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Property Rights, Consequences of Electrical Blackouts, and Measures of Institutional Quality

Kerianne Nicole Lawson

West Virginia University, kerianne.lawson@gmail.com

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Property Rights, Consequences of Electrical Blackouts, and Measures of Institutional Quality

Kerianne Lawson

Dissertation submitted to the John Chambers College of Business and Economics
at West Virginia University
in partial fulfillment of the requirements for the degree of
Ph.D. in Economics

Joshua Hall, Ph.D., Chair
Bryan McCannon, Ph.D.
Alexander Lundberg, Ph.D.
Todd Nesbitt, Ph.D.

Department of Economics

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Abstract

Property Rights, Consequences of Electrical Blackouts, and Measures of Institutional Quality

Kerianne Lawson

This dissertation is comprised of three essays. Chapter 1 is about a house titling program, called Khaya Lam, in South Africa. Despite it being legal in South Africa to acquire a title deed to a government-issued home, roughly 20 million South Africans do not hold title to their property. Millions of homes are eligible to have ownership transferred from the government to the individuals living in them, but legal costs and lack of awareness keep these renters from going through the steps to secure title deeds. Though they may occupy the property for years, without a title deed South Africans are unable, under the law, to make improvements to the property, sell it, or leave it to heirs. The government can seize the property at any time. The Khaya Lam project began in 2013 in an effort to streamline the title deed process and cover legal costs and has teamed up with municipalities to issue almost ten thousand deeds to date. The expansion of property rights are a positive shock to wealth, which can affect investment in security, but could also create opportunities for more crime. Chapter 1 employs the Synthetic Control Method to understand the relationship between securing property rights and crime. Chapter 2 is about identifying house fires as an unintended consequence of electrical load shedding. At the end of 2014, South Africa was unexpectedly required to implement load shedding, which is electricity blackouts aimed at relieving strain on the electrical grid. Soon after, it was revealed that the nationally owned power company, Eskom, had been neglecting infrastructure maintenance and that the people should expect load shedding to continue for many more years. Chapter 2 explores behavioral responses to load shedding in terms of household energy consumption, and then considers the prevalence of fires as a potential consequence. After load shedding started, there is evidence that households substituted away from using electricity to alternative energy sources for cooking and lighting energy. By exploiting plausibly exogenous variation in the timing and spacing of load shedding, estimates show that likelihood of residential fires increases when load shedding occurs in an area. Chapter 3 is about currency iconography, which is the study of the images on banknotes. The images on a country's currency are purposefully chosen by the people or government to be representative of that country. Potentially, one could learn a lot about the economic and political climate of a country by simply looking at the pictures on its money. Chapter 3 reports indexes measuring the political, religious, and cultural/scientific content as well as the representation of women on currency notes. The analysis suggests that currency iconography can be used as an indication of the quality of the institutions or socio-economic outcomes in that country.

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Chapter 1

Using Property Rights to Fight Crime: The Khaya Lam Project

1.1 Introduction

Scholars have analyzed the importance of well-defined property rights and the privatization of property for a long time. Much of the literature discusses the incentives created and possible outcomes of individuals having well-defined rights over their land and property. Capital is the key to the flourishing in some parts of the world (de Soto, 2000). However, resources and capital alone are not enough. They must be supported by well-defined and enforced property rights. In the absence of property rights, assets cannot be transformed into capital, and de Soto refers to this as “dead capital.” Growth, trade, and investment rely on ownership rights of buildings, land, and possessions. If individuals believe that their property can be seized or is not totally owned by them and them alone, they will have little incentive to invest in their property (Alchian and Demsetz, 1972; Demsetz, 1967). A number of things that can go wrong when a society lacks formal property rights (Besley and Ghatak, 2010). According to Besley and Ghatak, property rights are the main protection individuals have against expropriation, and insecure property rights can act as a barrier to trade. Property rights are often an assumption that is taken for granted, but without secure property rights, the competitive market economy falls apart. One of the main features of formalized property rights is that individuals are incentivized to invest, at least in theory.

Nearly 20 million South Africans do not hold titles to their property, while according to South African law, they have the right to do so. The Khaya Lam “My Home” Land Reform Project is run by the Free Market Foundation in South Africa. The project began in 2013 with the objective of granting title deeds to South Africans who were living in homes that they did not own, but had the right to gain ownership of the property. The right to own property comes from the Upgrading of Land Tenure Rights Act (1991), which repealed the Black Land Act. The Act granted property rights to South Africans living in homes because of their relocation to homelands and townships by the apartheid government. The sole caveat was that individuals needed to fill out paperwork and pay fees in order to obtain the title deed to the house in which they were presently residing. However, little to no effort was made to notify those who were eligible to become legal owners of their properties, nor to assist them in claiming these property rights. The number of individuals living in homes without a title equates to approximately 6 million homes. These homes could be owned privately, but are currently managed and owned by the government. If South Africans do not hold the title deed, they are unable to sell their home, make any improvements (legally), leave their home to heirs, and their property can be seized at any time.

Therefore, the Free Market Foundation began this project to, first, raise awareness to South Africans that they have a right to claim the title deed to the property, and second, assist them in the transfer process.

The Khaya Lam project runs on donations to help pay for the legal fees and work necessary to distribute a title deed to residents so that they may have full ownership over their property. It costs around 2,350 South African Rand, about \$150 US dollars, to go through the process to obtain a title deed. Estimates suggest that acquiring a title deed to one's property gives an individual an asset of about 120,000 Rand, or 8,000 US dollars Foundation (2020). With funds from businesses and private donations, Khaya Lam's pilot project was created in September of 2012 in partnership with the Ngwathe Local Municipality, and the first ceremony of title deed distribution took place in September of 2013 (Foundation, 2020). Since the project's inception, the Free Market Foundation has partnered with numerous other municipalities, distributed thousands of title deeds in Ngwathe and hundreds elsewhere, and raised funding for tens of thousands of deeds. After title deeds were first distributed in Ngwathe, some residents began to improve their property's structure, adding rooms, security systems, better windows, and better fixtures in general. This is just anecdotal evidence but suggestive that the acquisition of a title deed motivates individuals to improve their homes, and thus making their property more secure. If homes in the area improve their security, this improved security could reduce property crimes if criminals are deterred by the better fences, walls, windows, security systems, etc.

As more individuals have strong and well-defined property rights, all of the previous literature suggest that in theory, investment and development will increase. Williamson and Kerekes (2008) test this hypothesis and find that securing property rights improves investment in Peru. Aragón et al. (2020) also examine property rights in Peru, and find that a land titling program affects risk preferences of residents and makes individuals more risk averse. In Columbia, Muñoz Mora et al. (2018) find that securing property rights reduced risk-taking behavior. When property rights are formalized and enforced, there was significantly less land allocated to growing the illicit crop, coca. Meeks (2018) finds that securing property rights through land titling in rural Peru improves water and electricity access, as well as increased quality. It follows that more investment, increased risk aversion, and improved access to water and electricity, will improve security in an area. Thus, increased security should be reflected in the instances of crime. On the other hand, the distribution of deeds is like a positive wealth shock to the community. The shock could create more opportunities for crime as residents become wealthier. This article is the first, to my knowledge, to study a property rights expansion on this scale and also empirically examine the effects of an expansion on property crime and violent crime.

The positive shock to wealth generated by the Khaya Lam project distributing deeds could have many different consequence in Ngwathe and other municipalities. This article focuses on crime outcomes because of the prevalence of crime in South Africa. Property crimes are consistently considered as the most common

and most feared crimes in the country (StatsSA, 2018). Additionally, a majority of South Africans believe that crimes are increasing in their neighborhoods. Over the past decade, South Africa ranks in the top handful of countries in every category of crime (Harrendorf et al., 2010). Crime is a prevalent and costly problem in South Africa. If the Khaya Lam project does empower new home owners to invest in their homes and improve security as the theory suggests, then a way to reduce property crimes could be through the expansion of property rights.

Conversely, this project could be contributing to crime and fears of crime by creating more opportunities for crime, and so it is crucial to understand this connection between title deed transfer and crimes. Others have argued that South Africa is a unique case in history and that we should not be so quick to assume that land rights will improve investment, despite what theory may say. Cousins et al. (2005) attack Hernando de Soto’s book, *The Mystery of Capital*, stating that de Soto’s policy prescriptions are inappropriate in South Africa. The authors describe South Africa’s complicated history, the reparations after apartheid, and political agenda of the current government. They believe that handing the keys over, literally and figuratively, to individuals may result in a less safe South Africa. This could be because homes are registered in a single person’s name, and could negatively affect unmarried women who cannot make a case for their right to that home once a title deed is granted to a male partner. Cousins et al. (2005) state that government policies encouraging security and development would be better than granting property rights to the low income population in South Africa.

Using the Synthetic Control Method, this article measures the effect of the Khaya Lam project’s presence in Ngwathe on property crime. Specifically, robberies, aggravated robberies, burglaries, and property damages. Then, the focus turns to contact crimes, also known as violent crimes. To test the hypothesis set forth by Cousins et al. (2005) that women may be endangered by a program like Khaya Lam, the article looks at rates of total contact crimes, which includes murders, sexual offenses, and assaults. The study finds that Ngwathe experienced lower crime rates after Khaya Lam compared to the synthetically constructed counterfactual version of Ngwathe.

1.2 Literature Review

The study of property rights is particularly interesting on the African continent because of the large number of new governments transitioning from more traditional (communal) views of property to more modern (individualistic) views. Besley (1995) examines the changes in land reforms, particularly about transfer rights, in two regions of Ghana. The article asks if investment increases with more individualistic property

rights and analyzes the perception of property rights and new development in Ghana through a surveys. It is not clear that in Ghana, individualistic property rights boosted investment. If there is a common preference for improving the land for *all* inhabitants, which could be the case in a traditionally communal culture, then investment should occur regardless of who owns the land. Besley develops a theoretical model that considered the investment incentives that come from individualistic land rights, and then uses surveys and data from the Wassa and Anloga regions of Ghana and finds empirical support for the theory that investment increases with land rights. Besley concludes that there is a need for “careful empirical studies of land rights and investment in low-income environments” (Besley, 1995).

Despite South Africa’s unique history and current housing situation, there are very few academic articles written about this topic. Most of the discussion about South African housing policy comes from sociology and urban planning scholars who appear disappointed with the current state of housing in South Africa. Corruption, inefficiencies and a misunderstanding of the consequences of these widespread land reforms has tarnished the once optimistic view of the the promises made by the new African National Congress led government in the mid 1990s (Huchzermeyer, 2005; Rubin, 2011). Franklin (2020) is the sole economics article to discuss housing policy and property rights in South Africa examines the free housing program run by the government which hands out homes without charge. Over three million homes since 1994 have been distributed through this program. Franklin (2020) find that there is significant increase in household earnings for those who experience the shift from informal to formal housing with this program. This effect is driven through a positive effect on income for women, in particular. Franklin (2020) hypothesizes that this result is because receiving a free home frees up time to work, as formal housing is much less time consuming to maintain than an informal dwelling. While these individuals are not holding title deed to the homes they receive for free from the government, the shift from informal to formal housing generates a positive wealth shock to individuals. This article seeks to understand the effects due to the shift from formal housing without ownership to home ownership.

Politics and institutions play an important role in the security of property rights, and studies have shown that the success of legal titling is dependent on the type of governing structures in place in the country Murtazashvili and Murtazashvili (2016b); Cai et al. (2020); Murtazashvili and Murtazashvili (2019, 2015, 2016a). Further, in developing countries, such as Afghanistan, lack the qualities necessary to ensure that legal titling improves land security because of the political systems in place that deem a state to not be “property-protecting” (Murtazashvili and Murtazashvili, 2019). Additionally, Murtazashvili and Murtazashvili (2019) find that legal titling does not reduce political violence in Afghanistan. Murtazashvili and Murtazashvili

(2016b) state that the fragile state of Afghanistan prevents the creation of economic opportunities from legal titling and suggest community-based land reforms to achieve the goal of reducing terrorism and violence in the country. Murtazashvili and Murtazashvili (2016a) find that what they call Community-Based Land Adjudication and Registration (CBLAR) initiatives are much more successful in ensuring land tenure security because it is based on the community reaching a consensus on who owns what. The overarching theme of Murtazashvili and Murtazashvili's work on titling in Afghanistan is the importance of understanding the institutions in and stability of the geographic area one is studying. Some environments may be less receptive to a legal titling program, and thus jeopardize the land security in the area.

With regards to South Africa, the importance of stability and institutional quality is not as much of a concern. First, throughout the time period of this analysis, South Africa is not considered to be a fragile state. Second, the South African government would most likely be considered "property-protecting" for a number of reasons. South Africa's own constitution is the motivator for the Free Market Foundation's Khaya Lam Project, as it states that all South Africans have a legal right to own a title deed to their home (Foundation, 2020). But, the concerns of Cousins et al. (2005) are similar to what Murtazashvili and Murtazashvili find in Afghanistan. Ultimately, empirical evidence is necessary to determine if legal titling is effective in securing property for South Africans.

However, as more individuals have strong and well-defined property rights, all of the previously mentioned articles suggest that in theory, investment and development will increase. And so, it follows that more investment will improve security, and should be reflected in the instances of crime. There are a number of articles that study the relationship between subsidized public housing and crime. Rohe and Burby (1988) conduct a large survey and find that those living in public housing are more likely to be living in fear of crime. Lawton and Yaffe (1980) find that fear is even stronger for elderly persons living in public housing, even though they are no more likely to be victims of crime.

The findings in these studies may be relevant to the circumstances in South Africa. Many of the homes that are still owned by the government were given to individuals because of apartheid-era legislation that placed people of certain races or ethnic groups in dormitory townships. Even after the end of apartheid, nearly a quarter of South Africans remain in the townships and another quarter of the population live in "shantytowns" or slums (Pernegger and Godehart, 2007; UN-HABITAT, 2014). While it is common for many generations to live in a single dwelling at a time, the primary tenant, or potential homeowner, will most likely be a senior citizen who received the home during apartheid several decades ago.

Freedman and Owens (2011) examine the effect of tax credits for investment in low income housing on

crime. In other studies looking at crime and low income housing projects, the research suggests that the concentration of poverty itself could further exacerbate crime problems in neighborhoods (Glaeser et al., 1996; Bjerk, 2010). Freedman and Owens (2011) find that in the poorest neighborhoods, the increased investment in and development of low income housing projects significantly reduces violent crime, but has no detectable effects on property crime. They use an instrumental variable approach and take advantage of the thresholds in the formula used to determine which census tracts qualify for the tax credit to craft a model with a strong identification strategy. They find that a 1% increase in the share of county residents living in a qualifying census tracts corresponds with a 0.5% reduction in aggravated assaults and robberies. These results are quite small in comparison to other known deterrents of crime, but the authors make a strong case that the reduction comes solely from the increased investment in the area. Even so, the lack of results for property crime, and small, yet significant results, for violent crime is slightly puzzling. Freedman and Owens turn to some other articles in the urban crime literature to speculate as to why they find this relationship.

First, it could displace current residents with new ones. Immigrants and emigrants could impact criminal activity in the area (Roncek et al., 1981; McNulty and Holloway, 2000). People who receive a title deed through Khaya Lam in Ngwathe may sell their home and move out, which would change the composition of the neighborhood and may affect crime rates. Second, the existing population could become less criminal. The reduction in crime could be because of re-purposed vacant lots/buildings, greater police presence, more vigilant residents, or an improved sense of community (Wilson and Kelling, 1982; Cook and MacDonald, 2011). Anecdotal evidence suggests this could be the case for the homes affected by the Khaya Lam project (Foundation, 2020). As soon as residents in the area become homeowners they begin to improve their properties, adding security systems and new fixtures to their home. The added protection and pride in the community could deter crime on the margin. Also, as the residents' concerns shift from staying in their home and not being evicted by the government to keeping the value of their properties high for resale purposes, we could also see a reduction in crime. The takeaway from these papers is that the channel by which the crime is reduced may not be obvious, but it is reduced nonetheless.

The previous literature that states that giving individuals property rights improves investment, and those who own their homes or have more investment in their area experience less crime. However, no study has been able to examine the same area before and after a large number of the residents switch from renting to owning their homes. Also, this is still a highly contested topic in political debates as politicians are promising to give land to low income or disadvantaged citizens, and meanwhile it is in the constitution that

no individual is required to rent from the government and has a right to their home. Given the unique nature of the Khaya Lam project, awarding property rights to homeowners in Ngwathe can be seen as a natural experiment. Therefore, the following sections of this article will examine the impacts of the Khaya Lam project on crime in the Ngwathe municipalities.

