Flooding The Vote: Hurricane Katrina and Voter Participation in New Orleans

Betsy Sinclair†, Thad E. Hall‡ and R. Michael Alvarez*

November 10, 2008

† Corresponding Author, Assistant Professor of Political Science, The University of Chicago; ‡ Assistant Professor of Political Science, University of Utah; * Professor of Political Science, California Institute of Technology. The authors wish to thank the Louisiana Secretary of State's office for providing access to these data, the DIGIT lab at the University of Utah for their work integrating these data with Census and other data, and Delia Bailey who provided us with R programming assistance. Previous versions of this research were presented at the 2007 and 2008 Midwest Political Science Association Annual Meetings, and we thank conference participants for their comments on our earlier work. We also thank Alexander Trechsel, Mark Franklin, Thad Hall, Guido Schwerdt and other participants in the "Innovations in Research on Political Behaviour" Workshop at the European University Institute for their comments about this research project.

1 Abstract

The flooding of New Orleans from Hurricane Katrina resulted in a massive and rapid exodus of individuals from New Orleans to locations around the United States. In the midst of the hurricane recovery, the City of New Orleans reelected Mayor Ray Nagin to a second term in office. Arguments regarding when this election would be held were largely driven by views regarding the impact of the diaspora on the voting population in New Orleans. With more than half of the city's population gone, the unknown was who would be able to vote. We use voting record data from twenty election cycles, GIS-coded flood depth data, and census data to examine the voting behavior of registered voters in New Orleans before and after Hurricane Katrina. We apply a variety of statistical techniques, including propensity score matching methods, to compare the mayoral turnout of registered voters across flood depths. We find that registered voters who experienced more than six feet of flooding were more likely to participate in the mayoral election than registered voters who experienced less flooding. We attribute this to their increased motivation to participate in municipal politics in conjunction with voter mobilization efforts in the wake of Katrina. Our finding about the characteristics of the voters who participated in the mayoral election given the flooding provides us insights into the scope of change for the political landscape of New Orleans after the hurricane.

2 Introduction

On August 29, 2005, Hurricane Katrina, then a Category 3 storm, made landfall near Buras, Louisiana. The storm produced significant rainfall in the Gulf Coast region, ranging from 8 to 12 inches (Knabb, Rhome and Brown 2005, page 10). This rain, combined with strong winds and severe storm surge, caused multiple failures to the Lake Pontchartrain flood protection system. These failures resulted in approximately 80 percent of the City of New Orleans being flooded. The flooding was so extensive that recovery efforts in the city and region continue to this day.[1]

The flooding of New Orleans resulted in a massive and rapid exodus of individuals from New Orleans to locations around the United States. According to the RAND Corporation, the population of New Orleans went from 485,000 before Hurricane Katrina struck the city to a population of 155,000 in 2006; the "homes of about 55 percent of the city's population — 268,000 people — suffered severe damage after parts of New Orleans were inundated by floodwaters more than 4 feet deep when the hurricane hit and levees were breeched" (McCarthy et al. 2006). This level of damage meant that individuals were not merely forced out for the duration of the hurricane and a short period after; instead, a large segment of the New Orleans population was forced out of the city for an extended period.[2]

Although the general geography of New Orleans is at or below sea level, the actual extent of flooding varied across the city, based on this geography and where the breaches to the levees occurred. Studies have indicated that large sections of New Orleans were flooded by more than six feet of water, and parts of Lakeview, Gentilly, New Orleans East, and the Lower Ninth Ward were flooded with more than ten feet of water (ASCE 2007,

[1] Knabb, Rhome and Brown (2005) of the National Hurricane Center, wrote that "Katrina was on of the most devastating natural disasters in United States history" (page 1). Further into their report, they note that there were dramatic storm surges in Lake Pontchartain, for example, surges of 15 to 19 feet in eastern New Orleans, and 10 to 14 feet in western New Orleans (page 9)

[2] RAND estimates that in September 2008 (three years after Hurricane Katrina), the population of New Orleans will only be 56 percent of its pre-Katrina population — or 272,000 of the original population of 485,000.

32, Figure 5.10). In Figure 1 we display the depth of the flooding for all of New Orleans by Census Block, where darker colors indicate increased flood depth.

Figure 1 Goes Here

In the midst of the hurricane recovery, the City of New Orleans held an important mayoral election. The election raised an array of questions regarding when the election should be held (if it should be postponed), under what electoral rules and procedures should the election be held, and what the implications of the population diaspora would be on the campaign and election. Arguments regarding when the election would be held were largely driven by the views that people had on what the impact of the diaspora would be on the voting population in New Orleans. With more than half of the city's population gone, the unknown was who would be able to vote.

We begin by providing a context for understanding the aftermath of Hurricane Katrina, including the debate that surrounded the election and its administration, and a theoretical framework for understanding why we expect some voters to continue voting even after the hurricane devastated New Orleans. We then test three hypotheses. First, we hypothesize that voters who incurred flooding would be less likely to vote. The flooding damage and related disruptions would, we think, increase the costs of voting for all voters. Second, aligned with the literature on which individuals are likely to vote, we anticipate that there will be interactions between the flood depth and the individual voter characteristics which are consistent with the hypothesis that some types of voters (individuals with low socioeconomic status, for example) will have a particularly more difficult time voting when the turnout cost increases. Here we will look carefully at the interactions between flood depth and particular groups to determine if we see patterns of which voters are most affected by increasing the cost of voting. Specifically, we predict that the flood most affected voters who have historically had a more difficult time casting a vote, and many of whom were unlikely to vote prior to Katrina — voters for whom an increase in the cost of voting is likely to make voting particularly difficult. Our concern with heterogeneous costs is that for these voters their higher levels of absence from the pool of eligible voters would significantly change the outcomes of the election and the quality of representation during the Katrina recovery. Finally, consistent with the literature on motivation, we hypothesize that, while flooding does decrease turnout, it does not do so in a monotonic fashion, and in particular, that those voters who experienced the worst flooding may in fact be the most likely voters.

We answer these questions with voter history databases that span twenty years of elections in New Orleans. These data were supplemented with Census data, and with data on the devastation caused by the hurricane collected by the Louisiana State University. We use voting data, economic and social variables, as well as information regarding the highest level of flooding that occurred by Census block throughout the city. This is the first study of its kind to use individual level data. In addition, we apply the most rigorous statistical methods possible to draw inferences about the effect of flood depth on participation. In particular we apply propensity score matching in order to compare individuals across flood depths, in a way that allows us to test whether the relationship between flooding depth and turnout is linear.

We find that flooding does decrease turnout, but contrary to our expectations, there are no statistically significant interactions between voter characteristics and flood depth. Thus although voting is to some extent depressed in the post-Katrina era, there is some reason for optimism: we do not find that the effect of flooding is worse for particular groups. Most interestingly, for those with the highest levels of flooding, they appear to have been mobilized to participate in politics. We recognize that the literature in political science has typically considered participation to be determined by resources, recruitment, or motivation. Our findings here demonstrate the power of motivation and recruitment.

3 The Hurricane and Its Aftermath

Katrina hit New Orleans shortly before the city was to conduct a regularly-scheduled mayoral election. Incumbent Mayor Ray Nagin, who had first been elected to office in

2002, became internationally-known in the immediate aftermath of Katrina, due to his frequent television appearances and some concerns about his handling of the situation in New Orleans immediately after Katrina struck. Due to the concerns about his performance in office, by the time the municipal primary election season arrived, Nagin found that he had twenty-two challengers, including Lt. Governor Mitch Landrieu.

But the devastation left by Katrina raised many questions about whether the 2006 mayoral election should be held, when it should be held, and if held who would be able to cast ballots. The primary view among many advocacy groups was that the election should be either postponed or the election rules should be liberalized and modes of voting expanded to ensure that the displaced African American voters would be able to cast ballots in the election (AP 2005). However, the problems with holding the election were as much administrative as racial or political. As the *New York Times* reported, "something as simple as sending a mailing to people in a district ... has become a logistical thicket. Many of the address lists vanished when computers were submerged and, even if they could be found, the addresses were often meaningless" (Levy 2005). Many community meetings regarding the reconstruction of the city and regarding relief services were held outside the city because of lack of appropriate facilities for public meetings and because of the population diaspora. Moreover, there were concerns that the returning population was primarily White, which could harm the electoral chances of incumbent Mayor Ray Nagin, who is African American.

The mayoral election was postponed in December 2005 by order of Louisiana Governor Kathleen Blanco. Originally scheduled to be held in February 2006, the Governor indefinitely postponed the election based on the recommendations of Secretary of State Al Ater and state elections commissioner Angie LaPlace. Ater noted that many of the city's polling places were completely destroyed and much of the city's voting equipment had been devastated as well (AP 2005). An election date of April 22 was eventually set for the municipal primary election in New Orleans.

With the primary election day set, the key question became what method voters would use to cast their ballot. One proposal was to set up "satellite" polling places outside of New Orleans and outside Louisiana that would allow displaced voters to go to a polling place to cast a ballot. The legislature did create a total of ten remote polling places outside the City of New Orleans, within the state of Louisiana, but rejected the idea of having remote polling locations established outside the State. Although lawsuits were filed to force the Secretary of State to establish out-of-state satellite voting locations, the federal courts refused on February 23 to either delay the election beyond April 22 or to require satellite voting (AP 2006a). Again on March 28, a judge refused to delay the election (AP 2006b).

