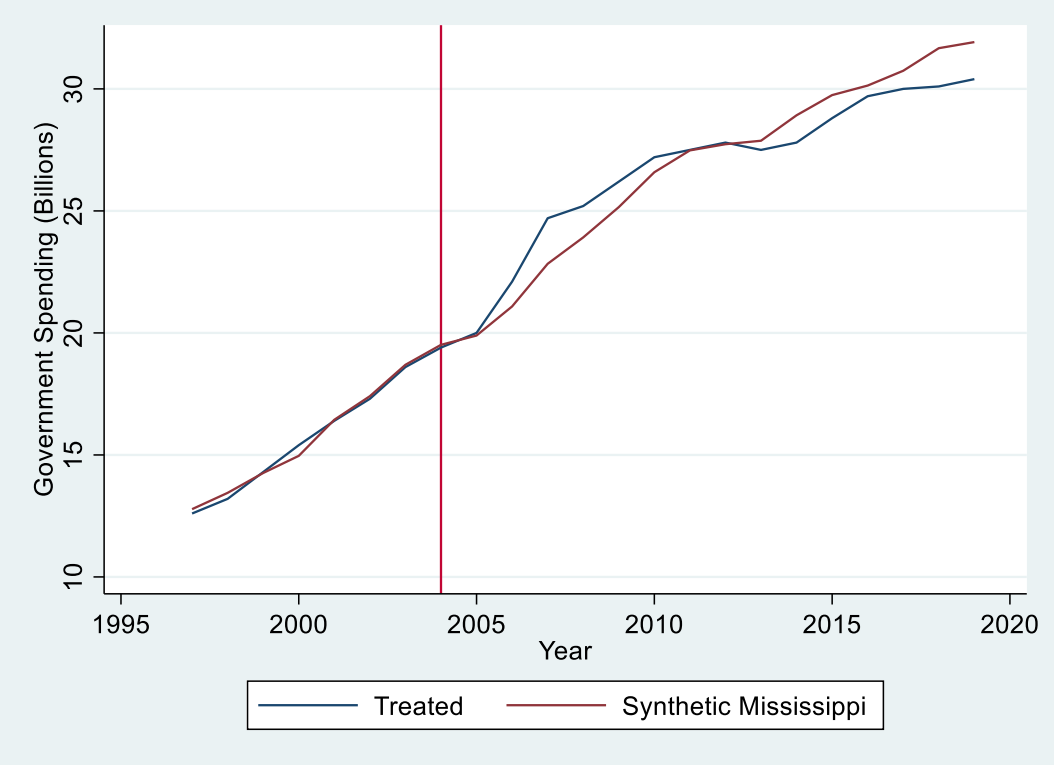
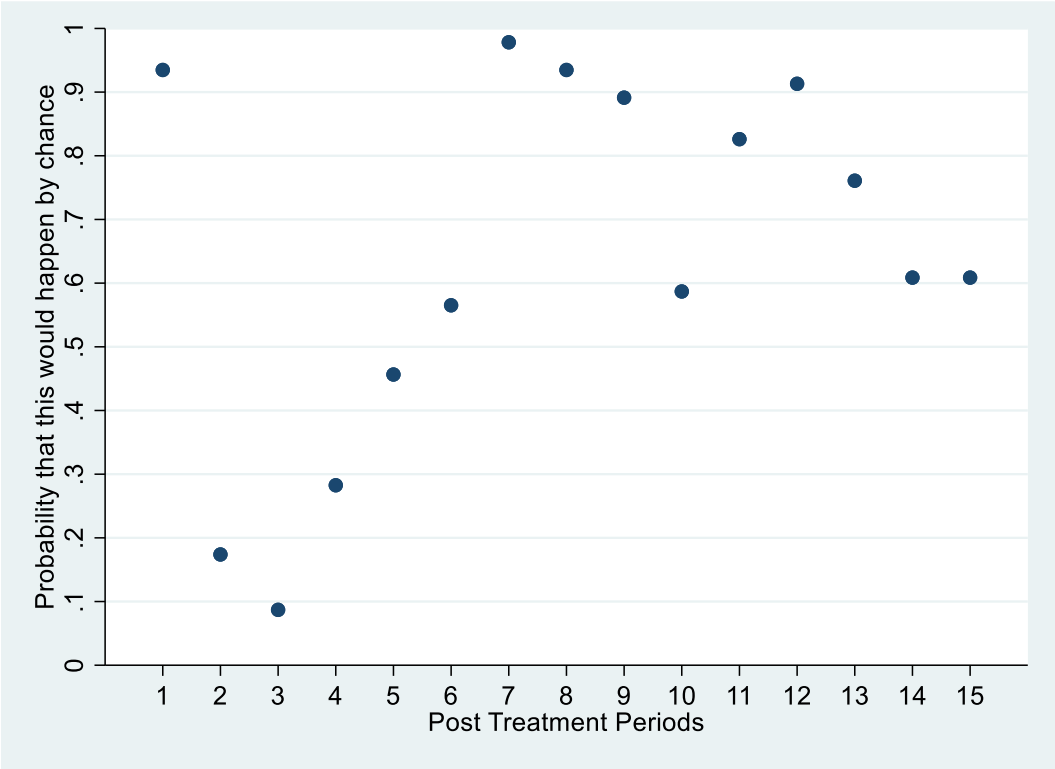


