ELECTRIFICATION, HEALTH AND DISTRIBUTIONAL POLITICS: THE CASE OF THE TVA

by

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(under the Direction of Micah Gell-Redman)

ABSTRACT

This dissertation examines how voters reward politicians for the provisioning of a new service. Using new data on the expansion of access to electricity under the Tennessee Valley Authority, this study asks if voters reward politicians based on how much benefit they receive from electrification (measured through health) or based on just on receiving a new service. This dissertation also tests if the common historical narrative of the TVA helping turn the last Republican areas of the South Democratic holds true.

Those areas that received TVA electricity gave a significant boost to Democratic candidates (about 3 percentage point) and experienced significant declines in crude mortality with the expansion of the service. The drops in mortality were largely driven by drops in respiratory disease, rather than other improvements. Lastly, the declines in mortality are not connecting to the increases in voting for the Democratic party, indicating that voters more closely responded to the easily visibly symbolic aspects of the new service.

INDEX WORDS: Distributional Politics, Electrification, Southern Politics, Public Health, Public Works, Tennessee Valley Authority, TVA, Health, Voting

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Contents

List of Figures

List of Tables

Chapter 1

Introduction

Politicians often seek to attract new voters by providing a new service to their constituents with the assumption that voters will reward them for distributing those new services with votes. Crucially, not all goods and services are the same - this may seem obvious, but the distinction between the types of goods and services being distributed has the potential to alter the ways in which voters respond to those goods and services. There is no reason to expect that voters should respond to a jobs program in the same way they would respond to improved water treatment or that they would respond to direct financial disbursements in the same way they would respond to the expansion of public schooling. These goods provide different forms of value to those receiving them, and therefore it is logical that there should be a variety of responses from voters. Specifically, some goods serve a more symbolic function while others serve a more practical function. The question central to this dissertation is: which element of a newly distributed public good is most salient and important to voters.

Testing this questions requires both a public good that has both elements - symbolic and functional, and a public good that was intensively and extensively implemented in an otherwise relatively isolated and controlled area. This nearly unique blend of factors can be found in the distribution of electricity (which may be the prime example of a public good that is both functional and symbolic) in the Tennessee Valley (an isolated and "backwards"

area) during the Great Depression by the Tennessee Valley Authority.

There are few government programs that have cast as long of a shadow through the South as the Tennessee Valley Authority. Burned into the collective memory are families who refused to move, homes that were modernized, grandfather's who went to work, childhood vacations fishing and boating in the man made lakes and controlled rivers. It is unusual for a government program to be canonized in song [Ketch Secor, 2008, Jason Isbell, 2009] and viewed as a symbol of pride in a region otherwise averse to federal intervention.

Founded the in May of 1933, the Tennessee Valley Authority was one of the keystone programs of Franklin Roosevelt's New Deal and like other New Deal programs represented a nearly unprecedented expansion of the federal government into the lives of everyday citizens, bringing electricity directly to the people by forming local cooperatives at the county level which went around both state policymakers and powerful state and local power companies. The TVA had one the most expansive mandates of any of the New Deal programs, with a straightforward yet amorphous goal of developing the largely rural Tennessee Valley and the surrounding rural areas and bringing this economically "backwards" area up to speed with the rest of the county. The Tennessee Valley Authority sought to do this through three primary methods: rural electrification - primary through hydropower, flood control and irrigation - using the same dams as the hydropower, and farm and crop improvement programs. The primary legacy of the TVA - and the focus of this dissertation - is the electrification of the South.

While it is important to understand the symbol and meaning of the TVA to those who it helped, it is also important to understand what the TVA did, how it worked, and if the real impact can match the legend of the impact. This dissertation will assess the real impact of the TVA on the lives of those living in the area and on the politics of the South, while seeking to avoid the legend and hagiography that often accompanies discussion of the Tennessee Valley Authority.

The ubiquity, popularity, and political profile of the TVA has led some to argue that

the TVA bears a great deal of responsibility for turning the areas of the South that still voted Republican (mainly mountain South areas that were Unionist and had few slaves) into Democratic areas thereby turning the South into the "Solid South". The TVA was so popular in many parts of the the South that in 1956 when Senators Adlai Stevenson and Estes Kefauver (Tennessee's native son) were the Democratic nominees for president they sought to very tightly wrap themselves in the flag of the TVA; 8 years after the Southern Democratic Party had rebelled against the national party for perceived overreach into state sovereignty the campaign poster below (1.1) is celebrating just this kind of action by the federal government.

Implicit in the argument that the TVA turned the South into the Solid South is the argument that voters, as a rule, vote for politicians who provide them with a new good or service. In short, the argument for the TVA turning the last Republican holdouts Democratic is an argument about the distributional politics - namely that distributional politics works. Testing this assumption - that distributional politics works and worked in the case of the TVA - is one of the central questions that this dissertation seeks to address. From the ten-thousand foot level, the central theoretical question being addressed in this dissertation is: how do voters reward politicians for a new service? Do they reward politicians for creating and distributing the new service? Or does she service have to improve their lives in a meaningful way for them to reward the politician?

1.1 Motivating Questions

Do voters reward politicians for new services and, if so, how? This dissertation seeks to answer those questions by looking at both cross-national and sub-national samples to assess the support for politicians when the access to a public good (electricity) is increased. Electricity is used for this study because, unlike many other goods that are distributed by governments, electricity is both a useful and a symbolic good [Kale, 2014]. This means both

Figure 1.1: 1956 Adlai Stevenson Campaign Poster

that electricity can be used to meaningfully improve lives, but also that getting access to electricity can help make people feel fully modern, like they are able to access the same services that everyone else can, and that the politicians distributing that service actually care about their lives.

The question of "how do voters reward politicians" is taken in this dissertation as three interrelated questions: do voters reward politicians for increasing electrification both on the cross-national level and within the Tennessee Valley Authority area? Did the Tennessee Valley Authority improve people's lives? And is there a relationship between how much voters' lives were improved and how much they increased their support?

The cross-national and sub-national data are both used to address the first question of whether or not voters reward politicians for increasing electrification and both samples tell a similar story. This dissertation finds that voters reward politicians for increasing the access to electricity; in the cross-national case this is measured through the approval rating of the regime in power and in the sub-national case this is measured through the electoral support for Franklin Roosevelt and the Democratic Party. Furthermore, this dissertation finds a significant benefit to people's lives in the form of decreased mortality when the TVA enters a county bringing power. Additionally, it is likely that decreases in deaths from respiratory disease - caused by improved indoor air quality - were likely a major driver of overall declines in mortality. Lastly, this dissertation finds that there is no evidence that the places that got more benefit gave larger bumps to the Democratic Party, by default this indicates that the symbolic value of electrification outweighs the useful value of electrification. While these results are bolstered by other work, this dissertation tests these questions in new ways with new data that both adds to the previous canon of literature on distributional politics as well as provides guidance towards answering a new question about political rewards.

1.2 Distributional Politics

There is some level of ambiguity in the literature about using the terms "distributional politics" and "vote-buying" with Diaz-Cayeros et al., 2016 using them in a way that is nearly interchangeable, but Blaydes, 2010 and others reserving the term for more direct quid pro quo actions. In part this confusion may arise out of disagreement about where the line between the two actions is. Distributional politics - as it will be used in this paper - is simply decisions about the allocation of governmental resources being made based on political considerations - whether this is to reward supporters so they remain supporters, or to incentivize new supporters to join. This can be done with or without an explicit quid pro quo; however, in both of the cases, goods and/or services are being allocated to win or retain votes - something of value is being exchanged for support - or the hope of support.

At some point on the continuum between a government providing public goods and services in the hope of winning new votes through competence and outright bribery of voters there is a line where normal governmental action becomes "vote-buying". This dissertation does not seek to address the placement of this line - as this is a topic better left to political philosophers - but rather will refer to all forms of governmental distribution of goods with a political motivation as "distributional politics"; this is done to allow for the broadest possible definition, rather than to take any particular stance.

1.3 How this Dissertation Will Proceed

This dissertation will proceed in seven following substantive chapters. Chapter 2 will cover the previous theoretical and empirical work that this dissertation builds on and attempts to fill gaps within. Included in this chapter is both a review of the relevant literature on distributional programs and electoral support as well as a full explanation of the theory at play in this dissertation.

Chapter 3 provides the first empirical study in this dissertation examining the role of

increasing electrification and support for the ruling regime in a cross-national study. This cross-national study provides much of the motivation for the empirical chapters that follow, not just through the positive results that it finds, but more importantly, through exposing a gap in the way that this - and other similar studies - think about electricity. Electricity provides tangible and intangible benefits and this cross-national study - as well as most others - do not seek to disentangle the potential electoral benefits of electricity from tangible benefits from those potential electoral benefits from the intangible benefits of electricity. In other words, electricity functions as both a direct service that makes people's lives better and is a direct benefit - much like a job or direct cash payment - and unlocks new technologies and can improve people's lives through second and third order benefits - much like other large public works programs. The rest of the dissertation will then build off of this with a three part study using a detailed sub-national dataset.

Chapter 4 begins the marquis sub-national study by exploring the historical context in which the creation and expansion of the Tennessee Valley Authority took place. While the sub-national study looks at generalizable questions which are not explicitly linked to this test case, in order to better understand the marquis case and it's applicability, it is important to understand the full context of this case. This chapter explores how and why the TVA was created as well as how the TVA rolled out across the sample region. This is important for understanding how plausible the claims of exogenaity are as well as understanding how and why this test case works. By exploring a bit of political context in the area it is easier to correctly interpret the results that will be presented later.

Chapter 5 begins the sub-national empirical explorations by understanding the effects of electrification on the presidential voting in the Tennessee Valley Authority service area. This is the first of the three questions discussed earlier that will allow this dissertation to understand how individuals reward politicians. This is done by first making sure that politicians do in fact get some electoral benefit for providing this new service - in this case through a detailed sub-national dataset. Additionally, chapter 5 also explores any potential

partisan filtering of the expansion of this new service. Lastly, this chapter puts those results into sufficient context to understand how they relate to the empirical chapters 6 and 7.

Chapter 6 dives into the second of the big three questions presented above by exploring the health effects of the expansion of the electrification through the Tennessee Valley Authority. This chapter uses a novel and highly detailed data set of several commonly used indicators of population health to understand if the TVA improved health in the service area. Understand the health effects of the TVA allows for a better understand of the intangible benefits that electricity provides. As with previous chapters, this chapter will also devote some time to what each population indicator means and how it can be substantively and meaningfully interpreted and understood in the context of the other chapters and the dissertation as a whole.

The final empirical chapter (chapter 7) will synthesize the results from chapters 5 and 6 in order to gain insight into how voters reward - or fail to reward - politicians from providing new services. This is directly aimed at the third question presented above and assesses if voters reward politicians primarily for the tangible or intangible benefits provided by a new distributional good, when that good serves both purposes. This chapter builds on the previous chapters and combines both chapters' findings.

Lastly, chapter 8 provides a summary of the previous empirical chapters and places the general broad findings back into the previous literature. It is important to lay a clear theoretical basis for this dissertation to proceed along. The follow chapter seeks to place this dissertation within a theoretical framework as well as place the study within the relevant literature.

Chapter 2

Theory and Hypotheses

2.1 Electrification, Distribution, and Electoral Support: Previous Work

In order to best understand the conceptual framework of the following chapters, it is important to examine the previous theoretical and empirical work on the subject. The relevant previous literature falls broadly into two categories: work on electrification and other large-scale public works projects (i.e. sewage or piped water) [Min, 2015,Miller, 2008,Kale, 2014,de Kadt and Lieberman, 2017] and work examining more direct forms of distribution such as jobs programs, food programs, and direct cash disbursements [Blaydes, 2010,Diaz-Cayeros et al., 2016]. Unsurprisingly, these two lines of inquiry can lead to differing conclusions as to the efficacy of distributional programs. In no small part, this difference may be attributable to the salience of these programs in the lives of those receiving them, and the ability of the individual to understand the on the ground consequences of abstract programs versus more tangible direct disbursements.

These two forms of distributional politics are important to the broader theory applied here both because they are relevant to understanding the questions presented here and because electricity is fairly unique in being both a tangible good and a abstract good - allowing

direct benefits and unlocking broader potential benefits [Kale, 2014]. That being said the mechanisms and causal pathways at play in these different forms of distributional programs are distinct enough that they warrant separate consideration in this chapter. The following sections will consider separately and then examine a few key insights from both literatures.

2.1.1 Electricity, Public Works, and Support

THe bulkl of the previous work on electrification and public works has focused on the actions of policy-makers and how they attempt to use these programs to capture new voters. Miller, 2008 finds that in the lead-up to women gaining the right to vote, politicians began to invest in public works projects and other progressive projects in hopes of gaining votes from the newly enfranchised female voters. The two assumptions implicit in this are that women supported progressive causes (which they seem to have) and that voters - women in particular - would reward politicians for the distribution of new public works and public services. Similar arguments are made in the work on democratization and increases in electrification arguing that democracy should increase access to public goods because democracy is able to aggregate the desires of the population and who want better services [Ahlborg et al., 2015a, Ahlborg et al., 2015b, MacLean et al., 2016].

This assumption is also implicit in much of the work on democracy and health. The causal link between health and democracy is assumed to be that voters place some level of priority on government action that improves health and therefore politicians will distribute public services as a means of securing votes [Kudamatsu, 2012, Kudamatsu and Besley, 2006, Ross, 2006, Navia and Zweifel, 2003].

The work directly examining the link between increasing access to electricity and improved voting for the party in control has been limited. What studies exist focus heavily on understanding variations in access to electricity across countries, with most identifying institutional and historical reasons for some countries not having greater access to electricity than others. Furthermore, these studies focus heavily on Sub-Saharan Africa and largely

study of modern samples [de Kadt and Lieberman, 2017, Gore et al., 2019, MacLean et al., 2016, Ahlborg et al., 2015a, Ahlborg et al., 2015b]. The time period difference is important in part because as MacLean et al., 2016 argues expectation of what services a government should deliver matters and while electricity is expected today, it was much less expected one hundred years ago.

de Kadt and Lieberman, 2017 make important findings to this study when finding that in Sub-Saharan Africa increasing the provisioning of electricity actually leads to a decrease in support for the dominant party. While the decease in support is found in both regime and opposition supporting areas, the strongest decreases are in opposition supporting areas. This indicates that all of these actions may be filtered through the lens of partisanship. This is especially important for this study because many of the areas were strongly supportive of Roosevelt's Republican opposition.

Where more work has been done is on the way that political considerations are used in the distribution of electricity as well as how well different forms of government are at distributing electricity. Kale, 2014's study of electrification and development in India focuses on the Damodar Valley Authority (DVA) - a program intentionally modeled after the TVA - and finds strong evidence that those areas that were more politically and economically important got more and better access to electricity which only served to deepen the existing inequality. Importantly for the primary case study of the TVA, those areas with the strongest political affinity with the central government had the most success in increasing access to electricity through the DVA - which was a federally administered program that cross-cut provincial lines, just like the TVA.

More broadly, electrification can be examined through the same general lens as other distributional programs. Min, 2015 places electrification within the broader context of distributional programs by arguing that - much as with other forms of public goods - democracies are better at distributing electricity than non-democracies due to the electoral pressure than citizens put on the government through competitive elections. This electoral pressure leads

to both better and more equitable distribution of electricity as a public good. Most importantly for the studies to follow, Min, 2015 finds that in Uttar Pradesh, India electricity was used as an electoral reward for areas that supported the winner in the most recent election with electricity being shifted from areas that supported the loser, to areas that supported the winner.

Importantly, both Min, 2015 and Kale, 2014 focus most heavily on the institutional factors that lead to the distribution of electricity as well and place their work within the broader context of distributional programs and distributional politics. As discussed above, while electricity can be be considered a somewhat unique good - due to its role as both a useful and symbolic good [Kale, 2014] - it can, and should, still be examined through the same lens as other distributional goods. In the next section, the broader literature on distributional politics will be discussed in order to better understand electrification as both a public good and a political tool.

2.1.2 Distributional Programs and Support

As with much of the work on electrification, much of the broader work on distributional politics focuses on the role of institutions - in particular the role of democratic and non-democratic institutions [Min, 2015, Blaydes, 2010, Diaz-Cayeros et al., 2016]. The most relevant work for this dissertation is Diaz-Cayeros et al., 2016's study of distributional politics and poverty alleviation in modern Mexico. While their work focuses primarily on public and private goods, they argue that these should not be viewed as a dichotomy, but rather - echoing Min, 2015 - the lines between the two can be rather blurry. The authors find that while public goods are able to deliver votes, they are less efficient at "vote-buying" than the distribution of private goods and less easily targetable for clientalism. The services provided by the TVA fit in with the authors' framework of public goods as they target a broad area and with a good that is difficult to exclude from based upon political affiliation. While the broad nature of public goods decreases the ability to clearly target supporters or opponents,

these broad public goods programs do have greater impact on the lives of those living in the area receiving the public good. This is due to the lack of excludability (see also: Troesken, 2004).

Institutions matter in the distribution of public good not just in that democracies are better at distribution that non-democracies, but in the level of political control that is placed over those institutions. Countries with higher levels of uncertainty are more likely to place distributive programs in the hands of non-partisan bureaucrats [Diaz-Cayeros et al., 2016] and are less likely to have those programs tainted by political manipulations. In the following test-case, the TVA was run by an independent organization that was chartered at the federal level, which allowed the TVA to break free from both national political control as well as the Democratic Party patronage network that was in full force at the state level - and will be discussed later.

This section has been focused on the relevant work for the examining the first question about electrification and electoral support, but equally important to the dissertation as a whole is understanding the tangible benefits of electoral support - in this case health improvements. The following section will examine the relevant literature about large-scale public works projects and the health of those gaining access to the these public goods.

2.2 Electrification, Public Works, and Health: Previous Work

The idea that the provisioning of a basic service like electricity would improve the lives of those receiving this new service seems no less than obvious; however, this has faced very little empirical scrutiny. Lewis, 2018 provides one of the few empirical analyses, but looks across the nation and only at infant and maternal mortality. During the time period of both the founding and expansion of the Tennessee Valley Authority as well as other pushes towards increased access to electricity - especially in rural areas - there was an overall trend

in increased health and well being brought about by improved technology, medicine, and a new understanding of the role or environment in health.