Instead, the Court decided that election liberalization legislation that had been passed by the Louisiana legislature was sufficient to ensure that the election would be fair. The liberalized election laws included allowing absentee voting for individuals who had never voted in person at a precinct. They also allowed voters to request a ballot by fax on election day, vote the ballot, and fax the ballot back on election day. In addition, voters who were displaced could receive a special exemption to the state's traditional ballot return requirements. Normally, ballots were required to be received the day prior to the election. For displaced absentee voters, their ballots could be postmarked on the day prior to election day if the appropriate affidavit were included with the ballot (Times-Picayune 2006). In addition, the state was given the authority to make modifications to the administration of the election that would facilitate voting in a devastated city. However, all legislative changes to the election, and several procedural changes, had to be approved by the Justice Department under the provisions of the Voting Rights Act of 1965.

Numerous new administrative procedures were adopted as well, either at the state or the local level. At the state level, Secretary of State Ater required that a chain-of-custody paper trail be created to track every action in the election in order to combat any litigation that resulted from the election outcome.[3] For example, all calls to the state's election hotline were tracked in a database and every absentee ballot was tracked using the

[3] See Alvarez and Hall (2008) for a discussion of chains of custody in elections.

United States Postal Service tracking service. Election officials also created a set of ”mega polling places” that combined a large number of voting precincts into a single polling place (Thevenot 2006a). The entire voter registration system was put online so that poll workers could help to get voters to the correct polling place and precinct. In addition to expanded absentee voting for displaced voters, some voters either drove or were bussed to participate in early voting in Louisiana (Filosa and Nolan 2006; Thevenot 2006b).

The first round of the 2006 New Orleans mayoral election (held April 22, 2006) was a contest between 22 candidates and, as no candidate received a majority of votes cast, resulted in the need for a runoff election, scheduled to take place on May 20, 2006.[4] Mayoral incumbent Ray Nagin won 38% of the vote in April and 52% of the vote in May, resulting in his final victory. We focus our attention on the runoff mayoral election (held May 20, 2006) which had a higher turnout rate (113,591 compared to 108,153) and had received a larger amount of publicity. The later election date also allowed each voter additional time to determine how to cast a ballot in the Katrina aftermath.

4 The Mayoral Election and Political Participation: Recruitment and Motivation

The underlying issue for critics of the 2006 mayoral election, such as the Reverend Jesse Jackson, was the concern that African American voters would not have the skills to navigate the electoral process, especially once they were displaced. As the *Times-Picayune* (Finch 2006) reported;

> NAACP Legal Defense Fund attorney Damon Hewitt told [U.S. District Judge Ivan Lemelle] that there are ”significant gaps in voter access to the ballot,” including difficulty that many displaced voters would have getting back to the city to vote and recent changes in the location of numerous polling sites in the city. ”No one remedy alone is sufficient to cure these violations,” he said.

[4]See the Louisiana Secretary of State’s record of the mayoral primary election, `http://www400.sos.louisiana.gov:8090/cgibin/?rqstyp=elcpr&rqsdta=04220636`.

Both Jackson and NAACP officials argued that the absentee ballot process was very confusing and that there were not enough remote voting sites outside of New Orleans (Thevenot 2006c).

Hurricane Katrina raised dual concerns about voter participation in the mayoral election. One concern was that the displacement of voters itself would have a direct and negative affect on voters most affected by the flooding. Specifically, Katrina might impose a high cost of voting on those directly displaced by the flooding, because they would not necessarily have easy access to polling places or voting materials on election day. The second concern was that the complex array of procedures that were put in place to make voting easier for displaced voters might, contrary to their intentions, raise the costs and reduce the participation of the very individuals these procedures were designed to assist.

These concerns mesh well with theoretical models of voter participation, models that have been shown to have solid empirical foundations through decades of research. Seminal theoretical work by Downs (1957) and Riker and Ordeshook (1968) articulated the notion that when it is more costly for an individual to participate in an election, ceteris paribus, the less likely it is for that individual to participate. This basic theoretical notion has been documented in a long line of work, beginning with the important contribution of Wolfinger and Rosenstone (1980). It and many later studies (e.g., Leighley and Nagler (1992); Nagler (1991)) have shown that complex procedures can hinder the participation of many voters, especially those who many not have the resources necessary to overcome these hurdles.

Verba, and Schlozman and Brady (1995) provided a deeper demonstration of the importance of resources — such as time, money, civic skills — that allow an individual to navigate the world of politics. Resource rich individuals are more engaged and interested in politics, and have connections to others that mobilizes them to participate. People who have resources, civic skills, engagement and connections to mobilization networks are much more likely to participate in politics. Congruent with this observation is the hypothesis that individuals who belong to particular groups tend to behave similarly — and many of those individuals who participate in politics report doing so because someone they knew asked them to participate. Similarity of behavior within a social framework is demonstrated across many classifications of social group structures, ranging from correlations in behaviors within urban ghettos and amongst home owners (Cutler and Glaeser 1997). Although there may have been a decline in social capital among American voters (Putnam 1993, 1995) , the relationship of individuals to particular groups is a good predictor of individual behavior (Coleman 1990). Finally, and relatedly, there is recent research that combines some of these strands and argues that voting participation may be something like habitual behavior (Plutzer 2002): once individuals are habituated into the behavior of voting (by sociological or political factors) they are likely to continue the habit of voting.

The flooding and displacement caused by Hurricane Katrina clearly increased the cost of voting for many individuals who had lived there prior to the flooding event. Although we cannot directly quantify these costs, we can compare these costs to those in a typical election. Consider, for example, that we know that moving a polling place one mile in a normal election can reduce turnout by one-half percent and that precinct consolidation generally results in reduced turnout (Brady and McNulty 2002; Dyck and Gimpel 2005; Gimpel and Schuknecht 2003; Haspel and Knotts 2005). Moreover, efforts to make voting more convenient typically do not increase turnout but instead merely make it easier for medium- to high-propensity voters to participate (Berinsky 2005; Flower 2006). In the 2006 mayoral elections, the election had both a consolidation of precincts, because many previously-used polling places were destroyed by the flood, and an expansion of convenience voting methods (early, absentee, and quasi-vote centers).[5] However, we should not expect, based on traditional research, for these improvements to improve turnout.

While the flooding caused by Katrina might have imposed a significant fixed cost on those who wanted to vote in the mayoral election, it is also the case that those who faced the highest flooding might have been highly motivated to vote. Here we posit that voters

[5]See Stein and Vonnahme (2008) for a review of voter turnout and convenience voting.

are affected by recruitment and increased motivational to express their political preferences. As Gerber and Green (2000) have noted, personal mobilization can play a critical role in improving turnout. In a multi-mode experiment, they found that face to face contacts can increase turnout by almost 10%. Although we have no data on efforts to mobilize Katrina victims — either those who were displaced or those who were able to remain in New Orleans — media accounts tell us that there were significant efforts to contact these victims using all three contact modes mentioned above. For example, The Metropolitan Organization in Houston conducted a face-to-face campaign to sign up 10,000 absentee voters (Moreno 2006) and the Association of Community Organizations for Reform Now (ACORN) conducted organizing campaigns in several cities, including Texas and Georgia, and provided bus transportation to allow voters to vote in person in Louisiana for the election. ACORN hired canvassers to go door-to-door in apartment complexes with high numbers of displaced voters, with the intention of registering them to vote, getting them absentee ballots, and/or offering them rides to the polls (The Hotline 2006). The candidates also engaged in mobilization efforts; for example, incumbent mayor Ray Nagin campaigned in several surrounding states in order to rally voters and his campaign also conducted face-to-face campaigning in states neighboring Louisiana.

The Louisiana Secretary of State, Al Ater, also noted that the catastrophe should be considered a motivational experience for voters, encouraging them to participate in the election and in the subsequent rebuilding of the city. Ater stated, "If this whole crisis, this whole disaster doesn't motivate people, I don't think we're ever going to get them motivated, are we?" (Moreno 2006). One displaced voter echoed this, saying "[voting] is the start of getting my life back" (Simpson 2006). Voters had reasons to be motivated to participate in the election that would determine who would lead the rebuilding of their city.

This motivation to participate and the importance of the mayoral election can be seen in national surveys as well as surveys conducted only of Louisiana residents. A survey of Louisiana resident adults by the Pew Center for People and the Press found that "just

34% give state and local governments an excellent or good rating on their handling of the disaster, down from 41% last week. Public evaluations of the federal government's response [were] 37% positive, 61% negative."[6] At the national level, there were concerns about the quality of the response to Katrina just two weeks after the disaster.

A state-level survey conducted by Louisiana State University also illustrates how important the election was for residents of New Orleans.[7] In this survey, the data show that the state government and New Orleans city government ranked last in a list of 12 organizations — including the federal government and FEMA — in evaluations of effectiveness in hurricane response. In addition, respondents were aware that the post-Katrina period would continue to be one where government would be tested, through choices regarding budget cuts, rebuilding efforts, and service provision. Respondents also were personally affected and were likely motivated by that as well. For example, more than half of respondents felt depressed (53%), 41% were unable to work and lost income, and 39% felt angry because of the storms.

Because it is possible that Katrina gave New Orleans voters a strong incentive to vote in order to hold their local elected officials accountable for their handling of the Katrina crisis, we hypothesize that highly motivated and frequently contacted voters will be more likely to turn out to vote. We are also able, within this data, to test theories of political motivation. Here we expect that increasing the depth of the flooding will increase the desire of voters to express their preferences. The motivational story here is expressive; the voters prefer to cast a ballot, and in fact their preference to do so may increase as costs increase. Although we anticipate a decrease in the chances of participation for voters affected by flooding, we anticipate that there will be a conflicting effect as well — some voters strongly affected by the flooding will be highly interested in casting a vote. In some ways, the simple descriptive data provide some support for the idea that despite the massive dislocation Katrina induced, New Orleans voters did figure out how to participate

[6] `http://people-press.org/report/256.pdf`

[7] "The 2005 Louisiana Survey: Post Hurricane Community Audit." Published by the Reilly Center for Media and Public Affairs. November 20, 2005. Manuscript. Louisiana State University.

in the mayoral elections in 2006. In 2002, during Nagin's first run for mayor, 45.7% of registered voters participated in the mayoral primary (February 2, 2002), and 44.3% participated in the mayoral general election (March 2, 2002); in 2006, the turnout percentages were 36.8% and 38.5%, respectively.[8] Certainly, turnout was lower in the 2006 mayoral elections than in the same type of elections in 2002, but the reduction in turnout is not necessarily as dramatic as one might anticipate given Katrina's damage.