Figure 23

Mississippi Government Spending Pseudo t-stats



Unfortunately, we only created one synthetic model that could be used in this analysis for Mississippi. This may be due to the outlier status that the state holds in regards to many of the outcome variables. Because it is at the lower end of the spectrum of many of those variables, it is difficult to create a synthetic state from a donor pool of other states. The following section unravels the possible mechanisms that occur in each of the states and relates them back to theoretical propositions and previous literature in the field.

DISCUSSION

Table 7 shows a summary of the results from the synthetic control models, with the impact of the hurricane and its direction as well as the number of significant time periods based on the pseudo t-stats for each outcome variable.

Table 7

Synthetic Control Summary

State	Outcome Variable	Direction (Real vs. Synthetic)	Significance (Time Periods)
LA	GDP per Capita	Positive	Yes (2)
	Population	Negative	Yes (6)
	Labor Market Freedom	Positive	Yes (11)
	Minimum Wage Freedom	Positive	No
	Property Tax Freedom	Positive	Yes (5)
	Government Spending	Positive	No
	Government Employment	Positive	Yes (4)
	Social Capital	None	No
FL	GDP per Capita	Negative	No
	Population	Negative	No
	Labor Market Freedom	Negative	No
	Minimum Wage	Negative	No
	Property Tax Freedom	Negative	Yes (11)
	Government Spending	Positive	Yes (3)
	Government Employment	Positive	No
	Social Capital	Positive	No
MS	GDP per Capita	Negative	No
	Population	Negative	No
	Labor Market Freedom	None	No
	Minimum Wage	None	No
	Property Tax Freedom	None	No
	Government Spending	Positive	Yes (1)
	Government Employment	None	No
	Social Capital	None	No

As outlined in the results section above, the impact of Hurricane Katrina had different effects on institutions across the three different states. The sharp decline in population that

occurred in Louisiana may show that, combined with the increase in per capita income and government spending, the aid is going to individuals who are already well off. This discrimination in aid dissemination has been well documented in the literature (Chapperll et al., 2007, Takasaki, 2014).

Due to the decrease in several economic freedom factors in both Louisiana and Florida compared to the counterfactual, we can infer that when the government intervenes and enacts new policies, it takes certain freedoms away from citizens. Previous literature has shown that as a government takes freedoms away from citizens, it is increasingly difficult for the public to reclaim those freedoms (Boettke et al., 2015, Boettke et al., 2008).

Hallegatte and Dumas' (2009) research on the productivity effect concludes that concludes that there is a positive effect of a natural disaster on economic growth if the underlying institutions are sound; we cannot conclude the same, although per capita GDP did increase significantly for Louisiana, albeit for two post treatment periods. The productivity effect highlights the possibility that in the wake of a disaster, there is an accelerated rate of replacement of capital. The authors emphasize that, in the productivity effect theory, economic growth is dependent upon reconstruction quality. In developed countries with stronger institutions, reconstruction quality is higher than in developing countries; this logic holds for states as well.