During the 1930s and continuing into the beginning of the 1940s, the emphasis in public health was placed on the disease environment and improving health through creating better and healthier living and working conditions. There was a new acknowledgment of the importance of basic sanitation and the importance of government in providing those basic public services. At the time, the epidemiological zeitgeist was large-scale prevention rather than individual level treatment [Packard, 2007].

This idea in many ways built on the successes of other earlier large public works programs such as the construction of sewers and water purification and filtration systems that took place during the progressive era. These large public works projects have been much more heavily studied that electrification [Gaspari and Woolf, 1985, Troesken, 2004, Troesken, 2008] with a the consensus of the most recent and applicable work being that thse programs provided a great deal of benefit to those receiving the services [Troesken, 2004, Miller, 2008, Cutler and Miller, 2004, Packard, 2016]. These successes stressed the importance of shifting emphasis of public health onto broad disease environments and regional and national efforts to combat disease by attacking the root cause of the disease.

The efforts to combat disease through large-scale intervention were not just reserved to public works construction projects, but also through other macro-interventions. This can be seen in the efforts to combat malaria in the South [Hong, 2007] where large-scale spraying and poisoning operations were used to attempt to control the vector of the malaria spirochete - the mosquito. Similar large scale interventions were used to attempt to combat the rise of pellagra during the first half of the 20th century by mandating that niacin - the lack of which causes pellagra - be added into corn meals intended for human consumption [Bollet, 1992, Clay et al., 2019]. These interventions were not without political conflict about both the role of government in health and who should be allowed access to these interventions. Large-scale public health interventions being subject to political considerations can be seen

not just in America [Miller, 2008], but the interventions can be used as tools of state power for both good and bad as in the case of the Rockefeller Foundation's work with the revolutionary regime in Mexico [Birn, 2006].

The fact that the Tennessee Valley Authority and other rural electrification programs came into existence at a time when a new emphasis was being placed on health - especially the disease environment - is not surprising; the TVA was part of that push towards a better human environment. This emphasis on using electricity and electrification as a part of a broader goal of health improvements is evident in the early strong emphasis that the TVA put on securing the milk supply in the Knoxville region and the TVA service area as a whole. This was done through the promotion of improved refrigeration, sterilization, and pasteurization technology at first in a test area and then spreading the technology. It is difficult to disentangle the overall health improvements seen during this time from one another and understand the individual impact of a single program. This problem can be acutely seen in TVA's milk safety program where there are no visible benefits of the milk safety program as will be discussed later.

Looking at this broader attempt to understand health socially and holistically it is possible to connect other trends to improved health, in particular trends in increased economic welfare. It is both well documented and intuitive that improving economic welfare increases health as in general if you can afford to not die you do not die [Prichett and Summers, 1996, Bleakley, 2010, Deaton, 2003, Szreter, 2003, Steckel and Rose, 2005, Steckel and Floud, 2008, Costa and Steckel, 2008]. This set of work - imperfect as it is - is important for this study because the bulk of work on electrification focuses on potential increases to economic activity with the introduction of electricity in an area.

Studies in the TVA [Kitchens, 2006] and the United States as whole [Neufeld, 2011] as well as in India [Kale, 2014] and South Africa [Dinkelman, 2011] have found boosts to economic activity resulting from the large scale increase in electrification. In contrast, DeFaria et al., 2017, [Kitchens, 2014], and others have found little to no impact on either health or economic

output. There are two likely reasons for these conflicting results: selection of indicators of interest and case selection of the countries who expanded being non-random - Brown and Mobarak, 2009 and Kale, 2014 show that not all regime types expand electrification at the same rates, to the same people, and with the same level of efficacy.

In particular, studies like Kitchens, 2014 and DeFaria et al., 2017 use readily available economic indicators such as the country level retail sales [Kitchens, 2014] and gross domestic product [DeFaria et al., 2017]. These are fairly narrow measures that while they are meant ot proxy for general economic activity may be too narrow to do so. An indicator like retail sales is likely to be affected by more than just general prosperity in a rural area where stores are often scare and people must cross county lines to make purchases. That being said, the TVA's own studies of the impact of the program on farm incomes in particular was skeptical that the program made a significant economic impact on the regions [Industrial Economics Branch,]. Importantly, this study was reserved to farm incomes and due to the year (1955) the empirical strategy leaves something to be desired.

This study seeks to circumvent these problems by directly examining the impacts on health rather than examining economic indicators. While there is a correlation between health and economic welfare, this relationship is far from perfect and individuals do not always spend more money on health and health can improve through increasing basic services without putting increased wealth in people's pockets [Bleakley, 2010, Prichett and Summers, 1996, Deaton, 2003]. While there are disagreements in the literature about the magnitude of the impact, the causal mechanism, and if the effects begin to wear off at a certain point, historically and during the stages of development relevant to this study, there is broad consensus that increasing wealth improves health. While there is clearly a correlation, it is also important to note that the causal arrows likely run in both directions with high potential for both virtuous and vicious cycles to emerge.

2.3 Hypotheses

The above sections provide a more broadly based theoretical framework that can be applied not just to the specific cases presented below, but to many other similar questions. Before discussing the cases below, it is important to understand the questions presented here at the macro-level and how the questions presented here fit into the broader theory. The following hypotheses are generalized versions of the questions explored in the following chapters:

Hypothesis 1 *Voters will reward politicians for increasing access to a technology enabling good or service.*

Hypothesis 2 *Increases in the distribution of a technology enabling public good will lead to improvements in overall welfare.*

Hypothesis 3 *Voters will reward politicians based on the level of welfare improvement they receive from the service, not simply from the provisioning of the new service.*

This final hypothesis gets at possibly the biggest question posed in this dissertation: what part of a new distributional program do voters most respond to? Because electricity is both a useful and symbolic good [Kale, 2014] it allows for the exploration of this question. Each of these hypotheses will be covered in much more detail in the following chapters with a chapter being largely devoted to testing the narrower more case specific version of the question.

Chapter 3

Electrification and Electoral Support

The following chapter focuses on the first question and the first of the three hypotheses presented at the end of the last chapter. This chapter seeks to understand the relationship between electrification and electoral support at the national level using a large cross-national sample set.

The central goal of this chapter is to establish a pattern and to act as a test of the broad level applicability of the hypothesis that increasing access to electricity will increase the support for the ruling regime or party 1. By examining this question as broadly as possible, it is possible to examine if the results presented below are an anomaly of whether they present a trend worthy of further examination. The results presented below indicate that regimes that increase access to electricity reap some level of electoral reward for this. This is consistent with the hypothesis presented below as well as the more generalized hypothesis presented in the previous chapter. In short, voters will reward politicians for providing greater access to electricity, making the provisioning beneficial to both parties.

3.1 Electrification and Regime Support: Cross-National Evidence

There is a shortage of cross-national studies on the political effects of increasing access to electricity(see de Kadt and Lieberman, 2017). Most of the previously cited studies of electrification - or other major public works - focus on a particular country or set of countries [Gaspari and Woolf, 1985, Cutler and Miller, 2004, Dinkelman, 2011, Lewis, 2018]. What cross-national studies do exist tend to focus on things like regime type and increases in electrification [Brown and Mobarak, 2009, Ahlborg et al., 2015a, Gore et al., 2019, MacLean et al., 2016], more broadly on redistributive programs [Dixit and Londregan, 1995, Cox and McCubbins, 1986], or treat increased expenditures on health and public welfare as a by-product or part and parcel of democratization [Ross, 2006, Kudamatsu, 2012, Kudamatsu and Besley, 2006, Navia and Zweifel, 2003, Bollyky et al., 2019]. While all of these studies also use large cross-national data sets, they seek to answer different questions from this dissertation.

This study chapter looks to ask a more specific question and on a broader level answer the central question of this study as a whole. Does increasing access to electricity increase support for the regime. This is simply a more broadly applicable iteration of one of this dissertation's central questions: Did electrification increase support for the Democratic Party? Importantly, the studies such as Brown and Mobarak, 2009 and Cutler and Miller, 2004 look at whether democracy and increasing the electorate increases spending on welfare improving services under the assumption that politicians will attempt to buy votes by providing new public goods and services. These studies, however, do not attempt to find if the politicians are successful in buying the votes.

This is among the earlier attempts to determine if buying votes through large public works programs actually works. While the later chapters will focus on this same question within a sub-national context, this seeks to examine these questions in a cross-national context.

This is important as it indicates the broad level of generalizablity of the follow chapters and provides a basis for understanding whether the sub national studies represent aberrations, or deeper understanding of a larger trend.

While the work specifically on electrification has been slim, it is important to think about electrification in this context as fitting in with the previously discussed work on distributional programs and support, in particular, the work of Miller, 2008, Diaz-Cayeros et al., 2016, Blaydes, 2010, Brown and Mobarak, 2009, and Ross, 2006.

3.1.1 Cross-National Results & Implications

In an attempt to better understand broad trends in the efficacy of redistributive politics, this study uses a panel sample of leader approval data from the Executive Approval Project's data set covering 33 lower-middle to high income countries across 23 years[1] from 1994 to 2016 [Carlin, 2019]. These approval data are matched with economic data from the World Bank. Additionally, this study controls for the percent of GDP spent on health services by the government; this is used to proxy for overall governmental expenditures on social services as this form of distributional politics could confound the findings especially in situations where increased electrification could be taking place in the context of generally increased governmental spending on social services and welfare improving programs.

The relationship between electrification and regime support will is tested in the following hypothesis:

Hypothesis 1a *Increases in electrification within a country will lead to increases in support for the ruling regime.*

What this study finds (see 3.2) is that while controlling for GDP, GDP growth, and changes in health expenditures as a proportion of GDP, increases in electrification are linked to increases in the overall approval of the national leadership. The electrification data is measured in percents of population (as opposed to households) and the executive approval

[1]See Appendix 9.1 for ANOVA and balance of variables tables

is likewise measured in percentages of respondents who said that they had a favorable view of the chief executive (either the president or the prime minister depending on the country).

Table 3.1: Summary statistics

Variable	Mean	Std. Dev.	N
Access to electricity (% of population)	94.82	9.055	695
Access to electricity, rural (% of rural population)	87.64	19.449	686
Access to electricity, urban (% of urban population)	98.90	2.048	696
Executive Approval: Not Smoothed	44.23	12.673	686
GDP growth (annual %)	2.99	2.956	694
GDP per capita (constant 2010 US$, thousands)	20.14	17.43	695
Domestic general government health expenditure (% of GDP)	4.99	2.058	511

The above table 3.1, provides a set of summary statistics of the cross-national samples tested in the models presented below (see: table 3.2). In the summary statistics (3.1) it can be seen that the countries represented in this sample are overwhelmingly wealthier, more developed countries with high levels of electrification both in urban and rural settings. The following figure (3.1) shows the countries included in this study. Importantly, during the time period in question (1994 to 2017) many of these countries did experience significant changes to their levels of electrification.

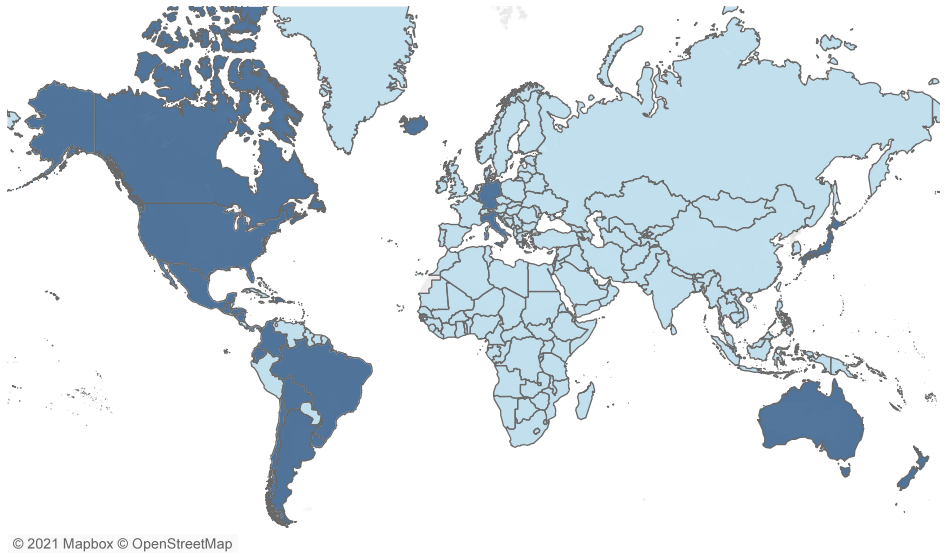

Figure 3.1: Countries in Dark Blue are Included in the Cross-National Study

Three similar models were run with Overall Percent of Population with Access to Electricity, Percentage of Rural Population with Access to Electricity, and Percentage of Urban Population with Access to Electricity using time-series cross-sectional regression with country-year level fixed effects with clustered-robust standard errors.

While all three models produce significant results the magnitudes of those results vary - as seen in table (3.2). The increase in electrification across both rural and urban populations is linked to increased support for the regime with one percentage point increase in access to electricity leading to a nearly .5 percentage point increase in regime support. Importantly, these results are not the same in both rural and urban areas. The magnitude of the increase in support is much greater in urban areas than in rural areas indicating that changes in approval are being largely driven by increases in approval in urban areas.

It is important to note that this is a very modern data set (1994 to 2017) and throughout this time (even in the middle-income countries studied) electricity has been seen as a basic utility.

Table 3.2: Regime Approval

	Model 1	Model 2	Model 3
Access to electricity (% of population)	0.462**		
	(3.22)		
Access to electricity, rural (% of rural population)		0.212**	
		(3.01)	
Access to electricity, urban (% of urban population)			1.091*
Domestic general government health expenditure (% of GDP)	0.792	0.801	0.843
	(1.37)	(1.38)	(1.44)
GDP per capita growth (annual %)	0.874***	0.884***	0.889***
	(5.13)	(5.18)	(5.19)
[1em] Constant	-4.426	20.74***	-68.68
	(-0.33)	(3.35)	(-1.57)
Observations	510	510	510
Adjusted R^2	0.020	0.018	0.011
Country Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

It is important to remember that at the national level there is an enormous amount of information that cannot be adequately controlled for and the bulk of the variation comes from a handful of countries who experience some level of variation in the percent of the population with access to electrification. This lack of variation is in part due to the available data, but also due to the nature and difficulty of assessing these things at such a scale. While the the results presented above are statistically significant they have both a low substantive effect as well as a relatively poor model fit.

Importantly, the lack of access to electricity is not uniformly distributed within a country. This means that certain regions will have very high levels and other regions will have comparatively low levels of electrification. This heterogenaity in electricity distribution can happen for amny reasons ranging from the purely practical, to the intentional selection of who does and does not get power by the ruling regime [Min, 2015, Kale, 2014]. Just as electricity varies within a country, so does support for the regime. This within country variation has the potential to be most informative as it tells a clearer story about increases in electrification within a country and the direct effects on voter's behavior within that state. Additionally, by using sub-national data, it is not necessary to control for what may be taking place within a country as the entire sample is being subjected to the same macro-level changes.

While the above models are able to find a relationship between the expansion of electricity and increased support for the regime, these results are unable to indicate a potential causal pathway. In other words, what about electricity do people respond to? Are voters more interested in the symbolic aspects of electricity as a hallmark of modernity, or do they truly care about the technological innovations and welfare improving potential of electricity? In order to attempt to answer this question, it requires a method of measuring the welfare improvements received by a population and then matching those welfare improvements to changes in support for the regime. The following chapters seek determine a plausible causal pathway between increased electrification and increases in support for the ruling regime by

examining county-level health and electrification data from the United States South during the expansion of electricity under the Tennessee Valley Authority. These data will allow for this same hypothesis tested above 3.1.1 to be more thoroughly tested with sub-national data, the health impacts of electrification to be assessed, and for the health data and political data to be combined; this should allow for some indication of that is the most plausible causal pathway for the transmission of electrification to votes.

Chapter 4

The Case of the TVA

The previous chapter found a positive relationship between electrification and support for the ruling regime in a large cross-national study and while these findings are interesting in and of themselves, these previously examined data are unable to indicate a potential causal pathway between increased electrification and increased support. This is important because electricity is of little use by itself and only provides value through the technologies it enables. This chapter will address the question: Why the Tennessee Valley Authority? What about the TVA makes it a well suited to answering questions about how voters reward politicians for the distribution of a new service.

The central case study examined here - The Tennessee Valley Authority - functioned as both a large public works program directly seeking to improve the health and welfare of those in the service area and as a program that sought to create economic growth. The size and importance of the TVA in creating the "New South" can be attested to by the program's long shadow and continued controversy within the South.

Electricity is unlike many other goods that can be studied through the lens of distributional politics because it is both a useful and a symbolic good [Kale, 2014]. What this means is that electricity can serve as both a symbol of modernity, progress, and status as well as serving the useful purpose of allowing for other technologies to be used. This study allows

for the examination of the same good as both a symbolic and useful good and attempt to understand how the electoral benefits may differ between these two framings of the same good.

The following chapters seek to answer three questions: Chapter 5 explores if the distribution of TVA power increased support for the Democratic Party who distributed the electricity, Chapter 6 attempts to quantify the benefits to welfare by measuring any potential improvements to health and well-being in the areas receiving electricity, and Chapter 7 seeks to understand if the benefits that the Democratic Party received were based on the distribution of the good or the amount that it actually improved welfare. This is to say, the goal is to determine if the primary electoral benefit of electricity (or any good that serves both a symbolic and useful function) is in the symbolic value it provides or in the useful value that it provides. The next section also explores the roll-out of the TVA to ensure that there there is not a selection bias in who received power that would affect the outcome.

Even in generalizable stories, the particulars of the case matter. The TVA differs from many other programs which sought to regional development, rural electrification, or health interventions in part because it sought to do all three. Only by understand the particulars of the case of the TVA is it possible to know how this test case fits in with similar programs and how this study fits in with the previous work on both electrification and distributional programs. In short, the facts of a case matter and without a solid understand of the history and facts of this case, it would difficult to understand where to apply the lessons and where it fits in with other work. The goal of this chapter is to provide that needed background to allow the empirical tests that follow to be both better interpreted and better applied to future work.