This hypothesis — that turnout will increase with motivation and recruitment — is consistent with literature on the expressive act of casting a ballot. Scholars suggest that voters will be more likely to vote when the civic duty term is larger than the cost of voting; if for example, voting increases the likelihood of the preservation of a democracy (Downs 1957, Riker and Ordeshook 1968, Blais 2000). Voters may also receive psychological benefit from voting (Schuessler 2000, Brennan and Buchanan 1984, Fiorina 1976). Voting may be in this sense a consumption good where voters seek to express themselves and are not concerned about being pivotal but instead place value, for some particular reason, on the act of casting a ballot (Silver 1986, Hinich 1981). This motivation may come from a particular experience, for example, Blattman (2008) finds that child conscription in Uganda results in a 22% increased likelihood of voting as an adult. Here we test another hypothesis as well — that voters who are particularly affected by flood depth will have additional motivation to turn out to vote. We use a particular statistical methodology that will allow us to evaluate the probability of voting given that we hypothesize there may be a nonlinear effect of flooding on turnout.

Given the commentary that surrounded the election and its aftermath regarding the stability of representation in the city (Would Mayor Ray Nagin, who is African American, be reelected?) and whether the real or potential voting population would change because the voters are themselves different (such as fewer Democrats or African Americans in the voting population), these questions are highly relevant to understanding the impact of a highly disruptive natural disaster on a city's politics. These results have the

[8]These data some from the Louisiana Secretary of State, `http://www400.sos.louisiana.gov/stats/Post_Election_Statistics/Parish`.

potential to be highly generalizable in the following sense: in the post-9/11 world and in the current environment of global climate change, there is an increased likelihood that such highly disruptive events will occur in other places (e.g., Alvarez and Hall 2008; Beck 1999). The 9/11 attack did disturb the mayoral election in New York City and, had it been more disruptive on Manhattan, it could have changed the voting population in the city. Similarly, natural disasters like Katrina could easily disrupt elections in many large and diverse cities in the United States, including other major cities along the Eastern seaboard and Gulf of Mexico that are potentially susceptible to future hurricanes, cities along the Pacific Rim that are in active tectonic zones, and even cities throughout the interior which might see future elections disrupted by major natural or man-made events. As some commentators have noted, little has been done to plan for how such events might affect elections and even government transitions (Fortier and Ornstein 2004; Hall 2003; Kiewiet et al. 2008).

5 Data

The Louisiana Secretary of State's office provided us with a voter file dataset, including individual data on all registered voters in the New Orleans parish, which includes 238,627 individuals. This file incorporates data from all 17 wards, some of which, like the Lower 9th Ward are now, post-Katrina, ubiquitous for the amount of flooding they experienced; the file also includes wards that experienced no flooding whatsoever. As noted in the Appendix, the voter file was augmented using Census block group information from Census Summary Files 1 and 3. The variance in the extent of flooding, combined with the wealth of information observed both in the voter history file, and data observed at the Census block level, will allow us to evaluate the extent to which flooding caused by Katrina influenced voter behavior in New Orleans' recent mayoral election.

From this voter file, we observe, for each registered voter, the last twenty elections in which that individual has participated and when each voter registered.[9] From these two

[9]Note that this is distinct from their participation in the last twenty elections — this variable records

variables we produce a "propensity to vote" variable that is calculated as a percent of the elections in which the individual participated divided by the number of eligible elections. In our dataset, the average voter propensity is 39.45% (with a standard deviation of 25%) and this variable takes values which range from 0 to 100%. This is the variable that we use to measure the effect of Katrina's flooding on habitual voters.

We also observe a number of characteristics about each individual. From their birth date we are able to discern their age – the average age of registered voters in this file is 46.37 years. Because Louisiana is required under the Voting Rights Act of 1964 to record the race of each registered voter, we know whether each registered voter is white or nonwhite: approximately 66% of the registered voters in this dataset fall under the nonwhite category. We know each registrant's party registration status and from this information we produce an indicator variable which states whether or not the individual's party registration is Democratic. About 67% of the individuals in the dataset are registered Democratic. We observe turnout in the first large election which occurred in New Orleans after Hurricane Katrina — the May runoff mayoral 2006 election. Of the registered voters in 2006, 38.21% cast ballots for the May runoff mayoral election; 36.80% cast ballots in the April 2006 mayoral primary election.[10]

Thus, the average individual in our dataset is more likely to be a nonwhite (66%), female (56%), registered Democratic voter (67%). Out of the last 20 (or fewer) elections for which they were eligible to vote, they have voted in approximately 39% and are approximately 46 years old. This average individual in our sample lives in a census blockgroup where 24% of the population has a high school diploma, 52% of the occupied housing units are renter occupied, and the median household income is $32,206.[11]

Each registrant's address is recorded in the voter file. Using this United States postal

the specific elections, up to twenty, in which the individual has participated. These elections could have occurred decades earlier. If the voter was eligible to participate in fewer than twenty elections, then the denominator here is the number of elections they were eligible to vote in.

[10]For discussion about the use of voter history or voter registration files for research like ours, see McDonald (2007).

[11]These variables are described in more detail in the Appendix.

address, the voter location was spatially located using ESRI's Streetmap© geocodable roads. This was done using a standard GIS procedure called geocoding that provides Latitude and Longitude for each address. Out of a possible 295,277 records, a total of 238,627 were kept in the dataset — these were both successfully matched to their appropriate addresses and had no missing covariates in the registration file.[12] Using data from the United States Geological Survey (USGS), we overlay each address with the approximate depth of the flood water post Hurricane Katrina. We tabulate the number of registered voter households who are affected by each category of water depth in Table 1. Almost a third of the voters had residences which were unaffected by Katrina flooding and remarkably few voters, only 43, had floodwater over 10 feet. The category of flooding with the highest number of affected voters is 5 feet of flooding.[13]

Table 1 Goes Here

This data provides a unique opportunity to analyze turnout behavior in the wake of Hurricane Katrina. In particular, almost all of our variables are individual level data, including the depth of the floodwater and the individual characteristics of each registrant. Much of the analysis thus far on Hurricane Katrina has dealt with aggregate data on turnout, race and district-level characteristics (for example, Logan 2006); this presents a problem commonly referred to as the *ecological inference* problem, where individual-level inferences are made using aggregate-level data. It has long been known in the social science research literature that individual-level inferences drawn from aggregate-level data are suspect, unless special care is taken to try to alleviate known biases in such ecological inferences (or the researcher uses individual-level data to make individual-level inferences, as we do).[14] The prior findings differ from our own for this reason — here we are

[12]We dropped 1173 individuals who are missing age information in the registration file are dropped from all analyses and 4 individuals who had no registration date. The remaining individuals are excluded as we were unable to match their listed address to an address recognizable on a USGS map.

[13]It is important to keep in mind that our population is registered voters, not the potentially larger population of New Orleans residents.

[14]The methodological literature on the basic ecological inference problem is well summarized in Achen and Shively (1995), and King (1997).

able to draw valid individual-level inferences with individual-level data, and to do so with the most rigorous statistical techniques possible.

6 Flooding and Turnout

We compare registered voter households with flooding against registered voter households who effectively had no floodwater in order to determine the effect of flooding on turnout in the May 2006 mayoral election. The turnout pattern by flood depth in May is similar to the pattern we observe in the April 2006 election as well. In Figure 2 we present the percentage turnout by flood depth (in feet) for each registered voter household in our dataset. When we compare Katrina's flooding to turnout in both elections, we see a very counterintuitive pattern. Had the extent of flooding presented a uniform barrier to voter participation, we would have expected to see a negative relationship between flooding and turnout: turnout should be high in areas with little or no flooding and turnout should fall as the flooding increased. We anticipate this pattern because we know that, with enough flood water, residents were forced to leave New Orleans. Over half of New Orleans' residents had not yet returned at the time of the primary election.[15] Instead, we see in Figure 2 something like a curvilinear relationship: high voter turnout in locations with little or no flooding, but equally high voter turnout in locations with the most extensive flooding. This conclusion, reached simply by examining the bivariate relationship between turnout and flooding, is one we will later examine in more detail in our multivariate analysis.[16]

[15] Says the Associated Press in "Katrina Evacuees Cast Early Votes in New Orleans Mayoral Race" as of Monday, April 10, 2006, of the city's primary mayoral election, "Fewer than half New Orleans' residents have been able to return to their devastated neighborhoods. New Orleans had nearly a half-million people, about 70 percent of them black, before Hurricane Katrina. Those who have returned number fewer than 200,000 and most are white."