The formal institutional outcome variables that we used in this study were impacted the most in Louisiana, with labor market freedom and property tax freedom having significant deviations from the synthetic counterfactual. In Louisiana, the repeal of the Davis-Bacon Act increased the freedom for employers to not pay local prevailing wages to laborers, and as evidenced in our model, had a significant impact on labor market freedom. The Fraser

Economic Freedom Index indicates that Louisiana has an overall low score for freedom. The weaker institutions may have led to more individuals leaving the state, and more government spending to mitigate the losses caused by the hurricane. In Florida, the variable of Property Tax Freedom significantly deviated from the synthetic counterfactual in the negative direction in the short-term, and then drastically shifts to significantly different in the positive direction in the long-term. The switch in direction happens after the year 2008, during which there was a massive economic crisis that caused policy change, altering the freedom of the state.[9]

In future research, we hope to have a measure of informal institutions that is more well-documented, similar to the Fraser economic freedom index that considers several factors that contribute to the strength of informal institutions. Some papers have addressed this; Harpham (2008) argues that surveys are essential to measuring social capital, but on a large scale this proves to be difficult. Borgatti, Jones, and Everett (1998) find that a single measure of social capital is tough to define due to the multifaceted definition of the term, and suggest using an "off-the-shelf" method, taking a different measure to fit the need of the project. We could not conclude that hurricane Katrina had any significant impact on informal institutions, which may explain why we did not see many effects across the board. As touched on in the literature review section, informal institutions matter more to economic development than formal ones, so no change in social capital may mean that the institutions were kept intact.

There was a significant amount of money that came in to the region through government aid and relief programs which may have negatied the detrimental effects of hurricane Katrina. This explanation is easily observable in Barone & Mocetti's aforementioned paper, but even

[9] The Deepwater Horizon oil spill of 2010 caused extensive damage to the Gulf of Mexico and led to costs of "a loss of over 25,000 jobs, $2.3 billion in industry output, $1.2 billion in total value added or gross regional product, $700 million in labor income, $160 million in state and local tax revenues, and $160 million in federal tax revenues" (Hodges et al., 2020). This could also be contributing to the shift in Figure 18.

when adjusted for that, the impact of the natural disaster was lacking. Another explanation for the low impact of such a devastating disaster may be that the outcome variables we have are not accurately measuring economic development.

After hurricane Katrina hit, there were concerns that there would not be enough people willing, or able, to pay minimum wage to employees, therefore the government stepped in and acted to suspend subchapter IV of Chapter 31 of Title 40. This law required the federal government to pay laborers prevailing wages. This meant that the minimum wage would be suspended in a limited geographic area and employers could hire low-wage workers (Bush, 2005). This type of institutional change may increase or decrease individual's property rights. The theory behind this can be found in a plethora of papers explaining the relationship between property rights and long-term economic development. A paper by J. Marvin Bentley and Tom Oberhofer titled succinctly *Property Rights and Economic Development* from 1981 combines the theory of property rights proposed by Demsetz, North and Thomas, and Cheung with Pryor, Clarkson and Bottomley's work investigating the applicability of property rights analysis to non-industrialized countries (Cheung, 1968; Clarkson, 1975; Demsetz, 1974; North & Thomas, 1973). This line of work can be seen in more recent work by Acemoglu and Robinson, mentioned above, in their book, *Why Nations Fail*. They build on the theory and link property rights to institutional changes in the different manners in which countries are founded, which can dramatically increase or decrease property rights, either buoying an economy or keeping it from achieving its full potential.

There was an overall increase in freedom following hurricane Katrina in Louisiana, spurred by the decrease in regulation and repeal of the Davis-Bacon Act, and the other states saw very little change, so we cannot conclude that Katrina had a significant impact on freedoms in

Florida nor Mississippi (save Property Tax freedom). Our findings support Cavallo et al. (2013), which found that larger disasters have a more severe impact overall; Louisiana, which had the highest property damage of the three states was more drastically impacted by the disaster in terms of institutional impact.

