



**MEASURING THE EFFECTIVENESS OF US
MILITARY HUMANITARIAN
CONSTRUCTION PROJECTS THROUGH
GEOSPATIAL ANALYSIS OF PUBLIC
OPINION IN BELIZE**

THESIS

Arthur Dietrich, Captain, USAF
AFIT-ENV-MS-16-M-144

**DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY**

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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Degree of Master of Science in Engineering Management

Arthur Dietrich, BS
Captain, USAF

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Arthur Dietrich, BS
Captain, USAF

Committee Membership:

Col Paul Cotelleso, PhD
Chair

Edward D. White III, PhD
Member

John J. Elshaw, PhD
Member

Abstract

As part of broader US foreign policy efforts the Department of Defense (DoD) increasingly conducts complex operations which focus on efforts to influence local populations. These “hearts and minds” operations often include humanitarian and development construction projects. The wider impact on US foreign policy effort from the US military’s participation in projects traditionally conducted by civilian agencies is not well understood. This research examined the effects on local public opinion from two US Air Force led “Operation New Horizons” Humanitarian and Civic Assistance (HCA) missions conducted in the nation of Belize in 2013 and 2014. The study specifically looked for a relationship between US led humanitarian activities and observational changes in local government performance and local attitudes towards the US. This research developed methodology to examine for these effects through geospatial analysis of the AmericasBarometer public opinion surveys already being collected at the national level. The results of this research showed the feasibility of incorporating analysis of this type of data into the evaluation of DoD humanitarian and development projects. Further, the results of this study suggest that the 2013 and 2014 New Horizons projects did not have a significant effect on local government performance. Additionally, this study found US activities to be associated with drops in both trust in the US government and US military among local populations.

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Arthur Dietrich

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MEASURING THE EFFECTIVENESS OF
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THROUGH GEOSPATIAL ANALYSIS OF PUBLIC OPINION IN BELIZE

I. Introduction

US military operations have grown in recent years to include humanitarian and civic assistance programs in an effort to “win hearts and minds” of foreign populations. The Department of Defense (DoD) now considers stability operations, including humanitarian and civil assistance, a core mission, which the service departments should be able to conduct with the equivalent proficiency as combat operations are conducted (US General Accounting Office, 2012, p. 1). Planners, however, do not adequately understand the wider impact of humanitarian projects on local populations. United States Combatant Commands claim humanitarian assistance programs help gain influence, promote US access, and increase stability in foreign countries, yet they offer little data to support these assertions (US General Accounting Office, 2012, p. 22). For these reasons DoD policy requires an examination of the long-term effects of the humanitarian assistance programs in partner countries (Department of Defense, 2014a, p. 2). In accordance with these mandates this study will measure the effects of US military humanitarian programs through spatial analysis of public opinion data.

This thesis explores and attempts to quantify the effect of humanitarian assistance construction projects on local populations in a traditional five-chapter format. The study examines specifically the impact on public opinion from the 2013 Operation New Horizons construction program in the Central American Nation of Belize shown

in Figure 1. Public opinion data from the AmericaBarometer semiannual survey was used to measure the impact of the New Horizons projects on the local population of Belize (Seligson et al., 2015).



Figure 1. Location of Belize.

1.1 Background

The US Military conducts a variety of humanitarian assistance programs throughout the world. These include both humanitarian assistance responses to natural disasters and development programs that target at risk populations. Within the sphere of development programs is the Humanitarian and Civic Assistance (HCA) program. The HCA program has multiple objectives: to train US Military Forces, to meet humanitarian need, and to address higher-order security cooperation strategic objectives (Rand Corporation, 2011, p. 18). The HCA program includes engineering

construction and medical outreach projects, which allow US military engineers and medical personnel to practice their skills while training for employment in austere foreign environments. HCA projects must also contribute to higher-order strategic goals that support the security and foreign policy goals of the United States, as well as meeting basic economic and security needs of the country where the projects are conducted (Department of Defense, 2014a, p. 2).

The effects of these projects on the nations where they are conducted is not well understood. Beyond the direct and indirect measures of performance (MOP), such as how many schools are completed or how many children are enrolled in school, measuring the wider effectiveness of DoD humanitarian programs proves challenging. The measures of effectiveness (MOE) should quantify progress towards military objectives and, in the case of HCA, progress towards US foreign policy development goals (Department of Defense, 2014b, pp. iv-6). While the DoD directs the assessment of HCA projects to determine their initial and long-term effects, findings reveal that project assessments are rarely completed (Department of Defense, 2014a, p.2; US General Accounting Office, 2012, p. 20). Without an effective assessment program, the positive and negative effects of HCA programs will continue to go unmeasured (US General Accounting Office, 2012, p. 22).

The DoD acknowledges a lack of understanding of the effects of its development projects. US military-led development projects, while meeting tactical military objectives, have unintended second-order and third-order consequences on wider US foreign development goals. Often, military leadership are not even aware of these higher-order effects. Due to the uncertainty of the effects, the GAO has recommended that DoD's role in humanitarian assistance be reexamined (US General Accounting Office, 2012, p. 38). This study attempts to examine some of the effects of DoD humanitarian assistance programs to better understand the justification and potential drawbacks

of the programs.

1.2 Problem Statement

If the US military is going to be a successful partner in developmental assistance, a better understanding of the effectiveness and ramifications of humanitarian assistance programs on local populations is needed. This research looks for effects on public opinion relationships in geographically-modeled AmericasBarometer survey data associated with exposure to completed US humanitarian projects. The scope of this research encompasses the effects from of the 2013 and 2014 New Horizons US Air Force humanitarian operations in the nation of Belize.

1.3 Research Questions

This study examines four research questions:

1. How do US military construction projects impact the performance of the local host nation government?
2. How do US military construction projects impact trust toward local populations in the US government and the US military?
3. How does time elapsed since project completion and the distance between project and population, affect the impact of US projects on the above factors?
4. How can exposure to US military construction projects be effectively modeled?

1.4 Methodology Overview

This study examines the role of the 2013 and 2014 New Horizons exercise on shaping citizen popular opinion in Belize. Specifically, this study looks at the difference

in public opinion prior to the New Horizons projects compared to after the projects using measurement of attitudes towards local government and attitudes towards the United States. The study compiles data from the semi-annual AmericasBarometer survey conducted in Belize in 2012 and 2014 (Seligson et al., 2015). The 2012 survey data was used to build a pretreatment baseline snapshot image of preexisting opinion in Belize. This image provides a control for geographic variation in demographic and latent distribution of popular opinion prior to the US intervention in order to better understand the effects of the 2013 US-led projects. The study employs a linear spatial regression model, which uses both measured demographic and opinion variables, as well as geographic inputs (LeSage, 2008, pp. 19-20). The primary analysis uses data from the 2014 AmericasBarometer survey to analyze citizen attitudes towards local government and the US to look for any significant relationship based on citizen exposure to 2013 and 2014 New Horizons projects.

1.5 Project Scope

This study develops a method to measure the wider effectiveness of US humanitarian projects. It strives to meet the need for measurement and evaluation which goes beyond basic project level assessment (Rand Corporation, 2011, p. 2). The study also examine how geography and population characteristics influence the effect of US humanitarian projects. Instead of focusing on the immediate measures of performance (MOP) of HCA projects, such as how many additional children attend school because of a project, this study examines the impact on higher order strategic measures (Rand Corporation, 2011, p. 15).

Using surveys to measure the effectiveness of development projects and programs has been found to be an effective methodology (Rand Corporation, 2011, p. 52). Surveys at the project level are typically tailored to measure more direct MOPs, while

national or wide area surveys are used to measure strategic Measures of Effectiveness (MOE) for projects (US Agency for International Development, 2011, p. 6). While MOPs can be directly attributed to a specific project or program, MOEs, such as local government legitimacy or attitudes towards the US, can be influenced by many factors beyond the development program. This study examines MOEs at the project level by controlling for variation in public opinion behavior using baseline, pre US intervention, imaging and spatial regression modeling (Ward and Gleditsch, 2008, p. 37).

Interaction between people is an important part of social science. Interaction, however, is not captured in most empirical social science research. Traditional regression models used in social science research assume individual observations are independent (LeSage and Pace, 2011, p. 20). This fails to capture the affect individuals have on each other. The strength of interaction between individuals has been shown to decrease with distance. Spatial regression can capture this observation by considering the effects of spatial dependence between observations (Goodchild et al., 2000, p.141; Ward and Gleditsch, 2008, pp. 1-2).

Using spatial regression this study can describe the behavior of how observations are influenced by neighbors. There are two sources of dependence between neighbors. First, geographic proximity causes increased interaction between observations; where neighbors can influence one other. Second, observations in close proximity will be affected by the same latent and apparent influences (Anselin, 2010, p. 3; LeSage and Pace, 2011, pp. 19-20). For example, an individual's satisfaction with his/her local government will be influenced by his/her neighbor's opinions both through interaction and proximity to apparent and latent influences. When examining this cluster phenomena in spatial regression, it is difficult to identify whether the clustering is caused by network, apparent, or latent influences. Spatial regression, instead, is a tool

that explains the behavior of how observations relate to each other based on their spatial proximity without necessarily being able to differentiate the cause (Goodchild et al., 2000, p. 149; Ward and Gleditsch, 2008, p. 83). For the purposes of this study, spatial regression was used to explain some of the natural clustering and variation found in geographically diverse survey data, which allowed a clearer analysis of any observable relationship between US projects and local populations. The causality of the clustering does not need to be explained.

In addition to expected variation due to spatial proximity, the effect of development projects were influenced by other non-spatial factors of the observed population. These factors include socio-economic demographics and the determinants of social capital. Socio-economic demographics include education, economic prosperity, and family status. Social capital broadly represents the institutions, relationships, attitudes, and values that govern interactions among people and contribute to economic and social development (World Bank, 2009, p. 2). For example, some communities have the social capital skills to band together and improve their situation while others do not. Differences in measured social capital of observed populations have been shown to influence the success of and measured attitudes towards development programs. Social capital can be broken down into several sub-factors which are measurable through a variety of ways including survey data from individuals and communities (Grootaert, 2004, p. 6; Grootaert and Van Bastelaer, 2002, p. 8; Social Impact, 2011, p. 122; World Bank, 2009, pp. 1-10). For this study, measures of individual social capital are found in the AmericasBarometer survey data. Additionally, measures of community social capital are derived through spatial analysis of neighborhoods of observations based on proximity (World Bank, 2009, p. 24).

The treatment being studied in this thesis is citizen exposure to the New Horizons 2013 US construction projects in Belize. For this study, exposure will be based on the

relative proximity of the survey observations to the 2013 project locations. Project location data came from the Overseas Humanitarian Shared Information System (OHA-SIS) project database, which includes spatial-temporal data for DoD humanitarian projects (Defense Security Cooperation Agency (DSCA), 2015). This study examined several methods for modeling exposure to US projects derived from the distance between survey locations and US humanitarian activity locations. The study will attempt to find a relationship between the exposure variable and the post-treatment variance in the 2014 data set. Figure 2 shows the location of the 2013 and 2014 US humanitarian projects relative to the 2012 and 2014 survey locations.

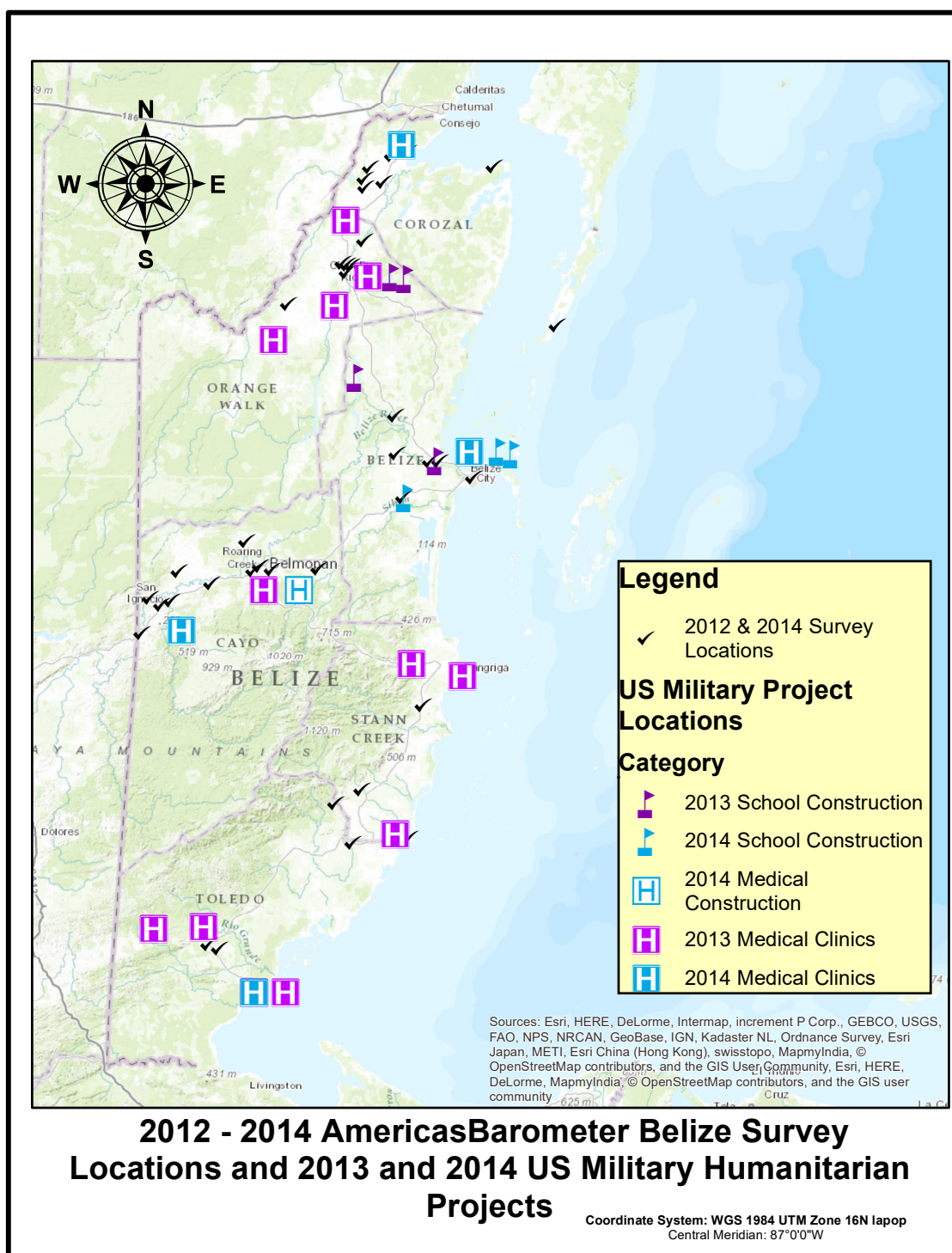


Figure 2. Locations of 2013 and 2014 US military humanitarian projects in Belize relative to surveyed locations.

1.6 Limitations

This study is not without its limitations. First, this project utilized survey data which have already been collected to measure the effects of a set of projects in the past, which limits the study to the data available from the AmericasBarometer surveys. There are also limits to what causality can be inferred from this type of ex post facto study without additional studies (Patten, 2009, pp. 5–7). An additional source of error in this study is the time between the surveys and the project completion. The baseline surveys for this study were completed a year before the projects, and the post-treatment surveys were completed a year after the 2013 projects. Typical methodology when designing surveys specifically for assessing a project would have the baseline survey completed just before the project and post-treatment survey completed just after the project (Rand Corporation, 2011, pp. 10–11). The delay between project completion and survey, however, could be considered beneficial in that any shock effects of the projects have dampened which allows study of the effects of the projects on the long-term equilibrium of local public opinion (LeSage and Pace, 2011, pp. 24–25).

This study is also limited in that it does not consider how different types and sizes of projects could affect citizen behavior. Additionally, the project methodology does not include survey observations that are in close proximity to multiple projects. Thus, this study is not designed to consider the saturation point for US assistance (Manu and Walker, 2006, p. 478). Additional limitations exist because the study only relies on survey data. While relationships between survey observations can be realized using survey data alone, some qualitative research is also required to have a full understanding of the causality of complex public opinion phenomena (Social Impact, 2011, p. 24; World Bank, 2009, p. 22). Finally, this study does not consider the structural elements of local government and citizen interactions, which impacts

the success of a HCA program. Belize is a single country with a homogeneous government structure. Differences in structural forms for government and social capital interactions are not measured in the data available (World Bank, 2009, p. 9). Specific influences from variation in these factors should be partially explained as latent geographic influences in the spatial model, which would allow a more accurate model of the effect of US government projects.

1.7 Benefits

Benefits of this study include that it can be developed into a tool which may reduce the need for on-site after action assessments (AAR) for every project. The DoD has been found to be slow in collecting required data for humanitarian assistance programs. From 2005 to 2009, 90% of DoD humanitarian assistance projects did not have the mandated one year AAR completed. Reasons why project evaluations were not performed included lack of personnel available to conduct evaluations, difficulties visiting project sites, and cost (US General Accounting Office, 2012, pp. 15-23). An additional benefit of this study is the examination of the geographic reach of US-led development projects (World Bank, 2009, p. 153).

A successful assessment program for humanitarian projects should include a plan to collect data before and after a project, so that outcomes can be measured (Rand Corporation, 2011, p. 10; Social Impact, 2011, p. ix). This study methodology benefits from utilizing freely available before and after data for the population where the projects were performed, which enables a retroactive before and after assessment to be carried out. Typical methodology for objectively measuring the effects of a project or program require surveys specific to the projects being measured. By extracting local spatial data from wide-area data that have already been collected, this study may eliminate the need for project-specific surveys to be performed (Rand Corporation,

2011, p. 52).

A final benefit to utilizing independently collected data is that the impact of a DoD survey can be reduced. Development measurement and assessment should not cause harm to populations being studied. There can be risks due to continued US-led survey assessments. Additionally, the requirement for baseline surveys for accurate assessment may lead to surveys being performed in areas where projects are planned but eventually canceled. The impact on populations which are surveyed in expectation of a humanitarian assistance project may have a negative consequence on opinions towards the US (Piombo, 2010, p. 8; Social Impact, 2011, p. 6).

This study aims to develop a methodology to exploit already collected data. The LAPOP AmericasBarometer survey provided a rich source of demographic and public opinion data including measures pertinent to US military operations. Data like the AmericasBarometer will continue to become available. The trend in collecting data for evaluation of development projects will continue into the future. The United Nations (UN) Sustainable Development Goals (SDG) are a major policy outline for worldwide development being laid out in 2015 (United Nations, 2015). Following the Millennium Development Goals (MDG), which were set in 2000 for development targets in 2015, the SDG outlines the collective development targets of the UN member states to be achieved by 2030 (United Nations, 2012). One of the major sections of the SDG is Data, Monitoring, and Accountability, which includes the collection of high quality development measurement data for least developed countries by 2020 (United Nations, 2015). This study will provide useful methodology for analyzing data with a spatial context which can be made available for program evaluation and planning (Rand Corporation, 2011, p. x; US General Accounting Office, 2012, p. 24).

By using academically rigorous survey data, this study provides an objective tool for assessing the higher order impact of US construction projects. DoD-led humanitar-

ian efforts often do not have the planned effects which they claim to achieve (Piombo, 2010, p. 8; Rand Corporation, 2011, p. 37; US General Accounting Office, 2012, pp. ii,22). The DoD tries to balance meeting humanitarian needs with strategic objectives when selecting project efforts, which can cause DoD projects to have a different effect on populations than projects carried out by other development agencies and Non-Government Organizations (NGOs) (Piombo, 2010, p. 11; Rand Corporation, 2011, p. 37). The unknown and negative effects of US military-run projects has led to a push for the role of the US military in development to be reconsidered (Piombo, 2010, pp. 10-11; US General Accounting Office, 2012, p. 39). This study provides a methodology for objective evaluation of the higher-order and long-term effects of using US forces in development programs (Social Impact, 2011, p. 3; US Agency for International Development, 2011, p. 9).

The results of this study may lead to future areas of study. First, data generated by the project may be utilized in decision analysis tools which help US military planners select the best projects for development efforts (Loomis and Crowley, 2001, p. 39; Piombo, 2010, p. 19; Rahman and Smith, 2000, p. 447; Saie, 2014; US General Accounting Office, 2012, p. 23; World Bank, 2009, p. xii). Additionally, the models of how public opinion behaves in developing countries may be useful to simulate the effects of hypothetical projects or determining the amount and types of projects required to achieve a desired stability and development goal (Goodchild et al., 2000, p. 149; US Agency for International Development, 2011, p. 7).

1.8 Originality

This study explores a novel methodology for utilizing national-level survey data that have already been collected to gauge the effectiveness of DoD humanitarian projects at the local level. The project will use local and spatial examination and

modeling of the AmericasBarometer data to develop a baseline of how public opinion behaves spatially and reacts to US development projects. This study further examines how non-spatial factors, such as social capital, influence how public opinion reacts to US projects (Claude, 2009, p. 124; Rand Corporation, 2011, p. 54; US Agency for International Development, 2011, p. 8; World Bank, 2009, p. 10).

II. Literature Review

2.1 Chapter Overview

This thesis breaks the literature review into three categories. The first section covers an overview of the US development policy and the humanitarian civic assistance program and includes strategic policy guidance as well as an examination of the literature supporting the need for a more robust assessment program. The second section summarizes literature related to the measurement of development programs with a specific emphasis on measuring development through citizen surveys. The final section covers literature related to the methodology of combining survey and spatial analysis in social science applications.

2.2 International Development Overview

The broad policy aims and guidance of development programs must be understood in order to effectively measure the impact of development programs. This section examines the broader aims of why nations conduct development assistance, specific strategic goals of US DoD development programs, and the need for and shortcomings of the measurement of development programs.

2.2.1 International Development Motivation and Strategy.

Nations and organizations carry out development programs for a variety of reasons. The motivations for giving aid span a spectrum from addressing purely humanitarian needs to fulfilling strategic foreign policy interests. Nations now recognize the national defense benefits that come from engaging in international development programs. More developed and more democratic nations better resist falling into conflicts which require military intervention. Military operations now include civil development as

part of their broader operations. Military strategic planners look at security threats across a wide spectrum that includes at the local neighborhood level and traditional state actor adversaries (Baylis et al., 2011, p. 102; Department of Defense, 2011b, p. ix; Donnelly, 2000, p.162; Piombo, 2010, p. 11; Sterling-Folker, 2013, p. 67).

2.2.2 Democracy and Development.

A healthy robust democracy represents the end goal for many international development programs and military “nation building” operations. Many factors contribute to the development of democracy. A successful democracy requires both competent government institutions, such as free and fair elections, as well as a conducive social and economic character at the local population level (Diamond, 2002, p. 21; Grootaert and Van Bastelaer, 2002, pp. 3-6; Inglehart and Welzel, 2005, pp. 3-6; Metcalfe et al., 2012, p. 6). Contemporary research by Inglehart and Welzel challenges the traditional assumption that democratic institutions cause value change. Instead, they found a causal relationship where self-expression values led to democratic values and successful democratic institutions. The challenges experienced in building successful democracies in post 2003 Iraq and the post-Soviet states show how democratic transition first requires an underlying democratic culture rather than reliance on competent institutions at the national level (Inglehart and Welzel, 2005, pp. 3-5).