[16] One possibility, which we explored due to a large amount of coverage in the media, was that the electoral consequences of Katrina flooding was due to a large extent to the particular ward effects. However, our findings indicate that is not the case. Although some wards sustained significantly different levels of damage and flooding, the average flood depth across wards is fairly constant. Looking at the percentage of registered voter households for each of the 17 wards that sustained more than four feet of flooding, this value varies only between 16-17%. Additionally, there are no great trends by ward with respect to flooding and turnout. This gives us reason to believe that in fact there will not be ward-specific effects in our analysis

Figure 2 Goes Here

7 Methods And Results

Based upon Figure 2, we recognize that a simple statistical analysis of the bivariate relationship between Katrina-induced flooding and turnout in the mayoral election is not sufficient given that there may not be a straightforward linear relationship between flooding and turnout. We therefore utilize a variety of methods to test the functional form; in four statistical models we successively relax the assumptions about the relationship between the depth of the flood water and a particular functional form to investigate the effect of flood depth on turnout in the 2006 mayoral contest in New Orleans. Consistent with our observation that the relationship between flood depth and turnout reported earlier does not appear to be linear, we find that, although flood depth does increase the cost of turning out to vote, the effect of the depth of flooding is not linear and additive.

We begin with a simple analysis to analyze likely voters in a classic turnout model; we first model turnout in the mayoral campaign as a function of an individual's characteristics, including the depth of the flood water post-Katrina. Thus the model is:

$$\text{Mayoral vote} = \alpha + \beta_1 * X + \epsilon$$

where X is a matrix of voter characteristics that include flood depth after Katrina, gender, race, age, party registration, and propensity to vote and ϵ is distributed logistically.[17]

and we focus on the flood depth on an individual level. In Table 9 we document the extent of more than five feet of flooding by zipcode and break this down into the percentage of individuals affected by more than five feet of flooding who were residents of blockgroups that were more than 50% black. We discern no clear patterns.

[17] We also consider a model where we take the log of the flood depth variable with the concern that given the distribution of depth seen in Table 1 that we might anticipate this distribution would not have a normal relationship with the voting outcomes. A reasonable transformation is then to take the log of the flood depth variable, however, given the presence of zeros this is not directly possible. We first transform the flood depth (which ranges from 0 to 10) into a variable which is extremely similar, so that flood = .995 * flood depth + .005. We then take the log of this new flood variable. The coefficient from this model is similar in magnitude and statistical significance; thus we continue to simply use the absolute depth for ease of interpretation in our analyses.

We present the coefficients for each of the variables in Table 2. We find that the coefficient on the flood depth is negative, as anticipated. As the amount of flooding increased, the probability that individuals would then be able to successfully cast a ballot in the mayoral contest should decrease, in large part because many of those residents were displaced by the flooding. This displacement should have increased the costs of voting, making it more difficult for voters to cast absentee ballots ahead of the election. Many organizations orchestrated bus trips to New Orleans so that voters could cast mayoral ballots and a bus ride from Texas to New Orleans, for example, dramatically increases the cost of voting. We find that the coefficient on the gender variable is effectively zero (and not statistically significant) as is the coefficient for the nonwhite indicator. Surprisingly, the age variable is negative and statistically significant, but effectively zero (the coefficient value is -.001).

The variables that do seem to impact the turnout decision — other than the flood depth — are Democratic registration and vote history. The coefficient on Democratic party registration is positive, which is surprising as many of the neighborhoods which experienced the worst flooding were also majority Democratic. However, as the two main candidates in the runoff election were both Democrats (Ray Nagin and Mitch Landrieu), it is also possible that Democratic voters were more interested in the election. The coefficient on vote history is large and positive, which we would expect. The relationship between voting history and turnout is extremely strong but there is little correlation between voting history and flood depth (correlation coefficient is .024). As the flooding did not primarily then take place in neighborhoods with high voting propensities, it is possible that the votes cast in May 2006 are similar in terms of the types of individuals they represent to those cast in earlier elections. The vote history variable also captures a large amount of the variance associated with the other characteristics that tend to predict turnout (socioeconomic status, for example). Leaving this variable out of the model results in a large, negative, and statistically significant coefficient estimate for race, for example. The coefficients produced from this model are fairly consistent with those we would anticipate from the literature on turnout. We present the coefficients from a model estimated when excluding the vote history variable in the second column of Table 2. From this table we conclude that in fact the depth of flooding decreases the probability that an individual casts a ballot in the mayoral election. Our next analysis will investigate whether or not any of these particular covariates interact with the depth of flooding. Consistent with what we find in the second column of this table, and although the vote history variable does capture a great deal of the variance associated with turnout, we will exclude it as it likely masks the effects of the flood depth and other characteristics.

Table 2 Goes Here

Our second analysis incorporates both the interactions between the water depth and the voter demographics, as well as a series of community characteristics. Thus our new model is:

$$\text{Mayoral vote} = \alpha + \beta_1 * X + \beta_2 * Z + \beta_3 * W + \epsilon$$

where X is the identical matrix as described above, Z is a matrix of some of the variables in X interacted with the flood depth, and W is a matrix of community-based characteristics, measured at the block group level that includes the education level of the blockgroup, the median income of the blockgroup, and information on the type of housing (percent renter occupied) for the blockgroup. We assume ϵ is logistically distributed. We include these variables as control variables and use them as proxies for the individual data.

This analysis enables us to examine our second hypothesis — that the interaction of flood depth and vote propensity should be positively related to the probability of voting in the mayoral contest. Here we hypothesize that those voters who are nonwhite, Democratic, younger, and are residents of blockgroups with less education, more renters, and lower median incomes, will be more affected by flood damage. It seems unlikely that the additional costs associated with post-flood voting would be evenly distributed across groups. We present the coefficients from this model in Table 3.

Table 3 Goes Here

Only one coefficient for the interaction is statistically significant — the coefficient between flood depth and Democratic registration — in Table 3 is not consistent. Our hypotheses about the effects of interactions are not supported here — in particular, the marginal effect of flooding for Democratic registrants is positive. For an additional one foot of flooding, the odds of a Democratic registrant voting would decrease less than for any other party registrant. Our other coefficients are sensible and consistent with the hypothesis that increasing flooding is likely to decrease turnout. In particular, in the second column of Table 3, we exclude the blockgroup variables (since we know there may be biases introduced by using aggregate variables) and find results that are extremely similar.

One possible explanation for thee results is simply the fact that the flood depth effects may not be linear and additive. This seems likely given the difficulty in understanding the coefficients presented in Table 3 in the context of the traditional voter turnout literature. It is likely that particular neighborhoods were affected disproportionately by the flood — one component of this may simply be in the targeting, post-Katrina, of different categories of social services. We are cautious in using these results as we understand that we are effectively treating an ordinal variable as though it were continuous. Given this concern, we turn to a different technique.

In order to better analyze the true treatment effects of the flood variable, we apply a method for determining appropriate cutpoints for the effect of flooding on mayoral vote (Walter, Feinstein and Wells 1987). First, we produce an indicator variable X_K for each K feet of flooding, where $X_K = 0$ if the flood depth is below K and 1 if the flood depth is equal to or above K. We incorporate each of these variables (X_1 through X_{10}) such that the model is:

$$\text{Mayoral vote} = \alpha + \beta_1 * X_1 + \beta_2 * X_2 + \ldots + \beta_K * X_K + \beta_{K+1} * W + \epsilon$$

where W is a matrix of voter characteristics that include gender, race, age, vote history and party registration, and each of the X_Ks is included with X_0 used as a base case and ϵ is distributed logistically.

We then analyze the results from this regression, in particular focusing upon the coefficients from each of the X_Ks. The interpretation of each of the coefficients for each of the X_Ks is as follows: the coefficient evaluates the relative impact of flooding between values k and $k+1$ compared to no flooding. For each X_K that has a coefficient which is itself statistically significant we determine that there is a true cutpoint at each of those values, so that in fact the probability that an individual votes in the mayoral election is affected by flooding between the two X_Ks with significant coefficients. After our analysis, we find that there are six X_K values which qualify: these are flood depths of 1,2,6,7, and 9. We repeat the above model incorporating only those X_K values. These results are presented in Table 4.

Table 4 Goes Here

With this method, we are able to see the jumps in treatment effects because we are no longer constrained to incorporate the flood variable as both linear and additive. The coefficients for the X_K variables range from positive to negative, implying that particular groups are often more affected by flooding than others. We observe a negative coefficient for flooding from 1-2 feet, but positive and statistically coefficients from 3 or more feet. The range in coefficients appears initially quite unintuitive, but in fact it is simply likely that the flood increased the cost of voting for individuals in some categories but not in others. Although it is surprising is that there is such a positive and statistically significant effect of flooding depth on turnout for flood depth of 6 feet or more, it is possible that these individuals were simply more likely to turnout already — that, for example, their voting history indicated they were likely voters. These results indicate that there is indeed a non-monotonic effect of flood depth on turnout. As we present the results from our final statistical technique, we anticipate finding a non-linear and in particular non-monotonic result from the coefficients we observe in Table 4.

We now turn to a final statistical technique which allows us to compare individuals directly with the fewest possible assumptions about the functional form used to describe the impact of flood depth. We have observed in the above results that a linear functional form was not appropriate, and furthermore we do not necessarily have a particular theory to motivate the choice of functional form. Therefore, in order to ensure that our results are not a consequence of our modeling assumptions, we apply a propensity matching method to the existing data, considering the treatment each individual received as the number of feet of flooding they experienced in the wake of Hurricane Katrina. We let t_i indicate that registered voter i has been exposed to treatment t_i, where t_i can range from 0 to 10 in terms of depth of flooding. We observe the mayoral turnout, y_i for each i, and, in addition, a series of covariates X_i, where X_i includes all individual-level covariates. Matching is necessary because t_i and X_i are not independent, for example, it seems likely that areas with higher median household income for example, there would be less flooding. We pre-process our data to eliminate the relationship between t_i and X_i: to do this, we must locate individuals across different flood depth values who have identical covariates and perform our analysis on these individuals only. Analysis on these individuals will return results that are similar to those from a randomized experiment and, to a large extent, there is little relationship already between the different treatment groups as the flooding from Hurricane Katrina struck without regard to many of the covariates included in our models.