4.1 The Creation and Roll-Out of the TVA

4.1.1 The Area Before the TVA

In 1933, one the most ambitious public works and development projects in The United States' history was launched - The Tennessee Valley Authority. The TVA was given unprecedented power over the redevelopment of an administrative area that had previously not existed, and was charged with bringing an area of the country which was economically and socially underdeveloped and mired in exceptional poverty into the 20th century and up to modern standards of living. While the TVA looms large in Southern history and lore, the fundamental goals of the program and the use of large infrastructure projects to spur development and improve well-being are a universal story.

In 1930 the South as a whole, but the Tennessee Valley in particular was lagging behind the rest of the country in most of the commonly assessed metrics of development. Figure 4.1 shows the area of interest. The area that would become the TVA service area was poorer [Kitchens, 2006], less developed (as measured through infant mortality) and had less access to electricity than both the rest of the country (see 4.1). During the Great Depression the area of the Tennessee Valley was hit exceptionally hard with incomes in the TVA area being approximately 1/3 of that of the rest of the county and approximately one in five households living on less than $250 per year (about $4,500 in 2020 dollars) [Van Fleet, 1987]. To put it simply, the Tennessee Valley was the poorest part of the poorest region [Lowitt, 1984].

Table 4.1: TVA Service Area vs Nation - 1930

Variable	TVA Mean	Non-TVA Mean
Infant Mortality (per 1000 Live Births)	69.6 (2.33)	62.83 (4.72)
Access to Electricity (% dwellings)*	18.8% (0.141)	25.2% (0.552)
Annual Depression Era Income†	$639	$1835

*Data from Kitchens, 2014
† Data from Van Fleet, 1987
Std. Dev. in parentheses (Not available for Annual Income)

Importantly, the goal of the TVA was not just to improve the area through the provisioning of electricity, but was also aimed to addressing other endemic problems plaguing the area including improving soil and farm productivity and controlling flooding. This was a crucial aspect of the program because the Tennessee Valley suffered from constant threat of flooding and significant environmental degradation [Lowitt, 1984,Van Fleet, 1987,Selznick, 2015] with 85% of land suffering from erosion and other forms of environmental degradation [Van Fleet, 1987].

While not a problem in many areas of the Tennessee Valley, some parts of the TVA service area were areas that had once been heavily dependent in slave labor and these areas still relied heavily on tenancy and other economically backward systems. In these heavily Black areas the economic and social backwardness were not incidental, but rather much of the population was intentionally cut off from the potential for economic growth and prosperity [Acharya et al., 2018, Mickey, 2015]. In other areas, the rugged terrain, dependence on extractive resources and plutocratic state governments inhibited economic development and equitable economic growth [Key, 1977,Bullock and Rozell, 2018]. This is important because the intentional exclusion of portions of the population from the benefits of development certainly had an effect on the region's past and may have had an effect on the things of interest in this study.

When James Agee and Walker Evens set out to document the lives of tenant farmers in the 1930s South, they found people who the advances of the past twenty or thirty years of progress had simply skipped over. Homes were largely heated by wooden stoves or coal, light was provided by gas lanterns and the sun, and homes and clothes were threadbare - "the bone pine hung on its nails like an abandoned Christ (p.17)". The poverty that they documented in both stories and images cross-cut racial lines with much of the poverty being among rural Whites who were disadvantaged in the system not due to race, but due to class (Agee & Evans 2001). The wealthy elites who controlled the political system at the state and local level were in many cases rent seeking and rather than allowing state or local services to

assist the rural farmers, many skewed the benefits of the system to their own benefit [Key, 1977]. The elite capture at the local and state level is one reason it is important to examine the TVA, because it involved direct federal control with little to no local input and worked directly with those on the ground creating a new political/geographical entity.

Before the TVA, the South and the Tennessee Valley were not areas completely devoid of electricity, but rather electricity was a patchwork of privately owned small-scale companies who provided power to whose who could afford it and mainly in areas where there was a high enough density of people to make the investment worthwhile. This meant that electricity was often considered a novelty to draw patrons to businesses like department stores and carnivals and was mainly found in the urban centers of the "New South" [Cater, 2019]. While during the first decades of the the 20th century electricity was not common or expected anywhere, electrification had already become a sign of modernity, it is for this reason that buildings as wide ranging as Rich's Department store in Atlanta and the Mississippi State Capitol in Jackson were covered in electric lighting - it showed that they were in fact modern.

The TVA did not pioneer the use of hydropower in the South. What electric generation capacity there was before the founding of the TVA was largely hydroelectric with it being the dominant power source in the two decades leading up to the founding of the TVA in 1933 [Cater, 2019]. Many of these smaller hydroelectric power plants were owned by private companies exclusively to power their own manufacturing processes such as textile mills in Georgia and Alabama [Cater, 2019] and nitrate plants in Muscle Shoals, Alabama [Van Fleet, 1987]. The remaining electricity generation capacity was supplied largely by smaller plants producing consumer electricity by burning bituminous coal from the Appalachian region [Cater, 2019].

The Tennessee Valley lagged behind the rest of the country in both economically and in terms of health (see: 4.1), and the state and local political structure, rather than encouraging development, sought to perpetuate the existing system. Those with the greatest power had an interest in maintaining both a racial and economic system that they profited from as well

as maintaining a core of low wage workers to engage in the extractive industries they profited from. The TVA, by being a federally created agency that worked directly with locals, sought to circumvent the state and local-level officials rent-seeking behaviors. The following sections will examine how the TVA was created and rolled-out and how this affected the region and the effects of the program.

4.1.2 The Creation of the TVA

The Tennessee Valley Authority was created with a single, but expansive, goal of modernizing an economically depressed area of the mountain South. One of the TVA's biggest proponents and its legislative father Senator George Norris of Nebraska viewed the Authority as "taking the Tennessee River as a whole and developing it systematically, as one great enterprise, to bring about the maximum control of navigation, of flood control, and of the development of electricity" [Lowitt, 1984]. The primary method for modernizing this area was bringing electricity to the Tennessee Valley where - as discussed above - rural and farm electrification was lagging behind the rest of the country. The area over which the TVA had power was large and cut across the lines of seven different states, as can be seen in figure 4.1, covering an area approximately the size of England. While the main activity of the TVA was electrification, the TVA had numerous other programs intended to improve the lives of those living in the TVA area including programs to help secure the milk supply, improve the use of fertilizer, and encourage heavy manufacturing.

The Tennessee Valley Authority Authorization Act that passed on May 18, 1933 was not the first attempt, but rather the 7th bill sponsored by Nebraska Republican Senator George Norris attempting to create an organization like what would become the TVA. Senator Norris had been fighting for the creation of the TVA against incredibly strong headwinds that included resistance to the idea from within his own party. By the time the TVA Act finally passed it had already been vetoed by two previous Republican presidents (Herbert Hoover and Calvin Coolidge) [Van Fleet, 1987, Selznick, 2015, Cater, 2019].

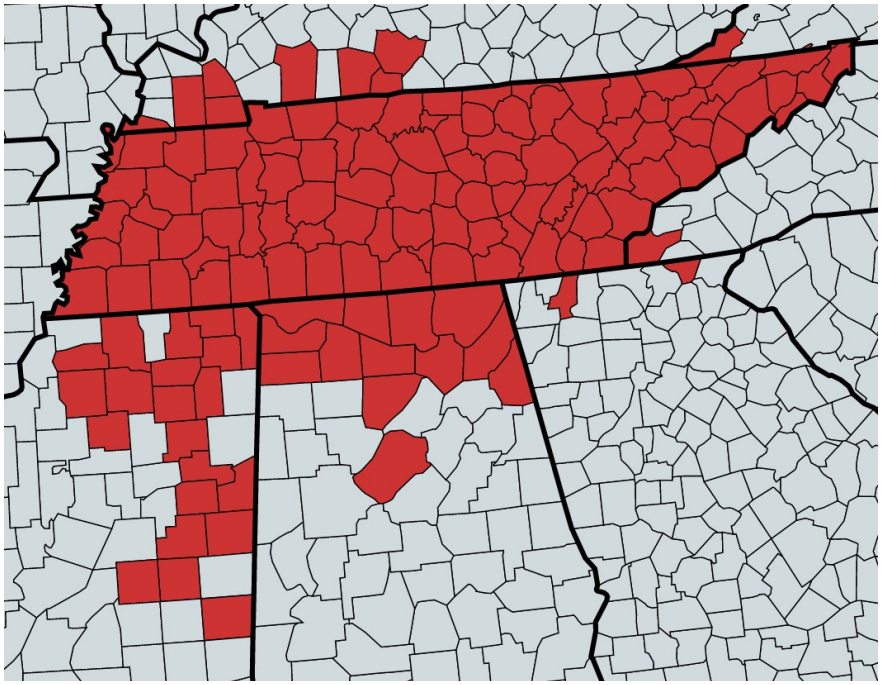

Figure 4.1: TVA Service Map

The battle over the creation of the TVA was far from one dimensional, but rather encapsulates many of the larger battles of the era, in particular battles over the role and scope of government and its relationship with the private sector as well as the ever present battle over race and inclusion in the South. The central battle over the creation of the TVA took place between proponents of government action and private power utilities and companies. This battle in many ways existed even before the creation of the TVA when in 1924 Senator Norris blocked a plan by Henry Ford to take over the existing Wilson Dam (which had been built to support the production of nitrate for the war effort). Ford had pushed a bill through the House of Representatives that would have sold Wilson Dam and the attached reservoir to Ford for a small sum. Senator Norris blocked this bill for two reasons: first he thought that the amount offered by Henry Ford was paltry and evidence of corruption, and secondly because Senator Norris believed that Wilson Dam provided the perfect starting point for the creation of a public power company [Van Fleet, 1987].

The fight over the creation of the TVA brought together anti-New Deal Republicans and private power companies who found a common cause in defeating the "socialist" plan.

The power companies who had a vested interest in defeating the plan had been crying socialism since Senator Norris' first proposals and anti-New Deal politicians saw this as a prime example of the government controlling an industry and service that should be allocated by the free market [Cater, 2019]. There are scholars today who argue that the private market (potentially with the help of the Rural Electrification Authority) could have expanded electricity without the creation of the TVA [Kitchens, 2006].

As with any political dispute in the South, race quickly entered into the debate. Both anti-New Deal politicians and the Southern power companies brought up race and the ghosts of Reconstruction arguing that this was just another way for the federal government to extend its reach over the South and bring about racial equality. They argued that electricity was a backdoor for the federal government to make Blacks and Whites equal and extend federal control. Others went so far as to argue that the inefficiency of the current way of life was good because it kept so much Black labor occupied. Modernization and mechanization, they argued, would lead to masses of unemployed Black men and women who would be free to be idle and engage in mischief. In short, they argued that lack of electricity was a positive because it kept Black people from having excess free time they could use to commit crimes, disrupt the social order, or agitate for better conditions [Cater, 2019]. Despite these racial appeals, the support for the TVA Act among Southerns was extremely high [Van Fleet, 1987, Katznelson, 2019].

Once the Tennessee Valley Authority Act became law the challenges did not end. The physical creation of the infrastructure of the TVA was a daunting undertaking requiring the building of 14 dams, the creation of massive system to distribute that power, and coordination with local and county cooperative organizations who would actually distribute the electricity. The next section will consider the roll-out of the TVA and how that roll-out may affect the subsequent chapters of this study.

4.1.3 The Roll-Out

Could the way that the TVA expanded across the South have introduced any biases into the study? This is important to consider given the fact that public goods are often used as a source to reward or punish citizens of an area for their political views and voting patterns [Blaydes, 2010, Min, 2015, Diaz-Cayeros et al., 2016, Kale, 2014]. Previous studies have found that politically and economically important areas receive more electricity [Kale, 2014] and have even noted electricity being shifted away from opposition areas to those supporting the party in power [Min, 2015]. Answering this question requires considering three questions: 1) how the roll-out took place, 2) what kind of biases could be introduced by rolling out this way, and 3) what the effects of those biases would be. These three things will be considered in this section.

The following figures (4.2 and 4.3) show how the roll out the Tennessee Valley Authority proceeded. Figure 4.2 shows the expansion of counties receiving the TVA treatment in the sample, with the bulk of the roll out taking place by the end of 1939 and a slow march for the next 8 years. Figure 4.3 displays the converse to the previous figure, displaying how many counties within the sample are not receiving the treatment over the same time period.

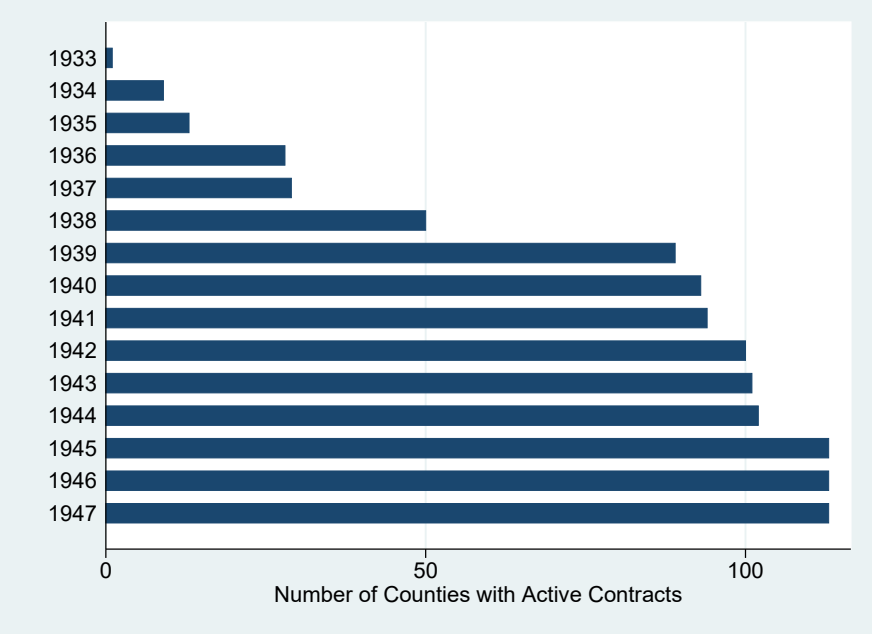

Figure 4.2: Number of Counties in the Sample With an Active TVA Contracts by Year

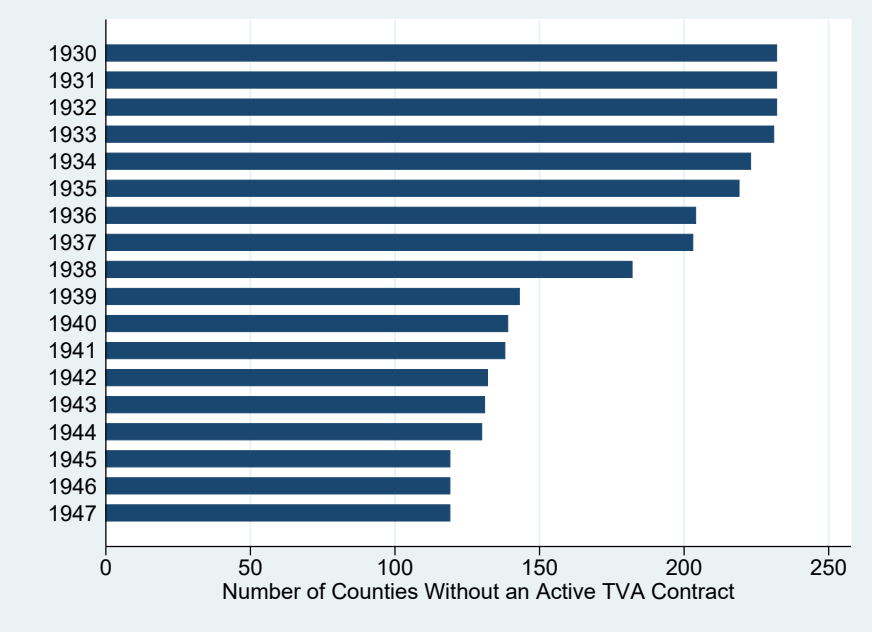

Figure 4.3: Number of Counties in the Sample Without an Active TVA Contact by Year

This dissertation argues that the treatment can plausibly be considered exogenous due to the method of roll-out and based upon both the qualitative and quantitative evidence avail-

able; i.e. that the expansion to additional counties was random rather than the selection of the counties set to get power in the coming year being made based on political considerations. Should political considerations be part of the equation that could create endogenaity issues. There are two possible motivations for the selection of counties to expand power to based on politics [Dixit and Londregan, 1995]. The first and most obvious is to expand to counties with strong support for the Democratic Party in order to reward the loyalty of supporters. The second reason would be to expand power to heavily Republican areas in an effort to use the program as a way to induce them into switching their party affiliation. In either situation the treatment is not exogenous and therefore would bias any results.

The actual work of the creation of the Tennessee Valley Authority power systems was led by the US Army Corp of Engineers who were responsible for both the building of 15 of the 17 dams in the TVA hydropower system (the two additional dams being preexisting dams purchased by the TVA) and planning and running the the high voltage power lines that allowed for new areas to get power. Historians and those working with and for the TVA have long held that the roll-out of the TVA was done without regard to the politics, strictly based on the ability of the Corp of Engineers to expand power to that area [Lilienthal, 1944, Van Fleet, 1987, Hargrove and Conkin, 1984, Selznick, 2015]. Importantly, some of these scholars were major figures within the TVA [Lilienthal, 1944] or worked for the TVA to produce the work [Van Fleet, 1987]. While other scholars have also found no evidence of political considerations in the roll-out of the either the TVA or other federal electrification programs [Kitchens, 2006,Kitchens, 2014,Lewis, 2018] it is important to test this empirically.

The role of politics in the selection of what counties to expand TVA service to is examined in 4.4 which shows the partisan make-up of the areas receiving TVA power using the Democratic vote share in 1932 as a gauge of the preexisting partisan leaning of the county. In other words, the chart shows how the counties that are in the TVA service area as of that year voted in 1932 - before the treatment of the TVA was applied. If the roll out was done in Democratic areas first and then in Republican areas, there would be a steady and

noticeable decline in Democratic voting as Republican leaning areas are slowly added to the TVA service area - the converse could also be true if the goal was to boost Democratic voting in Republican areas. The main thing to take away from this figure is the stability of the preexisting partisan make-up of the sample over time. Highly democratic and highly Republican areas both enter the sample early on, and do not show major shifts.