At the local population level, a successful democracy requires a high degree of free expression (Inglehart and Welzel, 2005, p. 6; US Southern Command, 2008, p. 14; White House, 2015, p. 21). Additionally, successful democratic development at the local level also requires a minimum level of economic development. Studies show how levels in the underlying democratic culture among different European and Latin American countries affect which countries successfully transitioned to healthy

democracies. Populations with low economic attainment remain in a survival mentality. Socio-economic change leads to value change, specifically self-expression values, which leads to democracy. As values shift from traditional to secular-rational, there is also a shift from survival values to self-expression values. An economically healthy and socially empowered population better resists setbacks common in all democratic development processes (Inglehart and Welzel, 2005, p. 6; Przeworski, 1991, pp. 170, 189).

2.2.3 Social Capital and Infrastructure in Development.

The socio-economic development required for democracy extend beyond the individual. The characteristics of the whole group must be considered. A healthy link between population and government and the links between members of a population is necessary for democracy and development. Social Capital, which can be defined broadly as the character and culture of the interactions within a population, enables development at the population level. For these reasons, this study included social capital considerations in analyzing the effectiveness of development programs. Social capital is associated with empowerment within populations. Empowerment is a component of both democracy development and the eradication of poverty (Grootaert and Van Bastelaer, 2002, pp. 2, 101; Knack and Zak, 2003, p. 1; White House, 2015, p. 21; World Bank, 2009, p. 3).

Social capital levels within a population are affected by many factors. One contributing factor is the institutional framework of the local government. A reliable, transparent, and predictable local government operation enables a population to have high social capital (World Bank, 2009, p. 6). A visible component of competent local government is infrastructure. Infrastructure projects contribute to social capital and development. In addition to infrastructure projects affecting positive change in

social capital, social capital levels also influence the level of success in infrastructure projects. Factors of social capital, including social cohesion, cognitive ability, and interpersonal trust, impact the success of development projects (Knack and Zak, 2003, p. 1; Manu and Walker, 2006, pp. 476-491; Reid and Salmen, 2009, p. 101; World Bank, 2011).

2.3 United States Development Programs

United States defense strategy recognizes that a wider comprehensive foreign policy safeguards US interests. US foreign policy objectives include the advancement of democracy and human rights. Beyond traditional conventional warfare tasks, the US military conducts stabilization missions which overlap military and humanitarian operations. Increasingly, humanitarian missions represent tactical objectives which have an impact on wider US strategic operations in a region (Metcalf et al., 2012, p. 5; White House, 2015, p. iv). The US considers international investment in infrastructure a national defense priority (White House, 2015, p. 17).

2.3.1 US Strategic Development Objectives.

The United States plays a large role in international development, for both humanitarian and strategic objectives. The US National Defense Strategy (NDS) recognizes the link between international development and US national defense. US development goals found in the NDS include the advancement of democracy, support for human rights, economic advancement, investment in critical infrastructure and security, promotion of trade, the end of extreme poverty, and good governance (US General Accounting Office, 2012, p. 39; White House, 2015, p. 21). The US conducts foreign aid across the development spectrum, from purely humanitarian missions to those which contribute to defense and foreign policy objectives. In a purely humanitarian

aid capacity, the US conducts Foreign Humanitarian Assistance (FHA) in response to humanitarian crises. US FHA missions are committed to the internationally accepted principles of humanity, neutrality, impartiality, and independence in conducting aid (Department of Defense, 2014b, p. I3).

At the other end of the spectrum, the US engages in stability operations with specific US foreign policy and national defense objectives in mind. Increasingly US foreign policy aims include an international development as part of its overarching strategy. The State Department (DoS) and the US Agency for International Development (USAID) lead US development strategy and execution. Generally, the DoD plays a supporting role in development, recognizing the leading role of DoS and USAID. The DoD, however, often undertakes an over-sized role in humanitarian assistance and international development, both due to its superior resources and strategic interest in development as part of a wider defense strategy (Department of Defense, 2014b, p. I1). DoD strategic goals now often include stability operations as primary objectives. Stability operations include promoting the rule of law, social well-being, and promoting stable government and economy (Piombo, 2010, p. ii).

Often characterized as complex operations; stability, security, transition, reconstruction, and counterinsurgency operations occupy an ever larger portion of overall military operations (Piombo, 2010, p. ii). These stability operations range from initial and transformation missions conducted in line with traditional military operation to long term stability operations, which enable sustainable development. The US conducts these “nation building” operations through a whole government approach, generally lead by the DoS (Department of Defense, 2014a, p. vii). Objectives driven by military strategy are different than those developed for strictly humanitarian missions or a broader holistic governmental goals approach. DoD objectives in development programs often prioritize short term security related objectives, rather

than the long term development objectives associated with civilian agencies (Metcalf et al., 2012, pp. 5-6; US General Accounting Office, 2012, p. 37).

2.3.2 US Southern Command Development Strategy.

The task of planning and coordinating US military development programs often falls to the geographic combatant commands. These commands manage military operations in a specific geographic area of the globe. This thesis focuses on development missions within the US Southern Command (USSOUTHCOM) which is responsible for US military operations in South and Central America and the Caribbean. USSOUTHCOM recognizes that poverty and lack of development negatively impact regional security and stability in its area of responsibility. Continued poverty leads to social stagnation which creates opportunities for criminal organizations to undermine local government legitimacy and recruit members (Feickert, 2013, p. 57). To this end, USSOUTHCOM developed strategic level objectives related to development, including working to help developing nations understand the linkages between economic development, economic and political freedom, and local government performance and the country's stability, security and sovereignty. Recognizing the link between democracy and stability, USSOUTHCOM actively works to promote democracy and development at all levels of government (US Southern Command, 2008, pp. 11-14).

2.3.3 Humanitarian Civic Assistance Overview.

The DoD employs several programs which contribute to international development and military objectives. One of these programs, the HCA program endeavors to satisfy both host nation development and US military training objectives. Department of Defense directives dictate that HCA projects advance the economic and social sit-

uation of the host nation while meeting the security and foreign policy interests of the United States. HCA projects need to contribute in some way to US strategic development objectives. DoD uses HCA and other programs as tools to build local capacity in order to promote democracy, avoid political and humanitarian crises, and promote rule of law. HCA projects must also satisfy US training operational readiness skills, specifically exercising the ability of engineering and medical forces to deploy and work in austere environments. (Department of Defense, 2014a, p. 2; Piombo, 2010, p. 5; Rand Corporation, 2011, p. 18).

2.4 The Need for Measurement in Development Programs

The need for analysis in international development is widely accepted. To perform meaningful analysis the right data is required. Development and democracy programs in general have been found to lack meaningful impact. This has been partially attributed to programs that do not incorporate appropriate evaluation methodology. To meet the requirement for effective evaluation, the United Nations (UN) includes data, monitoring, and accountability as a major effort area in the 2015 Sustainable Development Goals (SDG) (United Nations, 2015). To be effective, development programs need a viable measurement and evaluation program. Agencies often fail to, or fall short of, meeting this requirement for measurement. Development programs need effective assessment programs both to provide accountability and to learn from experiences. Lack of an appropriate evaluation methodology limits the effectiveness of development programs. Development agencies need to know how their programs pave the way for long term peace, social development, and political change (Department of Defense, 2014a, p. 14; Rand Corporation, 2011, p. 38; Seligson et al., 2015, p. 5; Social Impact, 2011, pp. ix, 3; US Agency for International Development, 2011, p. 2).

2.4.1 Analysis of Department of Defense Development Programs.

Both the need for, and shortcomings of, measurement in DoD development programs is well documented. As the DoD continues to play a larger role in development activities, a better understanding of the impact of military led projects is needed. The US General Accountability Office (GAO) found the DoD development program evaluation methodology ineffective in a 2012 report. DoD planners do not know if development projects are meeting established objectives, or even what the wider impacts of the programs might be. DoD departments struggle to measure the long term impacts of DoD development programs. Additionally, the impact of DoD projects within the broader context of the US government development program is not well understood. Military objectives differ from those of civilian and non-government development agencies. Often DoD projects are not well tracked within larger US government foreign development programs for a region (Metcalf et al., 2012, p. 6; Rand Corporation, 2011, p. ii; US General Accounting Office, 2012, pp. 20, 23, 40).

The DoD recognized the need for an effective measurement and evaluation program. HCA projects must be evaluated for their initial and long term effects within a host nation (Department of Defense, 2014a, p. 2). An effective evaluation program includes analysis of the impact on local populations. Further, DoD humanitarian assistance programs should include predictive analysis of the impact on local populations into project selection and siting. A sufficient understanding of the impact of DoD projects is necessary to predict the impact of development projects on a population. For these reasons, DoD encourages the incorporation of DoS and USAID development measurement lessons learned into DoD evaluation program (Department of Defense, 2014b, p. 10; Loomis and Crowley, 2001, p. 39; US General Accounting Office, 2012, p. 37).

2.5 Measurement of Development Programs

A successful development program requires an effective monitoring and evaluation program. Evaluation programs should look at the overall impact of a program. This includes examining if a program is meeting its goals, as well as exploring any unrealized effects. Specific performance indicator measurements should be developed (Rand Corporation, 2011, p. 2; Social Impact, 2011, p. 3; US General Accounting Office, 2012, p. 24; World Bank, 2009, p. iv). Effective measurement of development programs requires data beyond direct tactical project status. Stability and development programs require measurement of *soft* objectives, such as trust, confidence, and security (Loomis and Crowley, 2001, p. 40; Social Impact, 2011, p. 2). It is often difficult to link the impacts of specific projects to wider national objectives; this idea is often referred to as Measurement of Effectiveness (MOE). Current methodology effectively gauges the measurement of performance (MOP) for a project. MOP refers to data taken during the execution phase of a project, such as percent complete, number of new students enrolled in a school, etc. Development agencies struggle to determine the wider impact of specific projects on the local community without extensive on the ground analysis. (Department of Defense, 2011a; Department of Defense, 2014b, p. xv; Department of Defense, 2014a, p. 14; Piombo, 2010, p. 6; Rand Corporation, 2011, pp. 10–12; US Agency for International Development, 2011, p. 1).

The DoD and other US development agencies require accurate measurement of effectiveness in order to evaluate the true impact of a project or program. Examples of higher order objectives that can be developed into MOEs pertinent to DoD and wider US development programs include: measures of local government legitimacy, attitudes of local populations towards the US, and the level of military access and influence among others (Rand Corporation, 2011, pp. 12, 18). Both USAID and the RAND corporation, under contract with the DoD, developed guidance for measuring

the effectiveness or impact of development projects. Figure 3 shows the relationship between projects, MOPs, and MOEs. Effective collection of the MOE requires both pre and post project data (Griffith, 2014; Rand Corporation, 2011, p. 8). Further, effective evaluation of the impact of development projects requires cause and effect linkage between development projects and a measured change in a development outcome. For the evaluation program to give valid results a measurement program must include evaluation of other factors which could also explain a change in impact measurement as well as inclusion of evaluation of control groups which did not receive some sort of developmental intervention (US Agency for International Development, 2011, p. 1).

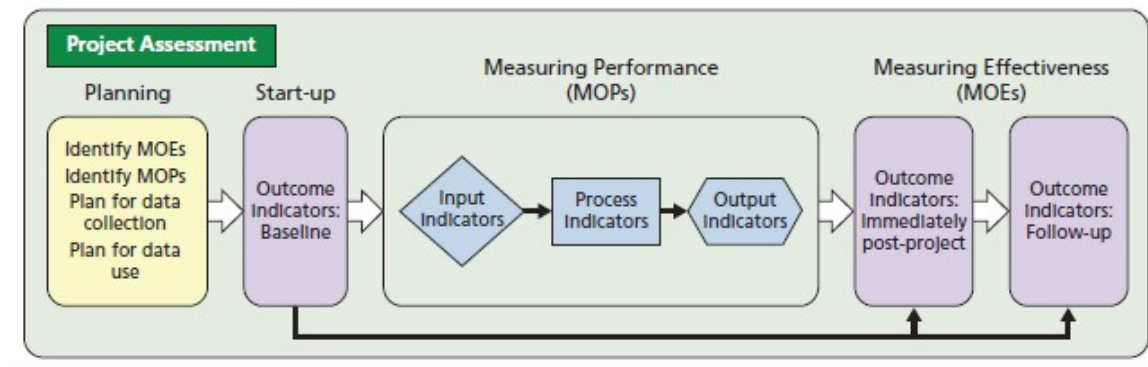


Figure 3. Diagram of the relationship between projects, MOPs, and MOEs developed by RAND (Rand Corporation, 2011, p. 8).

2.5.1 Using Surveys for Measuring the Impact of Development Projects.

Citizen population surveys provide an effective tool for assessing the impacts of projects and programs. At the project level surveys are used to measure well defined objectives, whereas, at the program level surveys provide data on wide ranging impacts. Surveys also provide data for analysis of how different population subgroups are impacted by development efforts. Traditional methods for measuring development programs with surveys are broken into two types. Mini surveys, with a few targeted

questions, are used to measure the performance of specific projects; and national level comprehensive surveys, which evaluate both planned and unintended program level effectiveness and impact (Rand Corporation, 2011, p. 104; Social Impact, 2011, p. 3). Data and analysis utilized in measurement of development programs should be unbiased and objective, repeatable, and valid. Additionally, reports which explore data generated from analysis should include “sufficient local and global contextual information so that the external validity and relevance of the evaluation can be assessed” (US Agency for International Development, 2011, pp. 7, 9).

For surveys to be effective in measuring development impact, proper survey design must be employed. To accurately show the effect of a project on a population, an experimental survey design should be employed. The study must include a pre-treatment baseline survey as well as a post-treatment survey. Further, for a valid measurement of project impact on development outcomes, both the population receiving the intervention as well as a control group must be surveyed. (Griffith, 2014; Grootaert and Van Bastelaer, 2002, p. 10; Patten, 2009, pp. 87-94; US Agency for International Development, 2011, pp. 6-7).

Additionally, proper survey design requires a sufficient number of samples based on the effects size and type of analysis. Cohen (1992) provides recommended sample sizes based on these parameters. This study employs post facto analysis of previously collected data. There should be no issue, however, in finding any significant results as the data being examined in this analysis, approximately 1500 surveyed persons, exceed the maximum required sample size of around 750 for regression analysis for small effects from up to 8 independent variables (Cohen, 1992, p. 158).

Measurements of effectiveness and performance in development programs often cannot be directly measured with surveys. For example, customer service surveys have been found to be accurate in measuring organizational performance in a vari-

ety of settings (Van Ryzin, 2004). A survey, however, gives a representation of public opinion which can be utilized as a proxy for these other measures (Social Impact, 2011, p. 4). One area of focus for US foreign policy requiring proxy measurement is the spread of democracy. Canache et al. (2001) looked at existing literature and research using satisfaction with democracy as a measure of the advancement of democracy. Their study was critical of surveying direct satisfaction with democracy as a useful measure. They offer two explanations for their conclusions: first, satisfaction with democracy may represent a level of support for different institutions, and second, satisfaction with democracy means different things to different people. Directly asking the question, “How satisfied are you with democracy?” is ambiguous in what it measures. Surveying direct satisfaction with democracy can have profoundly different meanings; such as support for the incumbent regime, support for the political system, support for democracy as a general form of government, or a mixture of the three. Further, populations interpret direct survey of satisfaction with democracy differently across geographic and demographic lines as well as across time and survey context (Canache et al., 2001, pp. 513-514). The variance over time makes measuring satisfaction with democracy particularly challenging in longitudinal studies. For these reasons more direct measures should be utilized when studying the advancement of democracy such as institutional confidence, political support, and alienation. Direct satisfaction with democracy is not an externally valid measure for the advancement of democracy (Canache et al., 2001, p. 526). This study utilizes measurement of satisfaction with local services as a more valid measure of democracy.

2.5.2 Measuring Local Government Performance with Surveys.

2.5.2.1 Satisfaction as a Measure of Performance.

Literature shows that surveyed satisfaction validly measures government performance. Van Ryzin (2004), James (2007), and Kelly and Swindell (2002b) found that surveyed satisfaction is a valid proxy for measuring government performance. Often, surveys are a more valid measure of performance than direct measures of service as surveys ensure that services are reaching the target populations. Satisfaction surveys represent a valid method for measuring government outcomes at the local level. When used in conjunction with other factors satisfaction surveys represent a valid measure of government performance (Kelly and Swindell, 2002a, p. 610). In addition to the effect of expectancy disconfirmation discussed in the next section, other factors have an impact on satisfaction with government services. McNamara (2012) found that attitudes towards local government and length of residence impact satisfaction with individual services. Additionally, other co-variate factors do not just effect the perception of performance. Some factors, such as social capital, influence actual government performance as well as the ability for populations to benefit from government services (Manu and Walker, 2006, p. 491).

2.5.2.2 Expectancy Disconfirmation Theory.

There are some considerations, however, which impact the effectiveness of measuring performance with satisfaction. Key among them is the Expectancy Disconfirmation Theory. Originally developed by Oliver (1977) for consumer product marketing, the expectancy disconfirmation theory shows how prior expectation skews the perceived satisfaction with performance. Van Ryzin (2004) applied the expectancy disconfirmation theory from consumer product satisfaction study to social science study, specifically in measuring government performance through measurement of satisfac-

tion, expectation and disconfirmation. Van Ryzin's expectancy disconfirmation model is shown in Figure 4. His work has been extensively tested by other scholars and has been successfully tested in experimental study (James, 2007, p. 107). Van Ryzin's theory is that there are several factors, not just satisfaction, that can be used as a model of government performance. He theorized that the citizen's prior expectation for services has an impact on how satisfied they will be with services. The highest level of impact on measured satisfaction is when citizens have a high expectation which is not met by government services. This is referred to as dissatisfaction and has been found to have a negative effect on citizenship satisfaction. Thus when attempting to measure government performance, satisfaction alone is not an accurate measure. The populations' expectation and disconfirmation should also be measured (Van Ryzin, 2004, pp. 443-448).

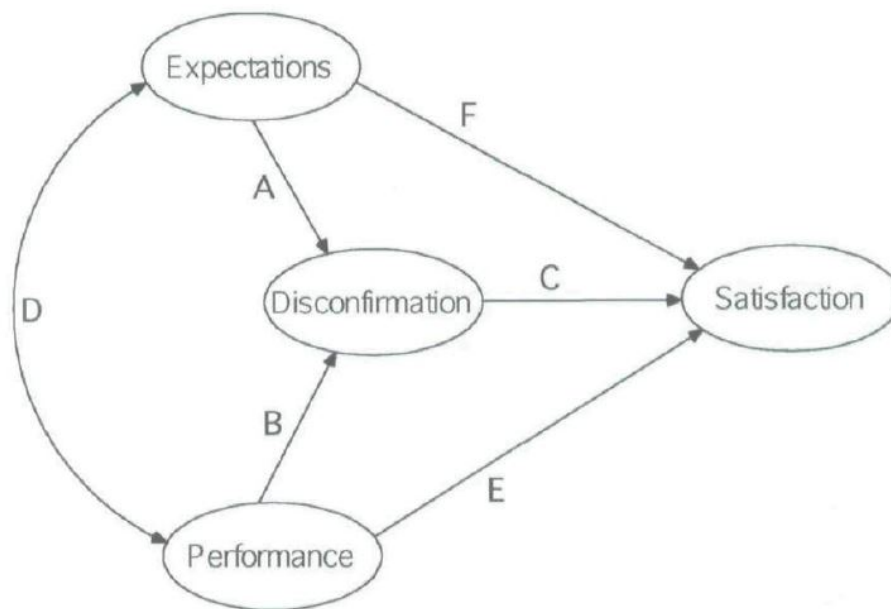


Figure 4. The Expectancy disconfirmation model (Van Ryzin, 2004, p. 435).

Van Ryzin's model validated the use of citizenship satisfaction surveys to model government performance. His original study attempted to use citizen satisfaction with

city street cleaning services to measure performance. Telephone interviews were conducted with residents of New York City. Their responses, in satisfaction, expectation, and disconfirmation were used as independent variables. Known reliable measures of street cleanliness were used as the dependent variable. Van Ryzin found that these inputs could be used to create a reliable measure of the street cleaning service (Van Ryzin, 2004, pp. 443-448).

Satisfaction validly measures government performance if proper considerations are taken. Low prior expectation, however, can skew results to showing higher performance. The initial expectations for government services that a population has should also be measured to get an accurate model for government performance (Van Ryzin, 2004, pp. 443-448; James, 2007, p. 107).

2.5.2.3 Trust as a Measure of Performance.

In addition to satisfaction, this study examines the impact of US military humanitarian projects on measures of trust. Trust is both influenced by development, as well as a precursor to development. Development research traditionally correlated capital investment with development outcomes. Different groups, however, experienced differentiated levels of development even at relatively similar investment levels. Dearmon and Grier (2009, p. 210) found that trust influences the level of development investment when considered in interaction with education. Generalized trust in individuals shapes how they react in all areas of their life. More trusting individuals are more likely to participate, back the government, vote, and avoid theft (Uslaner, 1999, p. 129).

There is evidence in literature that meaningful measurement of government performance is difficult. High citizen trust in government is desired for a successful government citizen relationship. Citizens who trust in government are more likely to

empower the government through participation and supplying revenue, which in turn allows the government to better serve the population. This upward spiral of trust and performance is also seen in distrust, where populations with low trust are less likely to participate in government or pay taxes, which in turn leads to lower government performance (Yang and Holzer, 2006, p. 114).

2.5.3 Measuring Attitudes Towards the US with Surveys.

This study measures the impact of US humanitarian projects on measures of trust in the US government and military within the population of Belize. US government and military planners are interested in promoting development programs that advance trust in US institutions. Trust from local populations in development organizations and foreign military forces is recognized as a key requirement for successful development and military operations to be conducted in a specific area (Grootaert and Van Bastelaer, 2002, p. 102; Uslaner, 1999, p. 129; Department of Defense, 2014a, p. 2). Often, projects conducted by the US military do not have the desired outcomes of increasing trust because US military objectives often diverge from broader US “whole of government” development objectives. Military projects often have a secondary focus on security and counter-terrorism, rather than strictly humanitarian or development outcomes. This short term military operation specific focus has been found to both confuse and have a negative affect on building trust in the US among local populations (US General Accounting Office, 2012, p. 38; Piombo, 2010, p. 6).

2.5.4 Covariate Factors in Measuring Developmental Impact.

Multiple factors affect measures of developmental progress in addition to the intervention of development programs. This section discusses some of the known factors which influence development. They are included in this study in order to explain

variance in measured satisfaction and trust from influences other than US projects. The effects hypothesis for this study is shown in Figure 5. This study included measures of social capital and socioeconomic demographics in the analysis of changes in satisfaction and trust.