1.3 Data

The crime data come from the South African Police Service (SAPS) crime reports. The data are published in annual counts of crimes by category for every police station in the country beginning in April 2006 and ending in March 2019. For this article, those annual counts were aggregated from the police station level to the municipal level because the treated unit is a municipality, Ngwathe.

Table 1.1 holds the summary statistics for the entire data sample and all statistics are calculated by municipality by year. The analysis covers 211 municipalities in South Africa, and all covariate data comes from the Census and Community Surveys conducted by the South African government in the years 1996, 2001, 2007, 2011, and 2016. In addition to population, the municipal level demographic information used in the model are the percent of residents that are black, white, coloured, female, living in formal dwellings, educated with a Bachelor’s degree or higher, or unemployed.¹ Population density, which is defined as the number of people per square kilometer is also used as a predictor for the synthetic control.

Crime variables are calculated using annual counts and then given as an annual rate per 100,000 residents. The crimes examined in this article are common robberies, aggravated robberies, residential robberies, residential burglaries, property damages. The total crime and murder rates are used as predictors for the construction of the synthetic control as well. In the main specification of this article, the focus is property crimes. The motivation for this is to measure the possible deterrence of property crimes when homeowners are able to invest in their properties and improve security. Alternatively, the increase in investment could create more opportunities for crime as homeowners may have more wealth and possessions to steal.

Robberies are thefts where the property or items are taken from the victims directly using fear or force. The SAPS coding system calls robberies without the use of a deadly weapon “common robberies”. Aggravated robberies are when these robberies are committed using a deadly weapon. Residential robberies, as coded by SAPS, are a type of aggravated robberies. A more appropriate name for this crime category would be “aggravated robberies occurring on a residential premises.” Residential burglaries are thefts committed

¹In South Africa, “coloured” is a term used as an ethnic label for people of mixed ethnic origin, including Khoisan, African, Malay, Chinese, and white (Oxford Dictionary)

by a person illegally entering the residential property and does not involve directly stealing from another individual who is present at the time. Finally, property damages are defined as maliciously intended harm caused to property, excluding arson. The article first looks at aggravated robberies, then common robberies, followed by residential robberies, residential burglaries, and finally, property damages.

Other crimes may also be affected by securing property rights. Cousins et al. (2005) mention that there could be adverse effects when a title deed is placed in one person's name. They argue that unmarried women may not be able to make a case for their right to own, or reside in, a home after the title is transferred to a male partner. There is a possibility that a title transfer program has an unintended consequence of increasing tension in the home over finances and assets which can result in domestic violence. In a later section of this article, rates of violent crimes including murder, attempted murder, sexual offenses and assaults are examined.

1.4 Ngwathe and the other municipalities

Ngwathe Municipal Government was the first to partner with Khaya Lam and most of the title deeds distributed by the project are in Ngwathe. The first title deed distribution ceremony took place in 2013, but more deeds are distributed over time. Therefore, the treatment effect is more like an intent to treat, as homes now are eligible to be switched to private ownership, and the number of homes with title deeds increased with time.

The main focus of the analysis is on Ngwathe, but other municipalities have also partnered with Khaya Lam and distributed title deeds to their residents.² Table 1.2 presents the number of title deeds distributed, in progress and pledged in each municipality, their registration date, as well as their first presentation date, if applicable. However, deeds distributed in Ngwathe alone make up over half of the completed and distributed title deeds since the project began. And, not only has Ngwathe had the most deeds distributed by Khaya Lam, but also the highest percentage of homes affected. Considering the population of Ngwathe in 2011, and the average number of people per household, 2,373 is about 6 percent of the houses in Ngwathe. Also, the next municipality to have its first presentation of title deeds was nearly 3 years later in Cape Town, in June 2016. Stellenbosch has the second highest number of deeds distributed at 610, but this is about 1 percent of the houses in Stellenbosch.

Even more municipalities are in the process of partnering with the Khaya Lam project, and many have

²Beyers Naude, Cape Town, Stellenbosch, Theewaterskloof

funding for deeds pledged, but have not distributed any title deeds yet.³ As you can see, the majority of these deeds were distributed in Ngwathe, and the others were distributed quite late in the period of analysis. There are 3 other municipalities that distributed deeds after the data ends in 2018, so they are considered to still be in the not-yet-distributed group, called “Pledged” in Table 1.3. Table 1.3 presents the averages for each of the variables by these municipal groups, Ngwathe alone, and the entire sample. The asterisks on various averages denote if the average for a given municipal group is statistically different from Ngwathe’s average. Statistical significance for various p-values are shown by ‘***’ for 0.01, ‘**’ for 0.05, and ‘*’ for 0.1.

There seems to be a decent amount of variation in the characteristics of these municipal groups, Ngwathe, and the entire sample. Cape Town is included in the group of other municipalities with distributed deeds, and Johannesburg is in the pledged municipalities group. This may explain the large differences in population, population density, and crime rates. The main specification includes all municipalities. The column labeled “Full sample” includes all municipalities in the pledged and distributed groups, as well as Ngwathe and the rest of the municipalities in South Africa. The full sample is much more similar to Ngwathe. However, it may not be suitable to use the distributed and pledge groups as a counterfactual for Ngwathe. First, they are dissimilar in a number of dimensions that make them an inappropriate comparison group, and second, there may be some selection bias for the municipalities that choose to work with the Free Market Foundation that may attribute to the treatment effect of Khaya Lam’s presence in their area. That being said, including the municipalities that have distributed deeds but not nearly as many as Ngwathe and those with deed titling in progress or pledged in the donor pool of the synthetic control will only downward bias the results, so including them in the donor pool is not as much of a concern. If anything, their inclusion will understate the effect of Khaya Lam in Ngwathe. Even so, the results generated after excluding the municipalities that also received title deeds from the donor pool are included in a later section of this article.

Figure 1.1 shows the location of Ngwathe (black), and the other municipalities involved in the Khaya Lam project with title deeds distributed during the period of analysis (gray) and includes the municipalities that have not had title deeds distributed yet, but have pledged funding for title deeds (dots). Figure 1.2 plots the annual total crime rates for the municipal groups in Table 1.3. The total crime rates for the distributed and pledged municipality groups are much higher than Ngwathe and the other municipalities and seem to be slightly increasing over time. Ngwathe and the other municipalities without pledged or distributed deeds appear to be more similar in their crime trends over time. This serves as additional justification for using the full sample of municipalities for the donor pool in the selection of the synthetic Ngwathe. Ngwathe seems

³Beaufort West, Bergrivier, Bitou, Breede Valley, Cederberg, Drakenstein, George, Hessequa, Johannesburg, Jozini, Kananaland, Kynsna, Laingsburg, Matzikama, Moqhaka, Nkomazi, Oudtshoorn, Saldanha Bay, Swartland, Tshwane, Witzenberg

to be a lot more like the rest of the country’s municipalities in terms of crime rates. This also eases some concerns on the selection of Ngwathe as the pilot program location for Khaya Lam. Perhaps the Free Market Foundation chose implement the program in only “safer” areas. On the other hand, the project could be selecting locations to target areas that could greatly benefit from an increase in property rights, which could be high crime areas. The high variation in the crime rates among the different municipality groups, as shown by Table 1.3 and Figure 1.2, suggest that the Free Market Foundation is not considering crime rates when approaching municipal governments to partner for the Khaya Lam project. They also make no mention of this in any of their reports, press releases or fundraising materials (Foundation, 2020).

1.5 Synthetic Control Method

This article seeks to measure the impact of transfer of title deeds to residents on the crime in the Ngwathe municipality. The synthetic control method enables the construction of a synthetic version of Ngwathe to simulate what would have happened in the municipality in terms of crime rates in the absence of the Khaya Lam project. In other words, the synthetic control methods allows me to create a counterfactual version of Ngwathe and compare it to what happened to Ngwathe in reality. This method was developed by Abadie and Gardeazabal (2003).

The synthetic control method uses weight averages from a donor pool of similar units, in this case these are the other municipalities in South Africa, and constructs a synthetic Ngwathe municipality that best matches actual Ngwathe in the pre-period, which is before the Khaya Lam pilot program began. The synthetic control method is appropriate to use in this setting because the Khaya Lam pilot program was a unique, one-off event, and no other municipality has had nearly as many title deeds distributed, nor was any other municipality selected to be the testing ground for the project. Ngwathe is the only municipality that experienced thousands of title deed transfers. Therefore, in order to get a like-with-like comparison in the analysis, it is necessary to construct a synthetic version of the municipality as a counterfactual rather than simply comparing Ngwathe to all other municipalities in South Africa.

Numerous other studies have employed the synthetic control method when examining unique and one-time events. Like economic liberalizations (Billmeier and Nannicini, 2013; Lawson et al., 2019), the reunification of Germany (Abadie et al., 2015), the effect of California’s Proposition 99 (Abadie et al., 2010), natural disasters (Cavallo et al., 2013), terrorism (Gautier et al., 2009; Montalvo, 2011), and the impact of Hugo Chavez in Venezuela (Grier and Maynard, 2016). Also, there is a relatively small, but growing literature that focuses on crime outcomes using synthetic control method. Some notable examples include right to

carry laws and violent crime (Donohue et al., 2019), place based policing in crime prevention (Robbins et al., 2017; Rydberg et al., 2018; Saunders et al., 2015), the impact of a drought in California on property crime (Goin et al., 2017), and organized crime in Southern Italy (Pinotti, 2015).

The treatment begins in 2013 which is the first distribution of title deeds by the Khaya Lam pilot project in Ngwathe Local Municipality. The pool of donors that are used to construct the synthetic control unit are the remaining 210 local and metropolitan municipalities in the data. The covariates used to construct the synthetic version of Ngwathe are the various annual crime rates per 1000 people and the percentage of the population in a municipality that are female, black, white, coloured, unemployed, had an education greater than or equal to a Bachelor’s degree and living in a formal dwelling. Table 4 presents the weights assigned to each municipality in the donor pool in order to construct the synthetic version of Ngwathe. Each column in Table 4 & 5 hold the weights for a specific outcome variable. Municipalities that had a weight of 0 for all of the property crime outcomes were not included in the table. Table 1.5 presents the predictor variable means used to construct the synthetic version of Ngwathe compared Ngwathe in reality. The following section covers the main results for the property crime outcome variables and the corresponding robustness checks and placebo tests. The next section looks at contact crimes.

1.6 Property Crimes

The first outcome examined is aggravated robberies per 100,000 residents annually. Figure 1.3 shows that after the Khaya Lam project began distributing title deeds in Ngwathe, the rate of aggravated robberies was much lower than it would have been in absence of the project. Then, in Figure 1.4, the outcome variable is common robberies per 100,000 residents annually. In both figures, it seems that the actual and synthetic Ngwathe follow the similar paths from 2006 to 2013 and then separate, with actual Ngwathe’s crime rate shown as consistently lower than the synthetic Ngwathe from 2013 onward. This is evidence that the rate of robberies was lower in Ngwathe after Khaya Lam began distributing title deeds in the municipality than it would have been otherwise. So not only did the rate common robberies decrease in Ngwathe after the Khaya Lam project began in 2013, but robberies with aggravated force. If there had been a null result or even an increase in aggravated robberies following the program’s introduction could have caused concerns that there was a shift in the types of robberies being committed in Ngwathe. But the result presented in Figure 1.3 paired with 1.4 means that the Khaya Lam project corresponds with a reduction in robberies overall, both common and those with aggravating circumstances.

In addition to recording the number of common and aggravated robberies per year, the South African

police divide the records of aggravated robberies in several subcategories, one of which being aggravated robberies that take place on a residential premises. So, to provide further evidence that the result shown in Figure 1.3 is driven by robberies that were prevented due to an increase in property rights at residential properties, and not a reduction in a different subcategory of aggravated robberies. Figure 1.5 plots the difference in aggravated residential robberies between the synthetic and actual Ngwathe. After 2013, the rate of aggravated residential robberies is initially much lower in actual Ngwathe compared to its synthetic counterfactual. This suggests that the reduction in the rate aggravated robberies is partially driven by a reduction in the rate aggravated residential robberies in Ngwathe. Next, this article examines the rate of burglaries at a residential premises. Figure 1.6 plots the residential burglaries per 100,000 residents annually in Ngwathe compared to a synthetic version of Ngwathe. It appears that after the project is established in Ngwathe in 2013, the rate of residential burglaries is consistently lower than in the synthetic Ngwathe. And finally, Figure 1.7 displays the results for the rate of property damages with malicious intent. Again, there is slight evidence that had the Khaya Lam project not occurred in Ngwathe, there would be higher rates of property damages for every year after 2013.

1.6.1 Placebo Tests

Next, placebo tests are used check and reinforce the results presented above. Placebo tests are a way to visually show what would have been the case if we pretended that any other municipality had been the location of the pilot project of Khaya Lam. Figures 1.8 - 1.12 are generated by running the same specifications as above, but instead of selecting Ngwathe as the treated municipality, every other municipality was considered treated and a synthetic version of each municipality was generated. The figures are plots of the difference between the actual and synthetic versions of each municipality using the same predictor variables and outcomes used above. The lighter gray lines represent the other municipalities, and the black line is Ngwathe. If the main results of this article are driven by Khaya Lam's presence in Ngwathe, then the placebo test plots would show that the line that represents Ngwathe is different than most of the controls. Table 1.6 holds the p-values for the placebo tests, which show where the MSPE from the main specification lies in the distribution of MSPEs generated by running the placebo test.

1.6.2 Robustness Checks

Ngwathe is not the only municipality with title deeds distributed through the Khaya Lam project. While all of these other deeds were distributed in the last two years of the data alone, they still may be affecting the

donor selection and construction of the synthetic Ngwathe. They could have a downward bias effect on the main results if they were also positively affected by Khaya Lam. It may be preferred to look at results where the donor pool consists of municipalities that do not have any title deeds distributed through the Khaya Lam project.

This article re-considers the five outcomes from the main specification with a restriction placed on the donor pool. The restricted donor pool consists of 206 municipalities, which have no deeds distributed. Some of these municipalities have pledged deeds, but they have not received the treatment of the Khaya Lam project like the four municipalities with distributed deeds. All four of the municipalities with distributed deeds are in different provinces than Ngwathe, with three in the Western Cape and one in the Eastern cape. In the main specification, none of the municipalities received a weight greater than zero in the construction of synthetic Ngwathe. However, the synthetic control method is very sensitive to changes like this. Excluding municipalities, even if they had zero weights, could change the results.

The results with the new donor pool are for the most part consistent with the original results. And as expected, the magnitudes are slightly larger when the municipalities distributed deeds are excluded from the donor pool for common robberies, aggravated robberies, residential robberies, and property damages. The results for residential burglaries, however, are not the same. With the restricted donor pool, there does not seem to be any difference in residential burglaries between the synthetic and actual Ngwathe after the Khaya Lam project began. In the main specification, the burglaries result was weak. This could be because of issues with reporting burglaries as compared to robberies. Crimes that are committed while the victim is not present tend to be under-reported in South Africa (StatsSA, 2018).

The donor weights are presented in Table 1.7. The donors and weights selected with the restricted group are similar to the main specification donor pool weights, donors with very small weights, less than or equal to 0.001 were excluded from the table. Table 1.8 presents the predictor means compared to actual Ngwathe as well as the p-values for the placebo tests. The placebo test plots using the restricted donor pool are in the Appendix. Finally, Figures 1.13 - 1.17 are the path plots for each of the property crime outcome variables.

1.7 Drug-related crimes

One of the possible reasons for why crime rates are increasing or decreasing in an area is a significant change in the population. Upon receiving a title deed to their property, South Africans can sell their homes and move away. Before, they would have to simply abandon their home if they wanted to leave the area. Therefore, the securing of property rights in an area may increase mobility. Population turnover is one

of the causes of neighborhood distress, and this can impact crime rates (Fasani et al., 2019; McNulty and Holloway, 2000; Roncek et al., 1981; Tosh, 2019). Numerous articles have been written on the relationship between immigration and crime, with mixed results (Chalfin and Deza, 2020; Bucheli et al., 2019; Leiva et al., 2020; Wadworth, 2010). The literature does not seem to have reached a consensus on the relationship between immigrants and crime, which may be because of the different types of crimes and contexts studied. Green (2016) finds that immigrants in the United States do not affect violent crimes, but there is a positive association between undocumented immigrant populations and drug crimes. While it is not possible to know how many people have moved in and out of Ngwathe, and which houses have been sold in the municipality, looking at the changes in drug-related crimes may be helpful in understanding how the expansion of property rights in Ngwathe has affected migration.