We assess the differences in covariates by flood depth for the data before we pull out the matched sample. We look at the means of each covariate by flood depth. Table 5 presents these values for each of the covariates of interest by flood depth. Although there are differences which are apparent across flood depths, these differences are not large and are easily correctable via matching.

Table 5 Goes Here

We begin by isolating individuals across different flood depth values with similar characteristics (matching), and we assess the quality of this comparison with a technique referred to as ”balance”, where we compare the distributions of the covariates by flood depth to assess their similarity. We do so using the statistical software MatchIt (2004) and employing subclassification matching.[18] This process is designed to match observations when there are many covariates to consider for the treatment and control groups. The goal is to form subclasses where the distribution of the covariate values is identical for the treatment and control groups as opposed the exact values of the covariates. After pulling out a subset of observations, we then assess the quality of the match by looking at the percentage of observations that are balanced before and after the match as well as presenting quantile-quantile-plots for each covariate for each treatment pair.[19] Table 6 presents information on the quality of the match in terms of the percent improvement for each covariate for each treatment pair. Percentage improvement is measured as $\frac{|a|-|b|}{|a|}$ where a is the balance before and b is the balance after matching. We only observe a decrease in the balance for two categories: for five feet of flooding, the percentage in the blockgroup who are high school graduates increases in terms of distance between zero feet and five feet, and for nine feet of flooding, there is a decrease in balance for the individuals who are registered as Democratic.

Table 6 Goes Here

Another way to compare the matched and unmatched samples in order to understand the quality of the match is to evaluate the quantile-quantile plots. Here we present only one set of such plots, the remainder of which are available from the authors upon request. In the figures below, there is little visible improvement to the dataset (these observations compare the flooding at zero feet with the flooding at one foot). However, in both cases, the balance is fairly close — most of the observations surround the 45 degree line — and given that this is the case, we have confidence in these estimates.

[18] For a review of the matching literature refer to Ho, Imai, King and Stuart (2007), and for a review of this particular procedure, see Imai and van Dyk (2004). Note that the authors also ensured that their results were consistent across matching methods; these include genetic matching, optimal matching, and nearest-neighbor matching. These results are available from the authors by request.

[19] A quantile-quantile plot is used to see if two data sets come from populations with the same distribution; it plots the quantiles of the first data set against the second. If the two sets come from a population with the same distribution, all the points should fall approximately along the 45 degree line.

Figures 3 - Figure 5 Go Here

In our analysis of results based upon these data, we consider the treatment effect comparing zero flooding to flooding in each of the categories. Each individual flood effect is plotted as a comparison against the base category (no flooding) in Figure 6, and the mean effects are tabulated in Table 7. We observe an upward-trending curve for effects when setting each covariate at its mean. There is a decrease in the probability of voting with some flooding, but as the flooding increases, the probability that those voters cast ballots in the mayoral contest actually increases. The bars around the effects in Figure 6 indicate the 95% confidence intervals. We also calculate the mean effects for each flood category against the base case using a matched sample.

Table 7 and Figure 6 Go Here

Our results indicate that flooding did decrease the probability of voting on average. But we also show that voters who experienced high levels of flooding were more likely to get to the polls than those with lower levels of flooding. Most important, considering the claims of potential racial bias that holding the election would cause, controlling for race and other matched characteristics, voters that experienced the highest levels of flooding were more likely to turn out than the baseline population (zero feet of flooding). Referring back to Table 3, note that there is no statistically significant relationship between the interaction of race and flood depth on the probability of turning out to vote. We do observe a heterogeneous effect of water depth on the probability of casting a ballot in the mayoral contest, and this effect follows a upward-shaped pattern. We hypothesize that this pattern could be consistent with the efforts of a variety of voter mobilization campaigns designed to assist those voters who were most affected by the flooding in casting a ballot.

8 Conclusion

This paper presents an optimistic story about mayoral voting after Hurricane Katrina. Voters whom the media portrayed as having likely higher costs of casting ballots are not seen here in this analyses to be negatively affected. Although flooding does decrease the probability that an individual casts a ballot, the relationship between flooding and race, partisan registration, and age are not key determinants of the likelihood that an individual casts a ballot. Interestingly, it is not the case that as we increase the depth of the flooding that this necessarily has a constant effect on the probability that an individual casts a vote.

By using appropriate modeling techniques, we are able to determine that the effects of flooding on the likelihood to vote is not linear. Individuals who live in areas that had large scale flooding were actually more likely to vote in 2006 than others who suffered less flooding. This finding suggests that, even though the costs associated with coping with the effects of the flooding for these voters was high, the direct costs of voting were lowered to the point that these individuals could vote in the election. Given the high level of interest in the election among interest groups, the candidates, and the media and the introduction of new voting procedures to minimize the costs of voting, such as vote centers, expanded absentee voting, and expanded early voting, both the informational costs of voting and transactional cost of voting were likely reduced. On the informational dimension, the media, interest groups, the candidates, and election officials in Louisiana all worked to reach out to displaced voters. The election reforms introduced reduced the transactional costs of voting. Likewise, the polarized racial dimension also may have increased the benefits of voting for low-income, African-american voters as well.

This findings distinguish this essay from much of the popular journalism on the impact of Katrina on the election. Rather than necessarily preventing those voters who had lost so much from participating, instead we observe that for the individuals who had experienced the worst flooding, they were in fact able to turn out and vote. The key component in our analysis is that we are able to use both individual data and the most rigorous statistical methods to draw our conclusions — the existing work has used aggregate data, and fallen prey to the ecological inference problems. Thus our findings also emphasize the need for methodological rigor in drawing social science inferences.

Our findings suggest that, in the aftermath of the Katrina disaster, it was possible to hold elections that were not biased against resource-limited voters. This normative finding should be comforting to those who were concerned that holding the election so close to the flooding disaster in New Orleans would systematically discriminate against the poor and minority voters. Through effective efforts to lower the cost of voting, and potentially an increase in perceived benefits of participating, the 2006 mayoral election allowed all voters including those most affected by the flood, to participate and shape the future recovery.

9 References

Achen, Christopher H. and W. Phillips Shively. 1995. *Cross-Level Inference*. Chicago: University of Chicago Press.

Alvarez, R. Michael and Thad E. Hall. 2008. *Electronic Elections: The Perils and Promises of Digital Democracy*. Princeton, NJ: Princeton University Press.
Alvarez, R. Michael and Thad E. Hall. 2008. "Building Secure and Transparent Elections through Standard Operating Procedures." *Public Administration Review*, 68, 5, pages 828-838.

American Society of Civil Engineers, Hurricane Katrina External Review Panel, 2007. "The New Orleans Hurricane Protection System: What Went Wrong and Why." `http://www.asce.org/files/pdf/ERPreport.pdf`.

Associated Press. 2006a. "Judge Refuses to Postpone New Orleans Mayor Election." www. foxnews.com. accessed April 4, 2007.

Associated Press. 2006b. "Judge Refuses to Postpone Vote in New Orleans." *Houston Chronicle*. March 28: A-6.

Associated Press. 2005. "New Orleans Mayoral Race Delayed." *Houston Chronicle*. December 13: A-8.

Beck, Ulrich. 1999. *World Risk Society*. London: Polity Press.
Blais, A. 2000. *To Vote or Note to Vote: The Merits and Limits of Rational Choice Theory*. Pittsburgh: University of Pittsburgh Press.

Blattman, Christopher. 2008. "From Violence to Voting: War and Political Participation in Uganda", Working paper Number 138, January, Center for Global Development.

Brady, Henry, Sidney Verba, and Kay Lehman Schlozman. 1995. "Beyond SES: A Resource Model of Political Participation." *American Political Science Review*. 89, 2: 271-294.

Brady, Henry and John McNulty. 2002. "The Costs of Voting: Evidence from a Natural Experiment." Paper prepared for the 2004 Annual Meeting of the Society for Political Methodology, Stanford University, July 29- 31.

Brennan, G. and J. Buchanan. 1984. "Voter Choice: Evaluating Political Alternatives,"]it American Behavioral Scientist, Vol. 28, pp. 195-201.

Coleman, J. (1990) "The Foundations of Social Theory". Cambridge, MA: Harvard University Press.

Cutler, D. and E. Glaeser. (1997) "Are Ghettos Good or Bad?" *Quarterly Journal of Economics*. Vol. 12, pg 827-872.

Diamond, A. and Sekhon, J. (2005), "Genetic Matching for Estimating Causal Effects: A New Method of Achieving Balance in Observational Studies," `http://jsekhon.fas.harvard.edu/`.

Downs, Anthony. 1957. *An Economic Theory of Democracy*. New York: Harper Collins.

Dyck, Joshua and James Gimpel. 2005. "Distance, Turnout and the Convenience of Voting." *Social Science Quarterly* 86 (3): 531- 548.

Filosa, Gwen and Bruce Nolan. 2006. "Voters Determined to Take a Stand." *Times Picayune*. May 21: A-12.

Finch, Susan. 2006. "Ruling Clears the Way for April Election." *Times-Picayune*. March 28: M-1.

Fiorina, M.P. 1976. "The voting decision: instrumental and expressive aspects", *Journal of Politics*, Vol. 38, pp. 390-413.

Fortier, John C. and Norman J. Ornstein. 2004. "If Terrorists Attacked Our Presidential Elections." *Election Law Journal* Vol. 3, No. 4, 597-612.

Fowler, James H. 2006. "Habitual Voting and Behavioral Turnout." *The Journal of Politics* 68: 335344

Gimpel, James and Jason Schuknecht. 2003. "Political Participation and the Accessibility of the Ballot Box." *Political Geography* 22 (4): 471- 488.