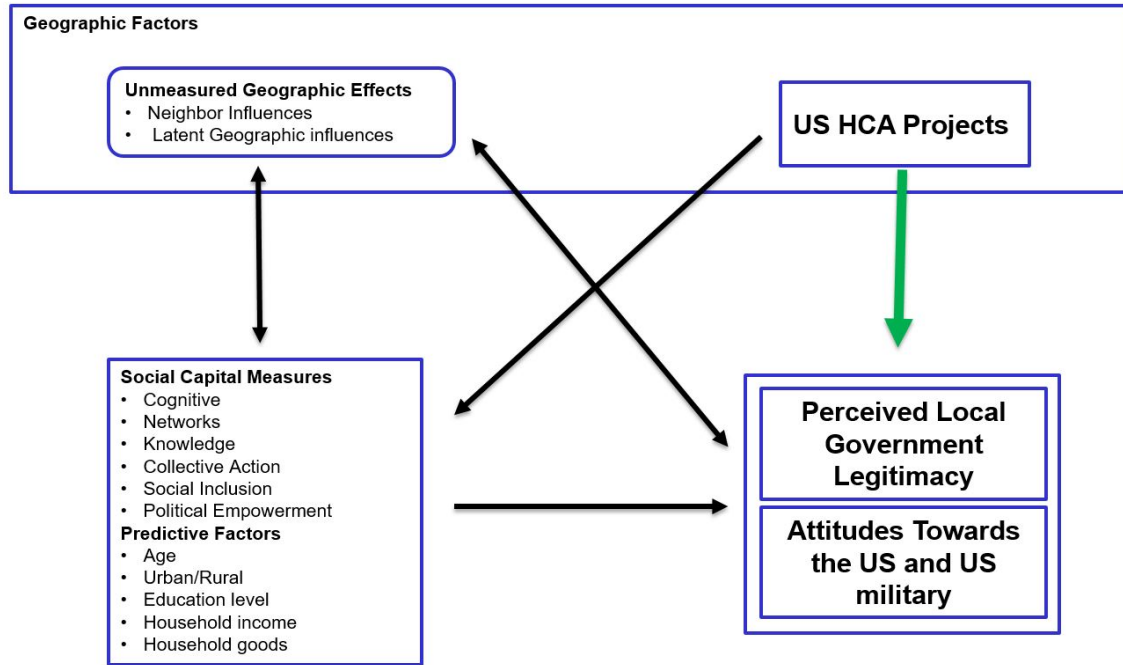


Figure 5. Effects hypothesis with covariate factors.

2.5.4.1 Measuring Social Capital.

As previously mentioned, social capital affects both citizen opinions and the effectiveness of develop programs. For these reasons, this study employs measures of social capital as co-variate factors in measuring development effectiveness associated with US military projects. Measuring the level of social capital of a population is complex, involving multiple methods including surveys, analysis of local institutions, and social network analysis (Grootaert and Van Bastelaer, 2002, p. 9; Uslaner, 1999, p. 140). This study is limited to employing social capital analysis through surveyed social capital proxy data from the AmericasBarometer survey. The study does not

employ analysis of institutions or social networks as required in a full social capital analysis. Social capital analysis, however, is not the objective of this study. Rather, this study utilizes social capital measures as controls for measuring government performance and trust.

The World Bank developed a system for measuring social capital, the Integrated Questionnaire for the measurement of Social Capital (SC-IQ) (Grootaert, 2004, p. vii). The SC-IQ breaks social capital into six factors: groups and networks, trust and solidarity, collective action and cooperation, information and communication, social cohesion and inclusion, and empowerment and political action. These first two factors, groups and networks, and trust and solidarity, represent the underling precursors for a population to develop social capital. The second set of factors, collective action and cooperation, and information and communication, measure how social capital operates within a population. The final two factors, social cohesion and inclusion, and empowerment and political action, measure the outcomes of social capital (Grootaert, 2004, p. 5). Detailed descriptions of each of the social capital factors are listed below.

- **Groups and Networks:** This measure represents the structural element of social capital analysis. Citizens increase their ability to gain information and engage with government and society through group interaction. Often citizens engage with the government through an intermediary, rather than directly. Groups and networks can be the link between citizens and government services. Populations with a more robust network, both in number of contacts and characteristics of the organization with which they are members, better engage with their surroundings. Memberships in organizations with more democratic and diverse structures is linked to a more engaged and democratically inclined population. Citizens who are exposed to a diverse mixture of people and settings

have a better chance of gaining the information and contacts to better participate as citizens (Krishna, 2007, p. 2; Kruks-Wisner, 2013, pp. 23, 43, 107; Grootaert, 2004, p. 11).

- **Trust and Solidarity:** This measure represents the cognitive dimension of social capital. Trust and solidarity are a psychological factor which have been found to be a precursor to engaged populations. Measurement of this factor can be difficult and generally relies on measuring the level of general trust in institutions and fellow citizens (Uslaner, 1999, p. 140; Grootaert, 2004, p. 11).
- **Collective Action and Cooperation:** High measures of collective action and cooperation are found in communities with high social capital. Measures of collective action focus on citizen participation in government. One definition for participation, claim-making, is the degree to which citizens engage and hold government officials accountable for services. Claim-making, as opposed to voting, represents the primary arena where citizens encounter the state. Average citizens experience government at the local level. Their experiences include government services and infrastructure, such as schools, clinic, roads and wells; as well as government bureaucratic processes which facilitates these services. Citizens who have lower levels of participation have low expectation of receiving help, either through institutional incompetence or because they believe they are not entitled to services due to their group membership or their philosophical understanding of the role of government and society (Collier, 2009, p. 300 Kruks-Wisner, 2013, pp. 17-25, 103-104; Mundial, 1997, p. 113).
- **Information and Communication:** Access to quality information represents both a product of high underlying social capital measures as well as an enabler to social action. Even though a population may have a need, they often do not have

the information necessary to work together to petition the government. The information about how to petition the government for services is valuable as it can be complex and often change. Citizens who understand how to successfully interact with the government are also valued as sources of information and as brokers for interaction with government authorities (Grootaert, 2004, p. 12; Kruks-Wisner, 2013, pp. 100-101).

- **Social Cohesion and Inclusion:** Measures of social inclusiveness represent a social capital outcome. Measurement focuses on attitudes towards both within and between groups. Specific factors include attitudes towards minorities and political deserters. Populations with higher social capital tend to be more inclusive. More inclusive communities achieve better social and government interaction outcomes (Grootaert, 2004, p. 13).
- **Empowerment and Political Action:** The final factor of social capital, empowerment and political action, represents the ultimate social capital outcome. Empowerment refers to the ability to have some control over the institutions and processes guiding society. Communities with high social capital measures exercise a higher degree of control over their ultimate outcome. Citizens with high empowerment and political action scores believe that they have a voice and can make a difference in affecting their outcomes (Grootaert, 2004, pp. 5, 14; Kruks-Wisner, 2013, pp. 108-110; Narayan-Parker, 2002).

2.5.4.2 Demographic Control Factors.

Citizens' experiences and attitudes during socioeconomic development vary widely based on their socioeconomic and demographic background. Effective measurement of development accounts for differences in experience and surveyed attitudes by including demographic factors for analysis. In addition to social capital, developmental

measurement programs find that the following demographic variables explain variance in measured developmental performance:

- Household income
- Household expenses
- Work status
- Education
- Gender
- Age
- Prosperity: household goods
- Social status
- Marriage status
- Number and status of children
- Race and ethnicity

(Dearmon and Grier, 2009; Grootaert, 2004; Grootaert and Van Bastelaer, 2002, p. 10; Knack and Zak, 2003; Manu and Walker, 2006; McNamara, 2012; US Agency for International Development, 2011)

2.6 The Spatial Dimension of Social Science Data

Social scientists recognize the influences of geography on socioeconomic phenomena. Empirical study of social science data often does not include geographic context

in analysis. Traditional social science and economic analysis assumes a single homogeneous population with perfect information, when, in reality, populations are geographically dispersed, heterogeneous, and have imperfect communication (Anselin, 1989, p. 141; Krugman, 1990, p. 483). Within the study of socioeconomic development analysis tries to determine why some populations flourish while others are stuck in poverty. Failures of development were traditionally attributed to corruption and retrograde culture. Often, however, physical geography plays an important role in why some people flourish and others do not. Underdeveloped areas are often disadvantaged by geography, such as through reduced access to transportation networks or unreliable access to water (Sachs, 2006, p. 57). In addition to the role of physical geography, the conditions of neighbors influences outcomes. Spatial concentration of poverty has been found to be one of the best predictors of whether a citizen ends up in poverty (Goodchild et al., 2000, p. 145). The influence of others can be explained mathematically and forms the basis of Tobler’s law, which states “everything is related to everything else, but near things are more related than distant things” (Tobler, 1970, p. 236).

2.7 Literature Review Concussion

This literature review provided the background necessary to evaluate the effectiveness of US humanitarian projects through spatial analysis. The first section covered an overview of the US development policy and the humanitarian civic assistance program. The second section summarized literature related to the measurement of development. The final section covered literature related to the methodology of combining survey and spatial analysis in social science applications.

III. Methodology

3.1 Chapter Overview

This study used spatial and regression analysis to examine how proximity to US projects effect popular opinion in the nation of Belize. The methodology is divided into five sections: an analysis of the data used in the study, an overview of the tools used to prepare the data analysis, testing of study data for spatial artifacts, development of project exposure variables, and an itemization of the specific regression methodology performed in the study.

3.2 Methodology Overview

The focus of this study is how the proximity to US projects impacts public opinion in Belize. The study will look for significant affects in the measured public opinion of satisfaction with local medical services, satisfaction with local schools, trust in the United States, and trust in the United States military. Public opinion measures from the 2014 AmericasBarometer aggregated at the village level is the dependent variable in this study. The 2012 AmericaBarometer survey forms a spatial-temporal image of the preexisting public opinion conditions before the US humanitarian intervention. This study employs additional data, including Social Capital and demographic measures, to explain additional variance seen in the dependent satisfaction and trust measures. Additionally, this study examines and develops a method for modeling exposure to US humanitarian projects across geographic space. The study looks for significant change in the generated dependent variables based on exposure to US military activities along with the developed co-variate 2012 spatial image and Social Capital and demographic factors. The impact of proximity to projects on public opinion is analyzed using spatial and non spatial regression analysis.

This study exploits the geographic dimension of the survey and project data. This type of analysis requires the utilization of the spatial characteristics of both survey observation locations, as well as US humanitarian project locations. Spatial analysis techniques are used to determine the relative spatial proximity of survey points and project locations. Generated spatial data include the distance between individual survey cluster locations as well as the distance between survey locations and the nearest type of project locations. This study also incorporates non spatial measures in the final analysis in addition to spatially generated data. These non-spatial co-variates include demographic data which may moderate the effects of US projects at a location as well as help explain variance in the observed survey measures. Non spatial measures include demographic data; such as sex, education level, and household income; as well as socio-political measures, such as social capital factors, ideology, opinions towards government, and knowledge of world affairs. This study combines these non-spatial factors with spatial proximity to US development efforts in an attempt to develop a model which predicts the dependent variables of satisfaction and trust discussed previously.

3.3 Data Overview

3.3.1 Survey Data.

Public opinion and demographic data for this study comes from the AmericaBarometer survey series, a product of the Latin America Popular Opinion Project (LAPOP) at Vanderbilt University. The AmericaBarometer survey series is widely used by academic and development agencies. The survey design is continuously updated to incorporate the latest state of the art survey techniques. Before data is released, the AmericasBarometer goes through a comprehensive auditing process to ensure data validity (Seligson et al., 2015).

The AmericasBarometer data sets utilized for this study include the 2012 and 2014 Belize national survey. Starting in 2012, the AmericasBarometer Belize survey was designed for municipal level analysis of survey data. The locations of the 2012 and 2014 AmericaBarometer Belize survey are summarized in Table 1 and shown geographical in Figure 6. The survey design ensures that surveyed municipal locations have at least 24 observations. Within each survey location, the survey was designed so that the 24 observations were a representative sample. Further, methodology was employed to ensure that the locations of the municipal survey clusters would give a representative sample across the country (Seligson et al., 2015).

3.3.2 Project Data.

This study uses data from the DoDs Overseas Humanitarian Assistance Shared Information System (OHASIS) and other government sources to determine where and when US humanitarian interventions in Belize took place. Planners track all DoD humanitarian assistance projects within the OSASIS platform. OHASIS is built on ESRI's ArcGIS enterprise platform; allowing for tracking of both spatial and non-spatial attributes of each project (Army Geospatial Center, 2015). Project data for US humanitarian operations in Belize between 2012 and 2014 are the primary independent variables for this study. Location data taken from OHASIS for projects was verified with AFSOUTH planning and after-action location documents. If necessary, more accurate location data for specific project sites may exist within these government documents. Projects pulled for this study are listed in Table 2.

3.3.3 Survey and Project Data Timeline.

The combination of project and survey data used in this study provides a platform to explore the impact of the US humanitarian project used as an intervention within

Table 1. 2012 and 2014 AmericasBarometer Belize Survey Locations

Location	Longitude (West)	Latitude (North)
Corozal Town	-88.3884	18.39315
Cristo Rey	-88.4972	18.34907
Libertad	-88.4573	18.31164
Louisville	-88.5118	18.31948
Santa Clara	-88.5092	18.29670
Sarteneja	-88.1426	18.35481
Xaibe	-88.4343	18.38411
Orange Walk Town	-88.5600	18.08357
August Pine Ridge	-88.7277	17.97570
Guinea Grass	-88.5976	17.96889
Palmar	-88.5608	18.06356
San Estevan	-88.5118	18.15049
San Jose	-88.5737	18.08962
Trial Farm	-88.5477	18.08326
Burrell Boom	-88.4137	17.57082
Gardenia	-88.4197	17.67374
Hattieville	-88.3941	17.44932
Belize City	-88.1962	17.50457
Pedro Town	-87.9611	17.92137
Ladyville	-88.2928	17.54891
Lords Bank	-88.3184	17.54998
San Ignacio	-89.0800	17.15228
Santa Elena	-89.0514	17.16396
Benque Viejo	-89.1349	17.07278
Belmopan	-88.7670	17.25111
Bullet Tree Falls	-89.1118	17.16865
Camalote	-88.8189	17.24683
Duck Run	-89.0309	17.24238
Roaring Creek	-88.7999	17.26012
San Antonio	-89.0239	17.07966
Frank Eddy	-88.6343	17.25426
Unitedville	-88.9378	17.21214
Valley of Peace	-88.8407	17.32833
Dangriga	-88.2315	16.96956
Independence	-88.4162	16.53476
Plancencia	-88.3713	16.52116
Pomona	-88.3723	16.99437
Silk Grass	-88.3349	16.88339
Georgetown	-88.5070	16.65179
Punta Gorda Town	-88.8095	16.09894
Bella Vista	-88.5312	16.50761
San Pablo	-88.5801	16.61326
Dump	-88.9364	16.22748
San Marcus	-88.9067	16.21559

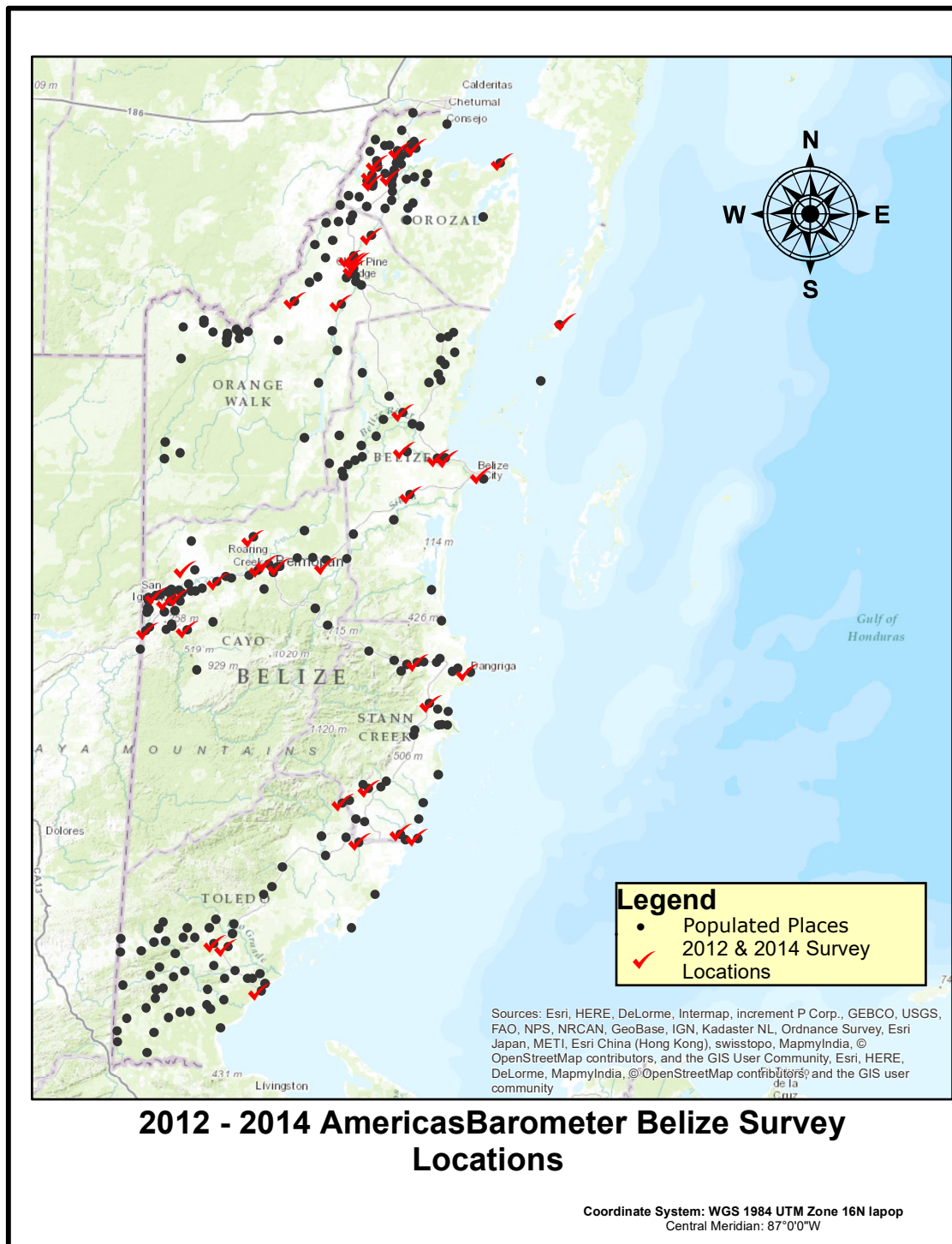


Figure 6. Locations of 2012 and 2014 AmericasBarometer survey locations in Belize relative to all named populated places.

Table 2. 2013 and 2014 US Military Humanitarian Projects in Belize

Name	Year	Construction	School Construction	Medical Construction	Medial Mission	Latitude (West)	Longitude (North)
Crooked Tree school	2013	YES	YES	NO	NO	88.54	17.78
Trial Farm School	2013	YES	YES	NO	NO	88.56	18.10
Hattieville School	2014	YES	YES	NO	NO	88.39	17.45
Ladyville school	2013	YES	YES	NO	NO	88.31	17.55
Louisiana School	2013	YES	YES	NO	NO	88.56	18.07
Western Hospital	2014	YES	NO	YES	NO	88.78	17.25
Yorke school	2014	YES	YES	NO	NO	88.20	17.51
Sadie Vernon School	2014	YES	YES	NO	NO	88.20	17.50
General Clinic	2013	NO	NO	NO	YES	88.81	16.10
General Clinic	2013	NO	NO	NO	YES	89.09	16.27
General Clinic	2013	NO	NO	NO	YES	88.95	16.27
General Clinic	2013	NO	NO	NO	YES	88.41	16.53
General Clinic	2013	NO	NO	NO	YES	88.37	16.99
General Clinic	2013	NO	NO	NO	YES	88.60	17.97
General Clinic	2013	NO	NO	NO	YES	88.57	18.20
General Clinic	2013	NO	NO	NO	YES	88.77	17.88
Dental Clinic	2013	NO	NO	NO	YES	88.81	16.09
ENT Clinic	2013	NO	NO	NO	YES	88.78	17.25
Plastic Surgery Clinic	2013	NO	NO	NO	YES	88.56	18.09
Eye surgery Clinic	2013	NO	NO	NO	YES	88.23	16.96
General Clinic	2014	NO	NO	NO	YES	88.39	18.39
Surgery and Dental Clinic	2014	NO	NO	NO	YES	88.20	17.51
General Clinic	2014	NO	NO	NO	YES	89.02	17.08
General Clinic	2014	NO	NO	NO	YES	88.81	16.09

the nation of Belize. This study explores impacts of proximity to US projects on measures in public opinion in Belize in 2014 relative to locations which did not receive any intervention. The temporal relationship between the data utilized for this study are shown in Figure 7. These primary data sources are used to derive the variables for the final analysis.

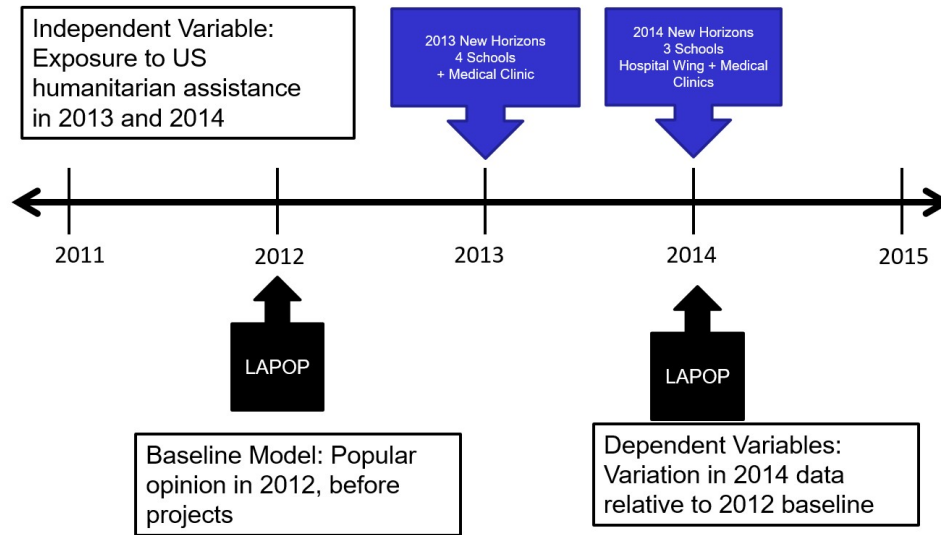


Figure 7. Data Timeline

3.4 Preparation of Data for Analysis

Utilizing data collected from the AmericasBarometer and OHASIS this study generates several derived variables for project analysis. This analysis relied on both spatial and non-spatial elements to perform the final analysis. Independent and dependent variables were calculated from data provided by the AmericasBarometer and project data as well as spatial relationships among different data sources. Table 3 shows the variables used in this analysis, as well as their sources. The next several sections focus on the methodology for developing the sources used in this analysis.