The South African police services database of crime counts has a category titled “drug-related crimes” which is comprised of any and all drug crimes. These crimes could be more minor, like possession or paraphernalia charges, or more significant like dealing drugs. It also does not specify what types of drugs are involved in the crime.

Table 1.10 holds the donor weights and Table 1.9 presents the predictor means comparing the synthetic Ngwathe and actual Ngwathe. Both of these tables are included in the appendix. Figure 1.18 plots the rates of drug-related crimes for actual Ngwathe and the synthetically constructed Ngwathe. There seems to be no difference in the rate of drug-related crimes between the two Ngwathes after the Khaya Lam project began. This is consistent with the restricted donor pool results in Figure 1.19.

In the previous section, the results indicate there is a small decrease in property crimes in Ngwathe after the introduction of Khaya Lam. And this section shows there is no change in the drug crimes for Ngwathe. Therefore, it is unlikely that the decrease in property crimes is driven by population change.

1.8 Contact Crimes

Next, this article addresses the concerns raised by Cousins et al. (2005) and also recognizes that there is a possibility that violent crimes could be affected by securing property rights, not just property crimes. There are a number of hypotheses in question. First, the transfer of title deeds to individuals may result in the expansion of property rights for a disproportionate number of men. Cousins et al. (2005) mention this could be problematic for unmarried women living with male partners who now have legal claim to a property, and access to the power and wealth that come from owning the home. A possible consequence of this could be increased tension in the home and result in domestic violence. Or, for the reasons why we may fear a rise

in property crimes or drug crimes, like a change in the population due to increased mobility, or increases in wealth creating more opportunities for crime, there may be a increase in the rates of violence after 2013 in Ngwathe. To the first point, this doesn't seem to be the case with the title recipients through Khaya Lam. Based on estimates provided by the Free Market Foundation, around 65% of the title deeds are transferred to women.

Conversely, the expansion of property rights could be empowering for women who have legal claim to their homes and are able to make improvements to their properties. The South African police services method of recording violent crimes does not specify if the crimes are domestic violence or other instances of violence. Therefore, this section simply looks at all contact crimes, which are murders, attempted murder, assaults, and sexual offenses. While this may not be a perfect way to capture the change in the rates of violence against women or violence in the home, it will show how overall violence in the area has changed. In roughly 60% of the cases of assault, the victims state that they knew their attacker (StatsSA, 2018).

Table 1.10 is the donor weights, column 1 is the where the full sample is included in the donor pool and the second column is for the restricted donor pool. Table 1.9 presents the predictor means for both synthetic controls, where the donor pool is restricted the second column. Both of these tables are included in the appendix. Figures 1.20 and 1.21 are the plots with the full sample and the restricted donor pools, respectively. Both figures are very similar plots depicting the different rates of contact crimes for Ngwathe and its synthetic counterfactual in each year. From 2013 onward, actual Ngwathe has a lower rate of contact crimes than the synthetic Ngwathe which represents what would have happened in absence of the Khaya Lam project.

1.9 Conclusion

The Khaya Lam Project facilitates and sponsors the transfer house title deeds South Africans. Upon receiving this asset, individuals are incentivized to invest in their property. One possible result of this is improved security and safety in the area. Another reasons for a decrease in crime could be that there is displacement of criminals due to shift in the population made possible by the property rights expansion. Or, the increase in wealth in the area from the increase in home ownership in an area could create more opportunities for criminals, particularly for property crimes. As discussed in the previous sections of this article, crime and property rights expansion could be related in a negative or positive way. This article examines Khaya Lam's pilot program location, the Ngwathe local municipality. It is the first to study a project like Khaya Lam, and discuss the relationship between a large scale transfer of title deeds and criminal deterrence.

This article examines the impact of Khaya Lam’s work in the Ngwathe local municipality on crime. Using the synthetic control method, this article’s analysis focuses on the expansion of home ownership in a specific geographic area, Ngwathe, and the change in property crimes. When compared to the synthetic counterfactual version of itself, Ngwathe experienced lower rates of robberies, aggravated robberies, aggravated residential robberies, and residential burglaries following the implementation of the Khaya Lam Project. This article posits that it is through the mechanism of investment by which these results occur.

This article’s analysis has limitations. First, the annual crime rates do not allow for the treatment period to begin exactly when the Khaya Lam project began in Ngwathe. Also, it is impossible to observe where and how many homes that have title deeds transferred through private means, not the Khaya Lam project. While it is important to note this, this omission would result in a downward bias of the results. Additionally, it is unlikely that any other municipality has experienced as many house title deeds transferred to individuals as Ngwathe, so it is still reasonable to assume this treatment is unique to Ngwathe municipality. There are no other projects similar to the Khaya Lam project operating in the country.

This article provides suggestive evidence that the expansion of property rights leads to improvements in security and therefore results in a reduction in property crimes. It also provides some evidence in response to concerns about title deed transfer programs. First, that expanding property rights would cause a shift in the population, which is not actually preventing crime, just shifting it to other areas. This does not seem to be the case as drug crimes, appear unaffected by the introduction of Khaya Lam in Ngwathe. Another concern is that there could be more opportunities for crime due to the positive wealth shock. The decreases in all areas of property crimes suggest this is not the case. Additionally, Cousins et al. (2005) argument against transferring title deeds in South Africa from the government to individuals is that granting home ownership to men may have adverse affects for women, particularly unmarried women. This article provides evidence that this is not occurring in Ngwathe as Khaya Lam facilitates title transfer in the municipality. Not only are a majority of the new homeowners women, but there is a slight decrease in violent crimes in Ngwathe after the program began.

The Khaya Lam project is still in its infancy. Currently, there is pledged funding for thousands of title deeds. Khaya Lam’s project leaders expect the project to grow in the years to come. Therefore, the findings in this article are simply a glimpse into the possible effects, in terms of criminal deterrence, that could come from the Khaya Lam project if it continues to transfer title deeds to individuals.

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Table 1.1: Summary Statistics

Variable	Mean	SD	Min	Max
Population	234,661	520,732.8	5,155	4,949,347
Population densiy	87.31	226.98	0.34	2,695.94
% Unemployed	10.30	3.54	2.26	22.46
% Education $\geq$ Bachelor's	2.91	2.06	0.14	16.00
% Black	73.40	32.14	0.06	100
% White	8.16	7.58	0.00	53.08
% Coloured	17.28	28.12	0.00	92.58
% Female	51.87	2.53	35.13	58.20
% Formal dwellings	69.41	21.16	7.79	98.88
Aggravated robbery rate	119.57	126.60	0.00	1,203.91
Common robbery rate	87.37	76.90	0.00	684.50
Drug-related crimes rate	342.83	455.56	0.00	6,037.10
Murder rate	35.80	21.71	0.00	175.99
Property damages rate	231.50	165.90	0.00	1,250.80
Residential burglary rate	492.60	356.77	0.00	4,116.50
Residential robbery rate	16.72	21.53	0.00	224.89
Total contact crime rate	1,354.70	825.44	0.00	7883.70
Total crime rate	2,013	1,370.98	0.00	11,075

Table 1.2: Status title deed distribution by municipality

Municipality	Distributed	In Progress	Pledged	Total	Registered	1st presentation
Ngwathe	2,373	671	750	3,794	Sept 2012	Sept 2013
Beyers Naude	70	830	–	900	Sept 2016	Nov 2018
Cape Town	384	500	–	884	June 2013	June 2016
Cederberg	50	80	–	130	Aug 2019	Dec 2019
Saldanha Bay	300	900	–	1,200	Sept 2019	Dec 2019
Stellenbosch	610	1,390	–	2,000	Nov 2016	Jan 2017
Theewaterskloof	364	130	–	494	Oct 2015	July 2017
Pledged/Progress Only	–	822	18,070	18,892	–	–
Totals	4,151	5,323	18,820	28,294	–	–

Note: There are other municipalities that only have deeds pledged or in progress (as of December 2019). They are included in the “Pledged/Progress Only” row.

Table 1.3: Averages by municipal group

Variable	Ngwathe	Others distributed	Pledged	Full sample
Population	113,426	966,568**	439,251***	234,661***
Population density	16.11	375.21**	153.75**	87.31***
% Unemployed	13.10	9.02***	8.51***	10.30***
% Education $\geq$ Bachelor's	2.78	5.75***	4.26***	2.91
% Black	86.03	28.33***	34.33***	74.27***
% White	10.28	13.63***	13.91***	7.49***
% Coloured	3.50	57.11***	50.90***	17.27***
% Female	52.54	50.79***	50.91***	51.64***
% Formal dwellings	77.73	83.46	83.89	70.86*
Aggravated robbery rate	79.81	182.67***	129.27***	119.57***
Common robbery rate	79.69	141.49**	113.63***	87.37
Drug-related crimes rate	264.26	942.60***	1,056.93***	342.83*
Murder rate	22.32	50.55***	37.50***	35.80***
Property damages rate	259.50	427.70***	393.18***	231.50
Residential burglary rate	533.30	781.70**	709.60***	492.60
Residential robbery rate	6.02	15.77***	14.98***	16.72***
Total crime rate	2,014	4,006***	3,553***	2,013
Total contact crimes rate	1,356.30	1687.50**	1,892.60***	1,354.70
Observations	1	4	21	211

Figure 1.1: Map of the local municipalities working with Khaya Lam. Gray municipalities are have had title deeds issued to residents, the black municipality is Ngwathe, and dotted are in the process of registering residents in the Khaya Lam Project

Figure 1.2: Total crime rate over time for Ngwathe (red line), the average total crime rate annually for the municipalities with pledged (green) and distributed (blue) deeds, and then all of the other municipalities (black)

Figure 1.3: Synthetic Control results for aggravated robbery rate. The dashed line shows the path synthetic version of Ngwathe, and the solid line represents actual Ngwathe's crime rate.

Table 1.4: Donor Pool Weights

Municipality	Aggravated robberies	Common robberies	Residential robberies	Residential burglaries	Property damages
Albert Luthuli	0.000	0.000	0.000	0.000	0.002
Ba-Phalaborwa	0.000	0.000	0.000	0.000	0.002
Bitou	0.009	0.000	0.000	0.000	0.000
Blouberg	0.000	0.000	0.000	0.000	0.003
Blue Crane Route	0.000	0.000	0.000	0.000	0.003
Bushbuckridge	0.000	0.200	0.000	0.000	0.029
Dannhauser	0.000	0.000	0.000	0.000	0.002
Dikgatlong	0.000	0.000	0.073	0.000	0.002
Dihlabeng	0.000	0.001	0.000	0.049	0.000
Dipaleseng	0.000	0.204	0.002	0.000	0.002
Emalahleni	0.000	0.000	0.145	0.000	0.000
Emfuleni	0.028	0.000	0.000	0.000	0.000
Enoch Mgijima	0.000	0.134	0.000	0.000	0.118
Ephraim Mogale	0.000	0.000	0.000	0.000	0.002
Fetakgomo/Greater Tubatse	0.002	0.000	0.000	0.000	0.002
Ga-Segonyana	0.000	0.000	0.000	0.075	0.002
Inxuba Yethemba	0.051	0.009	0.000	0.000	0.002
Joe Morolong	0.000	0.000	0.000	0.000	0.014
Kopanong	0.000	0.001	0.000	0.000	0.002
Lekwa-Tsemane	0.003	0.003	0.000	0.000	0.002
Lepelle-Nkumpi	0.000	0.000	0.000	0.000	0.002
Mafube	0.000	0.000	0.000	0.000	0.002
Magareng	0.001	0.005	0.007	0.321	0.128
Makana	0.000	0.025	0.000	0.000	0.106
Makhuduthamaga	0.000	0.000	0.270	0.091	0.002
Maluti-a-Phofung	0.001	0.034	0.000	0.000	0.003
Mamusa	0.000	0.000	0.000	0.000	0.002
Mantsopa	0.000	0.001	0.000	0.000	0.002
Maquassi Hills	0.000	0.001	0.000	0.000	0.002
Maruleng	0.000	0.000	0.000	0.000	0.002
Masilonyana	0.000	0.000	0.000	0.000	0.002
Mkhondo	0.000	0.000	0.000	0.000	0.002
Mogalakwena	0.000	0.000	0.000	0.000	0.002
Mohokare	0.000	0.001	0.000	0.000	0.002
Molemole	0.000	0.000	0.000	0.000	0.015
Moses Kotane	0.000	0.003	0.000	0.000	0.002
Nala	0.000	0.001	0.167	0.005	0.004
Naledi	0.000	0.000	0.000	0.000	0.002
Ndlambe	0.086	0.098	0.000	0.000	0.000
Newcastle	0.143	0.000	0.105	0.333	0.000
Nggushwa	0.000	0.000	0.000	0.000	0.003
Nketoana	0.000	0.001	0.000	0.000	0.002
Pixley ka Seme	0.391	0.108	0.001	0.000	0.104
Ramotshere Moiloa	0.000	0.001	0.000	0.000	0.002
Raymond Mhlaba	0.105	0.000	0.000	0.001	0.279
Senqu	0.000	0.000	0.000	0.000	0.002
Setsoto	0.000	0.001	0.000	0.000	0.002
Sol Plaatje	0.000	0.000	0.000	0.096	0.000
Tswelopele	0.149	0.002	0.203	0.001	0.004
Umdoni	0.000	0.082	0.000	0.000	0.000
Umsobomvu	0.007	0.053	0.000	0.016	0.011
uPhongolo	0.000	0.000	0.000	0.000	0.002
Walter Sisulu	0.000	0.001	0.000	0.000	0.002

Table 1.5: Synthetic Control Indicator Pre-Intervention Means

Variable	Actual Ngwathe	Aggravated Robberies	Common Robberies	Residential Robberies	Residential Burglaries	Property Damages
		Synthetic Ngwathe	Synthetic Ngwathe	Synthetic Ngwathe	Synthetic Ngwathe	Synthetic Ngwathe
Aggravated robberies	65.911	71.298	–	–	–	–
Common robberies	81.561	–	81.895	–	–	–
Residential robberies	4.223	–	–	4.710	5.706	–
Residential burglaries	504.324	–	–	–	500.459	–
Property damages	268.88	–	–	–	–	268.802
Total crimes	1,839.848	1,812.015	1,836.568	–	1,787.748	–
Murders	23.530	–	–	23.826	23.563	–
Population density	16.107	–	30.829	–	–	24.068
% Unemployed	0.131	0.130	0.130	0.128	0.130	0.131
% Education $\geq$ Bachelor's	0.028	0.028	0.028	0.028	0.028	0.028
% Formal dwellings	0.741	0.739	0.739	0.740	0.803	0.740
% Female	0.525	0.525	0.525	0.525	0.525	0.525
% Black	0.857	0.869	0.869	0.896	0.817	0.856
% Coloured	0.034	0.047	0.046	0.036	–	–
MSPE		294.288	501.250	4.567	6,481.660	1,316.635

Figure 1.4: Synthetic Control results for robbery rate. The dashed line shows the path synthetic version of Ngwathe, and the solid line represents actual Ngwathe's crime rate.

Figure 1.5: Synthetic Control results for aggravated residential robbery rate. The dashed line shows the path synthetic version of Ngwathe, and the solid line represents actual Ngwathe's crime rate.

Figure 1.6: Synthetic Control results for residential burglary rate. The dashed line shows the path synthetic version of Ngwathe, and the solid line represents actual Ngwathe's crime rate.

Figure 1.7: Synthetic Control results for property damages rate. The dashed line shows the path synthetic version of Ngwathe, and the solid line represents actual Ngwathe's crime rate.

Table 1.6: Placebo Tests					
Variable	Aggravated Robberies	Common Robberies	Residential Robberies	Residential Burglaries	Property Damages
p-value	0.137	0.545	0.346	0.943	0.796

Figure 1.8: Placebo test results for aggravated robberies. The darker line represents the difference between actual Ngwathe's aggravated robbery rate and synthetic Ngwathe. The lighter colored lines represent all of the other municipalities compared to their synthetic version had they been the treated unit.

Figure 1.9: Placebo test results for common robberies. The darker line represents the difference between actual Ngwathe’s common robbery rate and synthetic Ngwathe. The lighter colored lines represent all of the other municipalities compared to their synthetic version had they been the treated unit.