Policy-makers can use the results of this paper to aid in their decisions regarding where disaster recovery funding will go and what legal implementations should be enacted. In Louisiana, the repeal of the Davis-Bacon act led to an increase in freedom in the labor market which, according to the Fraser Economic Institute, leads to increased property rights and further economic development. In Florida, an increase in government spending decreases freedom (again, according to the Fraser Institute), but appears to stabilize the state, with very little significant effects on labor market freedom and minimum wage freedom. The different responses by the states can be used to inform policy-makers choosing between different options. Weighing the benefits from the repeal against the potential drawbacks is beyond the scope of this paper, but providing sufficient data is essential for informed decision-making.

CONCLUSION

Natural disasters are increasing in frequency and are devastating to communities that are affected by them. The literature on the impact that natural disasters have on economic outcomes is mixed, with conclusions that are contradictory. There is good reason for the confusion. Many different institutions play roles in guiding the economy in the wake of a disaster, and depending on the region of study, this may contribute to the different outcomes that the literature shows. There is no way to stop a natural disaster from occurring, but putting institutions in place that limit their lasting damage is key to mitigating economic as well as human impact. The models run above and the data produced suggests that a natural disaster increases government spending and GDP; decreases population, which increases per capita income. Along with this, the Fraser Economic Freedom index outcome variables increased in the wake of the hurricane in Louisiana. Contrary to the literature, the restrictions on freedom did not persist, which may be explained by temporary policies or flaws in the predictor variables. From our research, we conclude that as the magnitude of the disaster increases (property damage), so does the institutional damage.

Both formal and informal institutions tend to be "sticky" –in favor of maintaining the status quo- (Boettke et al., 2007). Policy makers tend to be reluctant to make drastic legislation changes to alter the underlying institutions, especially if the existing institutional setting aids in mitigating some detrimental effects of a natural disaster. Notwithstanding significant barriers, disasters can forcefully alter existing institutions (Rayamajhee, 2020). In some cases, institutions can revert back to their pre-disaster form, whereas in other cases the changes may be more persistent. Whether the resulting institutional change mitigates the detrimental effects the disaster or exacerbates them depends on whether the change generates economic opportunities or

stifles them. The type of policy that nets institutional change needs to be studied further and extends beyond the reach of this paper.

This paper contributes to the growing literature in two facets; first, it furthers the applications of synthetic control methods in the natural disaster literature. Synthetic control methods are most commonly used in policy implementation, but the possibility for applications are numerous, as is shown in this article. Second, this paper adds to the institutional economics in the natural disaster niche. The economic impact that a natural disaster has on a region is a debated topic in the existing literature, and this paper increases the available information as well as providing explanations for the effects seen.

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APPENDIX A. SUPPLEMENTAL TABLES

Louisiana

Table A1

Louisiana Population Estimated Synthetic Control Weights

State	%
Arkansas	33.3
New Mexico	26.4
New York	00.3
Pennsylvania	22.1
West Virginia	17.9

Table A2

Louisiana Population Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
GDP	10466.89	9784.76	6.52
Construction Employees	122.65	89.01	27.43
Unemployment Rate	5.78	5.38	6.85
Government Spending	25.71	27.36	6.42
Per Capita GDP	2334.72	2078.82	10.96
New Housing Units	1428.44	1407.50	1.47
Homeownership Rate	67.56	71.88	6.40
Hispanic %	4.30	14.23	230.97
African American %	31.05	9.04	70.87
Asian %	1.60	1.12	30.30
Murder Rate	12.74	6.16	51.63
Marriage Rate	7.99	8.75	9.54
Poverty Rate	17.41	15.82	9.14

Table A3

Louisiana Per Capita Income Estimated Synthetic Control Weights

State	%
Alaska	7.3
Arkansas	10.8
Hawaii	.1
New Mexico	26.8
North Carolina	1.1
Texas	13.4
West Virginia	40.3

Table A4

Louisiana Per Capita Income Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	4479960.00	4473665.00	0.14
Construction Employees	122.65	107.42	12.41
Unemployment Rate	5.78	5.74	0.53
Government Spending	25.71	25.58	0.52
Per Capita GDP	2334.72	2280.27	2.33
New Housing Units	1428.44	2275.41	59.29
Homeownership Rate	67.56	71.55	5.91
Hispanic %	4.30	17.98	318.14
African American %	31.05	6.11	80.33
Asian %	1.60	1.57	1.73
Murder Rate	12.74	5.71	55.18
Marriage Rate	7.99	8.10	1.44
Poverty Rate	17.41	16.31	6.33