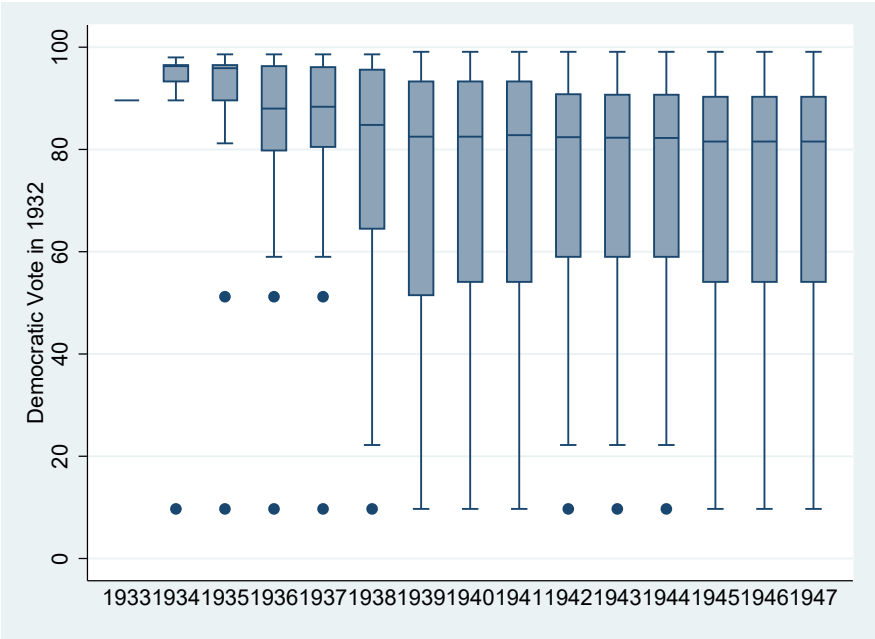

Figure 4.4: TVA Roll Out by Existing Partisan Make-up

Beyond simply looking at the chart above 4.4, statistical analyses of the effects of voting on the roll out of the Tennessee Valley Authority are problematic. This is in part because of the geographic nature of the roll out. What this means is that because the roll out took place along geographic lines with the extension of new lines being conditional on geography, terrain, available manpower, available materials, and the ability to secure the right of way through legal processes, determining anything beyond rough eligibility is difficult as is determining the influence of a single factor in a system with so many unknowns. That being said, statistical

tests including traditional probits and bivariate probits consistently fail to find evidence that the Democratic vote share affected the likelihood of a county receiving the TVA; these tests can be found in Appendix 9.2. This lack of statistical evidence indicating a bias coupled with the lack of any qualitative evidence of bias in the historical record creates builds a good case for the roll-out of the Tennessee Valley Authority lacking significant political biases that would complicate the analysis and inferences made in the following chapters.

The failure to find evidence of political bias in the roll-out of the TVA is consistent with Diaz-Cayeros et al., 2016's arguments about the importance of institutions that restrain political behavior. In this case the US Army Corps of engineers served as that mediating institution. Placing the distribution of TVA power with an apolitical bureaucratic institution prevents the ruling power from using the program for patronage, but it also prevents the opposition from using the program for political purposes. This is important for systems and situations where there may be political uncertainty. In this case, there were two systems with uncertainty, the federal government - where a Republican could be elected - and the highly fractured Democratic Party - who, while unlikely to lose power in the South, was riddled with sectional and ideological differences that had the power to make sustained consensus on the administration of such a large program difficult. These factors made it in the best interest of the politicians who created the TVA to keep the TVA as apolitical in its administration as possible. Between the qualitative and quantitative evidence and the politicians own best interest, there is a strong case for plausible exogenaity for the TVA roll-out. The politics of the South - and the Southern Democratic Party - are a crucial part of the story told in this dissertation and in order to understand the context of the primary test case, it is important to understand the politics of the South at this point in history.

4.2 Democratic Politics in the South

The electoral history of the South is more complicated than the popular story often suggests. The simple story is that since Reconstruction the South was the Solid South - solidly and consistently Democratic with little dissent or variation [Key, 1977, Caughey, 2018]. This is a drastically over-simplified view. Like all areas of the country, the South contained a wide variety or political views with significant variation based on the economic and racial make-up of the area [Caughey, 2018]. What is true though, is that throughout most of this time period, state politics were dominated by the Democratic Party and to win the Democratic Party Primary was to assure yourself victory in the general election. This lock on statewide office does not mean that there was no variation; there was a great deal of variation in support for the Democratic Party within both states and different counties within a state. The dominance of the Democratic Party at the state level also does not necessarily translate to equal levels of support at the national level - and this is the level of interest in this study - because of both the ideological distance between the state and local parties as well as some Republican voters only ever getting the chance to vote Republican at the national level. In the following section I will first explore the significant variation within the politics of the South both across party lines and within the Democratic Party to understand what the potential effects of the TVA would be on electoral support within the TVA service area. There have been many books written that cover the history and politics of the South during this time period [Key, 1977, Katznelson, 2019, Bullock and Rozell, 2018, Hood et al., 2012, Mickey, 2015, Bateman et al., 2018, Asch, 2008] and what follows is far from exhaustive; however, it provides a context through which to substantively understand the results of the following chapters.

By far the most dominant force in Southern politics in the century following Reconstruction was the Democratic Party [Bateman et al., 2018, Hood et al., 2012]. The Democratic Party was so dominant during this time period that scholars have gone so far as to argue that the area constituted a one party state and even an "authoritarian enclave" [Mickey, 2015].

While it is certainly true that at this time federal and state level offices were nearly exclusively held by Democrats in the South, there was significantly more variation than would be expected given the consistent political domination of one party. This variation exists along two separate and equally important axes: variation within the Democratic Party and Republican enclaves within certain areas of the South [Hood et al., 2012, Bullock and Rozell, 2018, Caughey, 2018].

During the time period under examination in this study, the Democratic Party was not a single party, but rather a national Democratic Party and a Southern Democratic Party held together by a few uniting economic priorities, but divided by social issues among other things [Bullock and Rozell, 2018, Bateman et al., 2018]. The strength of the Southern Democrats within the Democratic party meant that the support of Southern Democrats was essential for the passage of any major legislation, including, but not limited to, central New Deal programs like the Tennessee Valley Authority. The need for the votes of Southern Democrats meant kowtowing to their demands on a number of issues, but most importantly their demands on race and the disenfranchisement of Southern Blacks. In other words, Southern Democrats required that all programs be designed to minimize the benefit that was provided to Southern Blacks [Mickey, 2015, Katznelson, 2019].

The journalist Anne O'Hare McCormick wrote in a series of articles about the South that "the revenge of the slave is to place his master in such subjugation that they can make no decision, political, social, economical,or ethical without reference to him... Voteless, he dominates politics" [Katznelson, 2019]. In short, racism and a commitment to the preservation of White supremacy was as close to an overriding ethos as existed among the Southern Democrats at this time; beyond that most things were up for debate. This can be seen by the fact that one of the New Deal's most ardent supporters - Senator Theodore Bilbo - served at the same time and from the same state as one the New Deal's most ardent detractors - Senator James O. Eastland. And while Eastland and Bilbo may have disagreed on many

issues they both were renowned above all else for their deep racism [1] [Asch, 2008, Katznelson, 2019]. Importantly for this study, there was a high degree of cohesiveness among the Southern Democrats in congress [Hood et al., 2012, Caughey, 2018] and no senator or representative from the South votied against the bill authorizing the TVA - as will be discussed later.

The other form of political variation within the South was the traditional Republican-Democrat variation and while the South is commonly thought of as being the "Solid South" during this time period, there were enclaves of Republican voters in some parts of the South although they held little political power. The existence of Republicans in the Democratic South has been noted by earlier scholars [Key, 1977], but more recent works have focused more heavily on this variation [Hood et al., 2012, Caughey, 2018]. The Republican enclaves in the South at this time were overwhelmingly areas with lower Black populations, historically fewer ties to slavery, and high level of support for the Union (and the Republican Party of Lincoln). This put them at cultural and economic odds with much of the rest of the South.

These Republican leaning areas also tended to be concentrated in the Mountain South where plantation agriculture was not practiced (the Tennessee Valley includes a large part of the Mountain South). These Republican areas had two ways of expressing their political power: through strategic voting in the Democratic Primary and through voting for the offices where there were Republicans on the ballot (often this was only in national and and one or two statewide races) [Caughey, 2018]. While the phenomenon of Republicans engaging in cross-party strategic voting is an interesting one and certainly worth of study, it is difficult to assess in the context of the questions being asked in this dissertation.

This study exploits the fact that those areas with high levels of Republican voting were also included in the areas targeted by the Tennessee Valley Authority. In other words, while Democrats may have had a lock on federal and state offices during this time period, there was variation in the levels of support for the Democratic Party along geographical lines and in

[1] Theodore Bilbo was so notoriously racist even for a 1940's Southern politician that he was referred to as "the senator from the Klan".

the TVA service area. Lastly and critical to this study, is the fact that the "Solid South" was not a stationary object; it evolved and devolved over a period of decades and the 1930s and 1940s were a period of consolidation of power for the Southern Democratic Party where they extended their power over new areas [Key, 1977,Bullock and Rozell, 2018], consolidated their power within the areas they controlled, and cemented their within the New Deal Democratic coalition [Katznelson, 2019]. This study - in particular the following chapter (5) tests - and largely supports - the argument that the creation and expansion of the TVA was one fo the factors that helped the Democratic Party in their efforts to consolidate power during this time period.

Chapter 5

Electrification and Electoral Support in the TVA

This chapter asks the same question presented in Chapter 3 - does increasing electrification increase support for the ruling regime - using a sub-national data set. Specifically, this chapter uses county level data on elections to test this question in the Tennessee Valley Authority service area. Before proceeding to test how increased electrification increases support, it is first essential to demonstrate that in this sub-national sample increased access to electrification does in fact lead to increased support. This chapter uses county level election returns for the presidential elections of Franklin Delano Roosevelt. This chapter, and all of the following chapters treat the signing of a power contract with the TVA as the beginning of the treatment and assume that electrification increased in TVA areas due to the presence of the TVA. Importantly, this assumption is based on previous quantitative and qualitative work on the TVA [Van Fleet, 1987, Kitchens, 2014].

This chapter's central findings are consistent with the primary findings of Chapter 3 - that increases in electrification are electorally beneficial for the ruling regime. In particular, in this dataset rather than necessarily increasing the vote for Roosevelt and the Democratic Party, the provisioning of electricity through the TVA may have acted more as a buffer against

the inevitable decline in support that all presidents face as their time in office increases. Importantly, from the perspective of a politician, a vote won and a vote that you did not lose are interchangeable as in both cases it is one more vote than you would have in the counterfactual. While an empirical model may not be able to clearly make this distinction, figure 5.1 indicates a general decline in support among both counties with and without TVA power, but a smaller decline in Democratic support for those counties with TVA power. Furthermore, like the results presented in Chapter 3 this chapter does not speak to the pathway between electrification and increased votes - i.e. what about electricity voters are responding to.

This chapter will begin by first laying out the case for county level presidential returns being the most appropriate unit and level of analysis, then proceed to the primary findings of this section, examine the possibility that electrification was viewed through a partisan lens, and finally place the results into the broader context of this dissertation. Each of these will be handled in its own section in the rest of the chapter.

5.1 Why Presidential Elections?

This dissertation uses presidential election data for two reasons: the TVA was thought of as a federal program and voters will therefore reward or punish federal leaders for the success or failure of the program, and congressional level elections whitewash over much of the variation at the county level due to the presence of Republicans voting strategically. These points will be examined in more detail shortly.

First,TVA was most directly associated with the national Democratic Party and with President Franklin Roosevelt personally. This personal association between President Roosevelt and New Deal programs, including the TVA, was not accidental, but rather an intentional effort to have the highly popular new president communicate directly with his supporters through the new technology of the wireless radio [Katznelson, 2019]. Addition-

ally, many New Deal programs' brochures featured images of the president prominently. It is therefore logical that voters would approve or disapprove of the program at the governmental level it was administered. While there are often problems with blame attribution in federal systems [Wlezien and Soroka, 2011], the Roosevelt administration ensured that no confusion about who was responsible for the TVA.

Aside from presidential elections, the other options for assessing electoral support at the federal level are to examine electoral support for federal candidates - Senators and Representatives. This proves problematic for several reasons including the Democratic Party's one party rule for most offices and the high level of consistency in voting within the Southern block of the Democratic Party. The domination by the Democratic Party meant that essentially all congressional seats were going to be won by the Democratic Party, not matter what and in many of those races there was no Republican even on the ballot. Few Republicans were interested in becoming the sacrificial lamb in a general election. This meant that Republicans often voted in the Democratic Primary in order to have some say in the their eventual representative. In other words, Republicans would make the strategic choice to simply vote in the Democratic primary for state and local office, rather than enter a race there was no hope of winning; this allowed them to retain some say in teh system rather than being entirely shut out. Importantly, the presidential level was often the only chance Republicans had to vote for someone of their party. This one party dominance and Republican strategic voting meant that congressional elections whitewash over the substantial variation in Democratic approval that existed at the county level [Caughey, 2018].

The high level of uniformity within the Southern voting coalition [Key, 1977,Hood et al., 2012,Caughey, 2018] meant that no member of either house in congress from the South voted against the law authorizing the Tennessee Valley Authority [Katznelson, 2019][1]. This lack of variation in support for the TVA means there is no room to assess congressional votes or votes for individual congressional representatives. In order to examine the whether voters

[1]While Katznelson, 2019 notes that a Representative from Maryland and one from Oklahoma voted against the TVA Act, this is an overly broad definition of the South for this author.

rewarded politicians for authorizing the bill or punished them for not voting for the bill, it would require both congressmen who did and did not vote for the bill in the areas that would receive TVA power and this was not the case. If everyone voted for the bill then potential variations in electoral support are not likely to be due to the vote for the TVA.

In short, the fact that the program was most strongly associated with President Roosevelt and the national Democratic Party, Republican strategic voting and the high level level of cohesion among the congressional delegation means that no other level of analysis is appropriate to understand the effects of the Tennessee Valley Authority on the voting behavior of those in the service area. Lastly, and potentially most importantly, there is significant variation within the data for voting at the national level with some counties voting nearly 100% for Franklin Roosevelt and some counties voting approximately 90% against his reelection.

While the TVA continued to roll out additional counties into the 1950s, the electoral portion of this study only examines the elections of 1932, 1936, 1940, and 1944. This is for two reasons: first and foremost, those were the elections where Franklin Roosevelt was on the ballot making these most cleanly referenda on his leadership; and secondly, the election of 1948 had a major third party candidate - Strom Thrumond of the Democratic States' Rights Party or Dixiecrats - which both siphoned votes from the Democratic Party and supplanted them on the ballots of more than one state. In both Mississippi and Alabama it would be impossible to assess the voteshare for the national Democratic Party since they wer not on the ballot; in both of those states the States' Rights Democratic Party (or Dixiecrats) were the only Democratic Party on the ticket. This makes inference for this election and the ones after more difficult and less meaningful.

The following section combines the presidential elections data with the data on the roll-out of TVA power collected from archival materials to present a model of the effects of the introduction of TVA power on voter behavior. This will test Hypothesis 1 that increasing access to electricity will lead to an increase in support for the ruling regime. In this case, the

argument is that increasing access to electrification through the Tennessee Valley Authority will increase support for the national Democratic Party.

5.2 Results

The following section presents the primary models and findings on the effect of the TVA on Democratic Party support within the TVA service area. The section will proceed as follows: first an explanation of the data and how they were collected, then the primary results will be presented and discussed along with any potential complicating factors, and finally the results will be put into context.

5.2.1 Data

While there is some county-level data on health and voting in the 1930s and 1940s available the data was not adequate for a study of this level of detail. The available data is incomplete - covering only select counties in select years, coded in a way to make inference difficult, or not available from public databases; it is for these reasons that data used in this study come from archival sources and were all coded by the author. The data on county-level voting patterns is from Scammon's (1965) *America at the Polls: a handbook of American presidential election statistics, 1920-1964*. This book has county level data on every election between 1920 and 1964. The data on the arrival of the TVA and the number of contracts signed in the county was taken from the information in the TVA Power Manager's files housed at the National Archives in Morrow, GA, and the locations and construction dates of the dams were coded from the dam histories provided by the TVA on their website. These data were compiled by the author and combined into the data set used for the following models.

5.2.2 Results

The expectation based on the work of both Southern historians and previous work on distributional politics is that providing a new service to a group of people should increase their support for the regime or leader that provided the new service [Min, 2015, de Kadt and Lieberman, 2017]. The results presented here are consistent with much of this previous worl.

The expectation in the models presented below is that the presence of the TVA in a county will increase support for the Democratic Party at the national level - as measured through the vote share for Franklin D. Roosevelt. All of the following models are time-series cross-sectional models with county and election-year fixed-effects. These models use the election-year fixed effects as an attempt to control for the fact that each of these elections is different featuring differing opponents for Franklin Roosevelt and differing political climates and an evolving range of issues.

The following models are intended to test the following:

Hypothesis 1b *The presence of the Tennessee Valley Authority in a county will increase the vote share for the Democratic Party.*

The main results table presented below (5.1) finds strong support for the primary question of this chapter: Did the TVA increase support for the Democratic Party and Franklin D. Roosevelt? The answer seems to be a clear and resounding: yes. In all three iterations of the model presented below (table 5.1), support is found for the idea that the TVA helped the Democratic Party electorally. The fact that all three methods of assessing the presence of the TVA - whether or not the TVA is in the county, the duration the TVA has been in the county, and the number of power contracts signed within the county - provides an extra level of robustness. While the different units of measure make inference across the measure a bit tricky, the consistency of the results is important. In the tables below - as well as in later chapters - the Democratic vote share is measured in percentage of the vote going to the Democratic Party.