Figure 1.10: Placebo test results for residential aggravated robberies. The darker line represents the difference between actual Ngwathe’s residential aggravated robbery rate and synthetic Ngwathe. The lighter colored lines represent all of the other municipalities compared to their synthetic version had they been the treated unit.

Figure 1.11: Placebo test results for residential burglaries. The darker line represents the difference between actual Ngwathe’s residential burglary rate and synthetic Ngwathe. The lighter colored lines represent all of the other municipalities compared to their synthetic version had they been the treated unit.

Figure 1.12: Placebo test results for property damages. The darker line represents the difference between actual Ngwathe’s property damages rate and synthetic Ngwathe. The lighter colored lines represent all of the other municipalities compared to their synthetic version had they been the treated unit.

Table 1.7: Donor Pool Weights with Restricted Donor Pool

Municipality	Aggravated robberies	Common robberies	Residential robberies	Residential burglaries	Property damages
Albert Luthuli	0.000	0.000	0.000	0.000	0.002
Amahlathi	0.005	0.000	0.000	0.000	0.000
Ba-Phalaborwa	0.002	0.000	0.000	0.000	0.000
Bitou	0.002	0.000	0.000	0.000	0.000
Blouberg	0.000	0.000	0.000	0.000	0.005
Blue Crane Route	0.000	0.000	0.000	0.000	0.002
Bushbuckridge	0.000	0.186	0.000	0.000	0.000
Dihlabeng	0.002	0.000	0.000	0.307	0.000
Dikgatlong	0.003	0.000	0.000	0.000	0.000
Dipaleseng	0.000	0.201	0.000	0.000	0.000
Emalahleni	0.094	0.000	0.324	0.046	0.000
Emfuleni	0.115	0.000	0.000	0.000	0.000
Enoch Mgijima	0.002	0.143	0.000	0.000	0.160
Fetakgomo/Greater Tubatse	0.361	0.000	0.000	0.000	0.002
Ga-Segonyana	0.003	0.000	0.000	0.131	0.000
Greater Giyani	0.002	0.000	0.000	0.000	0.000
Inxuba Yethemba	0.002	0.013	0.000	0.000	0.003
Joe Morolong	0.000	0.000	0.000	0.000	0.019
Kareeberg	0.028	0.000	0.000	0.000	0.004
Lekwa-Teemane	0.000	0.003	0.000	0.000	0.000
Magareng	0.000	0.003	0.000	0.206	0.146
Makana	0.000	0.020	0.000	0.000	0.098
Makhuduthamaga	0.000	0.000	0.416	0.137	0.000
Maluti-a-Phofung	0.000	0.035	0.000	0.000	0.000
Maruleng	0.000	0.000	0.000	0.000	0.002
Mkhondo	0.000	0.000	0.000	0.000	0.002
Mohokare	0.000	0.002	0.000	0.000	0.000
Molemole	0.000	0.000	0.000	0.000	0.020
Moses Kotane	0.002	0.000	0.000	0.000	0.005
Nala	0.002	0.000	0.000	0.000	0.005
Newcastle	0.008	0.000	0.108	0.000	0.000
Ndlambe	0.000	0.099	0.000	0.000	0.000
Ngqushwa	0.002	0.000	0.000	0.000	0.002
Nketoana	0.002	0.000	0.000	0.000	0.002
Pixley ka Seme	0.002	0.123	0.000	0.000	0.103
Raymond Mhlaba	0.034	0.000	0.000	0.000	0.278
Senqu	0.000	0.000	0.000	0.000	0.002
Setsoto	0.002	0.000	0.000	0.000	0.002
Thulamela	0.000	0.000	0.000	0.000	0.000
Tswelopele	0.002	0.002	0.000	0.135	0.002
Umdeni	0.002	0.078	0.000	0.000	0.000
Umsobomvu	0.006	0.053	0.131	0.030	0.006
Umvoti	0.000	0.000	0.000	0.000	0.002
Walter Sisulu	0.000	0.000	0.000	0.000	0.003

Table 1.8: Synthetic Control Indicator Pre-Intervention Means with Restricted Donor Pool

Variable	Aggravated Robberies	Common Robberies	Residential Robberies	Residential Burglaries	Property Damages
	Actual Ngwathe	Synthetic Ngwathe	Synthetic Ngwathe	Synthetic Ngwathe	Synthetic Ngwathe
Aggravated robberies	65.911	66.129	—	—	—
Common robberies	81.561	—	82.031	—	—
Residential robberies	4.223	—	—	4.315	4.484
Residential burglaries	504.324	—	—	—	504.292
Property damages	268.88	—	—	—	—
Total crimes	1,839.848	—	1,835.782	—	1,787.748
Murders	23.530	—	—	—	23.582
Population density	16.107	—	—	—	—
% Unemployed	0.131	0.131	0.130	0.131	0.123
% Education $\geq$ Bachelor's	0.028	0.028	0.028	0.036	0.028
% Formal dwellings	0.741	0.741	0.738	0.777	0.748
% Female	0.525	0.525	0.525	0.525	0.525
% Black	0.857	0.858	0.869	0.871	0.856
% Coloured	0.034	—	0.046	0.053	—
MSPE		65.334	502.237	1.963	6421.751
p-value from placebo tests		0.178	0.662	0.154	0.942

Figure 1.13: Synthetic Control results for the aggravated robberies rate with the restricted donor pool. The dashed line shows the path synthetic version of Ngwathe, and the solid line represents actual Ngwathe's crime rate.

Figure 1.14: Synthetic Control results for the common robberies rate with the restricted donor pool. The dashed line shows the path synthetic version of Ngwathe, and the solid line represents actual Ngwathe's crime rate.

Figure 1.15: Synthetic Control results for the residential robberies rate with the restricted donor pool. The dashed line shows the path synthetic version of Ngwathe, and the solid line represents actual Ngwathe's crime rate.

Figure 1.16: Synthetic Control results for the residential burglaries rate with the restricted donor pool. The dashed line shows the path synthetic version of Ngwathe, and the solid line represents actual Ngwathe's crime rate.

Figure 1.17: Synthetic Control results for the property damages rate with the restricted donor pool. The dashed line shows the path synthetic version of Ngwathe, and the solid line represents actual Ngwathe's crime rate.

Figure 1.18: Synthetic Control results for the drug-related crimes rate. The dashed line shows the path synthetic version of Ngwathe, and the solid line represents actual Ngwathe's crime rate.

Figure 1.19: Synthetic Control results for the drug-related crimes rate with the restricted donor pool. The dashed line shows the path synthetic version of Ngwathe, and the solid line represents actual Ngwathe's crime rate.

Figure 1.20: Synthetic Control results for the total contact crimes rate. The dashed line shows the path synthetic version of Ngwathe, and the solid line represents actual Ngwathe's crime rate

Figure 1.21: Synthetic Control results for the total contact crimes rate with the restricted donor pool. The dashed line shows the path synthetic version of Ngwathe, and the solid line represents actual Ngwathe's crime rate

Figure 1.22: Placebo test plot with restricted donor pool

Figure 1.23: Placebo test plot with restricted donor pool

Figure 1.24: Placebo test plot with restricted donor pool

Figure 1.25: Placebo test plot with restricted donor pool

Figure 1.26: Placebo test plot with restricted donor pool

Table 1.9: Sythetic Control Indicator Pre-Intervention Means for Non-Property Crime Outcomes

Variable		Drug-Related crimes	Drug-related crimes	Contact Crimes	Contact Crimes
	Actual Ngwathe	Synthetic Ngwathe	Synthetic Ngwathe	Synthetic Ngwathe	Synthetic Ngwathe
Drug-related crimes	147.346	149.647	147.352	–	–
Contact crimes	1,377.794	–	–	1,378.368	1,377.678
Total crimes	1,839.848	1,838.913	1,839.449	1,841.406	1,840.060
% Unemployed	0.131	0.131	0.131	0.130	0.131
% Education $\geq$ Bachelor's	0.028	0.028	0.032	0.028	0.028
% Formal dwellings	0.741	0.741	0.741	0.739	0.741
% Female	0.525	0.525	0.525	0.525	0.525
% Black	0.857	0.858	0.858	0.869	0.859
% Coloured	0.034	–	–	0.045	0.057
Restricted Donor Pool		No	Yes	No	Yes
MSPE		969.458	501.250	20,801.800	13,875.840

Table 1.10: Donor Pool Weights for Non-Property Crime Outcomes

Municipality	Drug-related crimes	Drug-related crimes	Contact crimes	Contact crimes
Albert Luthuli	0.003	0.004	0.000	0.000
Alfred Duma	0.003	0.004	0.000	0.004
Amahlathi	0.003	0.003	0.000	0.000
Ba-Phalaborwa	0.000	0.003	0.000	0.000
Big Five Hlabisa	0.000	0.003	0.000	0.000
Blouberg	0.000	0.003	0.000	0.000
Blue Crane Route	0.003	0.003	0.000	0.000
Buffalo City Metrop	0.000	0.004	0.000	0.000
Bushbuckridge	0.020	0.025	0.020	0.005
Dannhauser	0.003	0.005	0.000	0.011
Dihlabeng	0.000	0.000	0.000	0.003
Dikgatlong	0.004	0.003	0.000	0.000
Dipaleseng	0.003	0.004	0.087	0.003
Dr JS Moroka	0.024	0.011	0.000	0.004
ECEmalahleni	0.005	0.000	0.000	0.027
eDumbe	0.000	0.003	0.000	0.000
Elias Motsoaledi	0.004	0.005	0.000	0.003
Emfuleni	0.176	0.234	0.000	0.272
Emthanjeni	0.014	0.003	0.000	0.000
Engcobo	0.000	0.003	0.000	0.000
Enoch Mgijima	0.000	0.003	0.272	0.000
Ephraim Mogale	0.005	0.006	0.000	0.003
eThekweni Metrop	0.000	0.000	0.000	0.005
Fetakgomo/Greater Tubatse	0.008	0.010	0.000	0.004
Ga-Segonyana	0.003	0.003	0.000	0.000
Greater Giyani	0.003	0.006	0.000	0.000
Greater Letaba	0.004	0.006	0.000	0.003
Greater Taung	0.003	0.003	0.000	0.003
Greater Tzaneen	0.003	0.004	0.000	0.000
Inkosi Langalibalele	0.003	0.004	0.000	0.003
Inxuba Yethemba	0.000	0.003	0.000	0.000
Joe Morolong	0.000	0.003	0.000	0.000
Kareeberg	0.004	0.003	0.000	0.000
KwaDukuza	0.000	0.000	0.000	0.004
Lekwa-Teemane	0.000	0.000	0.000	0.004
Lepelle-Nkumpi	0.000	0.003	0.000	0.000
Magareng	0.081	0.007	0.115	0.153
Mahikeng	0.000	0.003	0.000	0.000
Makana	0.017	0.092	0.063	0.000
Makhado	0.000	0.003	0.000	0.000
Makhuduthamaga	0.057	0.104	0.000	0.150
Maluti-a-Phofung	0.161	0.014	0.061	0.039
Mandeni	0.000	0.003	0.000	0.000
Maphumulo	0.000	0.003	0.000	0.000
Maquassi Hills	0.000	0.003	0.000	0.003
Maruleng	0.003	0.004	0.000	0.000
Matatiele	0.000	0.003	0.000	0.000
Matjhabeng	0.000	0.003	0.000	0.000
Mbizana	0.000	0.003	0.000	0.000
Midvaal	0.003	0.000	0.000	0.006
Mkhondo	0.004	0.004	0.000	0.003
Mogalakwena	0.000	0.003	0.000	0.000
Molemole	0.003	0.004	0.000	0.000
Moretele	0.059	0.038	0.000	0.000
Moses Kotane	0.000	0.003	0.000	0.000
Msinga	0.000	0.004	0.000	0.003
Mthonjaneni	0.000	0.003	0.000	0.000
Mtubatuba	0.003	0.003	0.000	0.000
Nala	0.004	0.005	0.000	0.011
Naledi	0.003	0.003	0.000	0.000
Ndlambe	0.004	0.004	0.000	0.003
Ndwedwe	0.000	0.003	0.000	0.000
Nelson Mandela Bay Metrop	0.000	0.003	0.000	0.000
Newcastle	0.000	0.003	0.000	0.000
Ngqushwa	0.003	0.005	0.000	0.003
Nkandla	0.000	0.004	0.000	0.000
Nkomazi	0.003	0.004	0.000	0.000
Nongoma	0.000	0.003	0.000	0.000
Nqutu	0.000	0.003	0.000	0.000
Okhahlamba	0.000	0.003	0.000	0.000
Phokwane	0.003	0.003	0.000	0.000
Pixley ka Seme	0.005	0.005	0.260	0.006
Ramotshere Moiloa	0.000	0.003	0.000	0.000
Ratlou	0.003	0.003	0.000	0.000
Ray Nkonyeni	0.000	0.000	0.000	0.004
Raymond Mhlaba	0.003	0.006	0.000	0.000
Renosterberg	0.000	0.003	0.000	0.000
Sakhisizwe	0.000	0.003	0.000	0.000
Setsoto	0.000	0.000	0.000	0.003
Sol Plaatje	0.011	0.003	0.000	0.000
Thembisile Hani	0.005	0.006	0.000	0.003
Thulamela	0.003	0.005	0.000	0.000
Tsantsabane	0.007	0.003	0.000	0.000
Tswelopele	0.000	0.003	0.000	0.004
Ulundi	0.000	0.003	0.000	0.000
Umdoni	0.000	0.000	0.091	0.003
uMfolozi	0.003	0.004	0.000	0.000
uMhlabuyalingana	0.000	0.003	0.000	0.000
uMhlathuze	0.000	0.003	0.000	0.000
uMlalazi	0.000	0.003	0.000	0.003
Umsobomvu	0.004	0.004	0.007	0.000
Umvoti	0.003	0.004	0.000	0.003
Umzimkhulu	0.000	0.003	0.000	0.000
Umzimvubu	0.000	0.003	0.000	0.000
Umzumbi	0.000	0.003	0.000	0.003
uPhongolo	0.000	0.003	0.000	0.000
Victor Khanye	0.004	0.003	0.000	0.000
Restricted Donor Pool	No	Yes	No	Yes

Chapter 2

Electricity Outages and Residential Fires: Evidence from Cape Town, South Africa

2.1 Introduction

Load shedding is the process of intentionally shutting off portions of an electrical supply in order to reduce the strain on the electrical grid. Periods of load shedding are deemed necessary by a electrical company when the grid is at risk of total collapse. The strain on the electrical grid may be caused by excess demand or disruptions in supply. Some electricity providers schedule periods of load shedding in advance to give people opportunities to work around them. But in other cases, load shedding happens without warning.

Studies have shown that unplanned power outages can generate great economic and social costs (Anderson and Dalgaard, 2013; Carlsson and Martinsson, 2008; de Nooij et al., 2009; Harish et al., 2014; Hensher et al., 2014; Rose et al., 2007; Wijayatunga and Jayalath, 2004). Additionally, load shedding can affect productivity (Carlsson et al., 2020; Kazmi et al., 2019), and consumption behavior (Abi Ghanem et al., 2016; Beenstock, 1991). Behavioral responses to the power outages affect health (Byrd and Matthewman, 2014; Gehringer et al., 2018; Ndaguba, 2017), pollution (Pretorius et al., 2015), and education (Lawson, 2021). This article explores how changes in consumption behavior due to unreliable electricity increase the likelihood of house fires as individuals turn to alternative and riskier energy sources.

The focus of this study is in Cape Town, South Africa. The nationally owned power company, Eskom, is no stranger to load shedding. After sporadic load shedding in 2007 and 2008, Eskom promised the public that it could handle growing demand for electricity, without implementing load shedding. Eskom was dedicated to keep the lights on, and so maintenance was neglected for years (Gibbs, 2014). However, that all came to an end in 2014 when a series of mishaps and malfunctions related to infrastructure occurred at several of Eskom plants and mines. These problems forced Eskom to close facilities that powered a significant portion of the grid, and consistent load shedding began in December of 2014 (Anhaeusser, 2014; Niselow, 2019).¹ In 2014, the duration of power outages was 12 days, summing to 121 hours for the year. Then, Eskom implemented load shedding on 99 days in 2015, totaling in 852 hours of power outages.