Table 3. Variables for Analysis Methodology

Dependent Variables	
Surveyed responses in 2014 for: –Trust in the US government –Trust in the US military –Satisfaction with local schools –Satisfaction with local medical service	Generated by aggravating, at the village level, the mean survey response for each measure.
Independent Variables	
Exposure to nearest US project Broken into classes: 2013 –Exposure to school construction –Exposure to medical clinic 2014 –Exposure to school construction –Exposure to medical construction –Exposure to medical clinic	Generated based on calculated distance between surveyed locations and US humanitarian activity. This study explored different models for converting distance into a measure of exposure including straight distance, inverse distance scoring, binary distance, and logarithmic distance. Ultimately, this study measured exposure to projects based on logarithmic distance.
Covariates	
Spatial image of dependent variables (satisfaction and trust) for location prior to treatment.	Calculated for each survey location, the spatial image represents a spatially weighted mean value for the public opinion at that location before the US humanitarian intervention.
2014 Social Capital measures: –Groups and Networks –Trust and Solidarity –Information and Communication –Collective Action and Cooperation –Social Cohesion and Inclusion –Empowerment and Political Action	Calculated by combining appropriate survey questions based on defined Social Capital measurement methodology.
Demographic and socioeconomic measures for survey locations	Appropriate measures from the 2014 AmericasBarometer aggregated at the village level

3.4.1 Primary Dependent Variables.

The primary dependent variables for this study are two measures of government legitimacy: satisfaction with local schools, and satisfaction with medical services; and two measures of local attitudes towards the United States: trust in the US government and trust in the US military. At each survey location, the aggregated response for each dependent variable was calculated using arithmetic mean. These measures form the basis for the primary analysis of this study and are summarized in Table 4. They were examined for any significant relationship based on exposure to US projects and any other derived co-variate factors.

3.4.2 Geospatial Preparation of Data.

Publicly available AmericasBarometer survey contains unique data for each individual respondent. In addition to typical demographic information such as sex, age, family size, and occupation, the survey also records geographical data down to the name of the village. These village names are associated with specific geographic coordinates. The spatial relationship among the surveyed geographic points and their relationship to other geographic events opens up a new dimension of analysis using the AmericasBarometer data.

3.4.2.1 Georeferencing of LAPOP data.

Useful geospatial analysis of AmericasBarometer data requires accurate location data for each survey location. This study utilized publicly available place name and spatial location data from several sources, including data from previous studies, Google Maps, and Government of Belize sources to validate the locations of survey clusters (Government of Belize, 2015; Meerman, 2004).

Table 4. Study Dependent Variables Measures by Location

Location	2014 Mean Trust In the US Military	2014 Mean Trust In the US Government	2014 Mean Satisfaction with Schools	2014 Mean Satisfaction with Medical	# surveyed at Location
Corozal Town	4.63	2.54	2.86	2.34	50
Cristo Rey	4.56	2.14	3.05	2.54	24
Libertad	4.73	2.53	2.83	2.74	24
Louisville	5.35	2.86	2.84	2.60	25
Santa Clara	3.91	2.43	2.52	2.54	25
Sarteneja	4.25	2.24	2.79	2.24	25
Xaibe	2.43	2.22	2.65	2.43	24
Orange Walk Town	3.55	2.69	2.88	2.32	73
August Pine Ridge	4.75	2.82	2.86	2.91	23
Guinea Grass	2.91	2.11	2.39	2.21	25
Palmar	4.26	2.48	2.95	2.58	24
San Estevan	4.35	3.00	2.83	2.17	25
San Jose	4.47	2.19	3.05	2.33	24
Trial Farm	4.30	2.15	2.95	2.50	25
Burrell Boom	4.00	2.57	3.17	2.83	24
Gardenia	4.48	2.79	2.96	2.58	24
Hattieville	4.63	2.26	2.70	2.48	24
Belize City	3.85	2.51	2.84	2.66	291
Pedro Town	5.18	2.67	2.81	2.88	24
Ladyville	4.00	2.41	2.70	2.72	25
Lords Bank	4.05	2.96	2.54	2.67	24
San Ignacio	4.69	2.60	2.83	2.45	48
Santa Elena	3.65	2.55	2.78	2.57	49
Benque Viejo	4.27	2.81	3.08	2.58	27
Belmopan	3.52	1.87	2.63	2.34	71
Bullet Tree Falls	4.04	2.90	2.87	2.67	24
Camalote	3.40	1.67	2.50	2.42	25
Duck Run	3.96	2.69	3.08	2.96	24
Roaring Creek	4.05	2.21	2.88	2.42	24
San Antonio	4.48	2.88	3.00	2.63	24
Frank Eddy	5.05	2.06	2.70	2.21	24
Unitedville	3.83	2.25	2.76	1.84	25
Valley of Peace	4.15	1.88	2.71	2.33	24
Dangriga	4.09	2.49	2.63	2.49	49
Independence	4.35	2.50	2.92	2.83	25
Plancencia	5.17	2.61	2.70	2.57	24
Pomona	4.26	2.91	2.58	2.67	24
Silk Grass	5.10	2.65	2.58	2.21	24
Georgetown	4.47	2.60	2.43	2.25	24
Punta Gorda Town	3.52	2.88	2.89	2.71	24
Bella Vista	4.58	2.16	2.38	2.46	24
San Pablo	3.88	2.29	2.43	2.52	25
Dump	4.84	2.64	2.60	2.42	25
San Marcus	3.50	2.55	2.92	2.71	24

3.4.2.2 Spatial Potential AmericasBarometer.

Survey design for the 2012 and 2014 AmericasBarometer survey data incorporated consideration and survey location selection to allow useful analysis at the municipal level (Seligson et al., 2015). Figure 6 shows a graphical representation of the country of Belize, the recognized cities or villages, and survey locations by AmericasBarometer in 2012 and 2014. Belize is an ideal country to validate spatial analysis techniques due to its relatively small geographical size and large ratio of survey locations to populated places. In analysis, a greater number of survey locations means a more representative sample of the Belizean population.

3.4.3 Modeling Exposure to US Humanitarian Projects.

The independent variables in this analysis is the exposure of a survey location to the nearest US humanitarian missions. This study employed measures of geographic proximity as a proxy for exposure. There are several ways in which survey and project locations can be related geographically. This study examined different methods to determine which would be most appropriate for modeling exposure to US humanitarian projects. The exposure variables considered for this study were all derived from the geographic distance between survey locations and the nearest projects. Distance was calculated using an algorithm for finding the shortest distance between two points on an ellipsoid using the R Statistical program and the Geosphere package. Distances were calculated using the WGS84 standard ellipsoid (Hijmans, 2015; R Core Team, 2015). The code for calculating distance information can be found in Appendix C. This study examined the following distance based exposure models:

- Distance in Meters

- Inverse distance, as calculated in Equation 3.1.

$$Inverse\ Distance\ Score = \begin{cases} 1 & distance(km) \leq 5km \\ \frac{20 - distance(km)}{15} & 5km < distance(km) < 20km \\ 0 & 20km \leq distance(km) \end{cases} \quad (3.1)$$

- Binary distance as calculated in Equation 3.2

$$Binary\ Distance\ Score = \begin{cases} 1 & distance(km) \leq 5km \\ 0 & 5km < distance(km) \end{cases} \quad (3.2)$$

- Logarithmic distance, as calculated in Equation 3.3

$$Logrithmic\ Distance = \ln distance(km) \quad (3.3)$$

This study evaluated each exposure measure for a significant relationship based on proximity to a US humanitarian project. Additionally, each measure was subjectively evaluated for appropriateness based on the study objectives.

3.4.4 Co-variate Development.

In addition to project exposure, this study employed co-variate factors to explain more variance in the dependent satisfaction and trust dependent variables. Co-variate factors for this study include composite variables for each of the six dimensions of social capital as well as demographic and socioeconomic factors. The social capital factors are based on a combination of several questions each. Selection and methodology for selection and combination of social capital factors is listed in the following

sections. The 2014 AmericasBarometer survey provided all social capital, socioeconomic, and demographic factors for this study.

3.4.4.1 Social Capital Measures.

This study utilized composite Social Capital measures derived from the AmericasBarometer survey as control variables for measuring the relationship between US humanitarian projects and public opinion toward government legitimacy and attitudes toward the United States. The World Bank's Integrated Questionnaire for the measurement of Social Capital (SC-IQ) categorized Social Capital into six factors: groups and networks, trust and solidarity, collective action and cooperation, information and communication, social cohesion and inclusion, and empowerment and political action. The SC-IQ provides both question groupings as well as prescribed methodology for combining these questions into composite measures of each of the Social Capital factors (Grootaert, 2004). The AmericasBarometer survey data provide a full cross section of specific questions from the SC-IQ. This study utilized questions which were found in the SC-IQ to create the composite Social Capital variables: groups and networks, trust and solidarity, collective action and cooperation, information and communication, social cohesion and inclusion, and empowerment and political action.

3.4.4.2 Social Capital: Groups and Networks.

The SC-IQ measures the Social Capital dimension groups and networks through analysis of a citizen's participation in groups and social activities (Grootaert, 2004, p. 45). The questions utilized in creating the variable are tabulated in Table 5. The measurement of groups and network strength is of both the breadth, the total number of groups a citizen participates in, and depth, the frequency of attendance and role played by the citizen in each group. This study creates a group and network score by

taking the cumulative measure of the frequency of different group type participation as shown in Equation 3.4. These individual scores were aggregated at the village level for inclusion as possible control variables in the main regression analysis.

Table 5. Social Capital: Groups and Network Questions

Frequency of organizational participation in:
CP7. Meetings of a parents association at school
CP8. Meetings of a community improvement committee or association
CP13. Meetings of a political party or political organization
CP20. [WOMEN ONLY] Meetings of associations or groups of women or home makers?

$$\text{Groups and Networks Score} = CP7 + CP8 + CP13 + CP20$$

Where each measure = frequency of participation in the specific group

$$0 = \text{Never} \tag{3.4}$$

$$1 = \text{Once or twice a year}$$

$$2 = \text{Once or twice a month}$$

$$3 = \text{Once or twice a week}$$

3.4.4.3 Social Capital: Trust and Solidarity.

Trust and solidarity represent the cognitive dimension of social capital, which is difficult to measure directly. The SC-IQ employs a proxy measure of generalized trust for the measure of trust and solidarity. This study created a trust and solidarity measure for each individual by combining several trust measures together. The measures of trust questions found in Table 6 were averaged for each individual. The measures for each individual were then aggregated at the village level which created a measure of trust and solidarity for each survey location (Grootaert, 2004).

Table 6. Social Capital: Trust and Solidarity Measures

Trust and respect in the following institutions or systems: 1-7 Likert scale with 1 being no trust and 7 being highly trusting
--

B2: Respect for the political institutions of Belize
B3: Citizens basic rights are well protected by the political system of Belize
B4: Pride living under the political system of Belize
B6: Belief one should support the political system of Belize
B10A: Trust in the justice system
B12: Trust in the Belize Defense Force (BDF)
B13: Trust in the National Assembly (House of Representatives and Senate)
B21: Trust in the political parties
B21A: Trust in the Prime Minister
B47A: Trust in national election system
N9: Belief that current administration combats (fights) government corruption
N11: Belief that the current administration improves citizen safety
B18: Trust in the Police Department
B32: Trust the City/Town/Village council

3.4.4.4 Social Capital: Collective Action and Cooperation.

Collective action and cooperation is a measure of how well Social Capital works in a community. Based on the World Banks SC-IQ, this study created a collective action and cooperation measure using the questions shown in Table 7. Each question was Z-score standardized before the questions were averaged for each individual. The individual measures were then aggregated at the village level, creating a measure of the level of collective action and cooperation for each survey location (Grootaert, 2004).

3.4.4.5 Social Capital: Information and Communication.

Information and communications represents another distinctive dimension of Social Capital. This study created a composite information and communications score for each citizen. The questions in Table 8 were included in the AmericasBarometer survey and the SC-IQ for measuring information and communications. They repre-

Table 7. Social Capital: Collective Action and Cooperation Measures

CP4a: In order to solve your problems have you ever requested help or cooperation from a local public official or local government: for example, a mayor or municipal councilperson?
NP2: Have you sought assistance from or presented a request to any office, official or councilperson of the city/town/village within the past 12 months?
CP5: In the last 12 months have you tried to help solve a problem in your community or in your neighborhood?
NP1: Have you attended a town meeting, city council meeting or other meeting in the past 12 months?

sent measures of how connected a citizen is to sources of information, as well as a measure of general knowledge of the political process in Belize. These measures were Z-score normalized and averaged for each individual. Finally, the individual scores were aggregated at the village level, creating a composite measure of information and communication for each survey location.

Table 8. Social Capital: Information and Communication Questions

WWW1: “how often do you use the internet?”
GI0: “About how often do you pay attention to the news, whether on TV, the radio, newspapers or the internet?”
GI4: “How long is the prime ministerial term of office in Belize?”

3.4.4.6 Social Capital: Social Cohesion and Inclusion.

To present a Social Capital outcome, this study included a measure of social cohesion and inclusion which focused on attitudes towards deserters and outsiders (Grootaert, 2004). The study averaged the measured values of the questions in Table 9 to develop a measure of social cohesion and inclusion for each individual. Individual scores were then aggregated at the village level, creating a measure of social cohesion

and inclusion for each survey location.

Table 9. Social Capital: Social Cohesion and Inclusion Questions

1-10 Likert scale with 1 being strongly disapprove and 10 being strongly approve
E5: Of people participating in legal demonstrations. How much do you approve or disapprove?
E15: Of people participating in the blocking of roads to protest how much do you approve or disapprove?
E3: Of people participating in a group working to violently overthrow an elected government. How much do you approve or disapprove?
E16: Of people taking the law into their own hands when the government does not punish criminals. How much do you approve or disapprove?
D1: There are people who only say bad things about the Belizean form of government, not just the incumbent government but the system of government. How strongly do you approve or disapprove of such peoples right to vote?
D2: How strongly do you approve or disapprove that such people be allowed to conduct peaceful demonstrations in order to express their views?
D3: Still thinking of those who only say bad things about the Belizean form of government, how strongly do you approve or disapprove of such people being permitted to run for public office?
D4: How strongly do you approve or disapprove of such people appearing on television to make speeches?
D5: And now, changing the topic and thinking of homosexuals, how strongly do you approve or disapprove of such people being permitted to run for public office?

3.4.4.7 Social Capital: Empowerment and Political Action.

The final Social Capital factor, empowerment and political action, also represents a Social Capital outcome. This was a measures of citizen perception of ability to influence his/her situation. The questions in Table 10 were in the SC-IQ and the AmericasBarometer survey. This study took the mean value of the Z-score standardized values for each question and created a score for each individual surveyed. Individual scores were aggregated at the village level, creating a measure of empowerment and political action score for each survey location.

3.4.4.8 Demographic Measures.

In addition to Social Capital measures, this study included several socioeconomic and demographic factors in its analysis. Table 11 shows the demographic measures and associated methodology. These measures were aggregated at the village level allowing them to be included in survey location level analysis.

3.4.5 Spatial-temporal Lag Variables.

As a measure of the pre-intervention state of public opinion in Belize, the study included spatial-temporal lag variables for the primary dependent variables from 2012. Variables include:

- 2012 Trust in the US Government.
- 2012 Trust in the US military.
- 2012 Satisfaction with schools.
- 2012 Satisfaction with local medical services.

For each location surveyed in 2014 spatial-temporal lag variables were created using Equation 3.5 with spatial weights from Equation 3.6. These lag variables were included in regression analysis of the 2014 post US humanitarian intervention dependent variables.

$$y_{2012lag} = \mathbf{W}y_{2012} \quad (3.5)$$

$$\mathbf{W} = \begin{cases} 1 & distance(km) \leq 5km \\ \frac{20 - distance(km)}{15} & 5km < distance(km) < 20km \\ 0 & 20km \leq distance(km) \end{cases} \quad (3.6)$$

Table 10. Social Capital: Empowerment and Political Action Measures

LS3: “In general how satisfied are you with your life?”
SOCT2: “Do you think that the countrys current economic situation is better than, the same as or worse than it was 12 months ago?”
IDIO2: “Do you think that your economic situation is better than, the same as, or worse than it was 12 months ago?”
PROT3: “In the last 12 months, have you participated in a demonstration or protest march?”
JC10: “When there is a lot of crime a military take-over of the state would be justified.”
JC13: “When there is a lot of corruption a military take-over of the state would be justified.”
JC15A: “Do you believe that when the country is facing very difficult times it is justifiable for the Prime Minister of the country to close the National Assembly (House of Representatives and Senate) and govern without the National Assembly (House of Representatives and Senate)?”
EFF1: “Those who govern this country are interested in what people like you think. How much do you agree or disagree with this statement?”
EFF2: “You feel that you understand the most important political issues of this country. How much do you agree or disagree with this statement?”
ING4: “Democracy may have problems, but it is better than any other form of government. To what extent do you agree or disagree with this statement?”
PN4: “In general, would you say that you are very satisfied, satisfied, dissatisfied or very dissatisfied with the way democracy works in Belize?”
DEM2: “Which of the following statements do you agree with the most: For people like me it doesnt matter whether a government is democratic or nondemocratic, or democracy is preferable to any other form of government, or under some circumstances an authoritarian government may be preferable to a democratic one.”
VB1: “Are you registered to vote?”
VB2: “Did you vote in the last general elections of 2012?”
VB10: “Do you currently identify with a political party?”
POL1: “How much interest do you have in politics: a lot, some, little or none?”

Table 11. Demographic Measures and Methodology

Measure	Method
Age	Number of whole years
Ideology	1–10 scale from far left to far right, as surveyed
Income	Income bins from AmericasBarometer survey
Satisfaction with Income	Recoded into 1 = Good enough, 0 = Anything else
Household Goods	The sum total of the following measures: Refrigerator: 0 = No, 1= Yes Landline/residential telephone: 0 = No, 1= Yes Cellular telephone: 0 = No, 1= Yes Vehicle/car: 0 = No, # = how many Washing machine: 0 = No, 1= Yes Microwave oven: 0 = No, 1= Yes Motorcycle: 0 = No, 1= Yes Indoor plumbing: 0 = No, 1= Yes Indoor bathroom: 0 = No, 1= Yes Computer: 0 = No, 1= Yes Internet: 0 = No, 1= Yes Television: 0 = No, 1= Yes Flat panel TV: 0 = No, 1= Yes Is the house connected to the sewage system?: 0 = No, 1= Yes
Number of Children	# of children recorded from survey

3.5 Testing for Spatial Auto-correlation

This study included spatial data in its analysis. The spatially dependent variables being studied which include trust in the US military and Government, and satisfaction with local schools and medical services, were tested for spatial auto-correlation before regression analysis. Variables with spatial auto-correlation were further tested for auto-correlation of post regression residual values.

The dependent variables for this analysis were tested for spatial auto-correlation using the GeoDa spatial statistics program (Anselin et al., 2006). Aggregated variables at the survey location level were checked for significant auto-correlation against a lag measure of that same measure. The lag variable for each measure was created using Equation 3.7 with weights created using Equation 3.8 where $\delta = 50km$ and d_{ij} represent the distance between survey locations in kilometers (Anselin and Rey, 2014, pp. 40, 77, 89).

$$[Wy]_i = \sum_{j=1}^n w_{i,j} y_j \quad (3.7)$$

$$w_{ij} = f(d_{ij}, \theta) = \begin{cases} \frac{1}{d_{ij}} & d_{ij} \leq \delta \\ 0 & d_{ij} > \delta \end{cases} \quad (3.8)$$

The lag variable created in Equation 3.7 were tested for auto-correlation against the corresponding dependent variable as shown in Equation 3.9. For example, satisfaction with schools was tested for correlation with a lagged satisfaction with schools. This test generated a coefficient, referred to as Moran's I. Significance was calculated using a Monte Carlo simulation comparing the observed Moran's I to Moran's I values for the same data set with random locations. For values with significant p-values the Moran's I is a measure of the relative influence of the lagged variable on that specific

measure (Anselin and Rey, 2014, p. 107; Cressie, 1993).

$$\mathbf{y} = \rho \mathbf{W} \mathbf{y} \quad (3.9)$$

Any exhibited auto-correlation should be explained through either spatial or non spatial regression analysis. After tentative models were created, the residuals were also tested for auto-correlation. If the models sufficiently explained any exhibited auto-correlation the residuals did not have any significant auto-correlation (Ward and Gleditsch, 2008).

3.6 Non-spatial Regression Analysis

The primary focus of this study attempted to explain some of the variance in the study's dependent variables which are trust in the US military and government and satisfaction with local schools and medical service in relation to proximity to US lead humanitarian projects. Additional covariate factors, included spatial-temporal lag factors, Social Capital factors, and socioeconomic demographic factors were included in this study to explain additional variance and possible moderator interactions. This study attempted to build four models, one for each of the study dependent variables, with the factors shown in Table 12. This study employed step-wise linear regression to create a model that predicted values for the study's dependent variables. The step-wise regression created a standard linear regression model as shown in Equation 3.10.

$$y = \beta_0 + \beta_1 X_1 + \dots + \beta_n X_n + \epsilon \quad (3.10)$$

Successful models were tested to satisfy the following statistical tests:

- Overall significance: Successful models had at a p-value of 0.05 or lower.

- Individual factor significance: Each factor included in the model had an individual p-value of $\frac{0.05}{n}$ where n = the number of factors in the model.
- Residual normalcy: Model residuals were tested for normalcy using the Shapiro-Wilk test. Models needed a p-value of at least 0.05 to assume normally distributed residuals.
- Outliers: Influential data points: The models were tested for overly influential data points with the Cook's Distance test. Target Cook's Distance was 0.25 while 0.5 would be acceptable with additional scrutiny.
- Constant variance: Study models were tested for constant variance with the Breusch-Pagan test. P- values of over 0.05 from a test statistic as calculated from Equation 3.11 where SSR = the sum of squares for a model of the residual factors squared, SSE = the sum of squares for the errors of the primary model, and n = the number of degrees of freedom in the model.

$$TS = \frac{SSR}{2} / \left(\frac{SSE}{n} \right)^2 \quad (3.11)$$

- Multicollinearity: Model factors were tested for multicollinearity between the factors using the variance inflation factor (VIF) score. VIF scores under 5 were acceptable.
- Spatial auto-correlation of residuals: The use of spatial data adds an additional statistical test for auto-correlation or residuals. Acceptable models did not have significant auto-correlation between their residuals and spatially lagged residuals.

Table 12. Factors for Regression Analysis

Dependent Variables
Trust in the US military
Trust in the US government
Satisfaction with local schools
Satisfaction with local medical services
Tested Factors
Study focus Independent variables
Exposure to 2013 US school construction projects
Exposure to 2013 US medical outreach missions
Exposure to 2014 US school construction projects
Exposure to 2014 US clinic construction projects
Exposure to 2014 US medical outreach missions
Spatial-temporal Image Lag factors
2012 Pre-intervention spatially lagged trust in the US military
2012 Pre-intervention spatially lagged Trust in the US government
2012 Pre-intervention spatially lagged Satisfaction with local schools
2012 Pre-intervention spatially lagged Satisfaction with local medical services
Co-variate factors
Social Capital: groups and networks
Social Capital: trust and solidarity
Social Capital: collective action and cooperation
Social Capital: information and communication
Social Capital: social cohesion and inclusion
Social Capital: empowerment and political action
Ideology
Income
Satisfaction with income
Household goods
Number of children

3.7 Spatial Regression Analysis

This study attempted to form spatial regression models for dependent variables which exhibited spatial auto-correlation before any regression analysis. The study included a spatial lag spatial regression model. This model adds a spatially lagged dependent variable to the traditional linear regression model as shown in Equation 3.12.

$$\mathbf{y} = \rho \mathbf{W}\mathbf{y} + \beta_0 + \mathbf{X}_1\beta_1 + \dots + \mathbf{X}_n\beta_n + \epsilon \quad (3.12)$$

This type of model allows for additional variance in the dependent variable to be explained by spatial neighbor observations. The relationship between an observation and its neighbors is defined in a spatial weights matrices, $\mathbf{W}$. $\mathbf{W}$ can be defined by different spatial relationships. This study attempted to build models with several different cutoff distance inverse distance spatial weight models. Spatial lag models cannot utilized ordinary least squares (OLS) methodology for model building. Instead, they must use specialized model building methodology such as maximum likelihood (ML) (Anselin and Rey, 2014, p. 189). In the study spatial regression models were tested in the GeoDa spatial statistics program. For a spatial lag variable to be included in a model, it had to satisfy the same statistical tests as normal linear regression. A final test for spatial auto-correlation of the residuals ensured the model sufficiently explained any spatial interaction between observations (Anselin et al., 2006).