The models presented in in Table 5.1 use the presence of a dam in the county as well as having a dam under active construction in the county. The goal of this is to control for any direct effects the dam could have through serving as a more traditional jobs program. Other studies have linked jobs programs to increases in electoral support [Zimmermann, 2014], and the dams required large labor forces to build and created jobs long after construction was completed. The fear in not control for this is that any increases in Democratic vote share in the 27 counties which will eventually have a dam in them could be due to the traditional jobs program effects of the Tennessee Valley Authority, rather than the expansion of electrification. This is not the only concern however, the concern with including dams in the model is that they may be a bad control. It is possible that there is co-linearity or that adding in dams as a control would place some underlying factors on both sides of the equation. To account for this, a separate set of models without the controls for dam location and dam construction are included in Appendix 9.3. The primary models and those provided in the appendix yield nearly identical results in both substantive magnitude and statistical power.

The models in Table 5.1 indicate that the presence of the TVA increased the support for the Democratic Party and Franklin Roosevelt. What the chart below (figure 5.1) indicates when taken with the statistical models is that rather than there being absolute gains in the Democratic vote, the presence of the TVA insulates against the losses that the incumbent (Franklin Roosevelt) would have otherwise suffered due to the general trend of incumbents losing popularity over time. Additionally, the support for the Democratic Party was so high in some areas (as high as 99.8%) that many places simply lacked converts to the Democratic cause to bring into the system.

What is easy to miss in the main results table above (Table 5.1) is how large the substantive effect of the TVA was on the election results. The presence of the TVA in a county is connected to a 3% increase in support for the Democratic Party. To put this increase into

Table 5.1: Effect of the TVA on Democratic Vote Share

	Extensive Margin	Intensive Margin	
	(1)	(2)	(3)
TVA in County	2.962***		
	(0.795)		
TVA Time In County		0.449***	
		(0.126)	
Number of Contracts			1.810***
			(0.477)
Dam in the County	3.021*	3.097*	3.334**
	(1.274)	(1.274)	(1.267)
Dam Under Construction	0.659	0.789	0.526
	(1.478)	(1.484)	(1.475)
Neighboring a TVA County	0.890	0.522	0.652
	(0.639)	(0.591)	(0.598)
Constant	73.44***	73.44***	73.43***
	(0.316)	(0.316)	(0.316)
County Fixed Effects	Yes	Yes	Yes
Election Year Fixed Effects	Yes	Yes	Yes
N	892	892	892
adj. R^2	0.010	0.008	0.011

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5.2: Democratic Voting in the TVA - Descriptives

Variable	**Mean**	**Std. Deviation**	**Range**
Democratic Vote Share	71.7%	21.8%	9.7% - 99.8%
Duration of TVA in County*	9.3 years	2.9 years	3-15 years

*This excludes counties that do not receive the TVA during this study

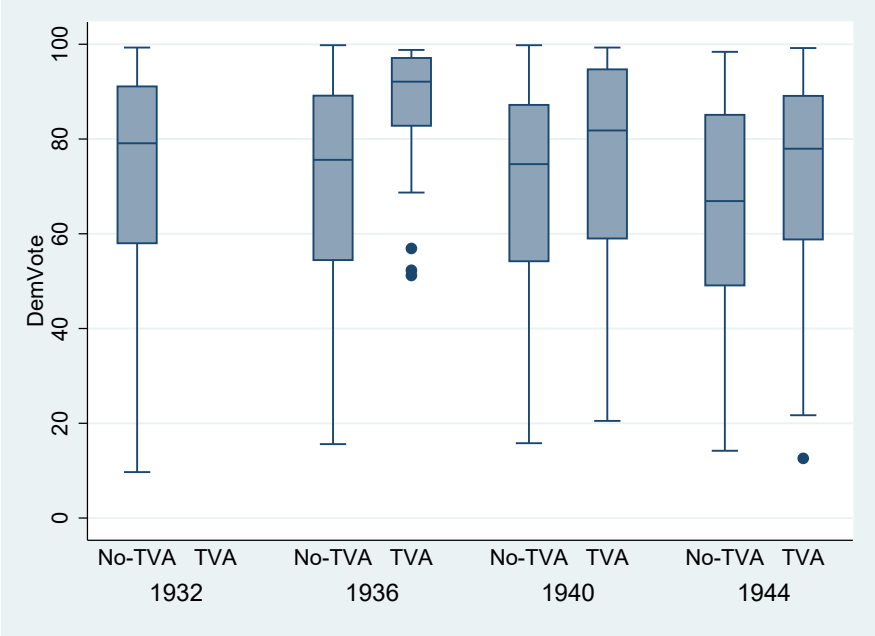

Figure 5.1: Democratic Voting by Year and TVA Status

perspective, in the 2016 elections there were 9 states and 98 electoral votes that were decided by a less than three percent margin. In both the 2016 and 2020 elections, had the incumbent party gained three percent in every contested state, the results of the election would have been changed. The substantive effect of these results should not be underestimated. Lastly, it is important to understand that like all political acts, the roll-out of the TVA was likely to have been viewed through a partisan lens. The potential differences in voting based upon the preexisting political leanings of the area must be explored, and are in the next section.

5.2.3 Partisan Filtering?

There is a significant body of work indicating that individual voters view programs and policies through a partisan filter [Ahlborg et al., 2015a, Wlezien and Soroka, 2011]. Voters are more likely to believe that a policy is good or program works if that program of policy is put into place by members of their party, and the converse is true as well, if a policy or program is implemented by a leader of the opposing party, voters are less likely to support it.

This has obvious implications for this study as there is the possibility that in areas of high Democratic support the electoral gains for the Democratic Party will be driving the results and those areas with low Democratic support - who this study is substantively interested in - could potentially even have losses of support because the Republicans in the area viewed the program negatively and as in intrusion. In the models presented below this does not seem to be the case, but there are reasons to be careful about any inferences from these findings.

The following table shows the same model as above run with the full sample as well as run separately for both areas of high and low Democratic support as measure by presidential voting in 1932 - the year before the TVA is formed. The "High Democratic" areas are those counties that were in the top quartile of Democratic support in 1932 and the "Low Democratic" areas are those counties in the bottom quartile of Democratic support in 1932. As with the other models using elections data, these models use support for Franklin Roosevelt as a proxy for support for the Democratic Party.

The above table (5.3) seems to indicate that areas with the highest initial support for Franklin Roosevelt did not see increases in electoral support associated with the introduction of TVA power. This may be largely because the areas with high support had support of up to 99.8% meaning that it would have been essentially impossible for support to get any higher and therefore the only way for support to move is down. In short, the high support areas have too high of a level of support to be able to register anything other than a loss of support or no change in support. Importantly, the areas with the lowest level of support saw the largest increases over similar areas with the TVA and those areas with average levels of support showed a statistically significant increase in voting comparing with those that did not get the TVA. What is more important when looking at the above results is that A) those areas with low support did not have declines in support and B) that the increases in support seem to take place across the political spectrum. There is always a significant risk associated with making inference about individual behavior from generalized models and

Table 5.3: Effect of the TVA on Democratic Vote Share by Preexisting Voting Quartile

		1932 Democratic Vote Quartile		
	Full Sample	Low	Middle	High
TVA in the County	2.962***	6.293*	2.730**	1.032
	(0.795)	(2.454)	(0.869)	(0.947)
Dam in the County	3.021*	-0.355	6.476***	.
	(1.274)	(2.904)	(1.471)	(.)
Dam Under Construction	0.659	4.285	-3.789*	.
	(1.478)	(3.203)	(1.723)	(.)
Neighboring a TVA County	0.890	0.938	1.466*	0.273
	(0.639)	(1.944)	(0.704)	(0.774)
Constant	73.44***	42.35***	77.10***	96.51***
	(0.316)	(0.979)	(0.354)	(0.327)
County Fixed Effects	Yes	Yes	Yes	Yes
Election Year Fixed Effects	Yes	Yes	Yes	Yes
N	892	220	448	224
Number of Counties	223	55	112	56
adj. R^2	0.010	-0.086	0.172	0.258

*High is the top quartile of support, Low is the bottom quartile of support and Middle represents the two quartiles on either side of the mean.

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

statistics, however, the above table (5.3) taken with the qualitative historical work makes the idea that voters were switching parties rather than simply rallying behind their flag more believable. These primary takeaways are what is important to keep in mind during the following section's discussion of the results within a larger context.

5.3 Voting Results in Context

When the results from the voting models are taken in context, the primary indication is that the presence of the TVA did provide a boost to Democratic party. It is important to note that the boost may not necessarily be in the form of adding votes from the previous election, but the TVA may have buffered against losses that the Democratic Party and Franklin Roosevelt would have otherwise suffered (see 5.1).

There are two ways to consider the idea of the TVA buffering against the loss of votes: the first being that the TVA did not actually change votes, but rather simply prevented votes from changing and therefore did not serve as an effective tool of securing new voters - the program failed to expand the margins to capture new voters who were previously not Democratic voters. This, first of all, makes the assumption that the buffer was not created by bringing in new voters Democratic voters, but just fewer than were being lost. The secret ballot makes it impossible to assess how individual voters behaved. More importantly though, this assumes that on the whole converting new voters matters to politicians and that retaining a vote does not involve changing a mind.

From the perspective of an elected official a vote that you fail to lose is just as important as a vote that you gain - it is a vote going to you that would otherwise be going to your opponent. Additionally, the counterfactual at play here is that some number of voters would have switched their votes from the Democratic Party to the Republican Party, but were convinced not to due to the introduction of the TVA. This is a change of mind, the voters who would have defected to the Republican Party, are convinced to remain with the party

and switch from their switch.

One final consideration is if the shape of the electorate changed. In other words, as the TVA rolled out, were more heavily Republican (or Democratic) areas now being included in TVA county sample, shifting the existing partisan makeup of both samples. As is discussed at greater length in chapter 4, while the roll-out does seem to have begun in more Democratic areas, this is quickly corrected and the shape of the electorate seems to be fairly stable throughout most of the sample. Potential changes to the electorate are therefore unlikely to have biased these results.

Chapter 6

Health and Electrification in the Tennessee Valley

The previous chapter (Chapter 5) found that the expansion of the Tennessee Valley Authority led to an increase in support for the Democratic Party and this chapter seeks to quantify the benefit for those living in the new electrified areas. The primary findings of this chapter indicate that the expansion of electricity by the TVA led to increases in the health of the populations newly gaining access to electricity. In addition, the following results also try to assess the causal that pathways may have led to the greatest reductions in mortality by assessing disease specific mortality rates for a few key causes of death. While there is little to no movement for most of these indicators, there is evidence of significant decreases in deaths from respiratory diseases. This indicates that improvements in air quality - most likely indoor air quality - were the driving force behind increasing electrification and reductions in mortality. Reductions in death are due to reductions in deaths from specif causes, and while it is possible for there to be improvements in health without reductions from a main specific cause being a driving force, most interventions work through a primary channel and historically most large reductions in disease are due to reductions in a specific type of disease [Packard, 2016]

This study measures the benefit to those living the it the TVA service area by the effect that the TVA had on health. This population health approach is not new to studies of development [Prichett and Summers, 1996, Preston and Haines, 2014, Bleakley, 2010], and studies of electrification [Lewis, 2018]; however, it has so far not been applied to studies of the TVA. Previous studies of the impact of the TVA have almost exclusively focused on traditional economic measures such as farm income [Industrial Economics Branch,] and retail sales [Kitchens, 2014]. While these studies fail to find any economic benefit to the provisioning of power through the TVA, the measures that they focus on may not be the best measures of development or of benefit to the local population. While there is typically a general correlation between health and economic development [Prichett and Summers, 1996], this relationship is far from perfect. The argument forwarded in these economic output based studies is that electricity unlocks technologies that allow for development and improvements in well-being, this study skips the intervening steps not focusing on economic indicators or attempting to quantify the fuzzy concept of development, but by simply looking at individuals' well-being. This study is able to do this because in addition to electricity unlocking development potential which can improve welfare, electricity can very directly improve welfare by unlock direct welfare improving technologies. In short, electricity can allow for technologies to improve welfare and tangibly better peoples lives without those benefits having to filter through economic development. What this means is that electricity can provide a significant benefit to people without it being noted by studies that purely examine economic output.

The following chapter first introduces the original data and health indicators that will be explored in this chapter, then explores how electricity affected those health indicators, and, lastly, places the health results into the context of the broader dissertation.

6.1 The Original Data

The way this dissertation conceptualizes the benefit to the populations gaining access to electricity is through assessing the population health of the affected areas. To do this requires high quality data at the same level of analysis as the data on both voting and electricity - i.e. the county level. The health data exploited in the study is original data coded by the author from both digital and hard copies of the state Vital Statistics reports that were required to be collected by the states starting in 1912. These data were collected, printed, and housed at libraries and archives in their home states - and in some cases other states. While the data have existed in these states from more than 70 years few of them have been digitized and many of them have been lost, destroyed, deaccessioned or moved to long term storage in uncatalogued boxes. In the case of Mississippi, many of the records were lost in a fire and ensuing flood.

While there is missingness in some of the states, the largest source of data - The State of Tennessee - remains nearly completely intact with only eight years of data from two independently reporting cities being missing. These data are not otherwise publicly available having already been coded at the county level. Importantly, the self-coding of the data allows for the data to be recoded and standardized to fit with the goals of the project and to reflect more modern understandings of both disease and diagnosis as well as to make the data more uniform. This restandardization was done in two places: the State of Kentucky independently reporting cities were folded into the surrounding counties and restandardized due to the fact that the cities come in and out of independent reporting, and the data for respiratory diseases were combined and recoded into the single indicator.

6.1.1 The Health Indicators and Their Uses

In order to get a full understanding of not just broad population health, but of how electricity creates changes in population health, it is important to look at more than just one or two

indicators of health. This study examines eight different indicators of population health all of which are commonly collected, commonly assessed, and frequently linked to broader trends in development [Szreter, 2003]. These indicators fall into two categories: general and disease specific. The general indicators that will be assessed here are:

- Crude mortality rate: Crude mortality will be the primary indicator of population health used throughout most of this study. It is a useful measure precisely because it is general. This means that changes in health are picked up no matter the cause of death and potential improvements brought about by the intervention (in this case the introduction of TVA electrification) would be picked up no matter the causal pathway that leads to the improvement. Crude mortality is among the most commonly examined indicators of health in both modern and historic studies due to the fact that it is easy to calculate, highly unlikely to misdiagnose, and almost universally collected. Mortality rate is calculated at the county level in deaths per 10,000 persons. The mortality calculations are not disability adjusted - while disability adjusting is standard practice in modern data, it is not in historic data.

- Infant mortality rate: Infant mortality rate (IMR) is likely the second most commonly assessed indicator of population health and is a commonly used proxy for development. IMR is useful for several reasons: because of the short time horizon, it is especially sensitive to changes; this sensitivity is enhanced by the fact that the population being measured (infants) is especially at risk and they are a population where extraordinary effort is put in to the prevention of death. Additionally, in pre-modern times, infancy was one of the most dangerous periods [Preston and Haines, 2014] and infant deaths were often a driver of both overall mortality and improvements in life expectancy. Lastly, IMR is both easy to calculate and extremely commonly collected. IMR is defined as deaths under one year of age per 1,000 live births (ie. exclusive of stillbirths and miscarriages).

- Maternal mortality rate: Maternal mortality rate is a commonly assessed indicator of both development and the status of women. In general childbirth is a dangerous process and maternal mortality is useful in assessing the ability of women to access basic pre-, perinatal, and postpartum healthcare. In these data, maternal mortality is calculated as maternal deaths per 1,000 live births.

In addition to the general indicators of health, there are disease specific mortality rates that are each intended to proxy for a different type of improvement that could have been brought about by electrification and could serve as the causal pathway for electrification improving mortality. These indicators are all based upon technologies that electricity allows for as well as ways that the TVA advertised they could improve the lives of those in their service areas. All of the following diseases are measured in deaths per 100,000 persons. The disease specific mortality indicators used in this study are:

- Respiratory Disease: Respiratory disease in this study is used as a catch-all for a six different commonly collected diseases: tuberculosis, whooping cough, diphtheria, bronchitis, pneumonia, and "other respiratory diseases". The data for each of these diseases was combined into a single indicator "respiratory disease". The diseases were combined because there are likely to have been issues of misdiagnosis where one of these diseases was confused for another as they can often present in similar ways [Barreca et al., 2014]. It is important to include respiratory diseases in this study because the other big things that the TVA advertised and advocated for were electric stove, lights, and heaters. The alternative to the electric versions pushed by the TVA were oil, wood, and coal burning stoves and heaters and oil burning lamps. All of these alternatives produce a fair amount of soot and smoke which damages the lungs and can lead to significant problems for those with existing respiratory problems [Jakab 1993, Ciencewicki & Jaspers 2007].

- Pellagra: Pellagra is a nutritional disease caused by a deficiency of niacin (also known

as B3). It is characterized by the four D's: diarrhea, dermatitis, dementia, and death. Being a nutritional disease it is non-communicable and purely due to poor diet. In particular it is linked to the traditional diet of poverty in the South, the three M's: meal (cornmeal), meat (saltpork or fatback), and molasses (most often from sorghum). In this study pellagra is being used to proxy for overall quality of diet with the assumption being that should people have access to greater resources they will use some of that to improve the quality of their diets. There are of course complications and contravening trends taking place during this time period that will be discussed in much greater length in the next section.

- Typhoid: Typhoid is a (primarily) waterborne diarrheal disease that is caused by fecal contamination. In this study typhoid is used to proxy for the quality of both the water and sanitation systems. If the water remains free from fecal contamination, there is a very low likelihood of typhoid spreading. One the the main things that the TVA advertised in both their promotional brochures as well as their customer magazine was equipment for digging and pumping water from deeper, better, and cleaner wells. The TVA also put a heavy emphasis on the ability to dig more secure privies that were less likely to overflow and/or seep into the groundwater. Electric water pumps also allow for modern running water and therefore generally better sanitation in the home.

For all of the above-mentioned indicators, they are reported by place of residence unless that was not available - this means that the deaths are attributed to the place where the person who died regularly lives as opposed to where they died as often people needed to travel out of county to seek medical help. The calculations are also exclusive of those living in large state-run hospitals and sanatoria - for examples, the calculations for Tuscaloosa County, Alabama do not include the deaths that occurred at Bryce Hospital.

In addition to the health indicators, there is the primary independent variable of interest (the presence of the TVA) and there are several additional variables controlled for.