Prior to the power plant shut downs, South Africans were not aware of the impending energy crisis. But by the beginning of 2015, it was clear that South Africa's issues were not temporary. Government and Eskom officials announced in January of 2015 that load shedding would likely occur for years to come. Upon receiving this news, South Africans were forced to adjust their daily lives, and perhaps make preparations in anticipation of more severe load shedding.²

¹First, there was an incident at Duvha power station, then at Majuba plant, a coal silo collapses and another cracks. Then, hydroelectric dams had to reduce output due to drought, and diesel shortages caused the gas turbine plants to shut down.

²Load shedding is still happening today, and the energy situation in South Africa gets worse each year. <https://www.thesouthafrican.com/news/eskom-load-shedding-timeline-since-2007/>

This article first considers the information shock’s effect on household energy consumption. Using results from the annual General Household Survey, it appears that individuals adjusted their consumption of energy after 2015 when power outages were often and widespread. Consumption of electricity as the main energy source for cooking and lighting decreased, and use of generators, wood, gas, and paraffin increased. For heating energy, electricity usage increased compared to its substitutes. A possible explanation is that electric heaters are cheaper and more convenient, and are compliant with Eskom recommendations to only heat rooms with people currently in them, rather than heating the whole home. These changes in consumption seem to reflect changes in attitudes about the reliability of electricity.

As households adjust their energy consumption in response to load shedding, there are potential consequences, like the prevalence of fires (van Niekerk, 2018). This article focuses on one of the major cities in South Africa, Cape Town. Using hand collected information about load shedding, as well as data on residential fires in Cape Town, this article exploits the exogenous variation in power outages to measure the effect of load shedding on house fires in South Africa. From a household’s perspective, the timing, duration, and spacing of load shedding is as good as random. First, Eskom announces load shedding via Twitter and news outlets, sometimes after they’ve already begun to shut off power. Then, Cape Town is divided into numbered load shedding areas, which correspond to a load shedding schedule. The schedule shows which numbered areas experience power outages depending on the day of the month, time of day, and severity of the load shedding. While the schedule remained unchanged for the period studied in this article, it would still be very difficult for individuals to anticipate which areas will experience power outages day to day. Additionally, the structure of the schedule and how it changes daily and with the severity of the load shedding, which makes the timing and spacing of power outages essentially random across Cape Town.

After the beginning of load shedding was announced in late 2014, there were significantly more residential fires in Cape Town. In addition, there more residential fires in load shedding areas if they experienced load shedding that day. For informal dwellings, the increased risk of fires during load shedding is much than in formal dwellings. Therefore, a consequence of load shedding is an increase in fires due to changes in household energy consumption. These results suggest there are unforeseen costs due to power outages, like residential fires, that should be considered in the on-going debate about electricity provision in South Africa and the rest of the world.

Reliable energy is an issue all over the world. In developed and developing countries alike, rolling blackouts often occur when electricity demand exceeds supply and threatens a total collapse of the electrical grid. The blackouts aren’t always caused by weather, but also by neglected infrastructure or rising demand that cannot

be met. Sometimes, the power outages are scheduled but other times the interruptions are a surprise to the public. Since 2010, there have been major power outages in Chile, Cyprus, England, Iceland, India, Indonesia, Sudan, Turkey, Ukraine, and the United States, to name a few. This article identifies residential fires as a cost of power outages, and the increased risk of fire should be a concern for countries experiencing electricity blackouts.

2.2 Literature Review

Electrification has a number of economic effects in addition to increases in productivity. After the electrification of Ghana, there was a reduction in fertility and wood fuel consumption, a shift from agriculture to higher skilled labor, and an increase in educational investments for existing children (Akpanjar and Kitchens, 2017). In rural South Africa, there was a mass electrification program in 1992, which resulted in residents turning away from alternative fuel sources, like wood, to electricity (Davis, 1998). The change in consumption of electricity intensifies as the household income increases. The load shedding happening in South Africa for the past six years could have the opposite effect of this electrification program.

Individuals care a great deal about the frequency and duration of outages, and there are severe negative welfare effects for households that experience power outages (Hensher et al., 2014; Carlsson and Martinsson, 2008). Also, the type of outages, whether they are randomly assigned or strategically placed, has varying costs (de Nooij et al., 2009). When determining how to implement power outages for energy rationing, there are two options. There is efficient rationing, which targets areas with the lowest costs per unit of delivered electricity, also known as the value of lost load (VOLL). The other option is to randomly assign which areas lose power. de Nooij et al. (2009) focus on the variation in VOLL by sector, municipality, and time of day and find that the costs of power outages are much lower when the power outages target the lowest VOLL. In their preferred specification, costs are 93% lower when using efficient rationing as opposed to random rationing. In the case of South Africa, the day to day variation, time of day variation, and spatial variation of load shedding is randomly determined, and VOLL is not considered. According to the findings of de Nooij et al. (2009), this is very costly and harmful to those affected.

Furthermore, there are severe economic costs in terms of lost output as well as monetary costs due to power outages that have affected large geographic areas, such as Cyprus (Zachariadis and Poullikkas, 2012), California (Sue Wing and Rose, 2020), the European Union (Anderson and Dalgaard, 2013), India (Harish et al., 2014), and Sri Lanka (Wijayatunga and Jayalath, 2004), as well as manufacturing in Ethiopia (Carlsson et al., 2020). Anderson and Dalgaard (2013) study the history of power outages in sub-Saharan Africa from

1995 to 2007 and find that power outages have stunted economic growth in Africa and contributed to vast differences in growth rates between countries. The authors find that if all of the African countries studied had had power quality on par with South Africa over this period, the average annual rate of real GDP per capita growth would have increased by 2 percentage points. In addition, the cross-country variation in growth rates would have been reduced by about 20%. Several years after the period of study in Anderson and Dalgaard (2013), South Africa is experiencing power outages like so many of its neighbors did previously. Therefore, the findings of the article should be a concern to South Africa. Load shedding is costly in terms of lost output and productivity, and this can affect the country's growth.

In addition to economic costs, power outages can generate other costs to society. Klinger et al. (2014) review the recent health literature surrounding extreme weather events that caused power outages and find in every case there were adverse health effects. Power outages were linked to increased difficulty accessing health care and providing front line and emergency response services. Even when power outages are not caused by extreme weather, the effects of power outages are similarly detrimental to the area (Byrd and Matthewman, 2014). For example, food safety, crime, transportation access, health are affected by power outages (Byrd and Matthewman, 2014). Electricity blackouts create unique incentives for criminals and can affect their behavior (Rodríguez and Domínguez, 2021). Individuals in areas connected to a power grid orient their lives with the expectation of electricity's reliability. Electricity disruptions upset those plans, resulting in direct and indirect consequences.

Abi Ghanem et al. (2016) examine the effects of the power outages following severe storms in the United Kingdom on consumption behavior and attitudes. They adopt a qualitative approach, interviewing households in the areas affected by the power cuts. They find that keeping warm, cooking, and preparing for the possibility of future outages drove people to find substitutes for electricity, even in the short run, as well as investing in generators and other useful equipment, in case a power outage would happen again. Normally, the electricity supply in the United Kingdom is incredibly reliable, and people were still motivated to buy generators, candles, battery powered gadgets, etc. (Abi Ghanem et al., 2016). Also, Beenstock (1991) provides a theoretical framework which states that the cost of power outages should be reflected in spending on generators. Generators are considered like insurance to unreliable electricity. When considering a setting like South Africa, where the electricity outages were expected to be frequent and without an end in sight, economic theory would suggest that households will use more generators and other more reliable forms of energy.

On days when their area is experiencing load shedding, South Africans must complete daily tasks without

electricity. There are a handful of articles about the impact of load shedding that have found there are health effects (Gehring et al., 2018; Ndaguba, 2017), socio-political angst (Neilson, 2017), and adverse effects to business owners (Goldberg, 2015). Load shedding can generate many unintended consequences. In Pakistan, changes in consumption because of load shedding suggest that individuals are switching to backup systems which results in technical losses and grid system issues (Kazmi et al., 2019). In South Africa, there may be increases in pollution as lower income household burn solid waste for energy and higher income households use diesel fuel generators (Pretorius et al., 2015). The increased risk of house fires during load shedding is a possible unintended consequence from changes in household energy consumption that is not yet addressed in the previous literature.

2.3 Data

Data on household energy consumption come from the General Household Survey, which is conducted annually by the South African government. Only responses from households in the Western Cape province, where Cape Town is located, are used in this article. While the Western Cape province is a larger geographic area than the city, 80% of the province’s population resides in Cape Town. The survey responses used in this article come from over 17 thousand households in the Western Cape province from 2012 to 2018. The responses of interest to this article are the main source of energy used for cooking, lighting, and heating the home. The options for cooking energy source are electricity, generator, gas, paraffin, wood, and nothing. For lighting, households could select electricity, generator, gas, paraffin, or candles as their main source. And finally, for heating energy source, the options are electricity, gas, paraffin, or wood. Of course, another option is to have no energy source, or an unlisted other source of energy for cooking, lighting, or heating. Basic information about the household such as the race, gender, and age of the household head is included to account for generational and cultural differences in energy consumption. The effects of Apartheid persist in housing in South Africa, and that is why racial controls are appropriate to use to proxy for neighborhood and housing characteristics that are otherwise not observed in the data (Budlender and Royston, 2016; Pieterse, 2009; Wilkinson, 1998). Table 2.2 displays the summary statistics of the General Household Survey responses. Each of the energy sources for each purpose is listed, where the mean value can be interpreted as the percentage of households that use this energy as their main source for cooking, lighting, or heating. In terms of demographics, the survey is balanced across all years used in this study, and is representative of the entire population in the Western Cape (STATS SA, 2020). The unit of observation is an annual survey response from a household.

Data about residential fires in Cape Town come from the city’s public database. The incident-level data spans from January 1, 2009 to March 31, 2016 and was aggregated to daily counts by load shedding area. Cape Town is divided into numbered load shedding areas, as seen in Figure 2.2. The outcome variables that come from this data are the count of fires on a day in an area, and then the data is split into fires at formal or informal houses. The load shedding areas are relatively large geographical areas, spanning many neighborhoods. In Cape Town, informal settlements are dispersed throughout the city. Typically, informal dwellings are made from materials that catch fire easily, and the homes are built close together, which poses a greater fire risk when compared to formal housing. Therefore, it is useful to look at both types of homes separately, as well as the overall effect.

The timing, spacing, and duration of load shedding is seemingly random, at least from the perspective of a household. Eskom announces load shedding via Twitter and the news, often with very little warning. In those announcements, the duration of the load shedding, which varies greatly from day to day, is usually not specified, or incorrect. Finally, to identify which areas experience power outages on load shedding days, there is a schedule that rotates through the numbered areas by day of the month and hour of the day. For example, in Figure 2.1 it shows that on August 8, 2015, Eskom announced over Twitter that load shedding had already begun by 11:30 AM and would likely continue to 10:00 PM. Individuals would be expected to know which areas are going to experience power outages in that time frame on the 8th day of the month. Table 2.1 is an abbreviated version of the load shedding schedule used in Cape Town. On the 8th day of the month, Areas 11-16 are expected to experience load shedding based on the details in Eskom’s tweet. The final step is to know which numbered area of Cape Town one is located. For instance, a student of the University of Cape Town may reside in Area 15 and attend school in Area 7. While campus will not lose power on the 8th, their home will experience a power outage from 6 PM to 8:30 PM. In Figure 2.1, Eskom mentions that the load shedding is Stage 1, which means it is the least severe kind of load shedding. As the numbered stages increase, more areas are added to each 2.5 hour window, like those shown on Table 2.1, increasing the probability that areas experience power outages on a given day.

Hand-collected information from Eskom’s tweets in 2014 and 2015 about when load shedding occurred was combined with Cape Town’s load shedding schedule to determine which areas would experience load shedding when and for how long. Data on load shedding from just 2014 and 2015 is used even though load shedding continues to this day. In 2016, there was no load shedding. In 2017, there was a water crisis and severe drought in Cape Town, and so results including 2017 may capture the effect of the drought on residential fires, and not load shedding. For 2018 and onwards, there have been multiple issues with individuals not

paying for Eskom's services as a way to protest load shedding, and so Eskom has retaliated with shutting off the electricity for neighborhoods or customers refusing to pay. Therefore, it becomes more difficult to identify which areas are experiencing power outages due to random load shedding or repercussions for not paying Eskom. A variable of interest is generated using this method. The variable, *LoadSheddingInArea* is for if a load shedding area experienced a power outage on that day based on the times given by Eskom and their eligibility for load shedding. The second half of Table 2.2 holds the summary statistics for the residential fire data and load shedding schedule.

2.4 Household Energy Consumption

This section reports the changes in household energy consumption in the Western Cape after load shedding. Though the infrastructural issues occurred at the end of 2014, all respondents in the surveys in the 2015 survey and onward would have experienced load shedding and be aware of the ongoing crisis. Therefore, respondents of the survey in 2015 and in the following years are considered to be affected by load shedding. The variable of interest in Tables 2.3 - 2.5 is called *PostLoadShedding* which a dummy variable that indicates if the survey response occurred in 2015 or later. The model is as follows:

$$EnergySource_{it} = PostLoadShedding_t + X_{it} + \epsilon_{it}$$

Where the outcome variable, *EnergySource_{it}*, is which sources of energy the households indicated they use for each purpose in a given year. *PostLoadShedding_t* is the dummy variable to indicate the year is greater than or equal to 2015, and *X_{it}* is a vector of covariates corresponding with a household in a year such as, the household's monthly income, and the age, gender and race of the survey respondent. The General Household Survey asked respondents to name their main source of energy for cooking, lighting, and heating in that year. The options are electricity, generators, gas, paraffin, candles, and wood. Some of these energy sources are only used for a single purpose, like candles are only used for lighting. The outcome variables are discrete and correlated due to the nature of the survey question's structure. Therefore, it is appropriate to use a multinomial logit regression. Multinomial logit regressions are often used in scenarios when a survey response can be selected from a list of options. Then, one possible answer is used as a reference point to the other responses. In this case, the coefficient on the variable of interest, *PostLoadShedding_t*, indicates the change in consumption of an energy source relative to the consumption of electricity after load shedding begins. For instance, in Table 2.3 the coefficient in the first column suggests that once load shedding began,

the logit coefficient for generator use, relative to electricity use, will go up by 2.57. In other words, households are more likely to stay with a generator than switching to electricity. For cooking energy source, the positive and significant coefficients for generator, gas, and wood usage suggests that households were more likely to use those energy sources compared to electricity after load shedding.

Table 2.4 shows the results regarding the household's main energy source for lighting. The positive and significant coefficients for generator, gas, paraffin, and nothing/other mean that households were more likely to continue using those energy sources, or lack thereof, or switch from electricity to those options after load shedding begins. Table 2.5 holds the results for the multinomial logit regression where the outcome is a household's main energy source for heating. Generator usage for heating is the only positive and significant coefficient for an alternative energy source. This means that those who were using electricity to heat their homes continued to do so rather than use another source of energy, like wood, gas, or paraffin. There are a couple possible explanations for why there are different results for heating energy source compared to cooking and lighting. First, electric heaters are typically cheaper than gas heaters. On Eskom's website about heating options during periods of load shedding, they admit that electric heaters are actually more convenient and controllable than gas heaters, even if they do not work during periods of load shedding. Additionally, Eskom recommends to only heat rooms that people are currently spending time in. They discourage the use of wall mounted heaters, but suggest that fan heaters or air conditioners with a heating cycle could be cost-effective and energy-conscious ways to heat a home (Eskom, 2020).

The results in Tables 2.3 - 2.5 provide evidence that households changed their consumption behavior after load shedding to alternatives to electricity. The substitutes for electricity are more reliable during the power outages and are often cheaper than electricity. As household increase their use of wood in place of electricity for cooking, the risk of house fires also increases. The same could be said for paraffin lamps, which pose a higher fire risk than electrical alternatives (Dlamini, 2020). Additionally, electric space heaters also present an increased fire risk when compared to gas furnaces. Load shedding causes the power to appliances to switch on and off, which can create power surges. During a power surge, the voltage coming through to the home can become too high, which degrades the insulation in wires and poses a very serious fire risk (Qukula, 2015). The results in Tables 2.3 - 2.5 suggest that individuals are consuming energy sources that are more risky in terms of fires because they are cheaper or more reliable during periods of load shedding. Residential fires are a possible unintended consequence of load shedding because of the patterns in household energy consumption.