3.8 Methodology Conclusion

This methodology seeks to explain variance in the study's dependent trust and satisfaction variables based on proximity to US lead projects, as well as covariate factors. Exposure to US projects required development of an exposure variable. This

required analysis of the spatial relationship between the observations and project sites. Additional co-variate factors were analyzed and processed to make any models more robust. In addition to Social Capital and socioeconomic factors taken from the same data set as the study dependent variables, this study included spatial-temporal lag image variables in its analysis. Additionally, incorporated are spatial analysis techniques in addition to the primary linear regression methodology. Study dependent variables and model residuals were tested for spatial auto-correlation to ensure spatial interaction effects were accounted for. If necessary, spatial regression analysis was employed in order to allow spatial influence to explain additional variance. All these techniques attempted to focus on the primary effects by removing additional variance which may otherwise cloud a significant relationship.

IV. Results and Discussion

4.1 Chapter Overview

Results of this study are broken into several sections. First, this study examines the variables derived for use later in the analysis. Next, a summary of results of the testing of study variables for spatial-auto-correlation. The next section summarizes the process of selecting an exposure to US projects measurement. Finally, this study includes results for the process of developing models for the study variables.

4.2 Development of Study Factors

This section summarizes the results from the development of the study variables and is broken down into three sections. The first section examines the dependent variables. The second subsection is a summary of the spatial-temporal lag variable that was developed for the 2012 data set. This section ends with a summary of the derived social capital and demographic variables used as covariate factors in this study.

4.2.1 Examination of Dependent Variables.

This study examines the impacts that US military humanitarian projects have on four different dependent variables: trust in the US military, trust in the US, satisfaction with local schools, and satisfaction with local medical care. The measures were included as questions in the AmericasBarometer survey. The study attempted to model the effects on these measures aggregated at the village level based on a measure of proximity to US projects. This section summarizes the data used to create these measures as well as the aggregated village level measures for each dependent

variable. Table 13 and Figure 8 show summary statistics and distributions of the study dependent variables for individual and aggregated responses, respectively.

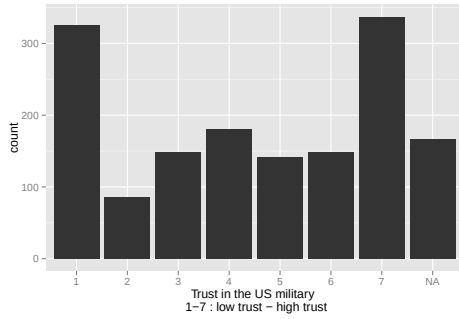
Table 13. Summary Statistics for Dependent Variable

Dependent Variable	Mean	Standard Deviation	Scale
Trust in the US Military	4.22	0.60	7 Point
Trust in the US	2.48	0.32	4 Point
Satisfaction with Local Schools	2.77	0.20	4 Point
Satisfaction with Local Medical	2.51	0.23	4 Point

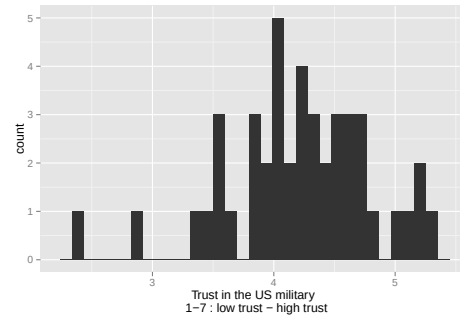
4.2.1.1 Trust in the US military.

The first dependent variable considered in this study was citizen trust in the US military. This measure is of strategic importance to US military planners as trust can be equated to access and cooperation (Grootaert and Van Bastelaer, 2002, p. 102). By measuring trust in the US military this study attempts to look at how US humanitarian operations affect local perceptions of the US military. Individual responses for trust were on a 1 to 7 Likert scale with 1 highly untrustworthy and 7 highly trustworthy. Figure 8a shows a distribution of individual responses for trust in the US military. Visual examination reveals a high occurrence rate of very low and very high returns, suggesting highly polarized opinions towards the US military and their operations within Belize. The mean response for trust in the US military was 4.8 and the standard deviation was 1.85.

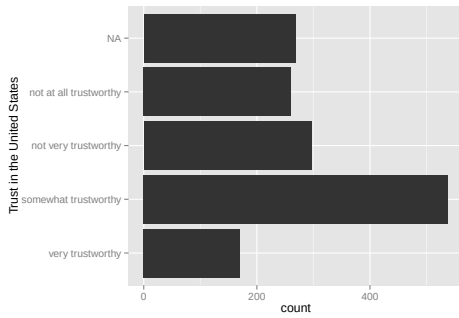
Based on location individual responses were aggregated, which created village level variable for mean trust in the US military. Figure 8b shows the distribution of the village level trust in the US military measure. Mean village level trust in the US military was 4.2 with a standard deviation of 0.60. Examination of the distribution



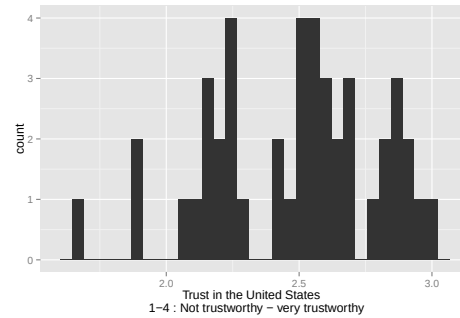
a Individual level Trust in the US Military



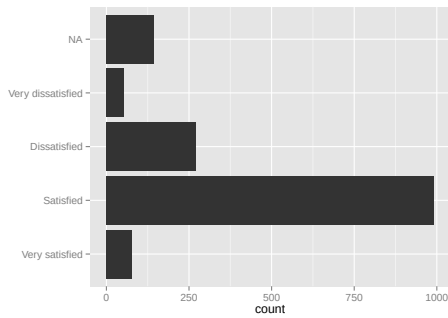
b Village level Trust in the US Military



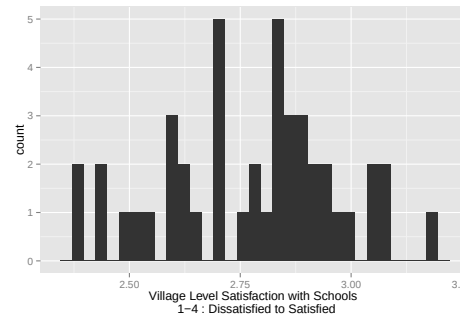
c Individual level Trust in the US



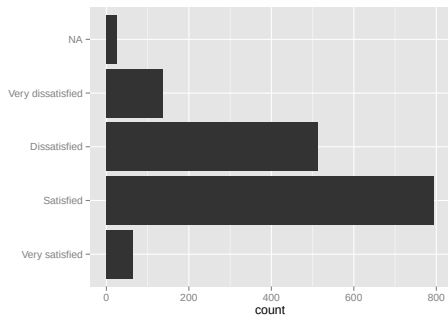
d Village level Trust in the US



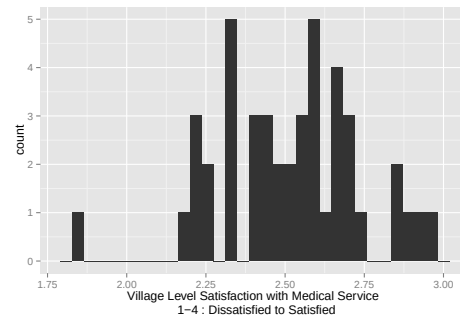
e Individual level Satisfaction with Local Schools



f Village level Satisfaction with Local Schools



g Individual level Satisfaction with Local Medical Services



h Village level Satisfaction with Local Medical Services

Figure 8. Distributions of Study Dependent Variables

reveals a highly stratified range of trust in the US military based on location with some villages having mean values as low as 2.4/7, and as high as 5.3. Several distinct groups of villages can be seen in the distribution suggesting several distinct classes of attitudes towards the US military. Analysis for this study included the village level trust in the US military as one of the primary dependent variables.

4.2.1.2 Trust in the United States.

The second dependent variable in this study is trust in the US. This variable is used to gauge how project in Belize affect the image of the US abroad. This variable was also aggregated based on location to create a variable for village trust in the US. The mean responses for individual trust in the US was aggregated at the village level revealing the distribution shown in Figure 8d. Like the trust in the US military measure, the distribution of village level trust in the US measure reveals that attitudes towards the US vary widely based on location. Village mean responses are concentrated in three distinct groupings with several outliers on the low trust side. Mean village level trust in the US was 2.5 with a standard deviation of 0.32 on a 4 point scale. Villages responses, however, ranged from 1.7 to 3.0. This study was interested in determining if US military humanitarian operations affected the observed geographic distribution in trust in the US.

4.2.1.3 Satisfaction with Local Schools.

In addition to measures of attitudes towards the US and US military this study was interested in measures of local government performance in an attempt to link US humanitarian projects to measures of government legitimacy. The first measure of local government performance considered in this study was citizen satisfaction with local schools. Schools make up the majority of US humanitarian construction

projects conducted during the study period were, which gives additional importance to this variable. The distribution of individual responses to satisfaction with local schools is shown in Figure 8e. This measure was also on a four point scale. Fewer response categories somewhat limit the total resolution. The distribution of the mean responses aggregated at the village level is shown in Figure 8f. Examination reveals that while individual responses appear normally distributed, with the largest percent responding with satisfied, village aggregated responses were highly stratified. Village mean scores ranged from 2.4 to 3.2 with a mean of 2.8 and standard deviation of 0.20 on a 4 point scale, found in Table 13. This study is interested in determining if US humanitarian projects had any relationship to this observed geographic variation.

4.2.1.4 Satisfaction with Local Medical Service.

The final dependent variable considered in this study was satisfaction with local medical service. US military humanitarian operation during the study period included running clinics for the local population as well as a major clinic construction project. This variable is used to find if a relationship exists between US humanitarian operations and an increase in in general satisfaction with medical services. The distribution of individual responses for satisfaction with medical care are included in Figure 8g. These responses were utilized to create a village level aggregated mean score which is shown in Figure 8h. Examination reveals that, like schools, medical outcomes vary widely based on location. Village mean responses ranged from 1.8 to 3.0 on a 4 point scale, with a mean of 2.5 and standard deviation of 0.23. These values are found in Table 13. As with the other measures, this study is interested in determining if US humanitarian projects had any relationship to this observed geographic variation.

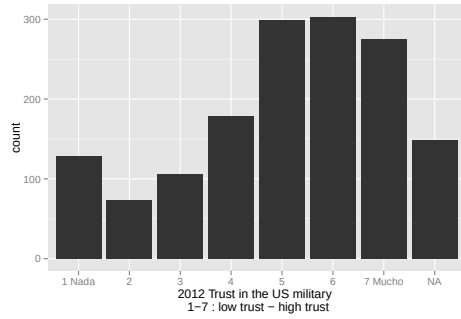
4.2.2 Examination of Spatiotemporal Lag Variables.

The control variables considered used in this study were created from answers to the AmericasBarometer survey prior to US intervention. Spatiotemporal lag variables were developed for each of the dependent variables. The new variables were intended to form a spatial image of citizen opinions and associated levels of performance before US involvement. The spatiotemporal lag variables were developed in such a way that measures did not need to be taken at the same locations both pre and post treatment. The intent was to provide a snapshot of the average response for each measure with a weight based on proximity to the study's dependent variable location. Examination of the pre-treatment measures reveals wide and uneven geographic distributions.

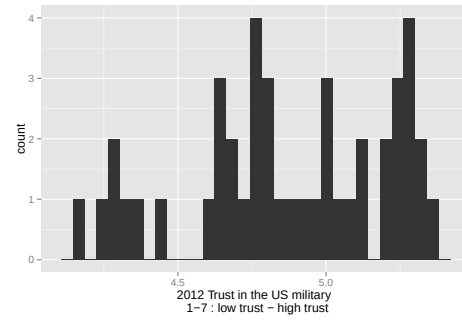
Figure 9a and Figure 9b show the individual and village level calculated spatial image distributions for the 2012 trust in the US military. Examination of the individual responses distribution reveals a curious absence of the post intervention polarization seen in Figure 8a. This observation will be further examined in the study conclusion. Individual 2012 measures of trust in the US are summarized in Figure 9c. The derived village level 2012 spatiotemporal trust is summarized in Figure 9d. Baseline 2012 individual responses for satisfaction with schools are shown in Figure 9e. The distribution of calculated village level spatiotemporal lag measures for satisfaction with schools is shown in Figure 9f. Finally, individual and derived spatiotemporal image measures of satisfaction with local medical service in 2012 are summarized in Figure 9g and Figure 9h.

4.2.3 Derived Social Capital and Demographic Factors.

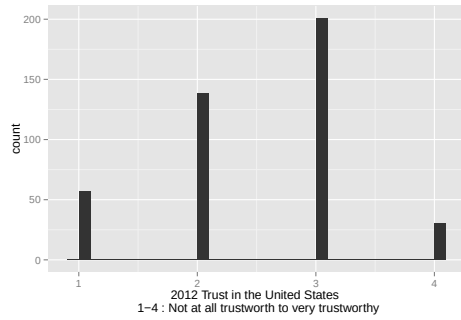
This study utilized Social Capital and demographic measures as additional covariate factors for regression analysis. Table 14 summarizes the derived Social Capital and demographic factors used in creating models for this study. Summaries of



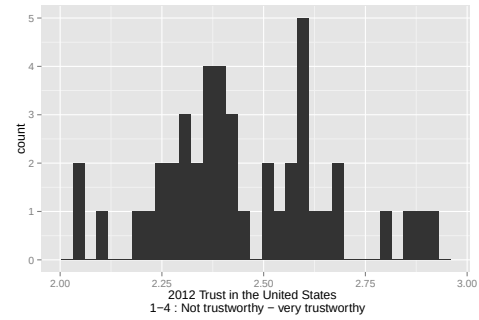
a Individual level Trust in the US Military



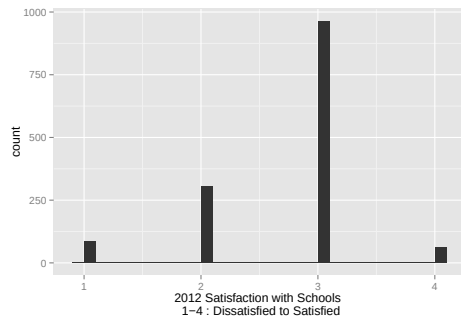
b Village level Trust in the US Military



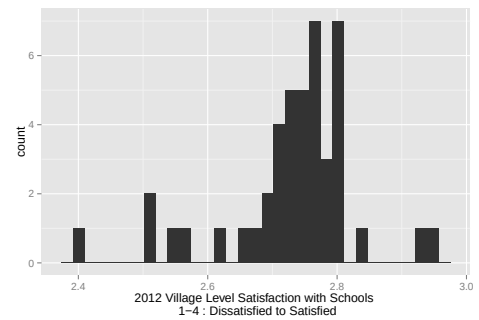
c Individual level Trust in the US



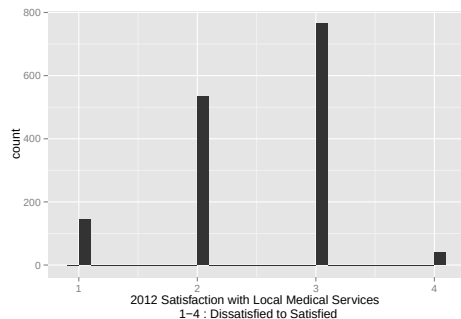
d Village level Trust in the US



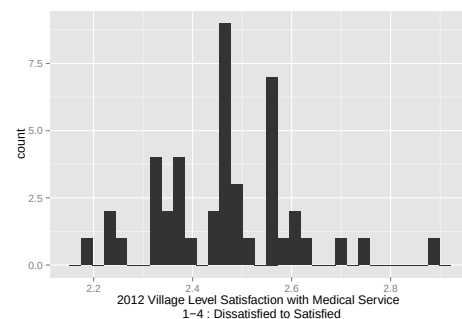
e Individual level Satisfaction with Local Schools



f Village level Satisfaction with Local Schools



g Individual level Satisfaction with Local Medical Services



h Village level Satisfaction with Local Medical Services

Figure 9. Distributions of 2012 Spatial-Temporal Lag Variables

individual factors utilized in the creation of these factors can be found in Appendix A.

Table 14. Summary of Social Capital and Socioeconomic Demographic Factors

Factor	Mean	Standard Deviation
Social Capital: Groups and Networks	2.20	0.95
Social Capital: Trust and Solidarity	3.77	0.26
Social Capital: Collective Action and Cooperation	0.01	0.25
Social Capital: Information and Communication	-0.06	0.39
Social Capital: Social Cohesion and Inclusion	4.71	0.72
Social Capital: Empowerment and Political Action	0.00	0.08
Demographics: Mean Village Income	BZ\$780	103.7
Demographics: Ratio of Village Population Satisfied with Income	0.11	0.089
Demographics: Mean number of House Hold Goods	20.8	1.22
Demographics: Mean number of Children	3.06	0.64

4.3 Testing Pre-model Data for Spatial Auto-Correlation

The study focuses on spatial analysis of spatial data which requires additional types of testing. Testing for spatial auto-correlation is important for any spatial data set. The test attempts to determine if there is any significant spatial clustering between observations. This study tested each of the four dependent variables for auto-correlation. Each test included calculation of the Moran's I correlation between observations and a spatially lagged variable. The spatial lag variable was calculated

by taking a weighted mean of all neighbor responses for each observation. Significance was then computed through a simulation of spatially random data. Several different lag variable weighting calculations were attempted. The results below were with inverse distance weighting with a 50 km cutoff threshold. This was the only criteria where any of the data sets exhibited significant auto-correlation.

2014 Trust in the US military was tested and found not to contain significant spatial clustering. The Moran's I scatter plot for trust in the US military is found in Figure 10. Figure 11 shows results of a simulation of spatially random distributions of the trust in US military data with a non significant pseudo p-value of 0.319.

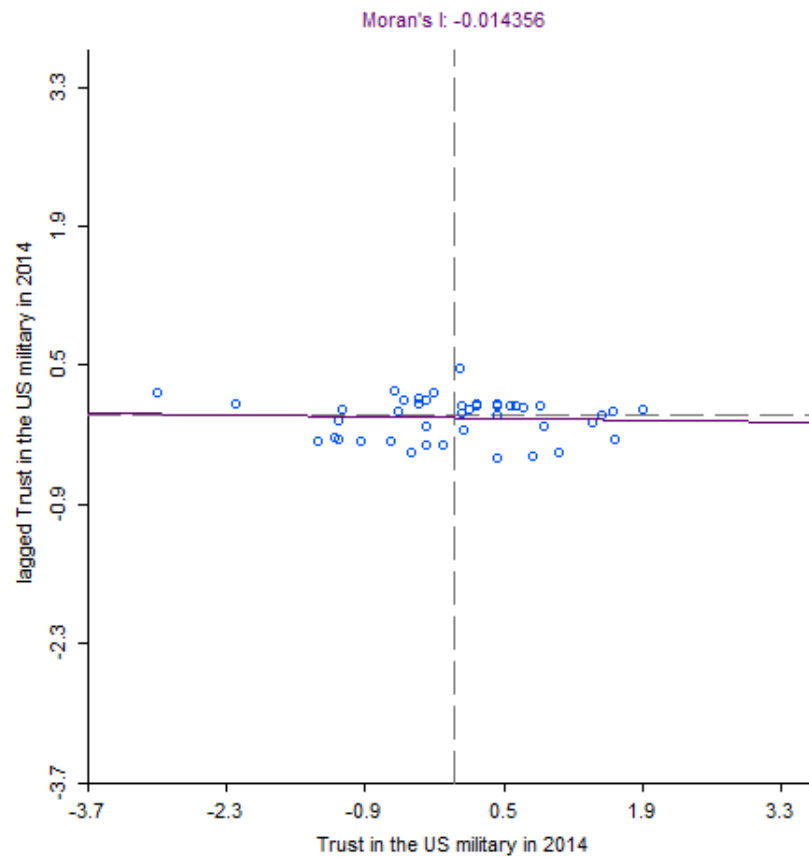


Figure 10. 2014 Trust in the US Military spatial autocorrelation Moran's I plot

2014 Trust in the US was tested and found not to contain significant spatial

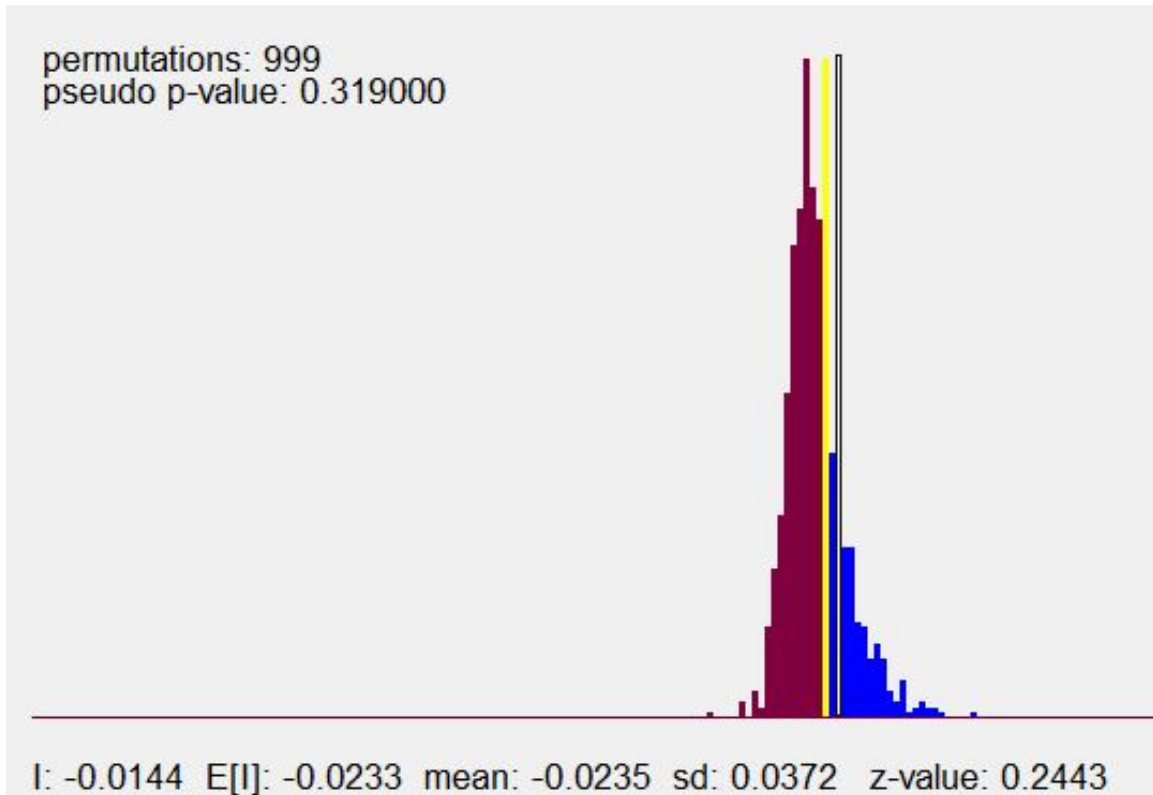


Figure 11. 2014 Trust in the US Military spatial autocorrelation significance Test Results

clustering. The Moran's I scatter plot for trust in the US is shown in Figure 12. The results from a simulation of spatially random distributions of the trust in US data, shown in Figure 13, is a non significant pseudo p-value of 0.107.