Table A5

Louisiana Government Spending Estimated Synthetic Control Weights

State	%
Alaska	34.2
North Carolina	2.5
Tennessee	63.4

Table A6

Louisiana Government Spending Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	4479960.00	4041657.00	9.78
Construction Employees	122.65	86.73	29.29
Unemployment Rate	5.78	5.51	4.58
per Capita GDP	2334.72	2781.48	19.14
New Housing Units	1428.44	2214.31	55.02
Homeownership Rate	67.56	69.59	3.00
Hispanic %	4.30	4.04	6.10
African American %	31.05	13.89	55.27
Asian %	1.60	4.14	158.69
Murder Rate	12.74	7.10	44.28
Marriage Rate	7.99	10.28	28.69
Poverty Rate	17.41	12.17	30.08

Table A7

Louisiana Labor Market Freedom Estimated Synthetic Control Weights

State	%
Arkansas	43.7
Illinois	2.9
New Mexico	42.2
New York	7.8
West Virginia	03.4

Table A8

Louisiana Labor Market Freedom Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	4479960.00	3846170.00	14.15
Construction Employees	122.65	74.68	39.11
Unemployment Rate	5.78	5.41	6.26
Government Spending	25.71	27.51	7.01
Per Capita GDP	2334.72	2138.96	8.38
New Housing Units	1428.44	1263.08	11.58
Homeownership Rate	67.56	68.79	1.82
Hispanic %	4.30	21.94	410.19
African American %	31.05	9.50	69.41
Asian %	1.60	1.28	20.29
Murder Rate	12.74	7.06	44.57
Marriage Rate	7.99	9.48	18.72
Poverty Rate	17.41	17.41	0.03

Table A9

Louisiana Property Tax Freedom Estimated Synthetic Control Weights

State	%
California	5.7
New Mexico	89.6
New York	4.7

Table A10

Louisiana Property Tax Freedom Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	4479960.00	4479701.00	0.01
Construction Employees	122.65	96.77	21.10
Unemployment Rate	5.78	5.61	2.89
Government Spending	25.71	33.61	30.73
Per Capita GDP	2334.72	2236.95	4.19
New Housing Units	1428.44	1717.37	20.23
Homeownership Rate	67.56	69.61	3.03
Hispanic %	4.30	41.65	868.63
African American %	31.05	1.97	93.67
Asian %	1.60	2.12	32.22
Murder Rate	12.74	7.85	38.40
Marriage Rate	7.99	7.27	8.95
Poverty Rate	17.41	18.34	5.34

Table A11

Louisiana Minimum Wage Freedom Estimated Synthetic Control Weights

State	%
Alaska	0.6
Illinois	7.9
New Mexico	57.5
New York	3.3
Texas	4.5
Washington	2.4
West Virginia	23.7

Table A12

Louisiana Minimum Wage Freedom Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	4479960.00	4186598.00	6.55
Construction Employees	122.65	93.46	23.80
Unemployment Rate	5.78	5.66	2.02
Government Spending	25.71	27.84	8.28
Per Capita GDP	2334.72	2285.80	2.10
New Housing Units	1428.44	1746.02	22.23
Homeownership Rate	67.56	71.15	5.32
Hispanic %	4.30	28.90	572.18
African American %	31.05	3.89	87.49
Asian %	1.60	1.69	5.46
Murder Rate	12.74	6.66	47.75
Marriage Rate	7.99	7.34	8.08
Poverty Rate	17.41	17.04	2.12

Table A13

Louisiana Government Employment Estimated Synthetic Control Weights

State	%
Montana	7.1
Nevada	0.2
New York	9.8
West Virginia	53.6
Wyoming	29.3

Table A14

Louisiana Government Employment Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	4479960.00	3044860.00	32.03
Construction Employees	122.65	55.75	54.55
Unemployment Rate	5.78	5.35	7.43
Government Spending	25.71	25.08	2.47
Per Capita GDP	2334.72	2639.25	13.04
New Housing Units	1428.44	625.75	56.19
Homeownership Rate	67.56	72.25	6.94
Hispanic %	4.30	5.14	19.57
African American %	31.05	3.67	88.19
Asian %	1.60	0.76	52.74
Murder Rate	12.74	3.47	72.79
Marriage Rate	7.99	7.93	0.74
Poverty Rate	17.41	14.27	18.04