Hall, Thad E. 2003. "Ensuring the Continuity of the United States Government: The Congress." Testimony before the United States Senate, Committee on the Judiciary, September 9, 2003.

Haspel, Moshe and H. Gibbs Knotts. 2005. "Location, Location, Location: Precinct Placement and the Costs of Voting." *Journal of Politics* 67 (2): 560- 573.

Hinich, M.J. 1981. "Voting as an Act of Contribution", *Public Choice*, Vol. 36, pp. 135-40.

Ho, Daniel; Kosuke Imai; Gary King; and Elizabeth Stuart. 2007. ”Matching as Nonparametric Preprocessing for Reducing Model Dependence in Parametric Causal Inference”, *Political Analysis*, 15(3): 199-236.

Ho, Daniel; Kosuke Imai, Gary King; and Elizabeth Stuart. 2004. ”Matchit: Matching as Nonparametric Preprocessing for Parametric Causal Inference”, http://gking.harvard.edu/matchit.

Hotline. 2006. ”New Orleans Mayor.” April 26.

Imai, K. and van Dyk, D. A. (2004). “Causal Inference with General Treatment Treatment Regimes: Generalizing the Propensity Score,” *Journal of the American Statistical Association*, 99, 854-866.

Kiewiet, D. Roderick, Thad E. Hall, R. Michael Alvarez and Jonathan N. Katz. 2008. “Using Incident Reports to Detect Election Anomalies and Irregularities.” In R. Michael Alvarez, Thad E. Hall and Susan D. Hyde, editors, *Election Fraud: Detecting and Deterring Electoral Manipulation*, Washington, D.C.: The Brookings Institution Press, forthcoming.

King, Gary. 1997. *A Solution to the Ecological Inference Problem: Reconstructing Individual Behavior from Aggregate Data.* Princeton: Princeton University Press.
Knabbe, Richard D., Jamie R. Rhome, and Daniel P. Brown, 2005. “Tropical Cyclone Report: Hurricane Katrina, 23-30 August 2005.” National Hurricane Center, `http://www.nhc.noaa.gov/pdf/TCR-AL122005_Katrina.pdf`.

Leighley, Jan E. and Jonathan Nagler. 1992. “Socioeconomic Class Bias in Turnout, 1964-1988: The Voters Remain the Same.” *American Political Science Review*, Vo. 86, no. 3, 725-736.

Levy, Clifford. 2005. ”New Orleans Election Nears, But Who Will Vote and How?” *New York Times*. November 17, A-1.

Logan, John. 2006. “Population Displacement and Post-Katrina Politics: The New Orleans Mayoral Race, 2006”. `http://www.s4.brown.edu/Katrina/report2.pdf`.

McCarthy, Kevin, D.J. Peterson, Narayan Sastry, and Michael Pollard. 2006. “The Repopulation of New Orleans After Hurricane Katrina.” RAND Gulf States Policy Institute, `http://rand.org/pubs/technical_reports.2006/RAND_TR369.pdf`.

McDonald, Michael P. 2007. “The True Electorate: A Cross-Validation of Voter File and Election Poll Demographics.” *Public Opinion Quarterly*, Vol. 71, no. 4, 588-602.

Moreno, Sylvia. 2006. ”Displaced Voters Make Wishes Known for New Orleans.” Washington Post. April 12: A-3.

Nagler, Jonathan. 1991. “The Effect of Registration Laws and Education on U.S. Voter Turnout.” *American Political Science Review*, Vol. 85, no. 4, 1393-1405.

Plutzer, Eric. 2002. “Becoming a Habitual Voter: Inertia, Resources, and Growth in Young Adulthood.” *American Political Science Review*, Vol. 96, No. 1, 41-56.

Putnam, R. (1993) ”Making Democracy Work”. Princeton, NJ: Princeton University Press.

Putnam, R. (1995) ”Bowling Alone: America’s Declining Social Capital”. *Journal of Democracy*, Vol. 6, pg 65-78.

Putnam, R. (1995) ”Tuning In, Tuning Out: The Strange Disappearance of Social Capital in America”. *PS: Political Science and Politics*, Vol. 28, pg 1-20.

Riker, William H. and Peter C. Ordeshook. 1968. ”A Theory of the Calculus of Voting”. *American Political Science Review*, Vol. 62, No. 1, pp. 25-42.

Rosenstone, Steven and John Hansen, 1993. *Mobilization, Participation and American Democracy*. New York: McMillan.

Schuessler, A. A. 2000. *A Logic of Expressive Choice*. Princeton: Princeton University Press.

Silver, B. D., B.A. Anderson, and P.R. Abrahamson. 1984. ”Who Overreports Voting?”, *American Political Science Review*, Vol. 80, No. 2 (June), pp. 613-624.

Stein, Robert M. and Greg Vonnahme. 2008. ”Engaging the Unengaged Voter: Voter Centers and Voter Turnout.” *Journal of Politics*. 70:1-11.

Thevenot, Brian. 2006a. ”Officials Go All-Out to Safeguard Vote.” *Times-Picayune*. April 21: A-1.

Thevenot, Brian. 2006b. ”N.O. Vote Kicks Off Across Louisiana.” *Times-Picayune*. April 10: A-1.

Thevenot, Brian. 2006c. ”Absentee Voters’ Interest is Brisk.” *Times-Picayune*. April 3: A-1.

Times-Picayune. 2006. ”Absentee Voters Can Mail or Fax Ballots.” *Times-Picayune*. May 13: Metro-1.

Verba, S., K. Schlozman, and H. Brady. (1995) ”Voice and Equality: Civic Voluntarism in

American Politics". Cambridge, MA: Harvard University Press.

Walter, S.D, A. R. Feinstein and C.K. Wells. (1987) "Coding Ordinal Independent Variables in Multiple Regression Analyses". *American Journal of Epidemiology*, Vol. 125, No. 2.

Wolfinger, Raymond E. and Steven J. Rosenstone. 1980. *Who Votes?* New Haven, CT: Yale University Press.

10 Appendix

Using the registered voters' addresses in the voter file, it is also possible to overlay US Census information. Specifically, we used Census block group information from the U.S. Census Summary Files 1 and 3. The census block data includes the number of housing units of rented in the census block, the median household income in the census block and the number of residents in the census block who are high school graduates. Census blocks are geographically compact areas which generally contain between 600 and 3000 people, with an optimum size of 1500 people. This data allows us to control for community effects which are likely to impact turnout.

In Table 8 we present a summary of all covariates which we include in our analysis. These variables derive from both the voter file, the USGS flood data, and the U.S. Census. Table 9 provides descriptive information on flooding levels.

Tables 8 and 9 Go Here

11 Tables and Figures

Table 1: New Orleans Flood Depth by Registered Voter

Depth (in feet)	Number of Individuals Affected	May 06 Turnout	Percent
0	89,431	38,258	42.78
1	23,751	7,788	32.79
2	34,158	11.640	34.08
3	25,138	8,715	34.67
4	25,437	8,842	34.76
5	16,243	5,740	35.34
6	7,823	3,128	39.98
7	8,060	3,348	41.54
8	7,005	2,972	42.43
9	1,538	730	47.46
10 (or more)	43	18	41.86
Total	238,627	91,179	38.21

Table 2: Logistic Coefficients, Dependent Variable Vote for Mayor 2006

Variable	Coefficient	Coefficient
Flood Depth	-.04*	-.02*
	(.002)	(.002)
Female	-.00	.00
	(.01)	(.01)
Nonwhite	-.01	-.02*
	(.01)	(.01)
Democratic Registration	.04*	.18*
	(.01)	(.01)
Voting History	5.30*	
	(.03)	
Age	-.001*	-.00
	(.0003)	.00
Constant	-2.66*	-.52*
	(.02)	(.02)
N	238,627	238627
Psuedo R^2	.21	.0017
*	.05	.05

Table 3: Logistic Coefficients With Interactions and Community Variables, Dependent Variable Vote for Mayor 2006

Variable	Coefficient	Coefficient
Flood Depth	-.03*	-.03*
	(.01)	(.01)
Female	.00	.00
	(.01)	(.01)
Nonwhite	-.02	-.03*
	(.01)	(.01)
Democratic Registration	.15*	.15*
	(.01)	(.01)
Age	-.00	-.00
	(.00)	(.00)
Flood Depth * Nonwhite	.00	.00
	(.00)	(.00)
Flood Depth * Democratic Registration	.01*	.01*
	(.004)	(.004)
Flood Depth *Age	.00	.00
	(.00)	(.00)
Percent in Blockgroup with a High School Degree	.02	
	(.06)	
Percent in Blockgroup of Renter-Occupied Housing Units	.02	
	(.03)	
Median Household Income in Blockgroup	.00*	
	(.00)	
Constant	-.55*	-.50*
	(.04)	(.02)
N	238627	238627
Psuedo R^2	.0018	.0017
* = .05, ** = .10		

Table 4: Logistic Coefficients with Ordinal Flood Cutpoints, Dependent Variable Vote for Mayor May 2006

Variable	Coefficient
Flood Depth 1-2	-.40*
	(.02)
Flood Depth 2-6	.01
	(.02)
Flood Depth 6	.15*
	(.03)
Flood Depth 7-9	.06**
	(.03)
Flood Depth 9 or More	.24*
	(.06)
Female	.00
	(.01)
Nonwhite	-.01
	(.01)
Democratic Registration	.09*
	(.01)
Voting History	5.29*
	(.03)
Age	-.001*
	(.0003)
Constant	-2.56*
	(.02)
N	238,627
Psuedo R^2	.21
*	.05