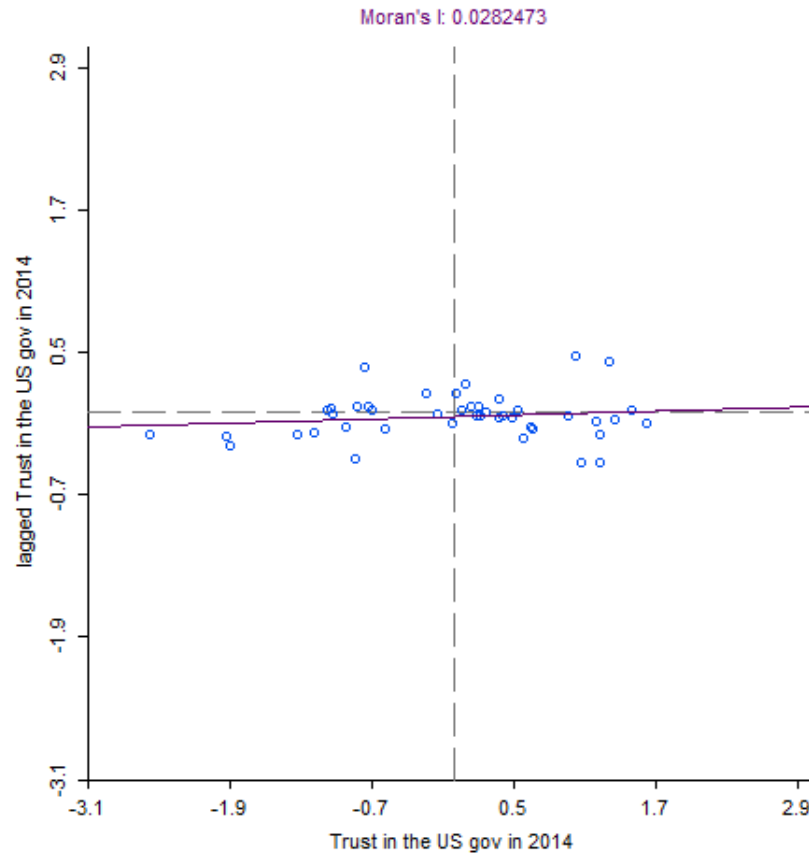


Figure 12. 2014 Trust in the US spatial autocorrelation Moran's I plot

This study found 2014 satisfaction with local schools to have significant spatial auto-correlation. Moran's I was calculated at 0.115 which can be interpreted as neighbor influences account for 11.5% of the variance in observed satisfaction with schools. The Moran's I scatter plot for satisfaction with local schools is found in Figure 14. The results of a simulation of spatially random distributions of the satisfaction with local schools, Figure 15, shows a significant pseudo p-value of 0.034. The presence of spatial auto-correlation in the satisfaction with schools dependent variable adds a new

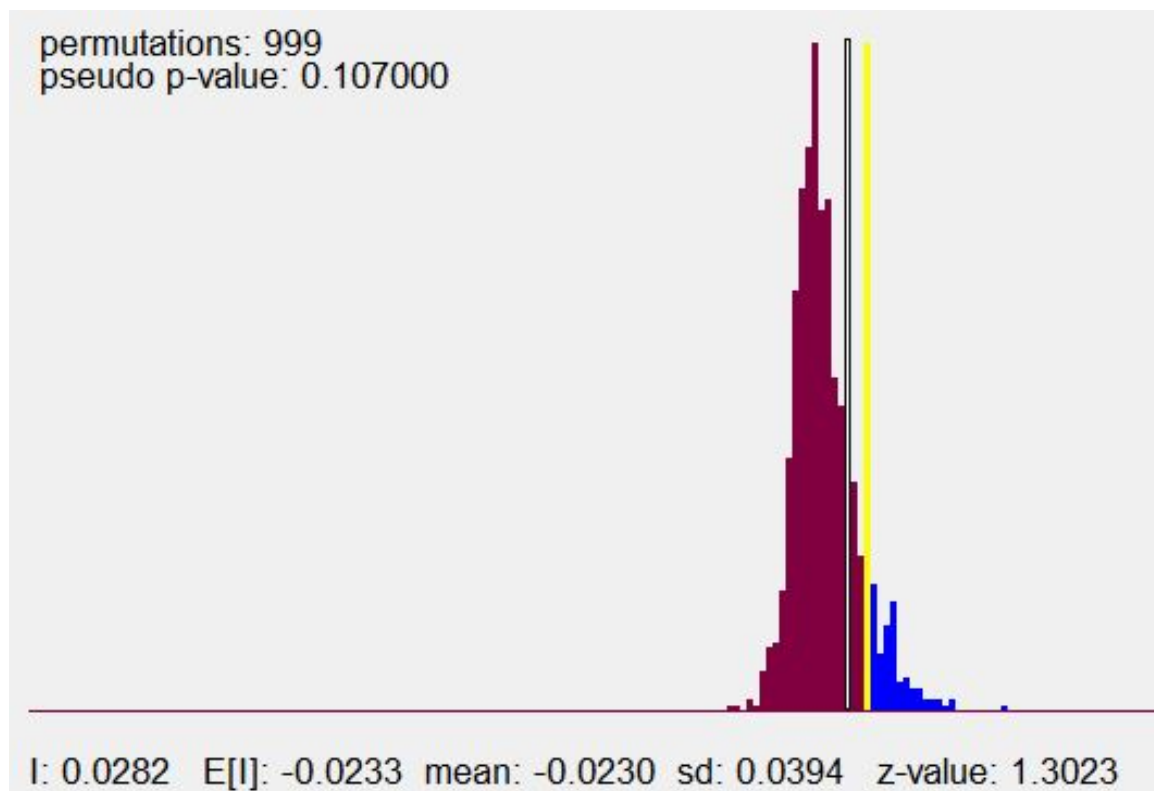


Figure 13. 2014 Trust in the US spatial autocorrelation significance Test Results

requirement for a satisfactory prediction model. A successful model must explain the spatial auto-correlation. This is tested in a model by testing the model residuals for spatial auto-constellation. If the residuals do not exhibit significant auto-correlation then the factors of the model sufficiently explain the auto-correlation seen in the untreated dependent variable.

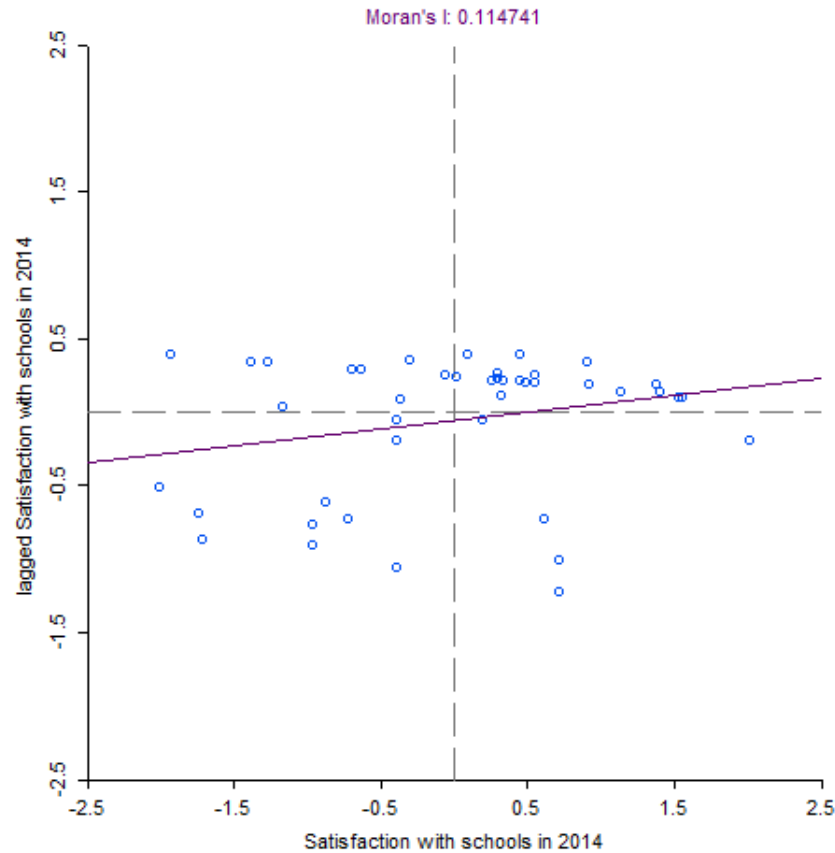


Figure 14. 2014 Satisfaction with Schools autocorrelation Moran's I plot

2014 satisfaction with local medical service was tested and found not to contain significant spatial clustering. The Moran's I scatter plot for satisfaction with local medical service is shown in Figure 16. The results of a simulation of spatially random distributions of the satisfaction with local medical services shown Figure 17, found a non significant pseudo p-value of 0.469.

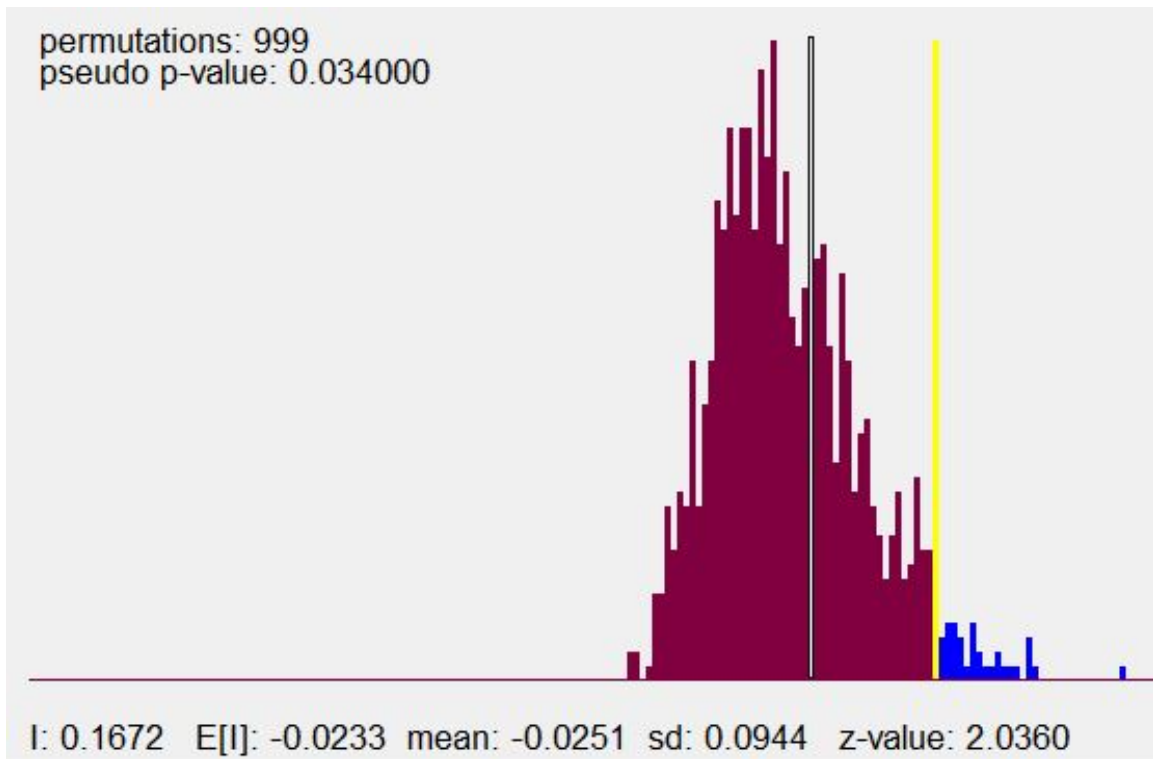


Figure 15. 2014 Satisfaction with Schools autocorrelation significance Test Results

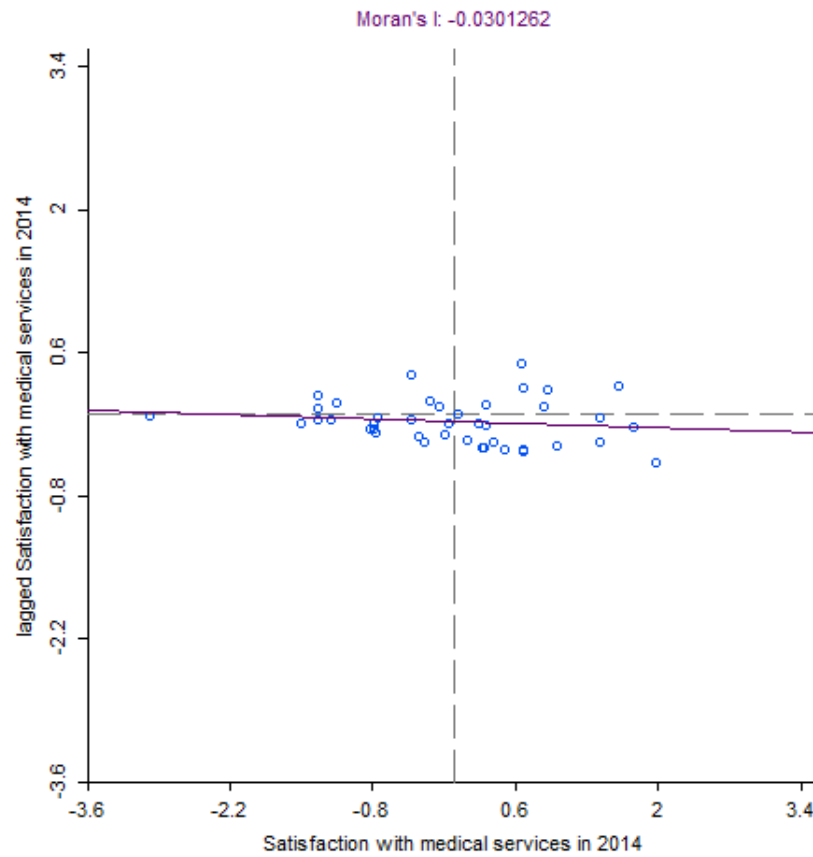


Figure 16. 2014 Satisfaction with Local Medical Services Auto-correlation Moran's I plot

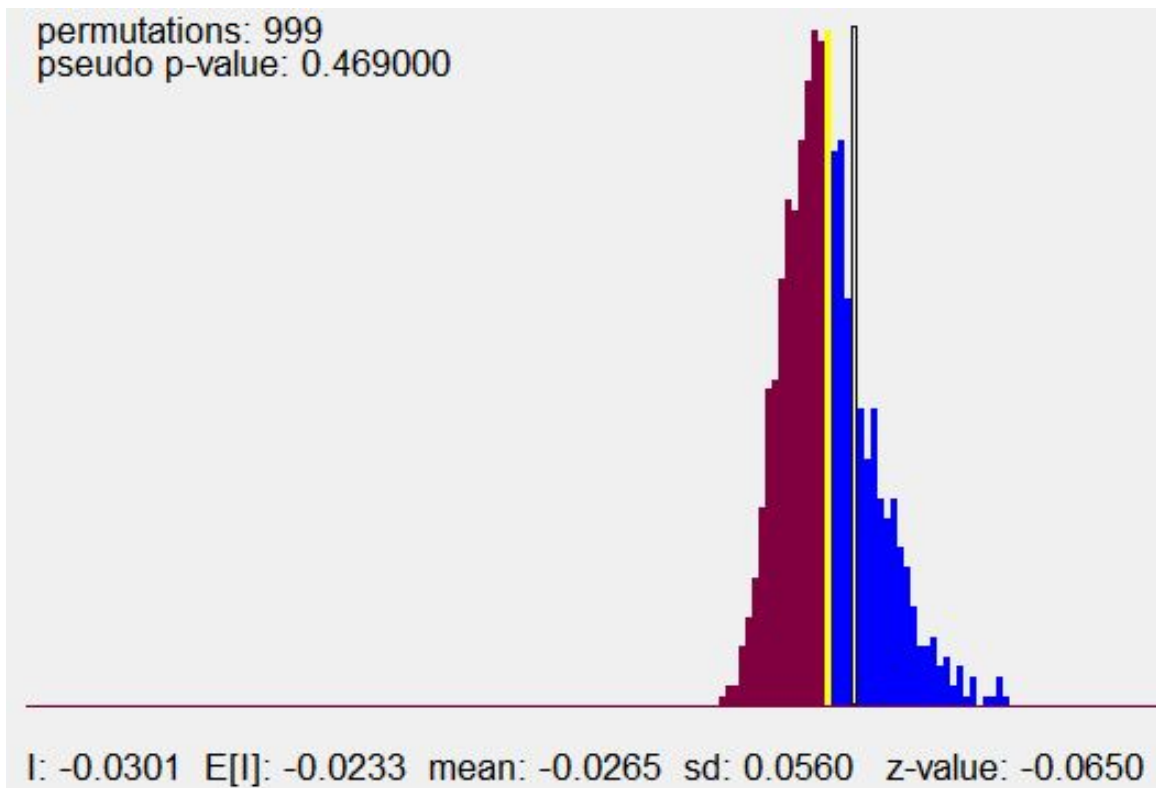


Figure 17. 2014 Satisfaction with Local Medical Services Auto-correlation significance Test Results

4.4 Analysis of Measures of Exposure to US Projects Models

The aim of this study was to explore the relationship between US humanitarian projects and public opinion outcomes across a wide geographic area. The primary independent variables in this study were exposure to US humanitarian projects of different classes. Classes were based on year, 2013 or 2014; type of mission, medical or construction; and type of construction, school or clinic. The exposure models were based on distance between survey locations and the nearest US humanitarian activity. This section compares the use of straight distance, inverse distance scoring, binary distance scoring, or logarithmic distance as the best fit to measure exposure to US projects.

4.4.1 Comparison of Methods.

The simplest exposure model considered in this study was straight distance. The distance in meters to the nearest US activity for each different class was calculated for each survey location. Figure 18 shows an example distribution of distances to the nearest 2013 school construction project location for each survey location. This exposure model was the least favorable because it over weighed changes in exposure at greater distances. In the straight distance model a change in distance from 9 to 10 km has the same weight in linear regression as a change from 90 to 100 km. Literature suggests that distance changes that occur at near distances have a greater impact on spatial phenomena. The scatter plot in Figure 19 shows the challenges in using distance as an exposure variable. The impact of observations at close distances are of more interest to the study's purpose. In this model, however, all changes in distance receive the same weight which may cause significant impacts at closer ranges to be missed.

The next exposure model considered was binary distance scoring. In this method

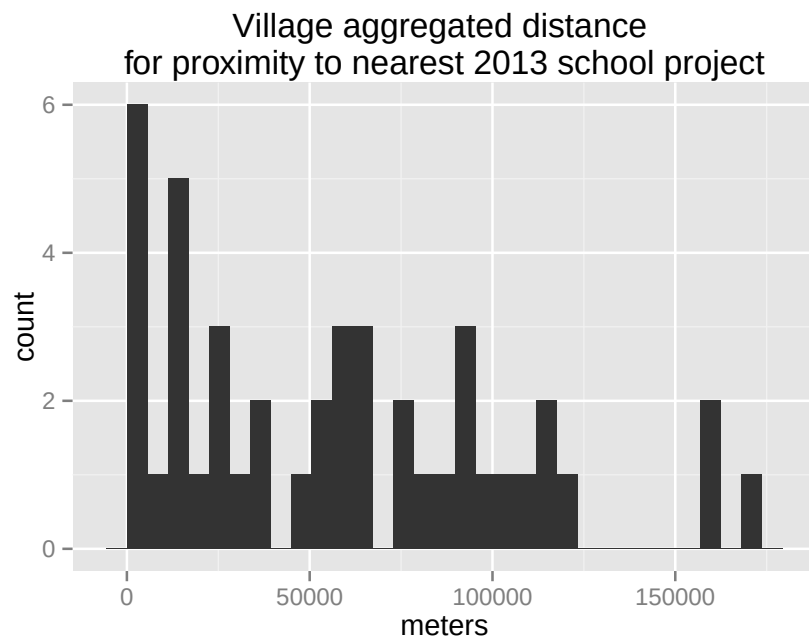


Figure 18. Distribution of Village Distances to Nearest 2013 US Construction Project

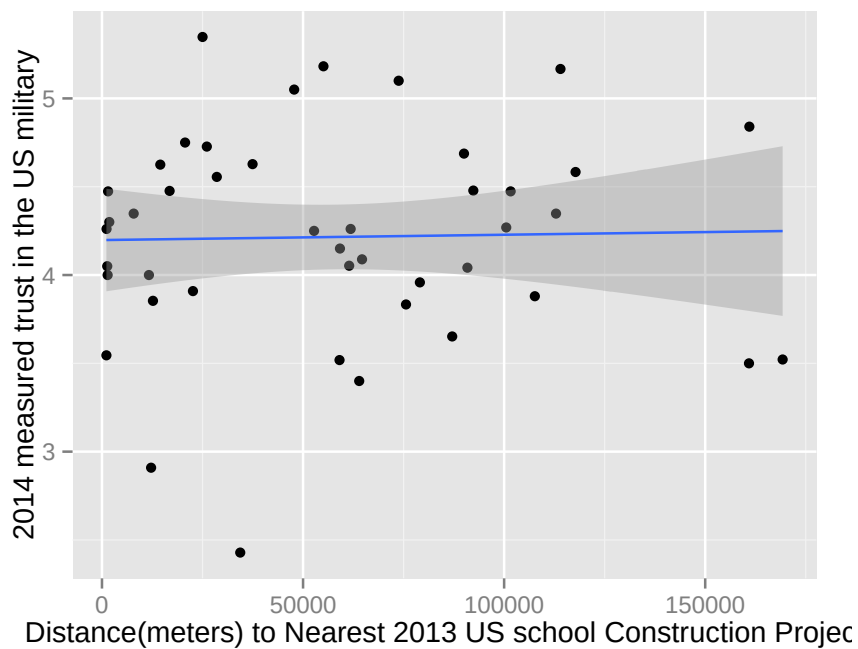


Figure 19. Plot of Trust in the US Military by Village Distances to Nearest 2013 US Construction Project

survey locations were considered exposed if they were within a specified threshold distance of the considered project class. Figure 20 and Figure 21 are examples from one project class of the distribution of exposure values and a scatter plot against one of the study dependent variables. The benefit of this method is that it created a distinct experimental and control groups. A drawback, however, is that this type of analysis is not designed to discover a relationship between changes in relative proximity and outcomes. Additionally, this method requires the selection of a threshold distance, introducing subjectivity into the analysis.