- TVA Time in County: This is the primary measure of the presence of the TVA in the county; it is simply a measure of how many years has passed since electricity provided by the TVA first began flowing into the county. This measure was chosen as the primary measure because what this study is primarily interested in the is the expansion of access to electricity in a county. The TVA set - and typically met or exceeded - year over year goals for new connections in every county in which they operated. This means that there is good evidence that the duration of the TVA presence is directly correlated with increased access to electricity. The logic is rather straightforward; the more people who have access to electricity, the greater the benefits of electrification will be.

- Time: For these purposes, time used to control for general secular trends in health improvement that are happening during this time period in both TVA and non-TVA counties. This was chosen over using year fixed effects because the lack of variation among several variables caused statistical issues. It is simply measured as a counter from 1 to 18 with 1930 being 1 and 1947 being 18. The goal of this is to account for the general secular trends in improving health over time [Preston and Haines, 2014].

- Percent Black: This is quite simply the percent of the county that is listed as being black. For some counties these numbers contain inter-census interpolation, however others only change based on decennial censuses. This study uses whichever measure is provided in the state vital statistics report for that county. It is important to control for the demographic as these states were highly segregated and the Black population of the states and counties in question would have faced significant discrimination that may have prevented them from fully realizing the benefits of electrification.

- Dam County: The dam county variable is a simple binary measure of whether or not there is a TVA dam located in the county. It begins being coded as 1 (for a dam is is present) when construction on the dam begins; it is important to not that most dams were completed on quite fast taking only one or two years to complete. This

is done to ensure that any potential health effects are not due simply to an increase in employment and direct economic development in the county, but are due to the electrification.

These variables will be analyzed and discussed in the following sections to better understand the effects of electrification on the lives and health of those living in the Tennessee Valley.

6.2 Primary Health Results

This section contains the main health results for this dissertation for both general and cause specific mortality. In this section, the primary measure of the presence of the TVA is "TVA Time In County" which measures the amount of time that the TVA has been in the county. This is becuase it is logical that the the longer the TVA was in the areas the greater the effect would be, because the electricity provided by the TVA would take some time to actually arrive at people's homes. The residential lines would have to be built, the technicians would have to schedule connections, customer contracts would have to processed, and the actual things that run on electricity (stoves, wells, electric lights, etc) would have to be ordered and connected. All of the models that follow will use "TVA Time In County" as teh measure of TVA activity. Additionally, all of the following models have been run both with and without the urban areas whose health data is reported separately from the surrounding counties. In all of these cases - except for the models for respiratory disease which have rural and urban iterations - the inclusion or exclusion of the independently reporting urban areas does not significantly or substantively alter the results.

For all of the following health models, the same hypothesis can apply:

Hypothesis 2a *The presence of the Tennessee Valley Authority in a county will lead to improvements in health in that county.*

All of the following health models, for both general health indicators and cause specific indicators, use this same hypothesis. Each of the indicators is just a different way to measure health. As with the models presented in Chapter 5, the following models include a control for the presence of the dam in the county and a dam under construction where it is theoretically relevant. As with the voting models in Chapter 5, the models are nearly identical with and without the dam control meaning that the dam control does not effect the main findings, but is meaningfully interpreted in some of the models.

6.2.1 Crude Mortality

This study finds that the TVA significantly reduced overall mortality in the areas they were present in, with the longer the duration of the TVA presence, the greater the effect of the intervention (see Table 6.1). These findings support Hypothesis 6.2. These findings are robust when time is controlled for, population characteristics are accounted for and does not seem to be be effected by whether or not the county is the home to a dam. In the models presented in Table 6.1, mortality is measured in deaths per 10,000 population. Although the magnitude may seem small in the table, given the average tenure of the TVA in a county was 9.3 years, if the entire United States had experienced the same decline in mortality as the average TVA county there would have been more than 9,000 fewer deaths in 1950 alone.

In this model, and the later models, the time counter is significant and correlated with improved health. During the time period in question, there were significant improvements in health seen in all parts of the country in all populations. These improvements in health are argued to be the result fo myriad technological and medical advances ranging from penicillin and improved public services [Preston and Haines, 2014, Costa and Steckel, 2008, Deaton, 2015, Fogel, 2010]. While this study is taking place during this period of rapidly improving well-being, the intervention being tested here is part and parcel of the broader system improvements. It is sometimes portrayed as though the broader trend of improving

Table 6.1: Effect of the TVA on Crude Mortality Rates

	Mortality Rate	Mortality Rate	Mortality Rate
TVA Time In County	-0.0665***	-0.0667***	-0.0670***
	(0.0122)	(0.0122)	(0.0122)
Time	-0.0966***	-0.0959***	-0.0968***
	(0.00559)	(0.00563)	(0.00577)
Percent Black		0.279	0.276
		(0.292)	(0.292)
Dam in County			0.0992
			(0.139)
Constant	10.08***	10.03***	10.03***
	(0.0485)	(0.0700)	(0.0701)
County Fixed Effects	Yes	Yes	Yes
N	3615	3600	3600
adj. R^2	0.120	0.118	0.118

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

health and well-being was an single trend, but it is more accurate to think of it not as a single trend, but rather a set of dozens of smaller actions, interventions, and discoveries. Rather than thinking of the TVA's intervention as taking place during a time of improving health, it may be better to consider this as one of the set of interventions taking place during this time period and look to asses the impact of this intervention and how it may have built into the greater trend of improvements.

Crude mortality paints not just the cleanest picture, but also the easiest to understand and will be the primary measure of health used later Chapter 7. While there are other methods of measuring health and welfare that will be employed later, crude mortality takes into account the wide variety of cause specific mortality rates. The other measures are used to help identify the driving forces behind this decline in health. There are an enormous number of potential explanations and causal pathways for the increase in access to electricity brought by the TVA to improve the health of those receiving the electricity. It is important to note

that electricity is neither beneficial nor welfare improving in and of itself, but rather allows for people to use a whole host of different welfare improving technologies, some of which are completely new and unique (radios) some of which improve on existing technologies (electric stoves and well pumps). The use of cause specific mortality can help us to identify which technologies and innovations may have been the most important in improving health in the areas receiving the intervention.

6.2.2 Infant Mortality

The expectation (see Hypothesis 6.2) was that electrification would have a significant effect on infant mortality and lead to a decline in the rate of deaths under the age of one. This expectation is largely found in the models (see: Table 6.2) with infant mortality declining in a statistically significant way. Infant mortality is important because it measures a very sensitive population and responds very quickly to changes in the health environment - infant mortality is measured in deaths per 1,000 live births.

While the findings here do provide a indication, there had been reason to believe that reductions in infant mortality might be more powerful of a force. Many of the welfare improving things that electrification allows for such as electric lights and cleaner water are even more important for infants than for adults. Infants are especially susceptible to poor indoor air quality due to the fact that the lungs are among the systems to develop last. Burning coal, wood, and oil for heat, light, and cooking produces a great deal of soot which is damaging to small developing lungs. Electrification leads to a major improvement in indoor air quality which would be especially beneficial for those infants. Along with the respiratory system, the immune system is also a later system to develop; it is for this reason that infants are also especially susceptible to poor quality water and the diseases (especially diarrheal diseases) that are associated with poor water quality. The ability to dig deeper and cleaner wells and deeper and more secure privies that electrification brings may have led to significant improvements in infant health and welfare. Both respiratory diseases and diseases

caused by poor quality water are considered drivers of infant mortality both historically and in modern contexts [Preston and Haines, 2014] and other studies have linked increases in rural electrification during this time period to declines in infant mortality [Lewis, 2018].

Table 6.2: Effect of the TVA on Infant Mortality Rates

	Infant Mortality	Infant Mortality	Infant Mortality
TVA Time In County	-0.353 †	-0.335 †	-0.323 †
	(0.181)	(0.183)	(0.183)
Time	-1.664***	-1.674***	-1.635***
	(0.0828)	(0.0839)	(0.0860)
Per Black		1.390	1.534
		(4.073)	(4.072)
Dam in County			-4.011*
			(1.954)
Constant	70.36***	70.19***	70.08***
	(0.711)	(0.942)	(0.943)
County Fixed Effects	Yes	Yes	Yes
N	3236	3215	3215
adj. R^2	0.140	0.139	0.140

Standard errors in parentheses
† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6.2 provides an indication that in fact the introduction of electrification is associated with a decreased risk of infant mortality. While the statistical power is weaker than other studies, these results are meaningful when taken in the context of the strong theoretical connections as well as the previous research on the subject [Lewis, 2018]. Furthermore, while the reduction seems small, if a reduction equal to the magnitude of a single year of the TVA in a county were to have happened across the entire United States, more than 900 infants would have been saved in 1945 alone - and the impact would have increased in each subsequent year. Given the previous work on the importance of infant and child deaths in the overall decline in mortality, an examination of child mortality (deaths under the age of 5)

should be able to provide greater insight; however, due to significant issues with the way the data was collected and presented, the results for child mortality rates are not meaningfully interpretable within the larger context of the chapter. The results for child mortality rate can be found it Appendix 9.4.

6.2.3 Respiratory Disease

While the previous sections examine broad population indicators of health, this section will focus on the first and most important disease specific indicator. The following table (6.3) finds significant declines in respiratory disease associated with the introduction of Tennessee Valley Authority electricity. The results are not just statistically significant but substantively large. Respiratory disease dropped by an average of 3 per 100,000 for every year the TVA was in a county and while this may not sound like a large change if the entire United States experienced a decline in respiratory disease of the same level as would have been experienced by a county with the average TVA tenure (9.3years), there would have been nearly 42,000 fewer deaths from respiratory disease in 1950 alone. The magnitude of this finding additionally meaningful as it indicates that this was likely the primary driver of the reduction in mortality seen above.

Previous studies have connected decreases in air pollution to decreases in both infant and all ages mortality [Clay et al., 2020] even over the short term [Chay & Greenstone 2003, Currie & Neidell 2005]. By converting heating, cooking, and lighting from burning coal, wood, and heating oil to electricity the indoor air quality would have been greatly increased as all three of these heating/cooking/lighting methods produce a lot of soot and particulate matter. While not all of these methods produce the same amount of particulate matter, they all are relatively dirty fuel sources [Barreca et al., 2014].

While air pollution and soot are most often thought of as being long-term problems potentially leading to cancer and other respiratory problems, indoor air pollution and damages the lungs more broadly making it more difficult to fight off general infections of the respi-

ratory system. Previous studies have linked pollution to increases in pneumonia [Barreca et al., 2014] and influenza [Clay, Lewis, & Severini 2018], as well as general respiratory viral infections [Ciencewicki & Jaspers 2007], general respiratory bacterial infections [Jakab 1993], and the likelihood of more serious complications post-infection [Jaspers et al 2005]. It is important to understand just how bad indoor air quality would have been at this time period and to understand how significantly this would have impacted the air not just of the home, but of the surrounding environment in more densely packed urban areas. The importance of urban air pollution will be discussed later in a slightly unexpected finding.

Table 6.3: Effect of the TVA on Respiratory Disease Mortality Rates

	Respiratory	Respiratory	Respiratory	Respiratory
TVA Time In County	-3.015***	-2.950***	-2.956***	-3.003***
	(0.544)	(0.549)	(0.552)	(0.550)
Time	-5.587***	-5.596***	-5.600***	-5.566***
	(0.271)	(0.273)	(0.276)	(0.274)
Percent Black		5.424	5.397	5.630
		(9.796)	(9.803)	(9.795)
Dam in County			0.594	
			(5.977)	
Dam Under Construction				-10.10
				(7.268)
Constant	218.4***	217.8***	217.9***	217.9***
	(2.266)	(2.605)	(2.607)	(2.605)
County Fixed Effects	Yes	Yes	Yes	Yes
N	1838	1798	1798	1798
adj. R^2	0.376	0.379	0.378	0.379

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results from the above models (Table 6.3) indicate that the TVA significantly reduced the rate of deaths from respiratory diseases in the service area. This is likely due to the reduction in pollution and particulate matter in the air that damages the lungs weakening

them to infections. In all of the above presented models the impact of electrification is not simply statistically significant, but also quite substantively significant. In the final model presented above there is an additional control not seen in previous models (Dam Under Construction) that is added into this model and warrants further explanation. As in previous sections, the models are run both with and without controls for a dam in the county and the results are nearly identical.

The inclusion of Dam Under Construction is important because of the labor demands required to build a large dam in a short period of time. During the height of construction, several thousand men were working on the dam site at a given time many from the surrounding counties [Van Fleet, 1987]. These workers would have been exposed to dust, smoke, solder, asbestos, and untold number of other hazardous chemicals. The significant exposure to these hazardous chemicals and particulate matter has the theoretical potential to confound the results by adding an additional source of hazard associated with the TVA. Importantly, there is no significant relationship between the construction of the dam and deaths from respiratory disease. This is surprising given the previous work on pollution and respiratory disease, but it does strengthen the findings by finding results highly consistent with the other iterations of the model.

Many of the previous studies have focused primarily on pollution and particulate matter in urban settings [Barreca et al., 2014]. Within the data here area a set of cities in Tennessee that report independently of the surrounding more rural county. This allows for the isolation of most of the populous urban areas from the rest of the more rural sample in order to understand if the reductions in disease are being more heavily driven by urban or rural changes. Unlike the previous indicators above, there are significantly different results when the urban and rural areas are examined differently. In the models seen below (Table 6.4), there are significant results for the rural areas that are in line with, but slightly stronger that those found for the area as a whole and no significant results for the separately reporting urban areas. This is likely due to the fact that urban areas were more likely to already be

electrified [Kitchens, 2014, Cater, 2019], so the presence of the TVA may not have greatly changed the situation on the ground. This reinforces the idea that this is primarily a rural story.

Table 6.4: Effect of the TVA on Rural and Urban Respiratory Disease Mortality Rates

	Urban Respiratory	Rural Respiratory
TVA Time in County	.345	-3.170***
	(2.075)	(.571)
Time	-9.022***	-5.322***
	(.989)	(.287)
Percent Black	11.008	4.682
	(37.950)	(10.115)
Dam in County		-1.0279
		(6.005)
Constant	256.861	214.222
	(12.331)	(2.661)
County Fixed Effects	Yes	Yes
N	120	1678
adj. R^2	0.495	0.284

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The previous parts of this section present the results which have a significant level of explanatory power in the larger story. While it is important to focus on those indicators with significant results, there is still much to be learned from those indicators that provide null results; the results for these indicators will be presented in the rest of this section.

6.2.4 Maternal Mortality Rate

Based upon both the theory at play in this studies as well as previous studies, the expectation here was that increasing access to electrification should lead to decreases in maternal mortality [Lewis, 2018]; these expectations are not supported by the data, however. This

models presented below (see: Table 6.5) find no evidence of any benefit to maternal health from the increase in electrification under the Tennessee Valley Authority.

The basic logic of why mortality should decrease is similar to the logic of the previous measures. In short, electricity should allow for increased sanitation and sterilization during the process of childbirth and postpartum. Childbirth and postpartum are a dangerous time with a relatively high chance of infection even in modern times with access to high quality sterilization.

Table 6.5: Effect of the TVA on Maternal Mortality Rates

	Maternal Mortality	Maternal Mortality	Maternal Mortality
TVA Time In County	-0.104	-0.105	-0.107
	(0.0953)	(0.0955)	(0.0955)
Time	-0.447***	-0.447***	-0.453***
	(0.0449)	(0.0449)	(0.0460)
Percent Black		-0.180	-0.200
		(2.054)	(2.054)
Dam in County			0.598
			(1.033)
Constant	12.48***	12.50***	12.52***
	(0.390)	(0.489)	(0.490)
County Fixed Effects	Yes	Yes	Yes
N	2824	2824	2824
adj. R^2	-0.007	-0.007	-0.008

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In attempting to uncover specific causes of mortality that were drivers of the decline in crude mortality found in the first model, maternal mortality was unlikely to be the primary driver as in absolute terms maternal mortality is much less common than other forms of mortality. That being said, as a proxy for the status of women and women's health the expectation was still that there would be declines. The crude numbers for the sample as a

whole indicate that maternal mortality was becoming less common throughout this time; it seems that an increase in electrification bares little responsibility for this decline.

6.2.5 Typhoid & Pellagra

As mentioned previously, typhoid and pellagra are being used in this study to proxy for quality of water and quality of food respectively. The results found in Table 6.6 run counter to the expectations laid out in Hypothesis 6.2 that electrification would decrease mortality from these diseases. This null finding is especially surprising for typhoid considering the amount to time, effort, and advertising space that the TVA devoted to promoting improvements in water and sanitation technologies.

Table 6.6: Effect of the TVA on Disease Specific Mortality Rates

	Typhoid	Pellagra	Pellagra
TVA Time In County	0.152	-0.0329	-0.0352
	(0.399)	(0.0845)	(0.0853)
Time	-1.124***	-0.625***	-0.634***
	(0.177)	(0.0390)	(0.0590)
Corn Fortification			0.120
			(0.584)
Constant	16.68***	12.28***	12.32***
	(1.497)	(0.326)	(0.373)
County Fixed Effects	Yes	Yes	Yes
N	2964	2493	2493
adj. R^2	-0.052	0.100	0.100

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Disease specific indicators are most important when they are in fact used as indicators, rather than when they are examined for their own sake. Should one of the major drivers of decline in crude mortality be improvements in water and sanitation, that should show up in declines in typhoid rates; the same is true for pellagra and nutritional improvements.

That being said, it is possible that these indicators are being asked to do too much; this is especially true for a disease like pellagra which has such a complex history - especially during this time period [Bollet, 1992, Clay et al., 2019].

In addition to being a disease of poor sanitation, typhoid is often considered a disease of crowding [Miller, 2008, Troesken, 2004]. In the rural areas most closely examined in this study crowding is not likely to be a major issue; however, the possibility remains that the TVA in situations where there was crowding, there may have been changes to typhoid rates that can be associated with the TVA. The first of these potential crowding situations would be urban areas. The state of Tennessee has separate reporting for urban areas with a population over 10,000 for the duration of the time examined in this study and so these areas can be separately examined to see the potential effects of the TVA presence on urban areas.

Table 6.7 examines the effect of the TVA on typhoid rates only in urban areas where crowding may be a problem. As with the broader findings, this presented above, there are no significant findings for the effect of the TVA on typhoid using either traditional year fixed effects or the measure of time used in the previous models. The two most likely reasons for this null finding are that either the sample size is too small to make any inferences, or that since urban areas were the most highly electrified areas of the South [Cater, 2019], the TVA may not have done much to increase electrification in urban areas.