2.5 Residential Fires

A decrease in household consumption of electricity and substitution to other energy sources could have many unintended consequences. One of the possible consequences is the prevalence of fires. This section of the article explores the relationship between load shedding and residential fires. The models are as follows:

$$(1) \text{ResidentialFires}_{da} = \text{PostLoadShedding}_d + \text{Area} + \text{Month} + \epsilon_{da}$$

$$(2) \text{ResidentialFires}_{da} = \text{LoadSheddingInArea}_{da} + \text{Area} + \text{Month} + \epsilon_{da}$$

The outcome variable, *ResidentialFires*, is the count of fires on a day, by load shedding area. First, the variable of interest is *PostLoadShedding* which indicates that the date in question is after the announcement of Eskom's load shedding crisis, December 5, 2014. Then, the variable of interest is *LoadSheddingInArea* for if there is load shedding on that day in the load shedding area. Different specifications of the two models split the data into the count of fires in an area for formal houses only, and then for informal houses only to see the heterogeneous effects of load shedding on the prevalence of residential fires. The outcome variable is a discrete count of fires, so it is appropriate to use an ordered logit regression in this case. Tables 2.6 - 2.9 show the results for the ordered logit regression, and determine the likelihood another fire occurring because of load shedding.

According to Table 2.6, there were more fires after the information shock about the energy crisis, and load shedding begins. Additionally, this effect is larger in informal housing than in formal housing. The variable, In the even numbered columns, the coefficients have been transformed so they can be interpreted as odds-ratios. For instance, in column 2 of Table 2.6, after load shedding, an area is 1.159 times more likely to have one more fire on each day than before load shedding.

In Table 2.8, the variable of interest is a dummy variable that indicates if an area experienced a power outage on that day, called *LoadSheddingInArea*. On days where Eskom implemented load shedding, the areas that had power outages saw an increase in the prevalence of fires. Overall, an area was over 1.1 times more likely to see an additional residential fire on a day when they experienced load shedding than they otherwise would in the absence of load shedding.

Tables 2.7 and 2.9 present the results for a linear probability model rather than the ordered logit. The results are consistent in sign and significance to the previous tables. This reinforces the findings that after load shedding began, there were more residential fires. Additionally, there are more fires in an area on days

when Eskom implemented load shedding, and the magnitude of this result is larger for informal housing. Another advantage to using a linear probability model is ease of interpreting coefficients. For instance, according to Table 2.9, on a day when an area had power outages, there were approximately 0.116 more fires. Of course, there can't be a fraction of a fire, but when the daily average in the data is 0.244 for an area, this is a sizable increase. In the data, different areas experience load shedding 722 times, which means there were approximately 84 more fires because of load shedding in a 9 month period between 2014 and 2015.

Fires are extremely costly to clean up and replace or repair damaged property. In the United States, the average house fire costs a household over \$11,000 (FIXR, 2021). Based prices per sq foot, homes are 1.5 to 4 times more expensive in a US city than in Cape Town (Lippi, 2021)³. While it is impossible to know the extent of the damage for these fires, because they were reported to the city and had an emergency response, it is likely they caused some kind of damage to the residence.

2.5.1 Stages of Load Shedding

There are different levels of severity of load shedding, known as stages. As the numbered stages increase, more load shedding areas are added to each 2.5 hour window on the schedule. For Stage 1, there is one area per 2.5 hour window, for Stage 2, there are two areas, and so on. Eskom determines what stage to implement depending on the strain on the grid. In Table 2.10, there appears to a positive relationship between the stage of load shedding and the instances of residential fires.

2.5.2 Placebo Tests

The results in Table 2.6 and 2.7 suggest that there are more fires after load shedding. Perhaps, the results in Tables 2.8 and 2.9 are driven by this change in the prevalence of fires over time, and not daily variation in load shedding. Placebo tests can help decipher if the previous results are truly being driven by load shedding. First, in Table 2.11, the areas are randomly selected to be “treated” with load shedding over the actual 11 month period where load shedding happened in 2014 and 2015. There is no significant relationship between the randomly selected areas with load shedding, also known as the placebo treatment, and residential fires.

Next, the exact same days and areas experienced load shedding received the “treatment”, but in the years 2012 and 2013 instead of 2014 and 2015. There was no load shedding in 2012 and 2013, so if positive and significant results were to occur from this, then that would mean the previous results are not coming from the power outages. Table 2.12 shows that there is no relationship between this placebo treatment of

³The analysis only considers cities of a similar size to Cape Town

load shedding and residential fires.

Tables 2.11 and 2.12 support the previous results, which find that in areas that experience load shedding on a given day, there are more residential fires. The findings suggest that the increase in residential fires is due to the heightened risk of fires caused by the power outages. Individuals in residences during a power outage are likely to switch to other energy sources to complete daily tasks, which can increase the risk of fires. There is evidence that people are changing their main source of energy due to load shedding, but individuals that typically rely on electricity could still switch to a substitute energy source just during periods of load shedding. Thus, the results in this article about household energy consumption serve as a lower bound estimate of how individuals respond to load shedding.

2.6 Conclusion

Power outages disrupt daily life, and the literature has shown that they can be quite costly. Scholars are beginning to understand the unintended consequences of shutting off electricity to reduce strain on the grid, but none have discussed how there is an increased risk of fire during power outages. Motivated by evidence of changes in household energy consumption during an energy crisis, this article looks at how power outages are related to house fires. After the news broke of South Africa's energy crisis, load shedding became an issue individuals had to face almost daily. Households were left with the option of using alternative energy sources or being left in the dark. Using data from Cape Town, South Africa to explore the behavioral responses to load shedding, there is evidence that significant number of households switched from electricity usage for cooking and lighting to other sources, like generators, wood, paraffin, and gas. But, there are trade-offs associated with switching to a more reliable form of energy.

By exploiting plausibly exogenous variation in load shedding timing and spacing, this article captures the true effect of power outages on residential fires. When an area is experiencing a power outage due to load shedding, there is an increased likelihood that there will be more residential fires that day. The increased risk of fires due to the change in household consumption of energy poses an economically significant cost of load shedding. After load shedding begins, there are significantly more fires in Cape Town. Furthermore, there were significantly more fires in the areas that were experiencing power outages on a given day. This article provides evidence that load shedding corresponds with an increase in the number of fires in Cape Town, which should be considered as a cost of the power outages.

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Figure 2.1: Example of Twitter notification of load shedding

Figure 2.2: Map of load shedding areas in Cape Town

Table 2.1: Abbreviated Load Shedding Schedule Example

		Stage 1									
Day of Month		1	2	3	4	5	6	7	8	9	10
From	To										
00:00	02:30	1	13	9	5	2	14	10	6	3	15
02:00	04:30	2	14	10	6	3	15	11	7	4	16
04:00	06:30	3	15	11	7	4	16	12	8	5	1
06:00	08:30	4	16	12	8	5	1	13	9	6	2
08:00	10:30	5	1	13	9	6	2	14	10	7	3
10:00	12:30	6	2	14	10	7	3	15	11	8	4
12:00	14:30	7	3	15	11	8	4	16	12	9	5
14:00	16:30	8	4	16	12	9	5	1	13	10	6
16:00	18:30	9	5	1	13	10	6	2	14	11	7
18:00	20:30	10	6	2	14	11	7	3	15	12	8
20:00	22:30	11	7	3	15	12	8	4	16	13	9
22:00	00:30	12	8	4	16	13	9	5	1	14	10

Table 2.2: Summary Statistics

Variable	Mean	St. Deviation	Min	Max
Cooking = electricity	0.874	0.332	0	1
Cooking = generator	0.021	0.143	0	1
Cooking = gas	0.093	0.291	0	1
Cooking = paraffin	0.013	0.075	0	1
Cooking = wood	0.003	0.054	0	1
Cooking = nothing/other	0.003	0.057	0	1
Lighting = electricity	0.401	0.490	0	1
Lighting = generator	0.003	0.057	0	1
Lighting = gas	0.025	0.155	0	1
Lighting = paraffin	0.013	0.075	0	1
Lighting = candles	0.001	0.035	0	1
Lighting = nothing/other	0.491	0.499	0	1
Heating = electricity	0.863	0.344	0	1
Heating = generator	0.022	0.149	0	1
Heating = gas	0.006	0.077	0	1
Heating = paraffin	0.013	0.075	0	1
Heating = wood	0.012	0.109	0	1
Heating = nothing/other	0.079	0.269	0	1
Fires per day	0.244	0.560	0	6
Fires in formal dwellings	0.124	0.038	0	4
Fires in informal dwellings	0.120	0.037	0	5
Load shedding day in area	0.013	0.113	0	1

Table 2.3: Multinomial Logit Regression Results: Cooking Energy Source

	Generator	Gas	Paraffin	Wood	Nothing/Other
Post Load Shedding	2.570*** (0.162)	0.371*** (0.054)	-0.101 (0.215)	0.627*** (0.283)	0.104 (0.278)
Age of respondent	-0.061*** (0.005)	0.006*** (0.002)	-0.031*** (0.009)	-0.016 (0.011)	-0.044*** (0.011)
Gender of respondent = female	-0.181 (0.121)	-0.345*** (0.059)	-0.351 (0.227)	-0.743** (0.344)	0.303 (0.269)
Race of respondent	✓	✓	✓	✓	✓
Observations	17,512	17,512	17,512	17,512	17,512

Table 2.4: Multinomial Logit Regression Results: Lighting Energy Source

	Generator	Gas	Paraffin	Candles	Nothing/Other
Post Load Shedding	2.256*** (0.309)	1.164*** (0.101)	0.926*** (0.069)	-1.849** (1.037)	0.807*** (0.0036)
Age of respondent	-0.041*** (0.012)	0.006 (0.003)	0.021*** (0.003)	0.005 (0.016)	-0.002 (0.001)
Gender of respondent = female	0.370 (0.272)	-0.305*** (0.115)	0.535*** (0.068)	0.276 (0.449)	0.041 (0.035)
Race of respondent	✓	✓	✓	✓	✓
Observations	17,512	17,512	17,512	17,512	17,512

Table 2.5: Multinomial Logit Regression Results: Heating Energy Source

	Generator	Gas	Paraffin	Wood	Nothing/Other
Post Load Shedding	2.203*** (0.148)	-2.011*** (0.369)	-3.839*** (0.452)	-4.830*** (0.999)	-3.153*** (0.170)
Age of respondent	-0.056*** (0.005)	-0.009 (0.007)	0.020*** (0.005)	-0.005 (0.005)	-0.002 (0.002)
Gender of respondent = female	-0.170 (0.116)	-0.243 (0.225)	0.366*** (0.124)	-0.320*** (0.157)	0.061 (0.060)
Race of respondent	✓	✓	✓	✓	✓
Observations	17,512	17,512	17,512	17,512	17,512

Table 2.6: Ordered Logit Regression Results

	All Houses		Formal		Informal	
	(1)	(2)	(3)	(4)	(5)	(6)
Post Load Shedding	0.148*** (0.029)	1.159*** (0.029)	0.166*** (0.036)	1.181*** (0.036)	0.226*** (0.037)	1.253*** (0.037)
Area FE	✓	✓	✓	✓	✓	✓
Month FE	✓	✓	✓	✓	✓	✓
Odds-Ratio		✓		✓		✓
Observations	55,587	55,587	55,587	55,587	55,587	55,587

Table 2.7: Linear Model Results

	All Houses	Formal	Informal
Post Load Shedding	0.041*** (0.006)	0.018*** (0.004)	0.022*** (0.004)
Area FE	✓	✓	✓
Month FE	✓	✓	✓
Adjusted R-squared	0.092	0.052	0.067
Observations	55,587	55,587	55,587

Table 2.8: Ordered Logit Regression Results

	All Houses		Formal		Informal	
	(1)	(2)	(3)	(4)	(5)	(6)
Load Shedding in Area	0.095 (0.096)	1.100*** (0.096)	0.512*** (0.100)	1.669*** (0.110)	0.280*** (0.110)	1.323*** (0.110)
Area FE	✓	✓	✓	✓	✓	✓
Month FE	✓	✓	✓	✓	✓	✓
Odds-Ratio		✓		✓		✓
Observations	55,587	55,587	55,587	55,587	55,587	55,587

Table 2.9: Linear Model Results

	All Houses	Formal	Informal
Load Shedding in Area	0.116*** (0.020)	0.073*** (0.014)	0.043*** (0.014)
Area FE	✓	✓	✓
Month FE	✓	✓	✓
Adjusted R-squared	0.092	0.052	0.067
Observations	55,587	55,587	55,587

Table 2.10: Stage of Load Shedding and Residential Fires

	All Houses		Formal		Informal	
	(1)	(2)	(3)	(4)	(5)	(6)
Stage of Load Shedding	-0.013 (0.037)	0.035*** (0.007)	0.171*** (0.039)	0.020*** (0.005)	0.135*** (0.042)	0.015*** (0.005)
Area FE	✓	✓	✓	✓	✓	✓
Month FE	✓	✓	✓	✓	✓	✓
Ordered Logit Model	✓		✓		✓	
Linear Model		✓		✓		✓
Adjusted R-squared	–	0.091	–	0.052	–	0.067
Observations	55,587	55,587	55,587	55,587	55,587	55,587

Table 2.11: Placebo Test: Randomized treatment over load shedding period

	All Houses		Formal		Informal	
	(1)	(2)	(3)	(4)	(5)	(6)
Load Shedding Day in Area (random)	-0.103 (0.103)	-0.008 (0.020)	-0.074 (0.126)	-0.004 (0.014)	0.010 (0.127)	-0.005 (0.014)
Area FE	✓	✓	✓	✓	✓	✓
Month FE	✓	✓	✓	✓	✓	✓
Ordered Logit Model	✓		✓		✓	
Linear Model		✓		✓		✓
Adjusted R-squared	—	0.091	—	0.051	—	0.067
Observations	55,587	55,587	55,587	55,587	55,587	55,587

Table 2.12: Placebo Test: Same load shedding treatment, but in 2012 & 2013

	All Houses		Formal		Informal	
	(1)	(2)	(3)	(4)	(5)	(6)
Load Shedding Day in Area (same days, other years)	-0.001 (0.101)	-0.007 (0.020)	0.068 (0.122)	0.010 (0.014)	-0.188 (0.136)	-0.016 (0.014)
Area FE	✓	✓	✓	✓	✓	✓
Month FE	✓	✓	✓	✓	✓	✓
Ordered Logit Model	✓		✓		✓	
Linear Model		✓		✓		✓
Adjusted R-squared	—	0.091	—	0.051	—	0.067
Observations	55,587	55,587	55,587	55,587	55,587	55,587

Chapter 3

Using Currency Iconography to Measure Institutional Quality

3.1 Introduction

The images on a country's currency are purposefully chosen by the people or government to be representative of that country and what it values most. Potentially, one could learn a lot about the economic and political climate of a country by simply looking at the pictures on its money. Using the MRI Banker's Guide to Foreign Currency, I record and categorize the images on every currency note for 198 countries and create indexes measuring the political, religious, arts/cultural, and scientific/agricultural content found on the currency notes. Additionally, I examine whether or not women were featured on the country's currency to create an index reflecting this dimension. The resulting index scores are then compared to various measures of institutional quality and socio-economic outcomes.

3.2 Literature Review

The iconographic analysis of currency notes is a much-discussed topic in disciplines outside economics. Sociologists, historians, anthropologists, and many others have looked at the images on currency notes to discuss the social and political environment within a country. There is even a 'Bank Note of the Year' contest held by the International Bank Note Society, which is decided by vote. Voters evaluate the "artistic merit, design, use of [color], contrast, balance, and security features of each nomination" IBNS (IBNS, 2018). It is widely accepted that the images on a country's currency hold significance, so they are worthy of discussion. Most of the iconographic work on money looks at a single country's currency: Denmark (Sorensen, 2016), Ghana (Fuller, 2008), Indonesia (Strassler, 2009), Laos (Tappe, 2007), Scotland (Penrose and Cumming, 2011), Palestine (Wallach, 2011), Taiwan (Hymans and Fu, 2017), and the former Soviet Union (Cooper, 2009).