Table A15

Louisiana Social Capital Estimated Synthetic Control Weights

State	%
Arkansas	92.9
California	0.9
New Mexico	2.3
New York	0.1
North Carolina	2.1
Texas	1.8

Table A16

Louisiana Social Capital Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	4479960.00	3044860.00	32.03
Construction Employees	122.65	55.75	54.55
Unemployment Rate	5.78	5.35	7.43
Government Spending	25.71	25.08	2.47
Per Capita GDP	2334.72	2639.25	13.04
New Housing Units	1428.44	625.75	56.19
Homeownership Rate	67.56	72.25	6.94
Hispanic %	4.30	5.14	19.57
African American %	31.05	3.67	88.19
Asian %	1.60	0.76	52.74
Murder Rate	12.74	3.47	72.79
Marriage Rate	7.99	7.93	0.74
Poverty Rate	17.41	14.27	18.04

Florida

Table A17

Florida Population Synthetic Control Estimated Synthetic Control Weights

State	%
Nevada	0.255
Texas	0.745

Table A18

Florida Population Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	1.62E+07	1.62E+07	0.00
Construction Employees	490.18	426.59	12.97
Unemployment Rate	4.60	5.20	13.10
Government Spending	91.30	89.57	1.90
Per Capita GDP	2956.00	2965.36	0.32
New Housing Units	14342.61	10138.19	29.31
Homeownership Rate	68.68	63.59	7.41
Hispanic %	19.75	30.83	56.09
African American %	14.95	11.05	26.06
Asian %	2.40	4.47	86.22
Murder Rate	5.80	6.91	19.10
Marriage Rate	8.41	19.78	135.21
Poverty Rate	12.55	14.31	14.06

Table A19

Florida Per Capita Income Estimated Synthetic Control Weights

State	%
Arizona	38.5
Connecticut	1.2
Iowa	0.3
Nevada	2.4
New Jersey	15.2
New Mexico	9.7
North Carolina	1.4
Virginia	16.2

Table A20

Florida Per Capita Income Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	1.62E+07	5935942	63.36
Construction Employees	490.18	160.88	67.18
Unemployment Rate	4.60	4.63	0.55
Government Spending	91.30	35.22	61.42
Per Capita GDP	2956.00	2503.64	15.30
New Housing Units	14342.61	4326.72	69.83
Homeownership Rate	68.68	68.71	0.05
Hispanic %	19.75	19.71	0.20
African American %	14.95	10.22	31.64
Asian %	2.40	3.29	37.15
Murder Rate	5.80	6.54	12.69
Marriage Rate	8.41	8.38	0.32
Poverty Rate	12.55	12.57	0.16

Table A21

Florida Government Spending Estimated Synthetic Control Weights

State	%
California	5.9
Georgia	8.5
Michigan	14.8
New Jersey	31.1
New York	0.2
South Carolina	3.3
Texas	34.3

Table A22

Florida Government Spending Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	1.62E+07	1.46E+07	9.88
Construction Employees	490.18	330.52	32.57
Unemployment Rate	4.60	5.13	11.45
per Capita GDP	2956.00	2949.60	0.22
New Housing Units	14342.61	7252.16	49.44
Homeownership Rate	68.68	66.46	3.22
Hispanic %	19.75	19.77	0.12
African American %	14.95	14.87	0.51
Asian %	2.40	3.98	65.76
Murder Rate	5.80	5.80	0.04
Marriage Rate	8.41	7.05	16.22
Poverty Rate	12.55	12.21	2.69

Table A23

Florida Labor Market Freedom Estimated Synthetic Control Weights

State	%
Connecticut	3.6
Maryland	13.8
Texas	28.9
Virginia	36.3
Wyoming	17.4

Table A24

Florida Labor Market Freedom Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	1.62E+07	9635823	40.52
Construction Employees	490.18	259.14	47.13
Unemployment Rate	4.60	4.25	7.69
Government Spending	91.30	54.01	40.84
Per Capita GDP	2956.00	2834.60	4.11
New Housing Units	14342.61	5625.79	60.78
Homeownership Rate	68.68	69.40	1.06
Hispanic %	19.75	14.97	24.19
African American %	14.95	15.27	2.16
Asian %	2.40	2.87	19.41
Murder Rate	5.80	5.79	0.17
Marriage Rate	8.41	8.04	4.44
Poverty Rate	12.55	11.19	10.80