The other possible instance of crowding associated with the TVA is during the construction of the dams. Because the dams were build very quickly they required large groups of workers to be present and housed in communal barracks in areas with otherwise poor infrastructure far from large developed population centers. Table 6.7 indicates that during times of construction, there were significant increases in deaths from typhoid. This is most likely due to the crowded conditions and communal living situations in the worker camps. Importantly, these models control for the percent of the population that is Black in order to control for the fact that dams were more likely to dispossess Black populations [McDonald

Table 6.7: Typhoid Rates in Urban Areas and Areas of Dam Construction

	Cities Only		Dam Under Construction	
	Typhoid	Typhoid	Typhoid	Typhoid
TVA Time In County	-0.399	-0.132	0.0560	0.372
	(0.217)	(0.198)	(0.429)	(0.401)
Percent Black	1.338	2.234	-2.301	-3.245
	(5.208)	(4.940)	(8.531)	(8.496)
Time		-0.504***		-1.245***
		(0.0968)		(0.178)
Dam Under Construction			26.74***	25.98***
			(4.734)	(4.703)
Constant	8.385***	7.928***	15.91***	17.10***
	(1.812)	(1.376)	(3.038)	(1.849)
Year Fixed Effects	Yes	No	Yes	No
County Fixed Effects	Yes	Yes	Yes	Yes
Number of Cities	9	9	NA	NA
N	135	135	2963	2963
adj. R^2	0.316	0.308	-0.039	-0.042

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

and Muldowny, 1982], who may already be at a higher risk for dying from typhoid, as well as controlling for the time the TVA has been in the county. These findings are robust when using traditional year fixed effects as well as when accounting for time in the same way as the other models presented in this chapter.

The most interesting finding in this section is spike in typhoid; an unintended consequences associated with dam construction. This finding complements Kitchens, 2006 study which found a spike in malaria associated with the dams. The spike in typhoid would of course have been much shorter lived than the benefits associated with electrification, but it is important to look at all the potential effects of the TVA programs.

6.2.6 Health Results in Context

The previous models indicate that the presence of the TVA in a county is correlated with a decrease in all-cause mortality in that county and that the longer the TVA is in the county, the greater the decline in all-cause; there is an indication that the same is true for infant mortality as well. These results are consistent with the hypothesis that increasing access to electricity would have significant effects on the health of those living in the newly electrified areas. The models presented below the main all-cause mortality model further the story by allowing us to narrow down what pathways were more and less likely to have led from electrification to increased health. This is important because electricity in and of itself is not especially welfare improving, but rather the improvements come through the technologies that are enabled through electrification.

These potential pathways - improved water and sanitation, improved maternal and infant health, and improved air quality - are explored through disease specific causes of death with changes in mortality from these diseases making certain pathways more and less likely to have been the drivers of the reduced all-cause mortality seen in this sample. The results for reductions in deaths due to respiratory disease are both statistically and substantively quite significant. The declines in deaths from respiratory disease can not be understated. This indicates that the significant improvements in indoor air quality caused by switching from combustion to electricity for heating, cooking, and light may have been one of, if not the primary, pathway for electricity to lead to increases in health and well-being. This is consistent with previous work on indoor health quality and respiratory diseases [Barreca et al., 2014]. There are additional tests for changes to fertility rates and child mortality that can be found in Appendix 9.4.

It is also extremely important to note that these results differ from results found in similar studies, most notably Lewis, 2018. Unlike this dissertation, Lewis, 2018 finds that increasing electrification under another New Deal program - the Rural Electrification Authority - infant mortality and maternal mortality. The natural inclination is to assume that when two studies

like this conflict one study is correct and one study is incorrect; however, it is crucial to understand that time, place, and context matter. Lewis, 2018 and this study both focus on new deal programs taking place during the same time, but the geography, preexisting health conditions, method of electrification, and size and density of the geographies covered differ widely. This is to say that the health studies such as the one presented above are best when the health indicators are viewed together as well as when the results are understood in a broader context that includes the fact that time, place, and method of action all matter.

Chapter 7

Health and Voting: The Case of the TVA

The big question tackled in this dissertation is: did the Democratic Party gain votes in proportion to the improvements in health? This question builds on the previous two questions examined in the previous two chapters (5 & 6) : did the Tennessee Valley Authority provide and electoral benefit for the Democratic Party and Franklin Roosevelt? And did the TVA increasing access to electricity provide a health benefit to those living in the areas serviced by the TVA? There are good indicators that the answers to both of these questions is: yes. The introduction of the TVA and the increased access to electricity they brought can be linked to both electoral rewards for the Democratic Party as well as improvements in the health and welfare of those living in the areas that now have access to TVA electricity.

The majority of previous studies of the electoral benefits of distributional programs have focused programs which provide a very clear and direct benefit to the voter such as a job [Zimmermann 2018], a direct cash payments [Diaz-Cayeros et al., 2016], or disbursements of food and goods [Diaz-Cayeros et al., 2016, Blaydes, 2010]. Electricity is among a small number of resources that provide both a direct benefit - being able to turn the lights on a listen to the radio - as well as second order effects in the form of technologies that are

enabled by electrification and can have massive welfare improving benefits [Min, 2015]. This means that electricity is both a tangible and intangible good. The question then becomes, is the provisioning of second order and intangible goods rewarded in the same way by voters as more direct distributions. To place this in the framework provided by Kale, 2014 - are voters more interested in the symbolic aspects of electricity or the useful aspects of electricity.

Hypothesis 3 speculates that voters will reward politicians based on the level of improvement they receive from the service. This chapter operationalizes this question as after the introduction of the Tennessee Valley did counties that had larger drops in mortality Authority vote more heavily for the Democratic Party compared to counties that had smaller drops in mortality (see: Hypothesis 3a)?

Hypothesis 3a *Counties with the greatest drops in crude mortality will have the greatest increase in support for the Democratic Party.*

This study examines whether or not voters reward politicians based on the level of improvement in their lives as measured through declines in crude mortality rates. The following models test this by seeing if counties that had larger drops in crude mortality also had larger increases in electoral benefits for the Democratic Party. If those areas with the largest decreases in mortality rates have the largest increases in votes for Franklin Roosevelt and the Democratic Party, this indicates that voters are responding to the useful aspects of electrification. If those areas with the largest decreases in mortality rates do not have larger increases is support for the Democratic Party, this would indicate that voters are most likely responding to the symbolic nature of electrification.

The first model presented here in Table 7.1 is also the most parsimonious and is a simple bi-variate time-series cross-sectional regression with year- and county-level fixed effects examining the effects of mortality on the vote share for the Democratic Party. The following model (Table 7.1) fails to find any effect of a change in mortality on Democratic vote share and this finding is held constant when the data is cut in different ways.

Table 7.1: Effect of Mortality on Democratic Voting

Variable	**Coefficient**	**(Std. Err.)**
Mortality Rate	-0.005	(0.006)
Constant	71.230	(0.309)
County Fixed Effects	Yes	
Year Fixed Effects	Yes	

Standard errors in parentheses

Chapter 5 tested for the potential of partisan filtering based simply receiving electricity, but the potential for partisan filtering based on the actual benefit of the program remains. The following table (7.2) examines the effects of changes in mortality on Democratic vote share by their Democratic vote share quartile in 1932. Those counties in the lowest quartile in terms of their Democratic vote share in 1932 are Quartile 1 and those counties with the highest Democratic vote share in 1932 are Quartile 4 (with 2 and 3 being in between). When the model is run by quartile, the results remain insignificant and, while there is variation, are not significantly different from one another. As with the previous model, the series of models presented in Table 7.2 fail to find a significant relationship between mortality and Democratic vote share.

Table 7.2: Effect of Mortality Rate on Voting By Democratic Vote Quartile

	Highest Quartile	2nd Quartile	3rd Quartile	Lowest Quartile
Mortality Rate	-0.0864	-0.385	-0.00544	-0.00188
	(0.295)	(0.276)	(0.005)	(0.041)
Constant	44.03***	72.19***	85.99***	97.23***
	(2.523)	(2.701)	(0.449)	(0.855)
County Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Counties	56	56	56	55
Observations	215	209	208	137
Adjusted R^2	0.170	-0.033	0.117	0.035

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

While the previous model disaggregates the data by quartile using voting data from before

the treatment was applied, the following model disaggregates data in quartiles based upon the levels of mortality in the counties before the application of the treatment of the TVA. Similar to the previous model, Quartile 1 represents those areas with low initial mortality and Quartile 4 represents those areas with high initial mortality. Again, similar to the previous models, this iteration fails to yield significant results.

Table 7.3: Effect of Mortality Rate on Voting By Mortality Quartile

	Highest Quartile	2nd Quartile	3rd Quartile	Lowest Quartile
Mortality Rate	-0.200	-0.133	-0.475	-0.005
	(0.403)	(0.291)	(0.272)	(0.005)
Constant	60.56***	68.32***	75.46***	75.54***
	(2.808)	(2.491)	(2.682)	(0.525)
County Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	174	168	176	173
Adjusted R^2	-0.023	-0.019	0.286	0.146

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Lastly, a potential fruitful avenue could be to more simply address the affects of mortality on voting patterns, by taking the previous model of Democratic turnout and the TVA and disaggregating the data by mortality quartiles as with the previous models in this section. The models shown below (see: Table 7.5)uses "TVA Time in County" as the independent variable of interest in order to maintain consistency with the models used in the mortality study and one of the methods used in the voting models in Chapter 2. Importantly, as with the voting models in Chapter 5, the models below are run with the number of active TVA contracts in the county and the presence of the TVA in the county as a binary instead of the duration of the TVA in the county as well. These other model iterations are substantively identical and can be found in Appendix III.

The model below indicates that there are not significant differences between the models when run separately. The models in the appendix differ slightly in that each individual model shows a significant finding, but the results of each model do not differ from one another. The

fact that the results do not differ between the models run for each specific quartile indicates that there are not significant difference in how how the TVA affected voting based upon the pre-existing health of the county.

Table 7.4: Effect of the TVA on Voting by High and Low Mortality

		Mortality Quartile		
	Full Sample	Low	Middle	High
TVA the in County	2.962***	3.119	1.468	3.459**
	(0.795)	(1.769)	(0.967)	(1.231)
Dam in the County	3.021*	11.40***	1.130	0.493
	(1.274)	(2.349)	(1.662)	(1.962)
Dam Under Construction	0.659	-2.341	0.841	-0.319
	(1.478)	(2.446)	(2.014)	(2.622)
Neighboring a TVA County	0.890	0.319	0.762	1.319
	(0.639)	(1.360)	(0.804)	(0.951)
Constant	73.44***	59.81***	76.57***	75.48***
	(0.316)	(0.693)	(0.390)	(0.490)
County Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
N	892	180	352	180
adj. R^2	0.010	0.235	0.129	0.158

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

There are many different ways to cut data to find a positive result for the efficacy of program mattering to voters. The results reported above consistently fail to find any positive results no matter how the data is cut and analyzed. The only positive finding is that counties with high initial mortality seem to be driving the results in 7.4, it is possible that this is confounded by the fact that those counties with high initial mortality also had high initial Democratic voting; it is therefore very possible that there are additional confounding factors not adequately controlled for. This more general lack of results may indicate that there is not a positive result to be found; it is important to allow null results to stand in cases where they are both consistent and where there are theoretical reasons that support the null

Table 7.5: Effect of the TVA on Voting by High and Low Mortality

		Mortality Quartile		
	Full Sample	Low	Middle	High
TVA Time In County	0.449***	0.482	0.172	0.284
	(0.126)	(0.308)	(0.152)	(0.215)
Dam in the County	3.097*	11.53***	1.274	0.0269
	(1.274)	(2.357)	(1.659)	(2.004)
Dam Under Construction	0.789	-2.236	0.835	-0.353
	(1.484)	(2.489)	(2.023)	(2.685)
Neighboring a TVA County	0.522	-0.166	0.411	0.275
	(0.591)	(1.266)	(0.726)	(0.898)
Constant	73.44***	59.81***	76.57***	75.48***
	(0.316)	(0.694)	(0.391)	(0.502)
County Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
N	892	180	352	180
adj. R^2	0.008	0.231	0.126	0.118

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

findings.

The lack of support for the hypothesis is not a lack of findings. The failure to find evidence that voters based their level of reward on the well-being improving aspects of electrification indicates that they based their findings on the symbolic aspects of the service. The idea that individuals reward politicians for the elements of the program that they are most easily able to notice and identify is both logical and fits with other work that finds that, in general, people are not very good at establishing and understanding counterfactuals. In the context of this study, this means that it is logical that the voters in the Tennessee Valley would reward politicians for bringing them electricity based on the tangible evidence of electrification - i.e. electric lights, water pumps, and stoves - rather than the more difficult to quantify second and third order benefits. Furthermore, this finding is supportive of other work which finds a disconnect between programs that gain the most support and those that provide the greatest benefit. Diaz-Cayeros et al., 2016, finds that those programs which provide the greatest political reward are those programs with the most narrow focus, while those that provide the greatest benefit to those in the targeted areas are those programs which are maximally inclusive - either public goods, bureaucratic programs with strict criteria, or other broadly accessed goods such as electricity. In other words, if the overall benefit of the program was what mattered most, the broader the program, the broader the benefit; however, this does not seem to be the case. These findings, coupled with the previous studies, indicates that the most important aspect of a distributional good may be the symbol that it represents and the signal that it carries.

Electricity is among a small group of goods that is both useful and symbolic [Kale, 2014] and this dual nature allows for the testing of questions that can not be tested through the distribution of goods that serve only one purpose - either having a great symbolic value or a great practical use. The lack of a relationship between improvements in health and increases in voting helps to answer this question because the importance of electricity as a symbolic good and a practical good, while not fully dichotomous, are largely opposites meaning that

if it is not one, it is likely the other which is the driving force behind increased support. The above tables find little to no indications that the efficacy of the program is at the forefront (that voters care most about useful value) which indicates that, by default, the primary value voters are responding to is electricity as a symbolic good. This finding is not simply important for understanding electricity, but also allows for a greater understanding of the magnitude of effect that might be found from other programs and what programs might be most useful in increasing electoral support for those in power.

Chapter 8

Conclusion

This dissertation set out to explore the ways in which voters reward politicians for the provisioning of a new good or service. In particular the goal was to assess if the rewards that politicians do get were most closely tied to the symbolic nature of the good or the practical value that the good provided. The dual nature of electricity - being both a symbolic and practical good [Kale, 2014] - allows this question to be most directly tested. Do voters most closely respond to the size of the benefit they get from increased access to electricity or do they just respond to getting a shiny new service. This dissertation tackles this question first by using a cross-national sample to establish as broadly as possible that electrification increases support for the regime supplying the electricity before engaging in more detailed tests at the sub-national level.

This dissertation operationalized only one question at the cross-national level: does increasing access to electricity improve the support for the ruling regime? The positive finds that increasing electrification at the national level - even when controlling for common indicators of good governance - both serves to motivate the sub-national questions as well as provide for a greater degree of external validity. In short the cross-national study indicates that the positive results found at the sub-national level are not necessarily reserved to the time and place of the case study.

The marquee case study presented in this dissertations is the case of the Tennessee Valley Authority and their rapid expansion of access to electricity across an area of the country most known for poverty and "backwardness". The Tennessee Valley and the surrounding areas lagged behind the rest of the county economically, socially, and in terms of both health and access to electrification. The TVA provided a strong intervention that has historically been given a great deal of significance, but many of the historical significance has never been tested. This dissertation allowed for both historical assumptions to be tested and larger questions about the efficacy of distributional politics to be at the same time.

The primary case study fo the TVA operationalized the questions presented above as three questions. 1) Did voters reward the Democratic Party for bringing increased access to electricity through the TVA? 2) Did TVA electrification improve people's lives and health? And 3) Was the increase in electoral support for the Democratic Party higher in places where health improved the most?

The results for question 1 indicated that voters did in fact give greater support to the Democratic Party as a result of the Tennessee Valley Authority being in the county. This finding echos what was found at the cross-national level and finds that the results hold for both a more finely grained sub-national study and for the headline case study that this dissertation relies on. The increase is support for the Democratic Party was substantively large - 3 percentage points. A change of this size has the potential to change the results of an election at both the state are federal level - it would have changed the results of both the 2016 and 2020 elections if the incumbent party had received a boost of that size across the board. What these results do not do is speak to what about electricity resonates with voters and leads them to greater support for the Democratic Party. In order to do that, it was necessary to assess how much benefit those getting TVA power got from receiving that electricity. This was done my using health data as a measure of benefit.

The results for question 2 were operationalized through the use of commonly recorded health data collected by the states at the county level. These data are useful because they

are commonly collected, standardized, , reliable, and commonly used in other studies of development and politics (see: Diaz-Cayeros et al., 2016, Prichett and Summers, 1996, Preston and Haines, 2014, Barreca et al., 2014, Bleakley, 2010, Bollyky et al., 2019, Costa and Steckel, 2008, Deaton, 2003, Deaton, 2015, Fogel, 2010, Lewis, 2018) which makes the results easy to compare to other studies. The results of the chapter that looks at question 2 are overwhelmingly positive and indicate that increasing access to electrification has a significant effect on reducing mortality with deaths from respiratory disease likely being one of the drivers of these reductions. The improvement to overall mortality indicates that the expansion of electricity may have been one of the significant factors responsible for the massive decline in death found during the middle of the 20th century in the United States. The strong findings for electrification reducing respiratory disease further strengthens the case for a causal relationship between electrification and health by providing a plausible causal pathway: electrification improves indoor air quality, improved indoor air quality decreases mortality. As with the findings for voting in Chapter 4, these findings are important not simply for their role in the larger questions of the study, but are significant on their own.

The results for the third question indicate that the benefit voters receive is not related to the electoral benefit they provide for politicians, but rather based on the existence of the new service. There was consistently no correlation between between declines in overall mortality and increases in support for the Democratic Party and Franklin Roosevelt. That being said, the findings in Chapter 5 indicate that increasing electricity did improve Democratic voting. While it is far from conclusive, these results suggest that voters were most responsive to the symbolic effects of electricity (lights, radios, general sense of modernity) than the welfare benefits. This is of course difficult to disentangle and it is not possible with this sample to test the responsiveness to the symbolic nature of the good; however, voters are responding and if they are not responding to (at least this aspect of) the welfare benefits, they must be responding to another aspect. This result is fitting with the work of Diaz-Cayeros et al., 2016 who find that those programs which provide the greatest welfare benefits to not provide

the greatest electoral benefits and vice-versa, thereby indicating that there is a disconnect between voter benefits and electoral rewards.