Table 5: Covariate Means: Unmatched Samples

Flood Depth (in feet)	0	1	2	3	4	5	6	7	8	9	10+
Female	.56	.57	.57	.57	.56	.57	.57	.55	.56	.56	.58
Nonwhite	.65	.66	.67	.67	.67	.66	.66	.65	.66	.65	.79
Democratic Reg.	.59	.69	.73	.77	.75	.75	.67	.64	.62	.58	.58
Vote History	.40	.37	.38	.39	.39	.39	.42	.43	.43	.44	.42
Age	46.48	46.30	46.31	46.33	46.41	46.22	46.23	46.51	46.19	45.91	.46.67
Percent HS Grad (Blkgrp)	.23	.23	.23	.23	.23	.23	.23	.23	.23	.23	.25
Percent Renter Occupied (Blkgrp)	.52	.52	.52	.52	.52	.52	.52	.52	.52	.52	.50
Median Household Income (Blkgrp)	32,432	32,006	32,110	32,050	31,962	32,095	32,387	46.52	31,860	32,101	30,308

Table 6: Quality of Match: Percent Improvement

Variable	Depth, 1 ft vs 0 ft	2 ft	3 ft	4 ft	5 ft	6 ft	7 ft	8 ft	9 ft	10 ft
Female	64.80	75.08	63.18	71.06	81.15	71.79	36.38	75.20	31.51	97.69
Nonwhite	76.02	88.48	63.30	60.47	71.11	84.75	85.99	81.48	30.05	87.82
Age	81.99	82.26	62.26	54.38	68.15	79.51	50.17	68.69	44.01	24.01
Dem	98.31	94.96	90.26	90.42	90.11	99.25	84.00	98.93	-65.53	57.49
Vote History	84.03	93.77	72.76	58.28	56.13	99.83	78.31	95.11	96.56	94.77
Percent HS Grad	73.86	87.75	55.88	51.94	-135.13	75.23	82.15	73.73	73.30	96.15
Median HH Inc	69.52	87.28	62.27	60.09	64.13	49.72	59.10	84.21	58.84	96.63
Percent Rent Occupied	74.25	84.71	40.95	70.24	71.07	47.92	30.91	82.65	52.52	91.57

Table 7: Average Treatment Effect: Probabilities of Voting in May 2006 Mayoral Contest, Matched Sample

Water Depth Comparison	Probability of Voting
Pr(Vote — 1 ft) - Pr(Vote — 0 ft)	.4031
Pr(Vote — 2 ft) - Pr(Vote — 0 ft)	.409
Pr(Vote — 3 ft) - Pr(Vote — 0 ft)	.4101
Pr(Vote — 4 ft) - Pr(Vote — 0 ft)	.4061
Pr(Vote — 5 ft) - Pr(Vote — 0 ft)	.4127
Pr(Vote — 6 ft) - Pr(Vote — 0 ft)	.4605
Pr(Vote — 7 ft) - Pr(Vote — 0 ft)	.4723
Pr(Vote — 8 ft) - Pr(Vote — 0 ft)	.4808
Pr(Vote — 9 ft) - Pr(Vote — 0 ft)	.5341
Pr(Vote — 10 ft or More) - Pr(Vote — 0 ft)	.515
Note: All control variables held at their mean values	

Table 8: Summary of Variables

Variable	Mean	Standard Deviation	Min	Max
Female	.56	.50	0	1
Nonwhite	.66	.47	0	1
Democratic Registration	.67	.47	0	1
Vote History	.39	.25	0	1
Age	46.37	17.93	18	100
Percent (Blockgroup) High School Degree	.24	.09	.02	.54
Percent (Blockgroup) Renter Occupied Housing	.52	.24	.02	1
Median (Blockgroup) Household Income	32,306	20,496	10,000	126,071

Table 9: Zipcodes with High Flooding and Greater Than 50% Black

Zipcode	Total	High Flooding (more than 5 feet)	if Pop of More than 50% Black
70112	2,772	10.17316017	9.941520468
70113	6,220	10.88424437	10.9751835
70114	15,602	10.33200872	10.38435088
70115	24,926	10.01364038	10.3909618
70116	10,000	9.76	10.082397
70117	30,970	10.25185664	10.2310231
70118	25,123	10.31723918	10.32839377
70119	25,614	10.64652143	10.540064
70122	29,925	10.31244779	10.22421963
70124	16,055	10.31454376	0
70125	14,742	9.917243251	9.745244187
70126	16,187	9.791808241	9.861997136
70130	9,836	10.0650671	10.35130565
70131	10,411	10.8058784	10.74766355
70148	241	11.61825726	0
70170	3	0	0
Totals	238,627		