Table A25

Florida Minimum Wage Freedom Estimated Synthetic Control Weights

State	%
Arkansas	11.4
California	5.9
Maryland	4.8
Montana	3.1
New Mexico	3.3
New York	14.7
Pennsylvania	50.5
Texas	3.5

Table A26

Florida Minimum Wage Freedom Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	1.62E+07	1.25E+07	22.84
Construction Employees	490.18	246.08	49.80
Unemployment Rate	4.60	5.12	11.27
Government Spending	91.30	89.56	1.90
Per Capita GDP	2956.00	2403.54	18.69
New Housing Units	14342.61	3790.69	73.57
Homeownership Rate	68.68	68.37	0.44
Hispanic %	19.75	10.16	48.58
African American %	14.95	11.87	20.59
Asian %	2.40	3.81	58.57
Murder Rate	5.80	5.78	0.32
Marriage Rate	8.41	8.34	0.86
Poverty Rate	12.55	12.35	1.61

Table A27

Florida Government Employment Estimated Synthetic Control Weights

State	%
Maryland	29.7
Massachusetts	21.9
Nevada	24.2
Texas	24.2

Table A28

Florida Government Employment Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	1.62E+07	8579999	47.04
Construction Employees	490.18	228.46	53.39
Unemployment Rate	4.60	4.58	0.48
Government Spending	91.30	50.81	44.35
Per Capita GDP	2956.00	2667.89	9.75
New Housing Units	14342.61	4802.95	66.51
Homeownership Rate	68.68	65.35	4.84
Hispanic %	19.75	16.84	14.73
African American %	14.95	14.22	4.89
Asian %	2.40	4.75	97.99
Murder Rate	5.80	6.84	17.96
Marriage Rate	8.41	18.41	118.92
Poverty Rate	12.55	10.80	13.92

Table A29

Florida Social Capital Estimated Synthetic Control Weights

State	%
New Hampshire	0.4
Texas	99.6

Table A30

Florida Social Capital Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	1.64E+07	2.12E+07	29.27
Construction Employees	498.71	548.43	9.97
Unemployment Rate	4.57	5.41	18.27
Government Spending	94.16	119.49	26.91
Per Capita GDP	3012.65	2964.02	1.61
New Housing Units	14840.22	12853.95	13.38
Homeownership Rate	68.93	63.81	7.42
Hispanic %	19.90	33.97	70.71
African American %	15.00	12.66	15.62
Asian %	2.40	2.89	20.55
Murder Rate	5.64	6.20	9.91
Marriage Rate	8.68	8.37	3.63
Poverty Rate	12.30	15.65	27.23

Mississippi

Table A31

Mississippi Population Synthetic Control Estimated Synthetic Control Weights

State	%
Michigan	0.3
Montana	12.2
Oklahoma	67.8
West Virginia	19.7

Table A32

Mississippi Population Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	2840500	2840748	0.01
Construction Employees	52.51	50.99	2.91
Unemployment Rate	5.76	4.65	19.33
Government Spending	15.90	15.03	5.48
Per Capita GDP	2009.39	1867.97	7.04
New Housing Units	978.65	857.13	12.42
Homeownership Rate	74.46	71.59	3.86
Hispanic %	0.60	4.05	574.93
African American %	36.35	5.25	85.55
Asian %	0.90	1.35	49.82
Murder Rate	9.67	5.01	48.24
Marriage Rate	6.61	6.79	2.76
Poverty Rate	17.23	14.20	17.56

Table A33

Mississippi Government Spending Estimated Synthetic Control Weights

State	%
Arkansas	9.7
Delaware	55.6
Kentucky	5.2
Missouri	19.4
Pennsylvania	0.8
Tennessee	6.2