While most scholars have looked at a country's currency at a point in time, Schwartz (2014) examined the change in images on Chinese currency from the 1940s to the 1990s. In particular, he examined the use of classical socialist, including Soviet, imagery on the Yuan. An oncoming train, for example, symbolizes the inevitability of the socialist revolution. Peasants and workers looking off into the distance reflected another theme in Soviet art, common people wistfully looking toward a promising socialist future. Mao's absence on the Yuan note until after his death might be attributed to communist ideas around money, and Mao him-self said the achievements of an individual should not be glorified. However, this is in direct contradiction with basically every other form of media, which painted Mao as practically a divine being. Schwartz argues that keeping his face off of the currency was a strategic decision to dissociate him from the state and maintain

his image as an ally to the masses.

Hymans (2004) investigated the evolution of currency iconography in Europe from the 19th century to the era of the Euro. He found that there were iconographic changes over time that reflected the social changes and trends we know from history. And yet, there are few iconographic differences across the European countries at any point in time. Hymans suggests that the images on European countries currencies were probably not used as propaganda towards their own citizens, but rather to mirror the values of their neighbors to legitimize themselves and fit in with a broader, collective European identity.

An unrelated strand of literature within economics has been trying to find new, unconventional ways to measure social or economic conditions. Chong et al. (2014) mailed letters to nonexistent addresses of businesses and then graded government efficiency by how promptly, if at all, the letters were returned. The goal was to create an objective measure of government efficiency across the 159 countries observed. They found that their measures of efficiency correlated with other indicators of government quality.

Henderson et al. (2012) used satellite images of nighttime lights to estimate economic activity. They found that their estimates were different by only a few percentage points from the official data. However, their method allowed for more specific regional and international analysis that was not possible from other conventional ways to collect this data.

Fisman and Miguel (2007) measured government corruption by recording foreign diplomat parking violations in New York City. Thanks to diplomatic immunity, foreign diplomats may legally ignore parking tickets, but many still do pay them voluntarily. Diplomats from highly corrupt countries did in fact pay less than those from other less corrupt countries. Thus, parking ticket payments may serve as a proxy for the cultural norms in the home country.

This paper attempts to unite the literature on the iconography of currency with the literature using unconventional methods to measure country-level characteristics. The images found on a nation's currency may be indicators for socio-economic conditions or underlying institutional quality. Unlike the previous literature which looks at why a currency's iconography has changed overtime in a certain country or region, this project seeks to answer the question: is currency iconography a good indicator of institutional quality for all countries?

3.3 Data Collection

The *MRI Banker's Guide to Foreign Currency* (MRI, 2015) publishes color images and descriptions of every currency note in circulation in the world. The images on all currency notes in circulation were coded using six

categories to create four indexes based on political, science and agricultural, arts and cultural, and religious content. A fifth index measures if women are on the currency. The six major categories are: current political, modern political, ancient political, religious, science & technology, and arts & culture. Things that did not fall cleanly into the above categories were coded as ‘other’ and were omitted from the analysis. The ‘other’ category included things like animals, plants, everyday objects, unnamed people, and views of generic scenes.¹

Political images were categorized in one of three ways: Current, Modern, or Ancient. Current political images included any depiction of a current head of state, government building still in use, any infrastructure named after current head of state, the flag of that country, constitutions, or other symbols of the state. For example, in 2015, Thailand’s money featured King Bhumibol, who was the king at the time. Queen Elizabeth II was coded as current political only for the United Kingdom. However, due to her lack of political power and cultural icon status in the Commonwealth, her picture was coded as cultural when featured on the money in countries such as the Cayman Islands. Modern political images included any depiction of previous heads of state in current form of government, political activists or revolutionaries helped found or create of the current form of government, a declaration of independence, government-built infrastructure, infrastructure named after previous heads of state of the current form of government, and government monuments for current form of government. For example, past presidents like George Washington and Andrew Jackson, were coded as modern political for the United States.

Finally, ancient political images included any leaders/activists from any previous form of government, any symbols, flags, monuments from previous form of government. For example, the Egyptian 100 pound note has a mask of Tutankhamen.

To generate a country’s political index score, all three types of political images were combined and weighted. Current political images were given a score of 1. Next, modern political images were given a score of 0.5. Finally, if the images were coded as ancient, they were given a score of 0.25. The scores were added up and divided by the number of sides of the bills in the country.

An image coded as science & agriculture if it depicted any people or things that have to do with science, math, education, technology, agriculture, navigation, economics, and energy. For example, Kuwait has an oil refinery on its 5 dinar bill, and Norway has scientist Kristian Birkeland on its 200 kroner bill. Each side of a bill that had this kind of imagery was added up and divided by the number of sides of the bills in that country.

¹For examples of using publicly available information to create a proxy for institutional quality or well being, see Helfer (2017), Lawson (2019) and Martin et al. (2017).

Additionally, an image was coded as arts & culture if it depicted any people or things that have to do with art, history, culture, architecture, sports, literature. All of Switzerland’s francs were coded as arts & culture, with different artists, musicians, writers on one side of the bill and then some of their designs, sculptures, manuscripts, etc. on the other. This category also included any mythical creatures or beings with cultural significance. For example, in Hong Kong many banknotes have pictures of dragons, which hold cultural significance. This score was calculated in the same manner as the science and agriculture score.

For the religious index, any religious building, symbol, or figure on a currency note went towards the country’s score. Like the previous two indexes, each instance of religious imagery was added up and divided by the number of sides of the bills in that country.

Irrespective of the category the image, the notes with women on them were considered for the fifth index. The women index was generated in a similar way to the political index. If the woman was real, it was coded as “named” and given a score of 1. For example, New Zealand has Kate Sheppard, a well-known suffragette, on its ten-dollar bill. A head of state that was not elected or a wife of a political leader was given a score of 0.5. The most common instance of this was Queen Elizabeth II, who is on a great number of currency notes. Women from mythology, fiction, and allegorical representations were also included in this category. Finally, if the picture of the woman was not based on any one in particular it was considered a “nameless” woman and given a score of 0.25. An example would be The Gambia, which has a woman posed with a bird on its 50 Dalasi note. Each instance was added up and then divided by the number of sides of the bills in each country.

3.4 Results

Table 1 shows the political index scores. The countries are ranked in order from most political imagery to least. Countries that did not have any political content on their currency received a score of 0. More than three-quarters of the countries had some form of political imagery on their currency. Thailand has the most political currency with a score of 0.73.

Table 2 shows the science and agriculture index scores. The score comes from currency notes with images of people or things that had to do with science, math, education, technology, agriculture, navigation, economics, or energy. If a country did not have any images in those categories, it received a score of 0. Somalia had the highest score on this index with 0.75, followed by the countries using the Central African franc. The Central African francs have images of children learning in school, various industrial and agricultural scenes, and technology and machinery on their banknotes.

Table 3 is the arts and culture index. The countries are ranked in order from having the most imagery about art, history, culture, architecture, sports and literature to least. Switzerland had a score of 1 indicating that every side of every bill had images that fell in this category. There were no political or religious (or other) images on Switzerland's currency notes.

Table 4 reports the religion index. Countries with no religious imagery on their currency received a score of 0. Macedonia had the most religious currency with a score of 0.61, meaning 61% of the available space on Macedonia's banknotes has a religious person, building, or symbol.

Table 5 gives the final index that measures how many women are depicted on a country's currency. A country's score was not only determined by if there was a woman, but who the woman was. A famous artist or political leader received a higher weight than a queen who simply was born or married into her position. Even so, royalty scored higher than nameless women. Australia had the highest score in the women index with 0.38. About one third of the 198 countries have women represented on their currency.

Table 6 reports descriptive statistics of the five indexes. 198 countries were scored in each iconographic index. Despite different scoring methods, the maximum possible score in all four currency indexes was 1. However, only the human achievement index had a score of 1, given to Switzerland.

Also in Table 6 are the descriptive statistics for four measures of institutional quality or socio-economic outcomes: economic freedom, political freedom, human development, and gender inequality. The economic freedom (EFW) index measures the consistency of a nation's politics and institutions with a market liberal economy (Gwartney et al., 2015). More economic freedom earns a higher numerical score using a 0–10 scale.

Freedom House, 2015 gives each country two scores, one for civil liberties and one for political rights. The degree of freedom is rated on a scale of 1–7, with a score of 1 being the freest (FreedomHouse, 2015). The two scores were averaged for an overall political freedom score. For this project, the scale was inverted so that countries with more freedom had a higher score, and those with less a lower score.

The United Nations publishes the Human Development Index (HDI), which rates 188 countries over 3 main criteria: health, education, and income (UN, 2015b). Factors like life expectancy, years in school, and GNI per capita are used to create a score with 1 being the highest possible human development and 0 the least. For the year 2015, Norway had the highest score of 0.949, and Central African Republic had the lowest score of 0.352.

The Gender Inequality Index (GII) published by the United Nations is calculated using a country's maternal mortality ratio, adolescent birth rate, share of seats in parliament, percentage of female population over age 25 with at least some secondary education, and labor force participation (UN, 2015a). A lower

score means that there is less inequality, and a higher score means that there is more inequality between the sexes. According to the GII, gender equality is at its highest in Switzerland, which received a score of 0.040. Yemen has the most gender inequality with a score of 0.767.

Table 7 shows the correlation matrix among the five currency indexes and the four measures of institutional quality or socio-economic outcomes. The Human Development Index and the Gender Inequality Index had the highest negative relationship of 0.9. The highest positive relationship was between the Economic Freedom of the World Report and the Human Development Index at 0.59. The women and arts/culture currency indexes have the highest positive correlation among the currency indexes at 0.36. This is probably because the women shown on banknotes were mostly artists, musicians, and scholars. Also, it is noteworthy that the women and the arts/culture currency indexes have a positive relationship with economic freedom, political freedom and the HDI. And they both have a negative relationship with the GII. In contrast, the political and science/agriculture currency indexes have a negative relationship with economic freedom, political freedom, and the HDI. And they both have positive relationship with the GII.

Table 8 shows some basic regression results. The independent variables are the political, science & agricultural, and arts & culture currency indexes as well as the women currency index interacted with a commonwealth country dummy variable, as well as the religion currency index interacted with a OPEC country dummy variable. The dependent variables are the economic freedom index, the political freedom index, the human development index, and the gender inequality index.

Countries that are in the Commonwealth of Nations, British overseas territories, or crown dependencies have Queen Elizabeth II on their banknotes. In an attempt to have the women currency index scores capture the representation of women on the banknotes, and not be British Commonwealth scores, I split the women currency index into these countries associated with the British monarchy and non-Commonwealth countries.

Additionally, I noticed a similar relationship between the countries with high religious index scores and OPEC countries, which originally led to a strong positive relationship between the religious currency index and the HDI which is partially based on per capita income, so I decided to separate the religious currency index into OPEC and non-OPEC countries.

For economic freedom, several coefficients stand out. For a one standard deviation increase in the science/agriculture currency score, a country's EFW rating was lower by about 0.3 units. But for a one standard deviation increase in the arts/culture currency score, a country's EFW rating was higher by 0.14 units. Furthermore, for the OPEC countries, with a one standard deviation increase in the religion index score corresponds with a lower EFW rating, by about 0.37 units, over two standard deviations. This was

not the case for non-OPEC countries, which have an insignificant negative relationship between the EFW rating and the religion currency index. And for the Commonwealth countries, with a one standard deviation increase in the women currency index, a country's EFW rating was higher by about 0.45 units. However for the non-Commonwealth countries, there was no significant change to their EFW ratings with a change in the women currency index.

It appears that having more political images on currency may indicate less political freedom in that country. For a one standard deviation increase in the political currency index, a country's political freedom rating was lower by over 0.5 units. For the science/agriculture currency index, the effect was even greater, with a lower political freedom rating of almost one point. The scale for the Freedom in the World index is 1–7 and a one-point change is quite meaningful. This is also the case with religious images, for both OPEC and non-OPEC countries, which with a one standard deviation increase corresponded with decreases in political freedom ratings of 1.04 and 0.22, respectively.

The only positive significant effect shown for political freedom in the table is with the women currency index for non-Commonwealth countries. For these countries, with one standard deviation increase, a country's political freedom rating was about 0.5 points higher. A standard deviation for the women index is 0.08. For reference, increasing a country's women index score by 0.08 is not that difficult. This would happen if a country with six bills, e.g., \$1, \$5, \$10, \$20, \$50, \$100, put just one named woman on one side of one of those bills.

In relation to the Human Development Index, a higher science/agriculture currency index score corresponds to a lower HDI. A standard deviation increase in the science/agriculture currency index corresponds with a lower HDI score of about 0.07 units. But a higher arts/culture currency index score corresponds to a higher HDI. A standard deviation increase in the arts/culture currency index score corresponds with a higher HDI score of about 0.02. The scale of the HDI is from 0 to 1, so these effects are actually quite large. The HDI is calculated using life expectancy, years of schooling, and GNI per capita. If the hypothesis of this paper is correct, the images on a country's currency should explain what the people value in that country. This is in line with the results for the science/agriculture and arts/culture indexes.

For OPEC countries, higher religion currency index is indicative of higher HDI scores. For standard deviation increase in the religion currency index, an OPEC country's HDI score is 0.05 higher. While some studies have shown that more religious communities are healthier and have longer life expectancy, the non-OPEC countries do not indicate this relationship with the HDI and religion currency index (Coruh et al., 2005; Koenig, 2012). One possible explanation for this is the oil-rich OPEC countries score highly on the

HDI because of the GNI per capita. Also, the women currency index scores for non-Commonwealth countries have a strong positive relationship with HDI scores. This was not the case with the Commonwealth nations that have a positive, but insignificant, relationship.

The Gender Inequality Index's relationship with the political currency index suggests that more politicized imagery on money could indicate less gender equality in that country. For a standard deviation increase in the political currency index, a country's GII score was 0.05 higher. Higher science/agriculture currency index scores imply less gender equality as well. For a standard deviation increase in the science/agriculture currency index, a country's GII score was 0.09 higher. Finally, a non-Commonwealth country with a higher women index score can expect a lower score on the GII, meaning more equality between the men and women in that country. For a standard deviation increase in the women currency index, a non-Commonwealth country's GII score was 0.03 lower. The GII is on a scale of 0–1, with 1 being very high gender inequality. And given the scale, these effects are quite large.

Table 9 is the countries that use the Euro, but what their scores would have been if they were still using the last issued version of whatever currency they used before the Euro. The Euro notes were purposefully designed to have neutral and non-political imagery (Anderson, 2006). All of these images are in the “other” category in the way I coded them. So in my five indexes, the countries that use the Euro get a score of 0. Because this project is only looking at the 2015 currency notes and numbers, several countries that would have had nonzero scores in the five currency indexes have zero scores. Luxembourg would have had one of the highest political currency index scores, and several of the other countries had very high arts/culture and science/agriculture scores. This means that if this project had been done looking at a world before the Euro, the results may look a little different. However, recall Hyman's 2004 paper, which finds that there are relatively indistinguishable iconographic differences between the European countries. Giving all of the Euro countries the same score should not drastically distort the findings of this project. While they may have had nonzero scores in a world before the Euro, giving them all the same score is still reasonable, given the previous literature.

Additionally, because these countries chose neutral imagery, and not to put pictures of people from each of countries in the European Union on the money, or famous works of art from Europe, or any other distinctly European scene, I believe that this is still inline with the premise of this paper. The governments decided to not emphasize political imagery, but they also chose to not emphasize any other kind of imagery. It is very possible to have a currency union and have political, cultural or religious currency iconography. Several other currencies used by multiple countries, like the Eastern Caribbean dollars, West African francs, and

Central African francs all had nonzero scores in the currency indexes.

3.5 Conclusion

This project's goal was to see if the currency iconography could tell us something about a country's characteristics. The images on currency notes represent a choice that is a reflection of what the people in that country value, whether that is their political leaders, religion, achievements in arts and science, etc. This study found that countries with more women on their money tend to have more political freedom, higher human development scores, and less gender inequality. Countries with scientific and agricultural imagery on their currency tend to have less economic freedom, less political freedom, lower human development scores and more gender inequality. Additionally, I found that political imagery corresponds with less political freedom in that country and more inequality between the genders. These results suggest that we can look to the iconography of a nation's currency as an indication of the quality of the institutions or socio-economic outcomes in that country.