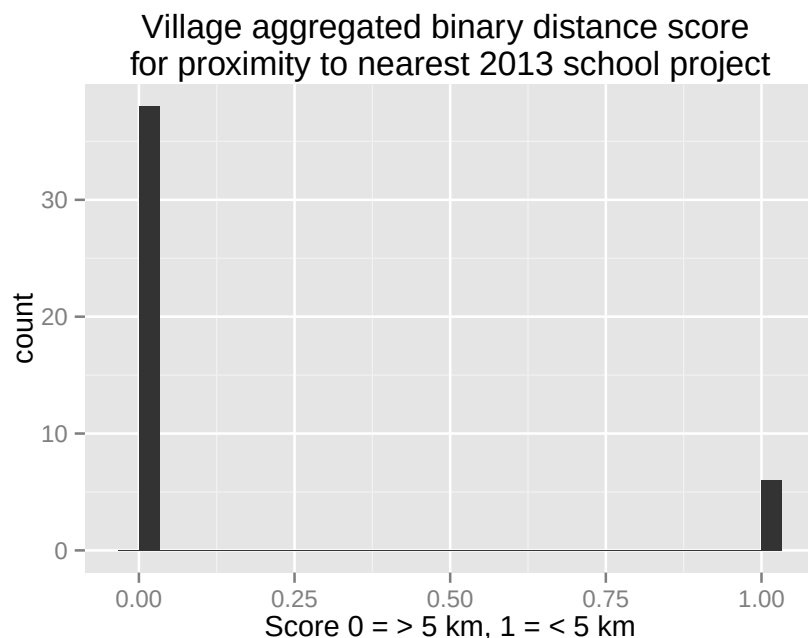


Figure 20. Distribution of Village Binary Distances Scores to Nearest 2013 US Construction Project

The next exposure model considered was based on inverse distance. Figure 22 and Figure 23 show examples of a distribution and scatter-plot against a dependent variable, respectively. Inverse distance scoring takes the form of $\frac{1}{dist}$ where $dist$ is in a unit of length. Inverse distance is suited to measuring effects in geographic distance because changes that occur at closer distances are given more weight than changes

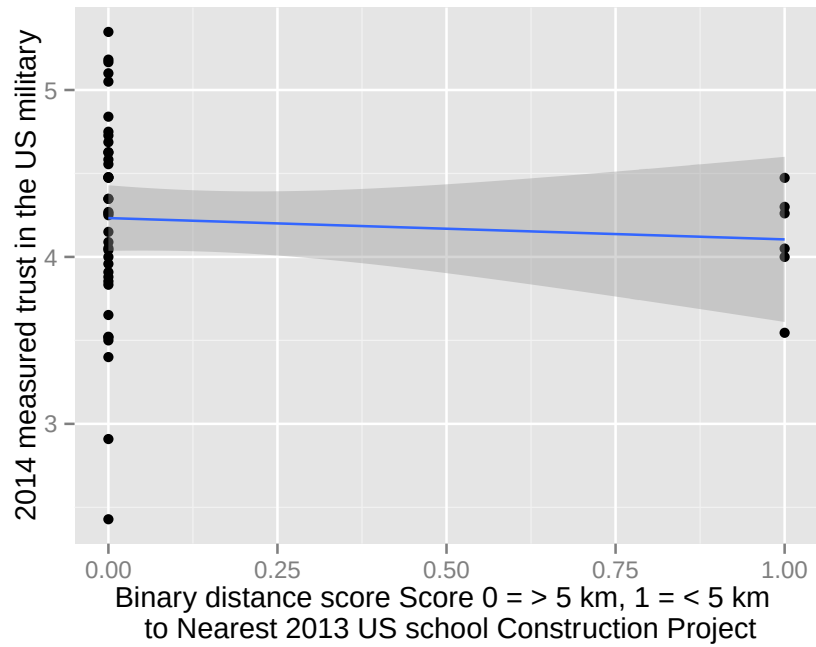


Figure 21. Plot of Trust in the US Military by Village Binary Distance Score to Nearest 2013 US Construction Project

in distance that happen further from a project. The unit of measurement alters the relationship between observations. For distances less than one unit of measure, the inverse distance will be greater than one and approach infinity as the distance approaches zero. Literature suggests the creation of threshold distances when using inverse distance weighting. This study considered villages with a project within 5 km were fully exposed and those over 20 km away from a project received no exposure. The values between these distances were given a scaled exposure beginning at 0 at 20 km to 1 at 5 km. Obviously, this method introduced subjectivity. It does not account for the fact that depending on which dependent variable is measured and which class of projects issued, the distances where saturation and no exposure are going to change.

The final exposure model considered was natural logarithmic distance. Figure 26a and Figure 25 show examples of a distribution and scatter-plot against a dependent

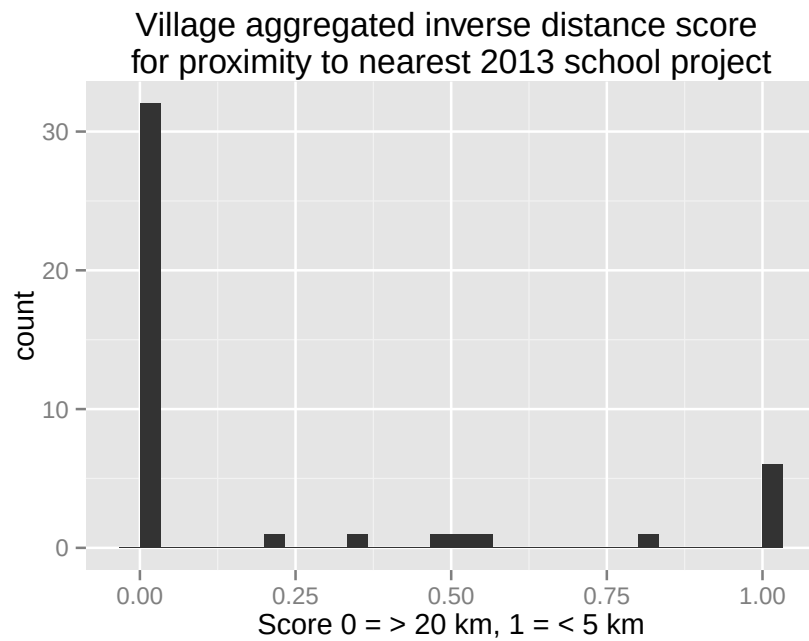
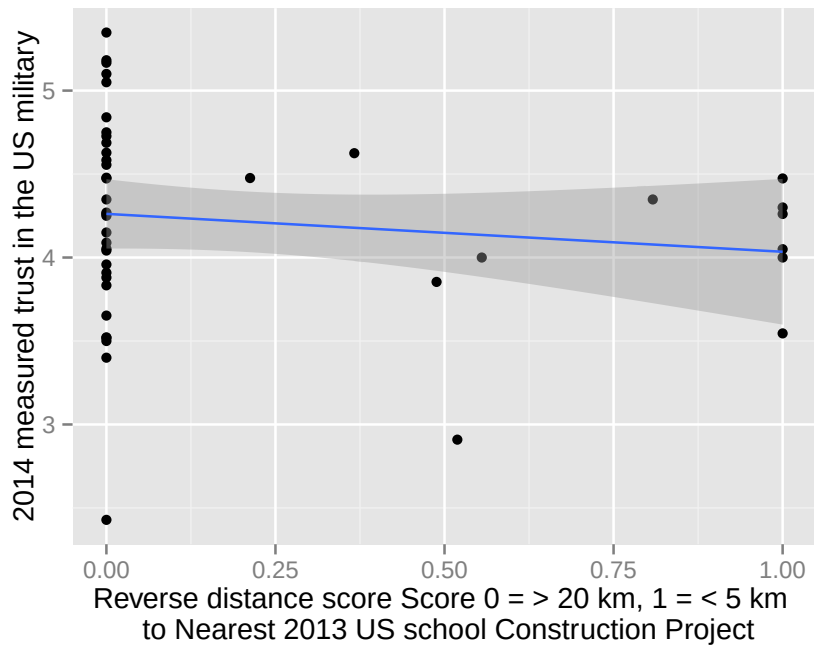


Figure 22. Distribution of Village Inverse Distance Scores to Nearest 2013 US Construction Project



variable, respectively. Logarithmic distance has the benefit of not being dependent on a unit of measurement or threshold distance. Regression models were tested using both meters and km as the unit of measurement. The β weight coefficients remained the same in both models; the intercept, however did change. With logarithmic distance the relative exposure of an observation is evaluated in terms of orders of magnitude. The result is a useful distribution of exposures favoring proximal changes in distance without the subjectivity of applied threshold distances or unit of measure selection. For these reasons, this study chose logarithmic distance as the best measure of exposure to US projects.

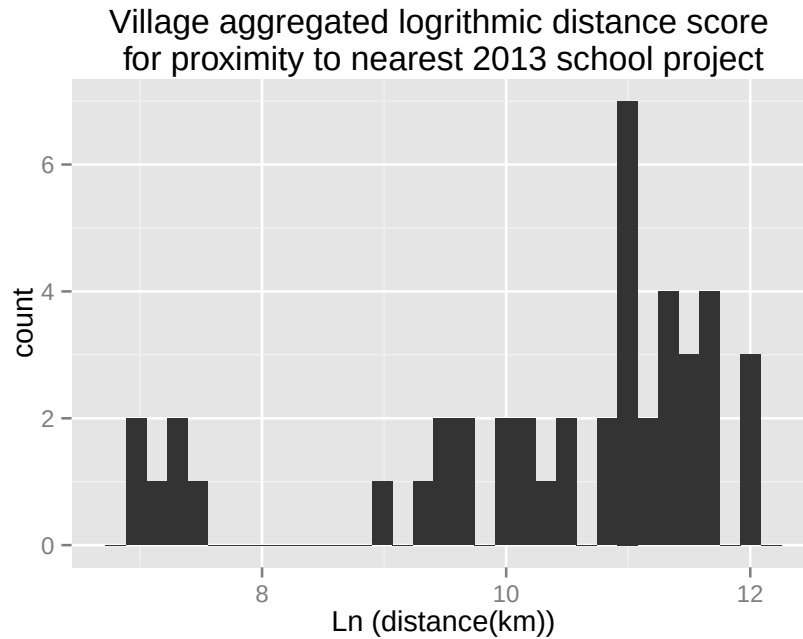


Figure 24. Distribution of Village Logarithmic Distances to Nearest 2013 US Construction Project

This study created exposure measures based on natural logarithmic distance between observations and the nearest US humanitarian operation of various classes. Table 15 shows summary statistics for the logarithmic distance exposure to US projects independent variables employed in this study. Figure 26 shows distributions for the

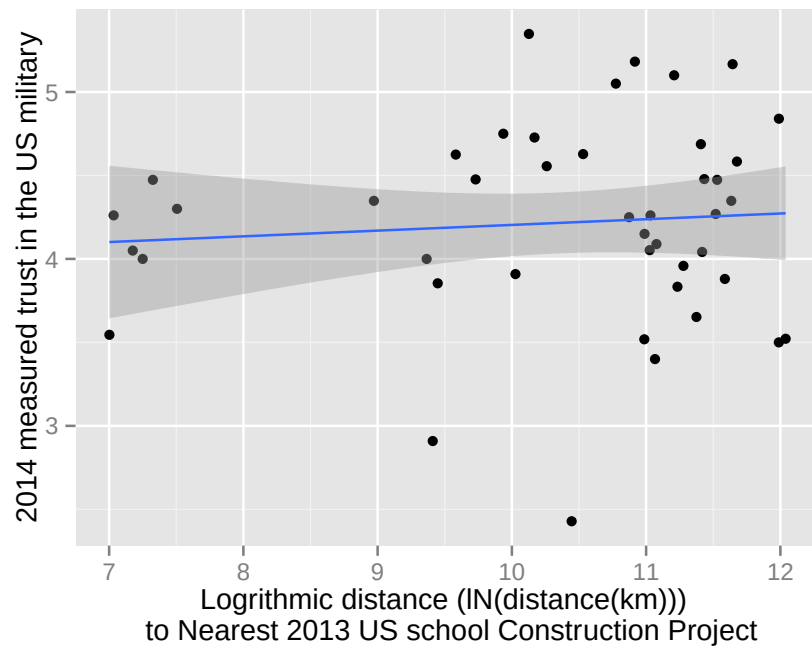
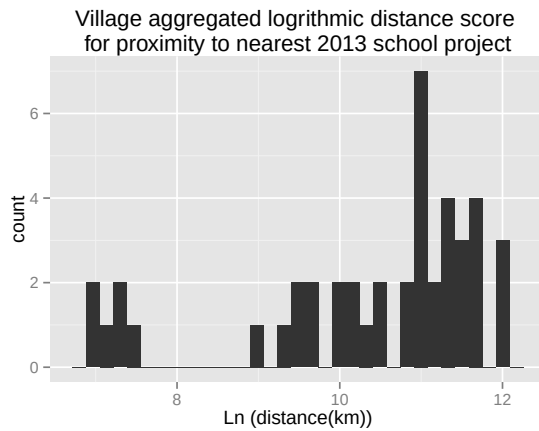
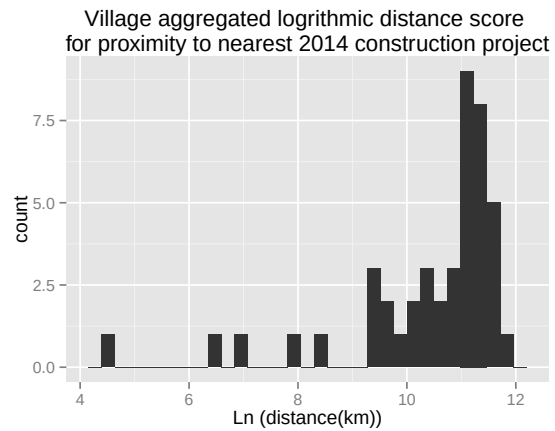


Figure 25. Plot of Trust in the US Military by Village Logarithmic Distance to Nearest 2013 US Construction Project

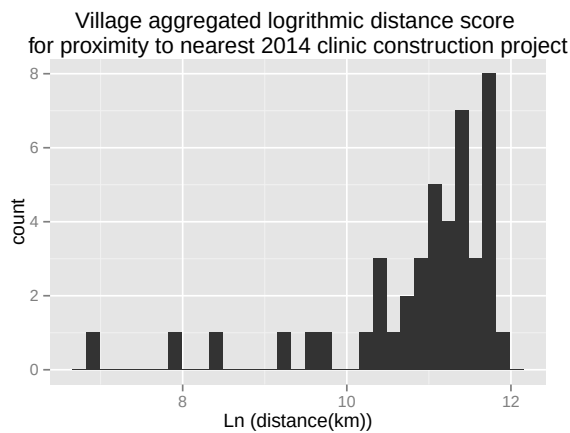
independent variables.



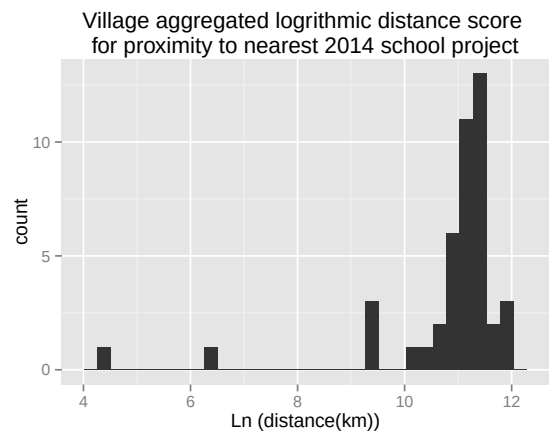
a 2013 Construction



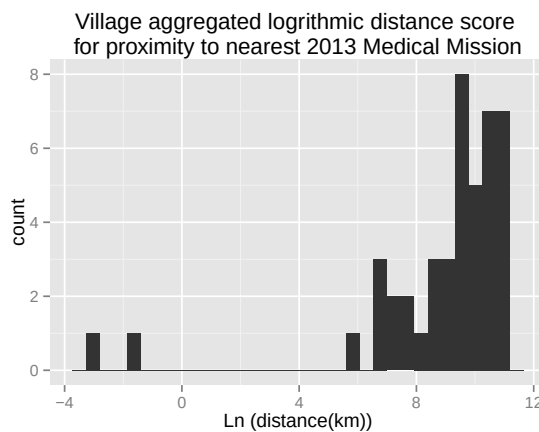
b 2014 Construction



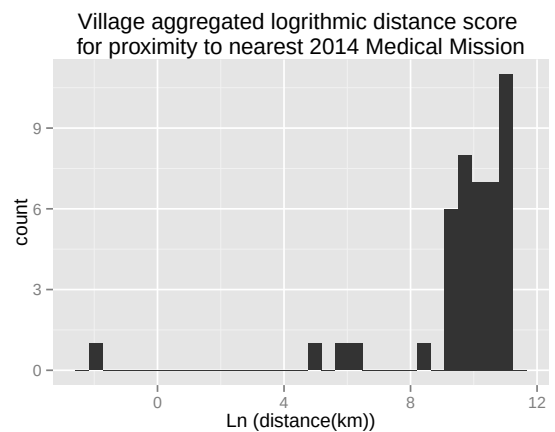
c 2014 Clinic Construction



d 2014 School Construction



e 2013 Medical Mission



f 2014 Medical Mission

Figure 26. Distributions of Logarithmic Distance Study Exposure Independent Variables

Table 15. Summary Statistics for Exposure to US Projects Independent Variables

Humanitarian Activity Class	Mean Distance (km)	SD Distance	Mean Ln(km)	SD Ln(km)
2013 School Construction	57.7	46.5	10.3	1.47
2014 School Construction	72.9	35.7	10.8	1.35
2014 Medical Construction	72.6	40.1	10.9	1.06
2014 All Construction	56.5	37.0	10.4	1.54
2013 Medical Outreach	20.4	19.0	8.8	2.8
2014 Medical Outreach	30.3	21.3	9.6	2.2

4.5 Results of Regression Modeling

The primary analysis for this study employed step-wise regression to build models to predict the behavior of the study's dependent variables:

- 2014 mean village trust in the US Military
- 2014 mean village trust in the US
- 2014 mean village satisfaction with local schools
- 2014 mean village satisfaction with medical services

This section summarizes the models created for these dependent variable measures.

4.5.1 Trust in the US Military.

This study was able to create a model predicting the 2014 trust in the US military mean response at the village level. The model had a R^2 of 0.52 with a significance p-value of less than 0.0001. A summary of the model fit can be found in Table 16. In

this model the significant factors in predicting trust in the US military in 2014 were: logarithmic distance to 2013 US military led school construction projects, logarithmic distance 2013 US Military led medical missions, satisfaction with income, and the Social Capital empowerment and political action sub-factor. Model coefficients are summarized in Table 17. The model satisfied statistical tests at the 95% confidence level. Model residuals satisfied the Shapiro-Wilk test, and were found to be normal. The model excluded a single outlier, the village of Xaibe. Xaibe is a Mayan village where mean measured trust in the US military dropped over 3 points on a 7 point Likert scale between 2012 and 2014. The model further satisfied tests for constant variance and multicollinearity. A summary of the satisfied statistical tests can be found in Appendix B. Logarithmic distance to both the 2013 school construction projects and medical missions had a positive relationship with trust, meaning that as distance from project *increased*, observed trust went also *increased*, which is opposite the expected relationship. The relative dominance of each factor is summarized in Figure 27. Exposure to US projects accounted for a combined 52% of the variance explained in the model.

Table 16. Trust in the US Military Regression Model Summary

Source	DF	Sum of Squares	F Ratio
Model	4	6.246965	10.3892
Error	38	5.712299	Prob >F
C. Total	42	11.959264	<.0001

In addition to modeling trust in the US military at the village level this study examined the change in individual trust between 2012 and 2014. Individual trust in the US military was significantly lower in 2014 relative to 2012. Analysis of variance is summarized in Figure 28 and Table 18. In addition to the observed significant change in mean individual trust in the US military, the distribution of responses changed drastically. Figure 29 shows the distribution of individual responses for trust

Table 17. Trust in the US Military Regression Coefficients

Term	Estimate	Prob>	R^2 Change
Intercept	1.7953198	0.0018	
Log Distance to 2013 medical	0.1039524	<.0001	0.21
Satisfaction with income (1 - good enough; 0 - not good enough)	2.4977653	0.0009	0.16
Social Capital: Empowerment and Political Action Z Score	2.6917879	0.0032	0.07
Log Distance to 2013 school projects	0.1213012	0.0094	0.09

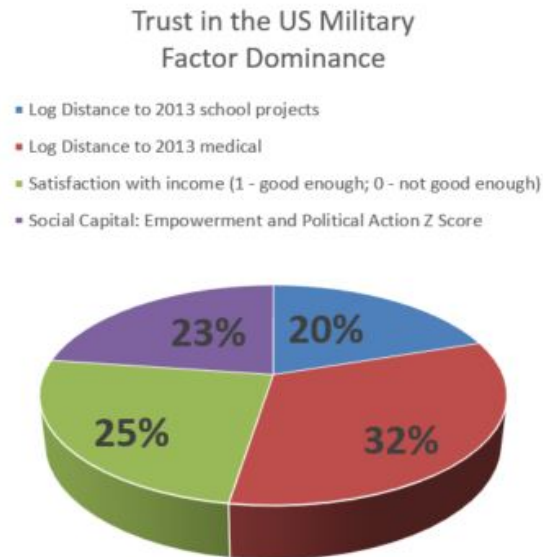


Figure 27. Factor Dominance for Trust in the US Military

in the US military in 2012 and 2014. Before the US humanitarian projects, the 2012 data appears to be normally distributed. After the US projects the responses appear to be highly polarized with a notable increase in extreme 1 (low trust) and 7 (high trust) responses. These results suggest that during the study period trust in the US military both went down, and became highly polarized. This study was not designed to examine the impact of US projects on the whole population of Belize. However, this research suggests that a localized negative relationship exists between the 2013 New Horizons projects and trust in the US military which might explain some of the national level changes observed between 2012 and 2014.