Figure 1: Flood Depth in New Orleans

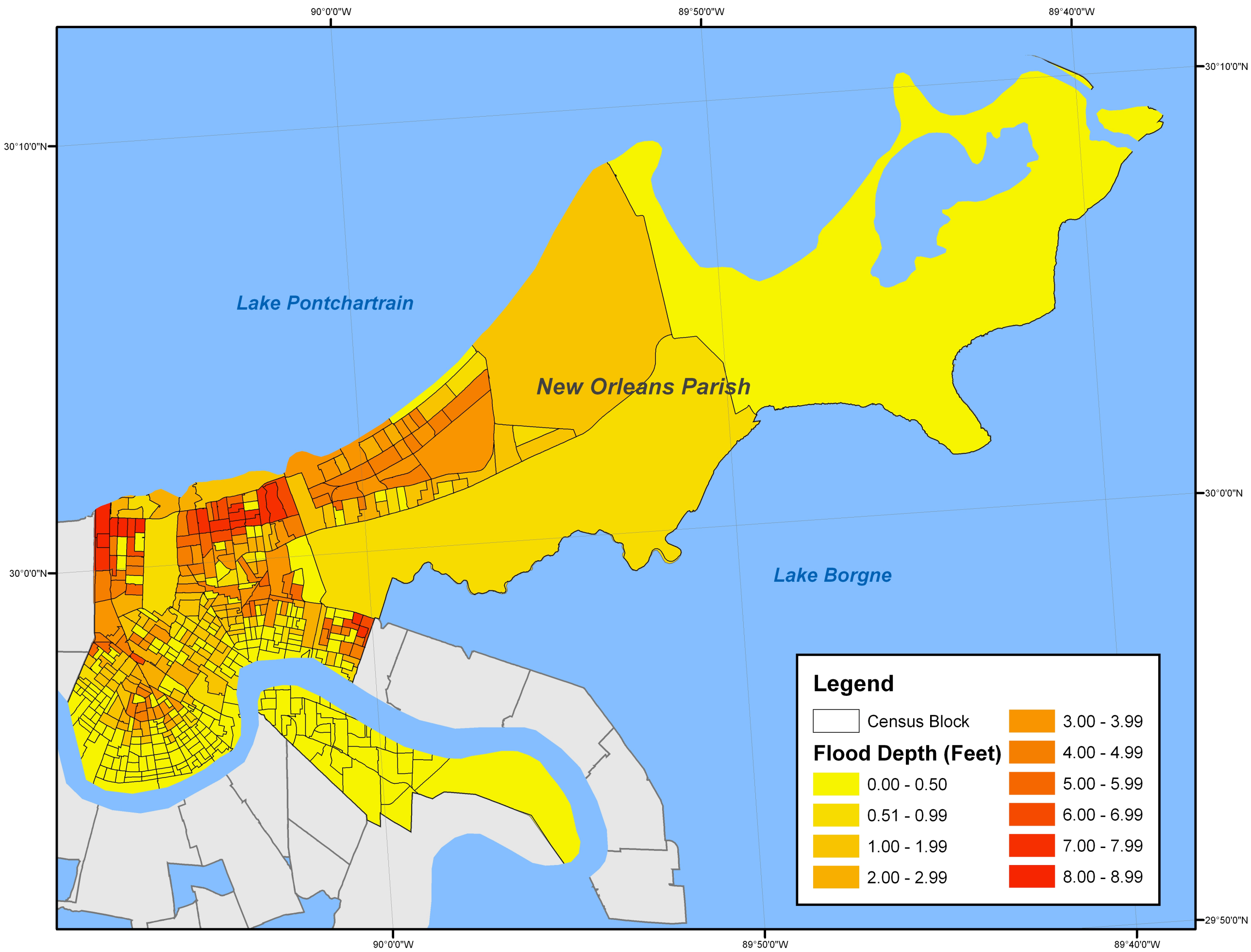

Figure 2: April and May 2006 Mayoral Turnout by Flood Depth

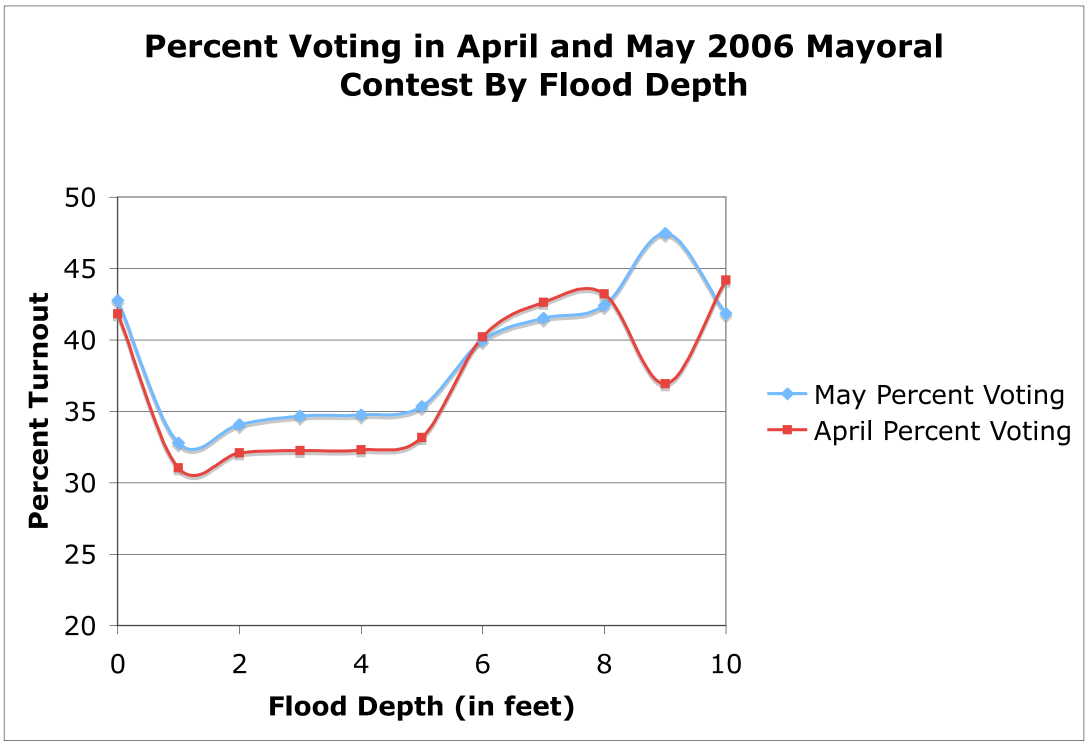

Figure 3: QQ Plots, Matched vs Unmatched Sample

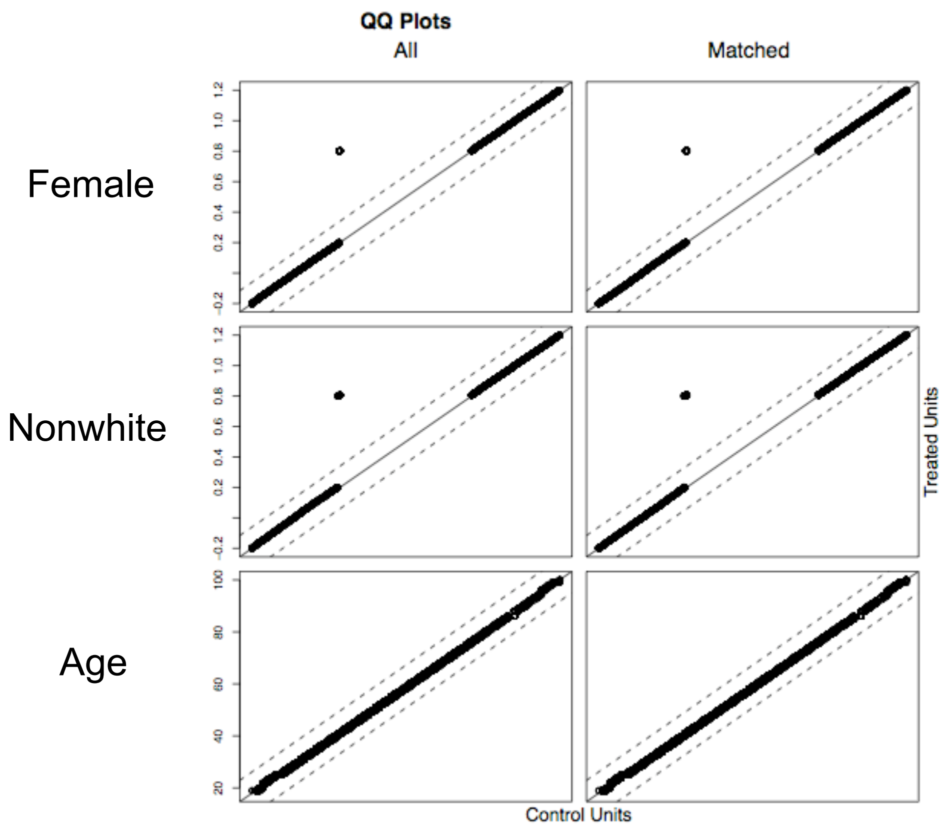

Figure 4: QQ Plots, Matched vs Unmatched Sample

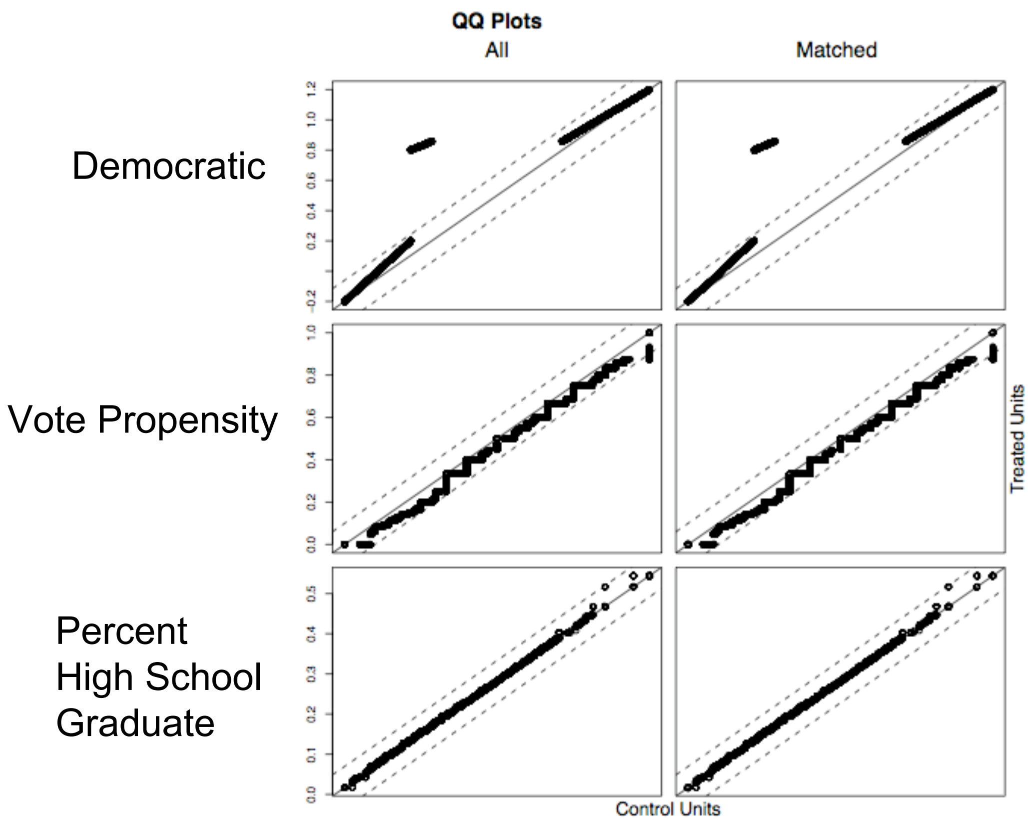

Figure 5: QQ Plots, Matched vs Unmatched Sample

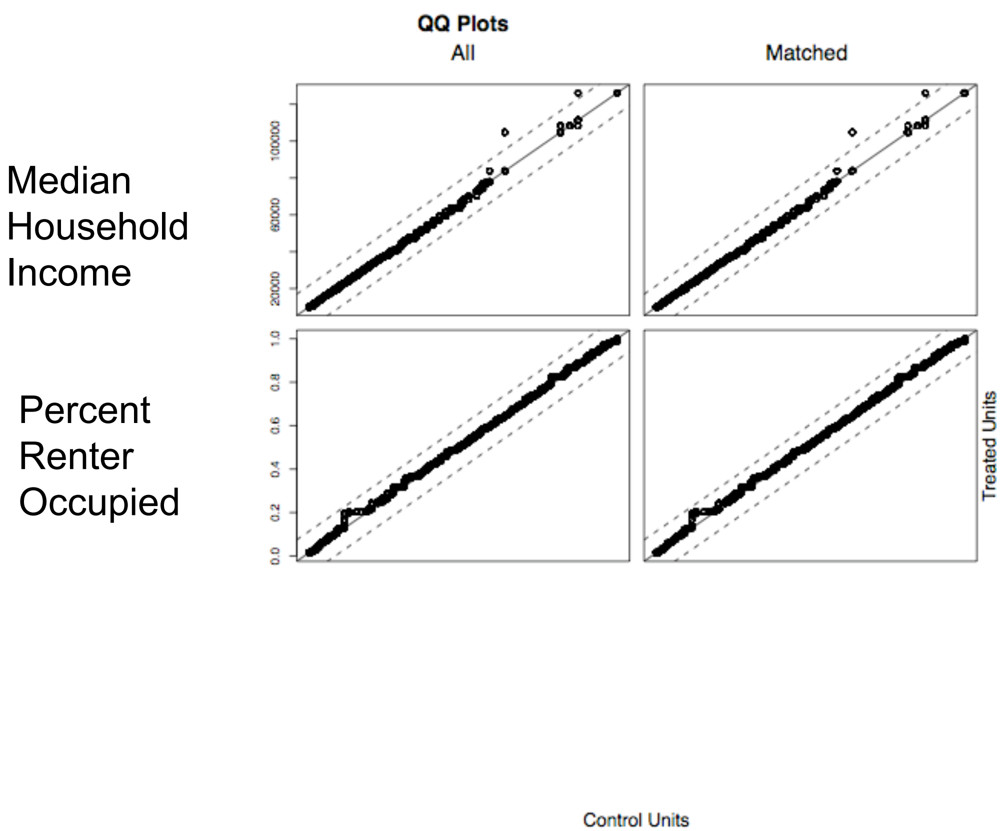

Figure 6: Matched ATE