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Table 3.1: Political Currency Index Scores

Country	Political Index	Country	Political Index
Thailand	0.73	St. Lucia	0.19
United States	0.64	St. Vincent and The Grenadines	0.19
Brunei	0.64	Djibouti	0.19
Swaziland	0.63	Uganda	0.18
Jordan	0.60	Albania	0.18
Oman	0.57	Australia	0.18
Solomon Islands	0.52	Gibraltar	0.18
Gambia, The	0.51	Northern Ireland	0.17
Macao	0.50	Hong Kong	0.17
Brazil	0.50	Belarus	0.17
England	0.50	Lebanon	0.17
Haiti	0.50	Paraguay	0.17
Suriname	0.50	Peru	0.16
Uzbekistan	0.50	Syria	0.16
Argentina	0.49	Ukraine	0.16
Cambodia	0.48	Qatar	0.15
Tonga	0.46	Bolivia	0.15
Cuba	0.46	Burundi	0.15
Honduras	0.46	Chile	0.15
Morocco	0.46	Myanmar	0.15
Guyana	0.44	Venezuela	0.15
Kenya	0.43	Korea, North	0.15
Mauritius	0.42	Mexico	0.15
Bangladesh	0.41	United Arab Emirates	0.14
India	0.40	Iran	0.13
Dominican Republic	0.39	Mongolia	0.13
Hungary	0.39	Serbia	0.13
Laos	0.39	South Africa	0.13
Angola	0.38	Uruguay	0.13
Bahrain	0.38	Czech Republic	0.12
Barbados	0.38	Guernsey	0.11
Namibia	0.38	Bulgaria	0.10
Tajikistan	0.38	Egypt	0.10
Bahamas	0.36	Nicaragua	0.10
Bhutan	0.35	Comoros	0.10
Turkmenistan	0.35	Georgia	0.10
Botswana	0.35	Iceland	0.10
Trinidad and Tobago	0.34	Isle of Man	0.10
Kuwait	0.34	Samoa	0.10
Ghana	0.33	Yemen, Rep.	0.10
Saudi Arabia	0.33	Zambia	0.09
Tanzania	0.33	Bermuda	0.08
Vietnam	0.32	Iraq	0.08
Singapore	0.31	Sri Lanka	0.08
Indonesia	0.30	New Zealand	0.08
Nigeria	0.30	Taiwan	0.08
Philippines	0.30	Scotland	0.07
Transnistria	0.30	Belize	0.06
Pakistan	0.29	Rwanda	0.06
Papua New Guinea	0.29	Kyrgyz Republic	0.05
China	0.28	Russia	0.05
Guatemala	0.28	Korea, South	0.05
Malawi	0.28	Algeria	0.05
Croatia	0.27	Benin	0.05
Jamaica	0.26	Burkina Faso	0.05
Canada	0.25	Cameroon	0.05
Colombia	0.25	Central Afr. Rep.	0.05
Curacao and St Maarten	0.25	Chad	0.05
Israel	0.25	Congo, Rep. Of	0.05
Lesotho	0.25	Cote d'Ivoire	0.05
Liberia	0.25	Equatorial Guinea	0.05
Libya	0.25	Gabon	0.05
Malaysia	0.25	Guinea-Bissau	0.05
Moldova	0.25	Madagascar	0.05
Mozambique	0.25	Mali	0.05
South Sudan	0.25	Niger	0.05
St. Helena	0.25	Sao Tome and Principe	0.05
Turkey	0.25	Senegal	0.05
Poland	0.24	Togo	0.05
Tunisia	0.23	Ethiopia	0.05
Vanuatu	0.22	Armenia	0.04
Sierra Leone	0.22	Azerbaijan	0.04
Costa Rica	0.21	Sweden	0.04
Jersey	0.21	Bosnia and Herzegovina	0.04
Anguilla	0.19	Cape Verde	0.03
Antigua and Barbuda	0.19	Denmark	0.03
Grenada	0.19	Seychelles	0.03
Montserrat	0.19	Kazakhstan	0.02
St. Kitts and Nevis	0.19	Macedonia	0.02
		Countries with 0 score ²	0.00

Table 3.2: Science Currency Index Scores

Country	Science Score	Country	Science Score
Somalia	0.75	Mauritius	0.18
Cameroon	0.70	Romania	0.18
Central Afr. Rep.	0.70	New Zealand	0.18
Chad	0.70	Oman	0.17
Congo, Rep. Of	0.70	Bulgaria	0.17
Equatorial Guinea	0.70	Colombia	0.17
Gabon	0.70	Czech Republic	0.17
Ethiopia	0.56	Georgia	0.17
Maldives	0.52	Mexico	0.17
Azerbaijan	0.50	Qatar	0.17
England	0.50	Somaliland	0.17
Liberia	0.50	Turkey	0.17
Rwanda	0.44	Canada	0.15
Serbia	0.41	South Africa	0.15
Benin	0.35	Swaziland	0.15
Burkina Faso	0.35	Vietnam	0.14
Cote d'Ivoire	0.35	Guinea	0.13
Guinea-Bissau	0.35	Sri Lanka	0.13
Mali	0.35	Tunisia	0.13
Niger	0.35	Vanuatu	0.13
Senegal	0.35	Macao	0.12
Togo	0.35	Saudi Arabia	0.11
Congo, Dem. R.	0.33	Cambodia	0.11
Syria	0.33	Uruguay	0.11
Guyana	0.31	Australia	0.10
United Arab Emirates	0.31	Bolivia	0.10
Northern Ireland	0.31	Bosnia and Herzegovina	0.10
Anguilla	0.30	Cape Verde	0.10
Antigua and Barbuda	0.30	Comoros	0.10
Botswana	0.30	India	0.10
Burundi	0.30	Indonesia	0.10
Grenada	0.30	Isle of Man	0.10
Madagascar	0.30	Lesotho	0.10
Montserrat	0.30	Libya	0.10
Nigeria	0.30	Yemen, Rep.	0.10
St. Kitts and Nevis	0.30	Tonga	0.09
St. Lucia	0.30	Afghanistan	0.08
St. Vincent and The Grenadines	0.30	Barbados	0.08
Sweden	0.30	Cuba	0.08
Iraq	0.29	Honduras	0.08
Mauritania	0.27	Pakistan	0.08
Laos	0.25	Venezuela	0.08
Russia	0.25	Iran	0.07
Sierra Leone	0.25	Guernsey	0.06
Singapore	0.25	Japan	0.06
Sudan	0.25	Transnistria	0.06
Taiwan	0.25	Ukraine	0.06
Scotland	0.24	Bangladesh	0.06
Kuwait	0.24	Hong Kong	0.05
Guatemala	0.21	Denmark	0.05
Kazakhstan	0.21	Gambia, The	0.05
Paraguay	0.21	Kenya	0.05
Solomon Islands	0.21	Peru	0.05
Korea, South	0.21	Morocco	0.05
Algeria	0.20	Cayman Islands	0.04
Bahrain	0.20	Hungary	0.04
Eritrea	0.20	Papua New Guinea	0.04
Fiji	0.20	Kyrgyz Republic	0.04
Malawi	0.20	Zambia	0.03
Norway	0.20	Thailand	0.03
Tanzania	0.20	Lebanon	0.02
Trinidad and Tobago	0.20	Philippines	0.02
Malaysia	0.19	Countries with 0 score ³	0.00

Table 3.3: Arts and Culture Currency Index Score

Country	Arts & Culture Index	Country	Arts & Culture Index
Switzerland	1.000	Fiji	0.200
Uruguay	0.625	Indonesia	0.200
Romania	0.619	Jamaica	0.200
Kyrgyz Republic	0.607	Bahamas	0.194
Bosnia and Herzegovina	0.600	Mexico	0.188
Norway	0.600	Tunisia	0.188
Aruba	0.500	Hong Kong	0.184
Australia	0.500	Syria	0.183
Bulgaria	0.500	Macedonia	0.179
Cayman Islands	0.500	Qatar	0.167
Falkland Island/Islas Malvinas	0.500	Sudan	0.167
Gibraltar	0.500	Uzbekistan	0.167
Iceland	0.500	Vanuatu	0.167
Isle of Man	0.500	New Zealand	0.150
Japan	0.500	Sao Tome and Principe	0.150
Jersey	0.500	Dominican Republic	0.143
Sweden	0.500	Barbados	0.125
Tajikistan	0.472	Congo, Dem. R.	0.125
Sri Lanka	0.429	Guatemala	0.125
Armenia	0.417	Kuwait	0.125
Belarus	0.417	Rwanda	0.125
Cape Verde	0.417	Macao	0.118
Georgia	0.417	Iran	0.111
Ukraine	0.406	Bahrain	0.100
Albania	0.400	Malawi	0.100
Bolivia	0.400	Samoa	0.100
Myanmar	0.400	Taiwan	0.100
Belize	0.375	United Arab Emirates	0.094
Nicaragua	0.375	Costa Rica	0.083
Serbia	0.375	Iraq	0.083
Turkmenistan	0.375	Kazakstan	0.083
Turkey	0.333	Maldives	0.083
Guernsey	0.313	Papua New Guinea	0.083
Paraguay	0.292	Solomon Islands	0.083
Colombia	0.286	Northern Ireland	0.081
Scotland	0.281	Yemen, Rep.	0.075
Azerbaijan	0.250	Cambodia	0.071
Czech Republic	0.250	Singapore	0.063
Guinea	0.250	Transnistria	0.063
Korea, South	0.250	China	0.056
St. Helena	0.250	Tonga	0.054
Peru	0.225	Denmark	0.050
Croatia	0.214	Malaysia	0.042
Russia	0.208	Mauritania	0.042
Algeria	0.200	Philippines	0.042
Canada	0.200	Haiti	0.031
Chile	0.200	Countries with 0 score ⁴	0.00

Table 3.4: Religion Currency Index Scores

Country	Religion Index	Country	Religion Index
Macedonia	0.61	Samoa	0.10
Egypt	0.50	Yemen, Rep.	0.10
Iran	0.33	Bangladesh	0.10
Saudi Arabia	0.31	Transnistria	0.09
Dominican Republic	0.25	Morocco	0.09
Libya	0.25	Bermuda	0.08
Moldova	0.25	Brunei	0.08
Mexico	0.23	Bulgaria	0.08
Cambodia	0.21	Israel	0.08
Bhutan	0.21	Jersey	0.08
Russia	0.21	Mauritania	0.08
Iceland	0.20	Nicaragua	0.08
Japan	0.19	Paraguay	0.08
Ukraine	0.19	Qatar	0.08
Afghanistan	0.17	Turkmenistan	0.08
Armenia	0.17	Korea, South	0.08
Iraq	0.17	Romania	0.07
Maldives	0.17	Serbia	0.06
Pakistan	0.17	United Arab Emirates	0.06
Guernsey	0.16	Macao	0.06
Czech Republic	0.15	Kuwait	0.06
Peru	0.15	Guatemala	0.05
Croatia	0.14	Sri Lanka	0.05
Guyana	0.13	Malawi	0.05
Thailand	0.13	Poland	0.05
Tunisia	0.13	Sao Tome and Principe	0.05
Albania	0.10	Scotland	0.04
Algeria	0.10	Hungary	0.04
Australia	0.10	Philippines	0.04
Bahrain	0.10	Kyrgyz Republic	0.02
Bolivia	0.10	Uruguay	0.02
Indonesia	0.10	Oman	0.02
Jordan	0.10	Countries with 0 score ⁵	0.00

Table 3.5: Women Currency Index Scores

Country	Women Index	Country	Women Index
Australia	0.38	Iceland	0.10
England	0.38	Jamaica	0.10
Anguilla	0.25	Peru	0.10
Antigua and Barbuda	0.25	Syria	0.10
Belize	0.25	Colombia	0.09
Cayman Islands	0.25	Argentina	0.08
Falkland Island/Islas Malvinas	0.25	Bahamas	0.08
Gibraltar	0.25	Costa Rica	0.08
Grenada	0.25	Switzerland	0.08
Jersey	0.25	Turkey	0.08
Montserrat	0.25	Venezuela	0.08
Philippines	0.25	Kyrgyz Republic	0.07
Scotland	0.25	Uruguay	0.07
St. Helena	0.25	Djibouti	0.06
St. Kitts and Nevis	0.25	Serbia	0.06
St. Lucia	0.25	Transnistria	0.06
St. Vincent and The Grenadines	0.25	Ukraine	0.06
Fiji	0.20	Cameroon	0.05
Isle of Man	0.20	Central Afr. Rep.	0.05
Norway	0.20	Chad	0.05
Sweden	0.20	Congo, Rep. Of	0.05
Czech Republic	0.19	Equatorial Guinea	0.05
Guernsey	0.19	Gabon	0.05
Canada	0.15	Thailand	0.05
New Zealand	0.15	Bhutan	0.04
Dominican Republic	0.14	Liberia	0.04
Brazil	0.13	Cambodia	0.04
Guinea	0.13	Ethiopia	0.03
Japan	0.13	Botswana	0.03
Korea, South	0.13	Burundi	0.03
Northern Ireland	0.13	Cape Verde	0.03
Somalia	0.13	Kuwait	0.02
Georgia	0.10	Trinidad and Tobago	0.02
Mexico	0.10	Zambia	0.02
Paraguay	0.10	Tonga	0.02
Chile	0.10	Sri Lanka	0.02
Eritrea	0.10	Countries with 0 score ⁶	0.00

Table 3.6: Summary Statistics

Variable	Observations	Mean	St Dev	Min	Max
Political Index	198	0.181	0.170	0	0.725
Science Index	198	0.141	0.172	0	0.750
Arts & Culture Index	198	0.124	0.184	0	1.000
Religion Index	198	0.043	0.086	0	0.607
Women Index	198	0.048	0.083	0	0.375
Economic Freedom	155	6.873	0.869	3.29	9.03
Political Freedom	198	3.111	2.173	1	7
Human Development	176	0.694	0.159	0.348	0.944
Gender Inequality	152	0.363	0.193	0.016	0.744

Table 3.7: Correlation Matrix Among All Indexes

	Political	Science	Arts	Religion	Women	EFW	PF	HDI
Political	1							
Science	-0.16	1						
Arts	-0.25	-0.07	1					
Religion	0.01	-0.18	0.12	1				
Women	-0.01	0.14	0.36	-0.01	1			
EFW	-0.01	-0.34	0.2	-0.08	0.16	1		
PF	-0.18	-0.4	0.12	-0.19	0.28	0.5	1	
HDI	-0.13	-0.4	0.26	0.09	0.29	0.59	0.56	1
GII	0.27	0.38	-0.26	-0.04	-0.18	-0.57	-0.57	-0.9

Table 3.8: Regression Results

	Dependent Variable			
	Economic Freedom	Political Freedom	Human Development	Gender Inequality
Political	-0.109 (0.388)	-3.094*** (0.757)	-0.096 (0.063)	0.336*** (0.083)
Science	-1.763*** (0.400)	-5.787*** (0.769)	-0.384*** (0.065)	0.499*** (0.083)
Arts & Culture	0.745* (0.505)	-0.785 (0.769)	0.124* (0.067)	-0.104 (0.085)
Religion	-0.743 (0.772)	-2.785* (1.596)	-0.012 (0.130)	0.122 (0.159)
(not OPEC)	-3.060* (1.621)	-8.696*** (3.377)	0.467* (0.271)	-0.203 (0.327)
Religion (OPEC)	-1.103 (1.528)	6.863*** (3.117)	0.535*** (0.256)	-0.604* (0.325)
Women (not Commonwealth)	3.739** (1.714)	4.682 (3.117)	0.144 (0.275)	0.025 (0.363)
Women (Commonwealth)				
Adjusted R-squared	0.147	0.373	0.246	0.265
Observations	198	198	198	198

Table 3.9: European Countries' Pre-Euro Scores

Country	Political	Science/Agriculture	Art/Culture	Religion	Women
Austria	0	0.5	0.46	0	0.08
Belgium	0.17	0.05	0.46	0.04	0
Cyprus	0	0	0.4	0.08	0.05
Estonia	0.08	0.13	0.5	0	0.06
Finland	0.04	0	0.43	0.14	0
France	0.06	0.43	0.56	0	0.06
Germany	0.01	0.05	0.02	0.02	0.23
Greece	0.06	0.07	0.29	0.18	0.07
Ireland	0.18	0.25	0.15	0.1	0.1
Italy	0.02	0.36	0.54	0.07	0.07
Latvia	0.02	0	0.25	0	0.02
Lithuania	0.08	0.21	0.42	0.13	0
Luxembourg	0.67	0	0	0	0
Malta	0.16	0	0.5	0	0.13
Netherlands	0.01	0.2	0.2	0.02	0
Portugal	0	0.85	0.1	0	0
Slovakia	0.15	0.07	0	0.43	0.04
Slovenia	0	0.16	0.63	0.08	0.06
Spain	0.25	0.22	0.19	0.03	0