This dissertation makes a contribution to a series of debates on the political effects of the Tennessee Valley Authority, the health effects of government sponsored electrification, and how voters understand distributional policies and how they reward politicians for those policies. The above work does not represent everything for which this new and novel dataset can be used, but there is also a great deal of room for further research both on this subject and with these data. These data can be used to help uncover the race based patterns of health and mortality caused by governmental action and can help to answer questions not just about how health improved over the first half of the 20th century [Preston and Haines, 2014], but why. These data and studies of these nature do more than to speak to teh past, but provide lessons and guidelines for future action. To understand how voters see government action and what actions can save the most lives allows policymakers to make real world changes in ways that are politically viable. The unique dataset presented here can be used not just to examine these questions, but to examine questions that have yet to be considered.

Chapter 9

Appendix

9.1 Appendix I

ANOVA, Balance Tables and Robustness Checks for Section 3

Country Name	Summary of Executive Approval: Smoothed Mean	Std. Dev.	Freq.
Argentina	45.179703	9.620627	23
Australia	50.526636	7.8518936	23
Austria	34.367251	6.1412573	23
Bolivia	47.163129	13.677935	19
Brazil	44.613494	15.503803	23
Canada	46.53023	5.5419619	23
Chile	45.328625	8.1882943	23
Colombia	49.478667	13.023314	23
Costa Rica	35.342602	9.9141119	23
Croatia	46.589888	7.319169	10
Denmark	37.729213	7.6285286	13
Dominican Republic	57.292951	13.380879	17
Ecuador	55.61242	14.757746	23
Germany	55.710419	8.0890207	21
Greece	38.919918	6.5143623	20
Guatemala	44.986222	13.216971	23
Honduras	42.214761	12.883923	23
Hungary	38.212842	5.277208	19
Iceland	48.956687	7.892308	23
Italy	38.928343	8.7157818	22
Japan	44.90107	5.7951218	23
Kosovo	38.12249	11.453044	10
Mexico	50.155009	6.7003244	23
Montenegro	41.480324	12.293631	10
New Zealand	52.960824	11.327277	23
Nicaragua	42.404355	14.92953	23
Panama	45.908826	12.231185	23
Paraguay	39.626382	15.879513	19
Peru	28.751853	11.821079	23
Spain	32.876692	5.8628963	23
United Kingdom	34.866156	7.8496645	23
United States	46.536722	7.3121945	23
Uruguay	50.139057	13.915787	23
Total	44.13534	12.43598	686

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	32655.4245	32	1020.48202	9.09	0.0000
Within groups	73282.2838	653	112.224018		
Total	105937.708	685	154.653589		

Bartlett's test for equal variances: chi2(32) = 138.5399 Prob>chi2 = 0.000

Figure 9.1: ANOVA Executive Approval

Country Name	Summary of Access to electricity (% of population) Mean	Std. Dev.	Freq.
Argentina	96.794	2.4301858	23
Australia	100	0	23
Austria	100	0	23
Bolivia	79.837915	9.472904	19
Brazil	96.788744	2.7024841	23
Canada	100	0	23
Chile	98.203178	1.5248299	23
Colombia	95.367431	2.0904344	23
Costa Rica	98.938823	.50377896	23
Croatia	100	0	10
Denmark	100	0	13
Dominican Republic	94.687923	4.3392338	17
Ecuador	95.283043	2.7380023	23
Germany	100	0	22
Greece	100	0	23
Guatemala	78.407058	8.3178771	23
Honduras	73.562172	9.2470954	23
Hungary	100	0	19
Iceland	100	0	23
Italy	100	0	23
Japan	100	0	23
Kosovo	99.172832	1.078998	9
Mexico	98.043282	1.3904579	23
Montenegro	99.74304	.19935536	13
New Zealand	100	0	23
Nicaragua	75.304824	4.0343621	23
Panama	84.656106	5.176003	23
Paraguay	94.111112	4.5415834	21
Peru	79.888194	9.6213589	23
Spain	100	0	23
United Kingdom	100	0	23
United States	100	0	23
Uruguay	98.511984	.81098268	23
Total	94.814945	9.0553876	695

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	47516.4671	32	1484.8896	104.67	0.0000
Within groups	9391.5634	662	14.1866517		
Total	56908.0305	694	82.0000439		

Bartlett's test for equal variances: chi2(17) = 437.2406 Prob>chi2 = 0.000

Figure 9.2: ANOVA Percent Electric

Summary for variables: Executive Approval (not smoothed) By Year					
Year	**N**	**Mean**	**SD**	**Min**	**Max**
1994	23	41.97781	12.30619	21.31329	61.89067
1995	24	39.22537	10.52629	19.9611	53.68538
1996	25	40.44553	10.10448	20.00757	58.18201
1997	26	40.5626	9.5795	22.14381	58.83935
1998	29	42.71247	8.331473	26.49739	62.54781
1999	29	43.28693	8.678557	24.92418	59.44593
2000	30	43.80126	11.48398	26.04262	61.87073
2001	30	43.42262	11.88109	17.53718	66.72381
2002	30	43.11774	13.77726	13.19663	68.82725
2003	30	40.55983	13.98136	14.86367	62.79428
2004	31	42.83339	11.5401	12.4354	64.98039
2005	31	44.59476	12.75576	8.155357	71.45386
2006	31	46.54271	10.71906	27.00037	64.27398
2007	32	46.85598	13.13695	21.8678	82.46522
2008	32	46.87577	14.06349	21.05379	72.51823
2009	32	50.44015	14.46319	23.82351	83.168
2010	32	48.86072	12.779	23.03661	74.56777
2011	32	45.13977	11.86051	24.57926	71.37425
2012	32	44.41023	12.40969	29.05457	73.07234
2013	32	45.86176	14.9678	20.66408	82.9491
2014	31	46.35757	15.62446	20.58821	81.93253
2015	31	43.18548	14.70933	14.04182	77.01546
2016	31	42.11757	14.12768	18.77078	71.24892
All Years	686	44.2252	12.67263	8.155357	83.168

Summary for Percent Electrified
By Year

Year	N	Mean	SD	Min	Max
1994	26	92.06446	12.38285	64.73395	100
1995	25	91.74288	12.65528	60.8	100
1996	27	92.17624	12.04159	61.68112	100
1997	27	92.59965	11.39844	64.79475	100
1998	29	92.42586	11.44957	66.85952	100
1999	29	92.77581	10.99002	67.3941	100
2000	30	92.8743	10.76698	67.61672	100
2001	30	92.95915	10.70979	68.81343	100
2002	30	93.02492	11.12844	63.14114	100
2003	30	93.67226	10.12536	65.09046	100
2004	31	94.00731	9.629039	67.11353	100
2005	31	94.08124	9.980471	68.28821	100
2006	31	94.88291	8.570786	71.26645	100
2007	32	95.36143	7.910521	73.54819	100
2008	32	95.90546	7.149455	76.3969	100
2009	32	96.21576	6.623581	77.91631	100
2010	31	96.33501	6.5046	78.05746	100
2011	32	96.77508	5.919985	78.66057	100
2012	32	97.11222	5.412335	79.2757	100
2013	32	97.39328	5.079001	79.89984	100
2014	32	97.58345	4.787625	81.85307	100
2015	32	97.87578	4.306042	81.16314	100
2016	32	98.11883	4.257346	81.7968	100
All Years	695	94.81494	9.055388	60.8	100

9.2 Appendix II

Table 9.1: Estimation results : Probability of Having the TVA

Variable	**Coefficient**	**(Std. Err.)**
Democratic Vote	0.002	(0.002)
Intercept	-0.179	(0.144)

9.3 Appendix III

	Extensive Margin	Intensive Margin	
TVA in County	3.137***		
	(0.794)		
TVA Time In County		0.462***	
		(0.126)	
Number of TVA Contracts			1.833***
			(0.479)
Neighboring a TVA County	1.003	0.587	0.688
	(0.642)	(0.594)	(0.601)
Constant	73.46***	73.46***	73.46***
	(0.317)	(0.318)	(0.317)
County Fixed Effects	Yes	Yes	Yes
Election Year Fixed Effects	Yes	Yes	Yes
N	892	892	892
adj. R^2	-0.001	-0.005	-0.003

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

9.4 Appendix IV - Additional Health Indicators

9.4.1 Child Mortality Rate

Child mortality rate (CMR) is less commonly assessed than IMR, but it is still among the more commonly examined indicators. CMR is useful for many of the same reasons that IMR is useful, it allows for the examination of a particularly at risk population, but unlike IMR it has a broader time horizon and is less sensitive to short term changes. CMR is defined in this data as deaths under 5 per thousand total population. CMR is commonly collected in most areas, however, the data is less complete than IMR and CMR collection does not begin until 1935 - five years after IMR is available. Similar to IMR, CMR can give an indication as to who and what sub-populations may be making the gains or losses that are driving the changes to overall crude mortality. While modern studies most commonly use deaths under five per thousand persons under five, at the time these data were collected, there were data limitations that did not allow for this. This failure to age-adjust has the potential to complicate inferences in certain situations and these issues will be discussed at length in the next section. Despite the potential for complication, it is still important to examine this indicator.

Child Mortality Results

The results on child mortality initially appear to be both statistically and substantively/theoretically significant. More parsimonious regressions (like those seen in the first two models of Table 9.2) seem to indicate a positive relationship between the amount of time the TVA has been in a county and the child mortality rate. This finding is both unexpected and difficult to substantively explain within the historical and disease context of this study. However, it appears that this may be related to a flaw in the method of calculating Child Mortality Rate in the original data set.

The original data set calculates Child Mortality rate as deaths under five per 1,000

persons in the total population, rather than deaths under five per 1,000 persons under the age of five (the population of real interest). This means that if those under five become a larger proportion of the population (as in during a baby boom) they can appear to have an increase in rates while in reality the same or even a smaller proportion on the those under five are dying. For example if those under five are 200 out of every thousand persons and 10% of them die, the rate as calculated in the sample would be 20 per 1,000. If the proportion of those under five increases to 250 per 1,000 and it remains that 10% die the rate as calculated in the data would be 25 per 1,000. Modern data uses the correct denominator, but in this historic sample this may not have been possible due to limitations in both the data and the ability to analyze the data.

This flaw in the data is primarily important if the proportion of those under five within the population increases - the deaths under five would increase in the general population, but still be the same for the population under five. The most likely cause for an increase like this would be a baby boom such as the one seen everywhere during the time period in question and seen more strongly in this sample. Issues of flawed analysis due to failure to age correct the data has been previously examined and found to have the potential to insert significant bias into the findings [Gelman and Auerbach, 2016]. The findings on fertility (see below) indicate that the presence of the TVA in the county led to a increase in the fertility rate in that county. While there are certainly confounding issues in that finding, the fact is that during this time period fertility rates - and therefore the number and proportion of the population that was children - were increasing. When this increase in fertility rates is taken into account (see the third model of Table 9.2), the relationship between child mortality and the duration of time the TVA is in a county disappears. This lack of significance is seen in both the preferred measure of TVA activity (Time in County) as well as the lesser measures. In short, the nature of time period in question and the poor quality of the data reporting mean that little to no inference can be drawn as the potential benefits of Tennessee Valley Authority electrification on child mortality.

Table 9.2: Effect of the TVA on Child Mortality Rates

	Child Mortality	Child Mortality	Child Mortality
TVA Time In County	0.195***	0.194***	0.0729
	(0.0542)	(0.0543)	(0.0561)
Time	-0.423***	-0.423***	-0.495***
	(0.0324)	(0.0324)	(0.0353)
Percent Black		-0.198	-0.226
		(0.869)	(0.823)
Dam in County			0.509
			(0.604)
Fertility Rate			0.308***
			(0.0299)
Constant	17.53***	17.55***	12.05***
	(0.301)	(0.325)	(0.654)
County Fixed Effects	Yes	Yes	Yes
N	1535	1535	1432
adj. R^2	0.069	0.068	0.123

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Should the results of the third model prove correct estimates and there is no effect on child mortality of increasing access to electrification, this runs counter to the expectations of this study. The theoretical evidence argues that those under five should be especially sensitive to changes and likely to show greater changes than the public at large; however, this does not seem to be the case.

9.4.2 Fertility Rate

Fertility Rate: Fertility rate is commonly used both as a proxy for development as well as for the status of women. During the time period under investigation, increases in development and the status of women are associated with decreases in fertility rates as women often

choose to have fewer children. Alternatively, increases in fertility may be indicative of a previously unfulfilled desire for children. In these data fertility rate is assessed as live births (ie. exclusive of stillbirths) per 1,000 persons.

Fertility Rate Results

The general trend that is seen is most of the literature is that increased development in modern (or relatively modern) contexts is equated with a decline in the fertility rate [Oatley, 2019, Fogel, 2010]. There are several reasons for this that are argued in the literature and will be discussed here.

First and foremost the argument in the development literature [Deaton, 2003, Deaton, 2015] is that as parents become more secure in the idea that their children will survive infancy and childhood they will have fewer children as they do not feel the need to maximize the number of children with the hope that at least one or two will survive. This basic argument underpins much of the work on the demographic transition [Fogel, 2010, Oatley, 2019]. There is some gentle indication that infant mortality is reduced by the presence of the TVA therefore making it more likely that families would choose to have fewer children as a result.

Another line of argument attached to the decline in birth rates that accompanies increases in development is that those in rural areas will have less need for farm labor and therefore less need to have children to help with the labor as development allows for increased automation and the introduction of labor saving technologies. While this line of argument largely ignores urbanized development, the Tennessee Valley is and was a largely rural area with farming and agricultural activity being the main industries and therefore could hold explanatory power in for this sample.

Lastly, it is also argued that fertility declines with development because development leads to the increased status of women. When the status of women increases they are better able to control their own reproduction and will therefore choose to have fewer children,

begin childbearing later, and end childbearing earlier [Oatley, 2019, Fogel, 2010]. For all of the above stated reasons, it was theorized that an increase in electrification would lead to an increase in development and therefore a decrease in fertility rates. As will be seen in the models that follow, this is the opposite of the findings presented here.

Table 9.3: Effect of the TVA on Fertility Rates

	FertRate	Fertility Rate	Fertility Rate	Fertility Rate
TVA Time In County	0.324***	0.318***	0.317***	0.249***
	(0.0309)	(0.0311)	(0.0311)	(0.0312)
Time	0.0776***	0.0811***	0.0778***	0.0178
	(0.0144)	(0.0145)	(0.0148)	(0.0156)
Percent Black		-0.783	-0.794	-0.786
		(0.736)	(0.736)	(0.724)
Dam in County			0.367	0.544
			(0.357)	(0.351)
Baby Boom Year				2.294***
				(0.219)
Constant	21.58***	21.69***	21.70***	22.11***
	(0.126)	(0.181)	(0.181)	(0.183)
County Fixed Effects	Yes	Yes	Yes	Yes
N	3496	3481	3481	3481
adj. R^2	0.030	0.031	0.031	0.062

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results presented above run counter to expectation. Rather than showing a decline in fertility as would be expected in cases of increasing levels development, these data show that fertility increased during this time period with the introduction of the TVA and an increase in access to electricity. It is important to note that this time period also catches the beginning of the Post-War Baby Boom (1946 - 1964) and the final model accounts for this. While accounting for the Baby Boom, these findings still indicate that the presence of the TVA increased the fertility rate for those in the service area.

While these results run counter to expectation, they could simply be a display of a corollary to the second line of argument about increasing development decreasing fertility due to lower labor demands. Much of the advertising for the TVA (and for Roosevelt's reelection) focused on the time and labor saving aspects of electricity with advertisements and even whole magazines focusing on how much time can be saved on household chores. There were also testimonials collected from women in the service areas about how much time and energy is being saved by electric ranges, washing machines, water pumps, and refrigeration. The traditional explanation is that a reduction in farm labor requirements should lead to a decline in the need for children to act as laborers. What may be happening here is that the lower demands for household labor from women allowed them to fulfill a previously unfulfilled desire for more children. In other words, when women had to spend less time cooking, cleaning, and performing other household chores, they chose to spend that extra time rearing more children. Confirmation of this hypothesis would require a type of qualitative data that is not available, but there are few other logical explanations.

It is important to note that the other potential explanation would be that incomes rose and those living in the TVA area felt that they were able to support more children. In this case men could have encouraged/required their wives to have more children as they felt financially comfortable having additional children. This explanation is less likely as Kitchens, 2006, Kitchens, 2014 and the TVA's own study [Industrial Economics Branch,] were unable to find significant increases in either overall economic activity or farm income associated with the introduction of the TVA and TVA power.

9.5 Appendix V

	Full Sample Democratic Vote	High Mortality Democratic Vote	Low Mortality Democratic Vote
TVA in County	2.962***	3.459**	3.119
	(0.795)	(1.231)	(1.769)
Dam in County	3.021*	0.493	11.40***
	(1.274)	(1.962)	(2.349)
Dam Under Construction	0.659	-0.319	-2.341
	(1.478)	(2.622)	(2.446)
Neighboring County	0.890	1.319	0.319
	(0.639)	(0.951)	(1.360)
Constant	73.44***	75.48***	59.81***
	(0.316)	(0.490)	(0.693)
N	892	180	180
adj. R^2	0.010	0.158	0.235

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	Full Sample	High Mortality	Low Mortality
	Democratic Vote	Democratic Vote	Democratic Vote
Number of Contracts	1.810***	2.497**	3.171*
	(0.477)	(0.856)	(1.312)
Dam in County	3.334**	0.620	11.37***
	(1.267)	(1.961)	(2.285)
Dam Under Construction	0.526	-0.389	-2.198
	(1.475)	(2.615)	(2.401)
Neighboring County	0.652	1.226	0.462
	(0.598)	(0.916)	(1.291)
1em] Constant	73.43***	75.48***	59.81***
	(0.316)	(0.489)	(0.685)
N	892	180	180
adj. R^2	0.011	0.162	0.250

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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