Table A34

Mississippi Government Spending Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	2840500	2750800	3.16
Construction Employees	52.51	53.82	2.48
Unemployment Rate	5.76	4.28	25.72
Per Capita GDP	2009.39	2284.79	13.71
New Housing Units	978.65	1224.98	25.17
Homeownership Rate	74.46	72.87	2.14
Hispanic %	0.60	5.14	756.33
African American %	36.35	17.42	52.08
Asian %	0.90	1.22	35.31
Murder Rate	9.67	4.56	52.82
Marriage Rate	6.61	7.58	14.61
Poverty Rate	17.23	10.64	38.23

Table A35

Mississippi Property Tax Freedom Estimated Synthetic Control Weights

State	%
Kansas	11.2
New Mexico	0.9
Oklahoma	50.6
South Carolina	19.9
Tennessee	4.9
Wyoming	4.4

Table A36

Mississippi Property Tax Freedom Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	2840500	3320699	16.91
Construction Employees	52.51	70.78	34.78
Unemployment Rate	5.76	4.56	20.82
Government Spending	15.90	18.54	16.61
Per Capita GDP	2009.39	2086.07	3.82
New Housing Units	978.65	1483.57	51.59
Homeownership Rate	74.46	71.54	3.93
Hispanic %	0.60	8.56	1326.29
African American %	36.35	10.74	70.45
Asian %	0.90	1.39	54.33
Murder Rate	9.67	6.19	35.98
Marriage Rate	6.61	7.47	13.03
Poverty Rate	17.23	13.49	21.68

Table A37

Mississippi Minimum Wage Freedom Estimated Synthetic Control Weights

State	%
Oregon	16.6
West Virginia	83.4

Table A38

Mississippi Minimum Wage Freedom Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	2840500	2082704	26.68
Construction Employees	52.51	41.93	20.15
Unemployment Rate	5.76	6.04	4.77
Government Spending	15.90	13.00	18.23
Per Capita GDP	2009.39	1953.57	2.78
New Housing Units	978.65	628.20	35.81
Homeownership Rate	74.46	74.66	0.27
Hispanic %	0.60	3.44	472.75
African American %	36.35	3.68	89.89
Asian %	0.90	0.80	11.20
Murder Rate	9.67	3.39	64.90
Marriage Rate	6.61	7.48	13.14
Poverty Rate	17.23	15.50	9.99

Table A39

Mississippi Government Employment Estimated Synthetic Control Weights

State	%
New Mexico	63.3
North Carolina	36.7

Table A40

Mississippi Government Employment Predictor Mean Comparison

Predictor Balance	Treated	Synthetic	% Difference
Population	2840500	4140939	45.78
Construction Employees	52.51	109.32	108.19
Unemployment Rate	5.76	5.28	8.29
Government Spending	15.90	24.66	55.09
Per Capita GDP	2009.39	2175.79	8.28
New Housing Units	978.65	3038.57	210.49
Homeownership Rate	74.46	71.02	4.62
Hispanic %	0.60	29.95	4892.11
African American %	36.35	7.47	79.44
Asian %	0.90	1.57	74.11
Murder Rate	9.67	7.66	20.84
Marriage Rate	6.61	7.38	11.64
Poverty Rate	17.23	16.90	1.89

APPENDIX B. ROBUSTNESS CHECKS

Dropping States

To test the validity of the results and to determine whether the results were not the product of chance, two different checks for robustness were performed. This process was done for all three states for every outcome variable. The first robustness check that will be done is dropping the states with the most weight. The states with the most bearing on the synthetic are shown in Appendix 1. When the states with the most weight are dropped, we expect the results to be the same or similar to the findings of the primary experiment. If we find that this is the case, it implies that the initial results are valid. All models pass this test; for every outcome variable in each of the three states.

Shifting Treatment Year

The second robustness check that is done is shifting the treatment period to 2003, creating a "false" treatment. This is done also to see if the results of the primary experiments are valid. If the results are the same as the initial experiment, and we see no divergence at the new treatment year of 2003, then there the result holds and is robust. This check ensures that the divergence is caused by the treatment of the Hurricane and not any erroneous reason. The new treatment period of 2003 is chosen because it is before the impact of Hurricane Katrina, and there was very little damage done by tropical storms, so we should not see the same effect as with Hurricane Katrina. Again, for the significant results, no robustness check revealed that the results were not robust.