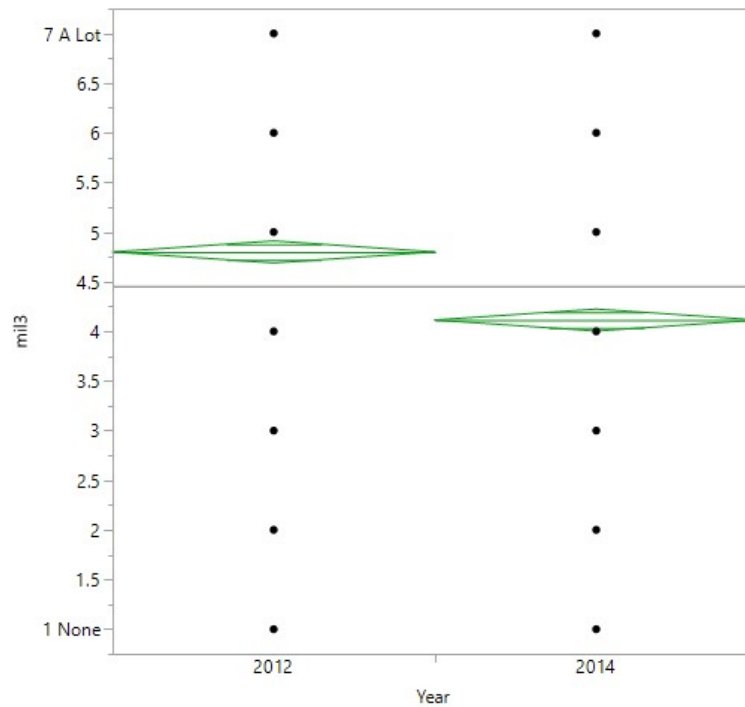


Figure 28. 2012 to 2014 Trust in the US Military ANOVA

4.5.2 Trust in the United States.

This study also created a model predicting the mean 2014 trust in the US aggregated at the village level. The model had an R^2 of 0.33 and a significance p-value

Table 18. Analysis of Variance in Individual Trust in the US military between 2012 and 2014

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob >F
Year	1	321.051	321.051	73.983	<.0001
Error	2729	11842.557	4.34		
C. Total	2730	12163.608			

Means for oneway ANOVA					
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
2012	1364	4.79985	0.0564	4.6893	4.9105
2014	1367	4.11412	0.05634	4.0036	4.2246

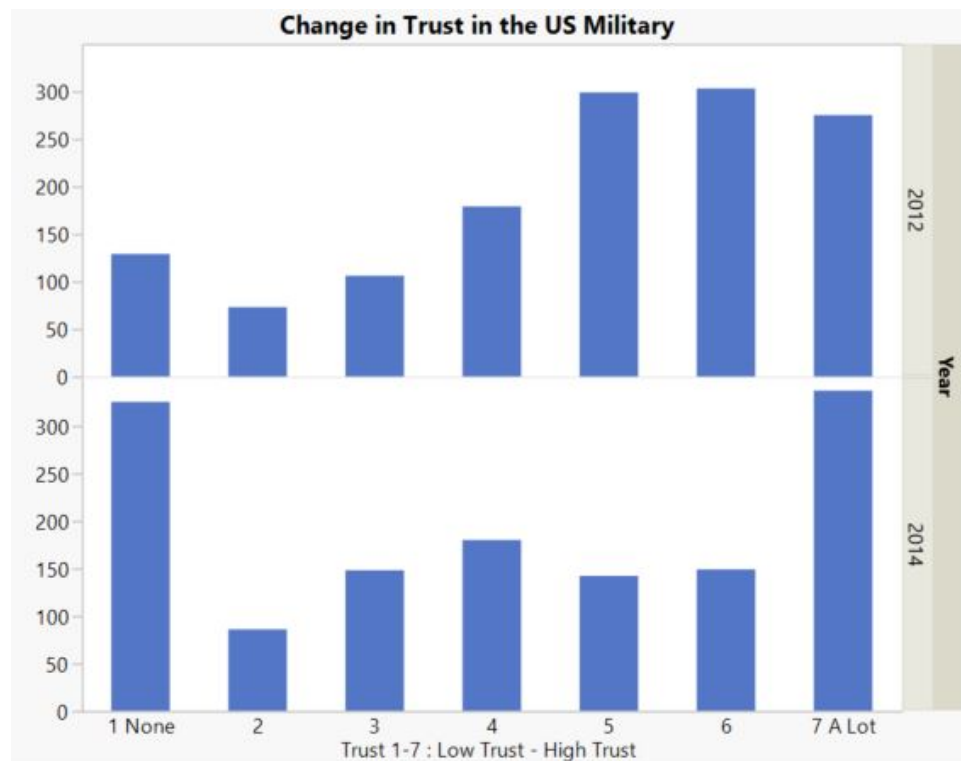


Figure 29. 2012 and 2014 Change in Individual level Trust in the US Military

of 0.0003. Table 19 contains a summary of the significance of the overall model. This model found number of household goods and logarithmic distance to 2014 clinic construction project to be significant predictors of 2014 village level trust in the US. Logarithmic distance to the 2014 clinic construction project had a positive relationship with trust in the US, meaning as distance away from the project *increased* trust also *increases*. Table 20 summarized the model factors. The relative dominance of each factor is summarized in Figure 30. Logarithmic distance to the 2014 project accounted for 59% of the variance explained in the model. The model satisfied statistical tests at the 95% confidence level. Model residuals were found to be normal by satisfying the Shapiro-Wilk test. The model excluded a single outlier, the village of Xaibe based on the irregular measures found in the trust in the US military measure. The model further satisfied tests for constant variance and multicollinearity. A summary of the satisfied statistical tests can be found in Appendix B.

Table 19. Trust in the US Military Regression Model Summary

Source	DF	Sum of Squares	F Ratio
Model	2	1.418101	9.9125
Error	40	2.861241	Prob >F
C. Total	42	4.279342	0.0003

Table 20. Trust in the US Regression Coefficients

Term	Estimate	Prob>	R^2 Change
Intercept	-0.64588	0.4109	
Log Distance to 2014 clinic construction project	0.134818	0.0013	0.24
Number of household goods	0.080218	0.022	0.10

The exposure to 2014 medical construction projects measure included in the trust in the US model represents a single project, an addition to the Western Regional Hospital, which was under construction during the 2014 survey data collection. It

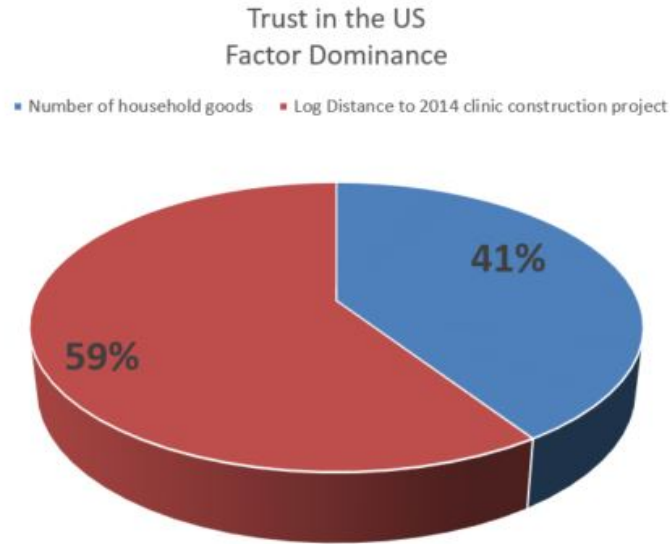


Figure 30. Factor Dominance for Trust in the US

should be further noted that this project was located in the capital city, Belmopan. This suggests that trust in the US may be lower in the city of Belmopan and higher based on economic attainment, as measured in mean village household goods.

4.5.3 Satisfaction with Local Schools.

Satisfaction with local schools exhibited spatial auto-correlation. Therefore, the model development required the additional steps of testing model residual values for auto-correlation and, if necessary, development of a spatial regression model.

4.5.3.1 Initial Non-spatial Model.

Initially this study attempted to form a non spatial regression model to explain the variance in satisfaction with local schools. The model would be satisfactory only if the model residuals are not found to be auto-correlated. The study was able to find a satisfactory non spatial model with an R^2 of 0.37 and significant p-value of

0.0007. Table 21 contains a summary of the model. Significant factors found to influence 2014 satisfaction with schools include preexisting satisfaction with schools, number of household goods, and the Social Capital information and communication score. Table 22 shows a summary of the coefficients for the model. This study was unable to develop a significant model with any of the exposure to US project measures. The relative dominance of each factor is summarized in Figure 31. Mean household good attainment was found to be the most influential factor, explaining 44% of the variance explained by the model. The model satisfied statistical tests at the 95% confidence level. Model residuals were found to be normal by satisfying the Shapiro-Wilk test. The model excluded a single outlier, the village of Xaibe based on the irregular measures found in the trust in the US military measure. The model further satisfied tests for constant variance and multicollinearity. A Summary of the satisfied statistical tests can be found in Appendix B.

Table 21. Satisfaction with Local Schools Regression Model Summary

Source	DF	Sum of Squares	F Ratio
Model	3	0.59856	7.1126
Error	37	1.037909	Prob >F
C. Total	40	1.636469	0.0007

Table 22. Satisfaction with Local Schools Regression Coefficients

Term	Estimate	Prob>	R^2 Change
Intercept	-1.44684	0.1482	
Number of household goods	0.112772	0.0007	0.14
Social Capital: Information and Communication Z Score	-0.28193	0.0071	0.09
Satisfaction with schools in 2012	0.68127	0.0157	0.11

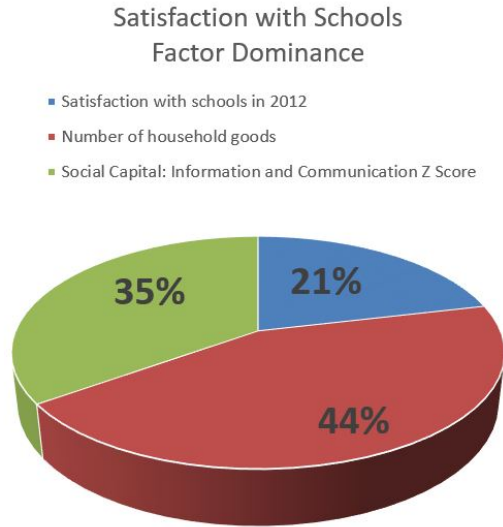


Figure 31. Factor Dominance for Satisfaction with Local Schools

4.5.3.2 Testing Residual for Spatial Auto-correlation.

Because of the observed spatial auto-correlation in the pre-model satisfaction with schools, any model developed required an additional test for non auto-correlated residuals. Residuals from the non-spatial model developed in this study were tested and found not to display spatial auto-correlation which satisfies the test. Figure 32 displays the Moran's I scatter plot and Figure 33 shows a significance simulation for this satisfaction with schools model residuals. The observed Moran's I of 0.04 clustering was not found to be significant relative to a simulation of 999 spatially random trial using the same data. Passing this test showed the absence of spatial auto-correlation and validated the non-spatial regression model developed for satisfaction with local schools.

4.5.3.3 Attempt to Develop a Spatial Lag Model.

While the non spatial regression model developed for satisfaction with schools passed all statistical tests, including the spatial auto-correlation, this study attempted

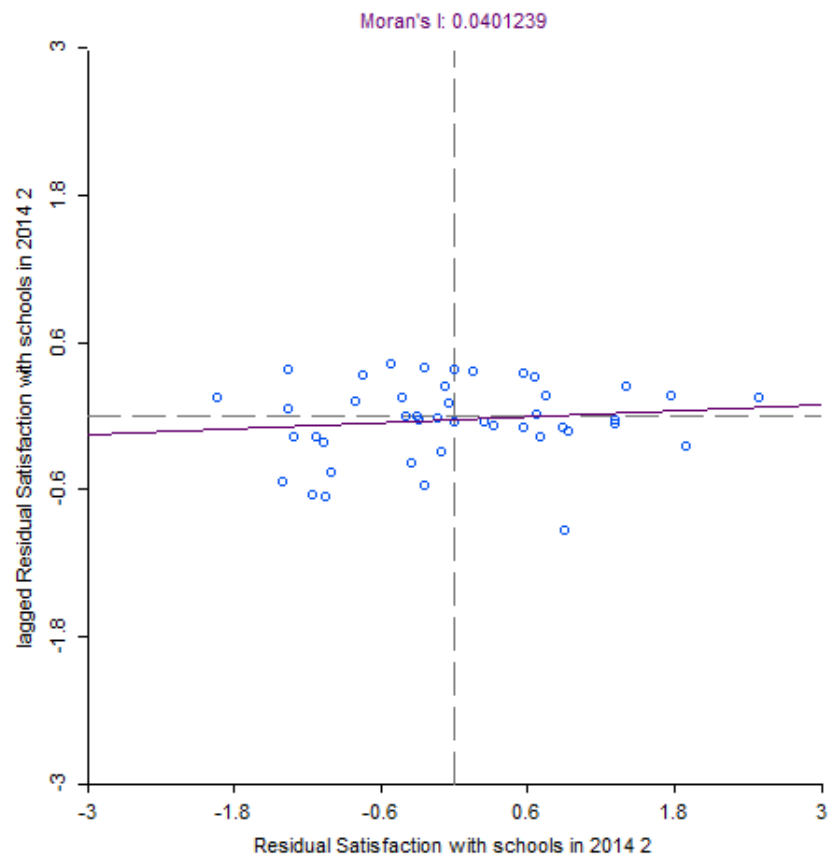


Figure 32. 2014 Satisfaction with Schools Residuals Auto-correlation Moran's I plot

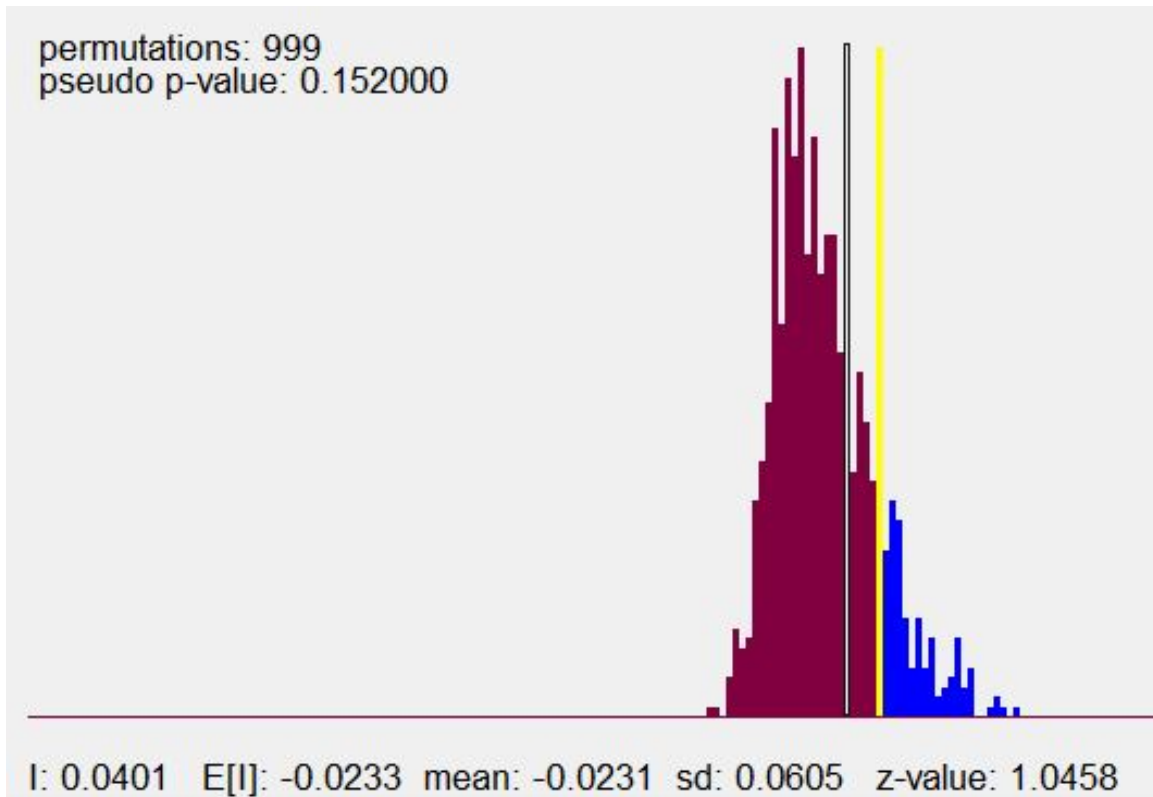


Figure 33. 2014 Satisfaction with Schools Residuals Auto-correlation significance Test Results

to develop a more explanatory model through spatial regression modeling. This study was unable to create a satisfactory spatial lag model for satisfaction with schools. The model failed in two regards: first, the added spatially lagged dependent variable was not significant in the model; and second, the overall R^2 for the model decreased relative to the non-spatial model. Either of these factors would cause the model to fail. The failure to form a spatial regression model does not take away from the significance of the non spatial model. In fact, it validates the fact that the non spatial model sufficiently explained the observed spatial auto-correlation in the pre-model data with the non spatial factors.

The results of the research suggest that satisfaction with local schools can be predicted with: socioeconomic attainment, as measured in village mean household goods; village level Social Capital information and communication; and pre-existing satisfaction with schools, as measured two years prior in 2012. The results further suggest US humanitarian projects, neither those completed a year prior to the survey in 2013, nor those conducted during the survey, had a significant relationship with satisfaction with local schools in 2014.

4.5.4 Satisfaction with Local Medical Services.

The final model developed for this study was satisfaction with local medical service. This study was able to build a significant model, however, the only factor found to be significant was the developed measure for satisfaction with medical services in 2012. The R^2 for this model was 0.40 with a significant p-value of less than 0.0001. Table 21 contains a summary of the significance of the overall model. Table 24 provides a summary of the model coefficients. Dominance analysis is unnecessary as there is only one predicting factor. The model satisfied statistical tests at the 95% confidence level. Model residuals were found to be normal by satisfying the Shapiro-

Wilk test. The model excluded a single outlier, the village of Xaibe based on the irregular measures found in the trust in the US military measure. The model further satisfied tests for constant variance and multicollinearity. A summary of the satisfied statistical tests can be found in Appendix B.

Table 23. Satisfaction with Local Medical Services Regression Model Summary

Source	DF	Sum of Squares	F Ratio
Model	1	0.645368	26.0223
Error	39	0.96722	Prob >F
C. Total	40	1.612588	<.0001

Table 24. Satisfaction with Local Regression Coefficients

Term	Estimate	Prob>
Intercept	0.319823	0.467
Satisfaction with medical services in 2012	0.901006	<.0001

The results of this research suggest that preexisting satisfaction with medical services, as measured in 2012, has an observable relationship to measured satisfaction with medical services in 2014. Further, this research suggests proximity to US medical outreach and construction projects, both those conducted in 2013 and 2014, did not have a significant relationship with satisfaction with local medical services.

4.6 Summary

The results of this study provide key insights into the the behavior of measured attitudes towards the US, as measured in trust in the US military and US government; and local government legitimacy, as measured in satisfaction with local school and medical satisfaction in relationship to exposure to US humanitarian projects, Social Capital and socioeconomic measures, and pre-existing opinions. A specific observation from these results that warrants further discussion includes the observed drops in

the trust in the US military relative to exposure to US projects. This research found the methodology employed to be effective in evaluating the relationship between US humanitarian project and public opinion.

V. Conclusions and Recommendations

5.1 Chapter Overview

This chapter summarizes the findings of this research, makes recommendations for improvement to US humanitarian project selection and evaluation, and suggests areas for future research. The first section discusses the study results in the context of the established research questions. Next, a generalized conclusion and summary of study significance is provided. Finally, this summary includes recommendations for action and for future research.

5.2 Research Questions Answered

This study initially set out to examine four research questions:

1. How do US military construction projects impact the performance of the local host nation government?
2. How do US military construction projects impact trust of local populations in the US government and the US military?
3. How does time elapsed since project completion and the distance between project and population, affect the impact of US projects on the above factors?
4. How can exposure to US military construction projects be effectively modeled?

This section summarizes the results of this study within the context of these questions.

5.2.1 Question 1.

How do US military construction projects impact the performance of the local host nation government?

This study was unable to find a significant relationship between exposure to US projects and local government performance as measured through the proxy satisfaction with government services. This finding, however, does not mean that no relationship exists. The US military projects may very well have had an effect, however, the explained variance could not be distinguished from the overall variance of the control group. Further, the geographic resolution of the AmericasBarometer data may have made a more limited impact of the project difficult to detect.

5.2.2 Question 2.

How do US military construction projects impact trust of local populations in the US government and the US military?

This study found a *negative* relationship between proximity to US projects and trust in the US government and US military. Trust in the US military was significantly lower in 2014 at locations where the 2013 US construction projects were built. There was also a *negative* relationship between 2013 medical outreach missions and trust in the US military measured in 2014. The 2014 construction projects or medical outreach missions which were ongoing during the AmericasBarometer surveys were not found to have a significant relationship with trust in the US military.

Observed trust in the US government in 2014 was significantly lower relative a 2014 clinic construction project which was in progress during the 2014 AmericasBarometer survey. The other measures of exposure to US projects, including construction projects in 2013, medical outreach missions in either 2013 or 2014, or school construction projects in 2014 were not found to have significant relationships to trust in the US government.

5.2.3 Question 3.

How does time elapsed since project completion and the distance between project and population, affect the impact of US projects on the above factors?

This study explored distance between projects and populations through the creation of an exposure to US projects variable based on logarithmic distance. Elapsed time was considered through the inclusion of two years of projects. The 2013 projects were completed approximately a year before the survey was completed while the 2014 projects were ongoing during the survey. This provided point data for both immediate effects as well as relationships after a year of time elapsed. A summary of the observed relationships based on time and distance can be found in Table 25. This study was unable to find any significant relationship between US operations and local government performance, as measured through satisfaction with services. Both construction and medical outreach projects had a negative relationship with trust in the US military a year after mission completion. These projects, however, had no measurable relationship with trust in the US government a year after mission completion. As for projects that occurred during the survey period, for which no time had elapsed between projects and measured effect, medical outreach and medical construction projects had a negative relationship with trust in the US government. These medical projects had no measurable relationship with trust in the US military measured while the projects were on ongoing. School construction projects had no significant relationship with either trust in the US military or trust in the US government measured during project execution.

This study measured exposure to projects using logarithmic distance which requires special consideration for to interpret the results. For trust in the US military the β weights for logarithmic distance to the nearest US project were 0.12 for

Table 25. Summary of the effects of time and distance on observed relationships between projects and study measurements

Time	Immediate relationship	Relationship after one year
Trust in the US Military	No observed relationship for any class of project.	<i>Negative</i> relationship based on proximity to both medical construction and medical outreach missions. No observed relationship based on school construction projects.
Trust in the US government	<i>Negative</i> relationship based on proximity to both construction and medical outreach missions.	No observed relationship for any class of project.
Local school performance	No observed relationship for any class of project.	No observed relationship for any class of project.
Local medical performance	No observed relationship for any class of project.	No observed relationship for any class of project.

construction projects and 0.10 for medical outreach projects. These beta weights form a relationship between projects and changes in trust and distance such that $trust = 0.12 * \ln dist_{construction}$ and $trust = 0.10 * \ln dist_{medical}$. To understand the impact of this relationship it is useful to test this relationship in terms of easily comprehensible straight distance. As an example, the strength of the relationship between 1 and 40 km can be used. The difference between the logarithmic distances for these two distances is 3.7 as calculate in Table 26. Applying this change to our model β weights gives us values of 0.41 and 0.38 for 2013 construction and medical outreach mission respectively. The interpretation that trust in the US military is 0.41 points higher at 40 km than trust at 1 km for construction projects; and trust in the US military is 0.38 points higher at 40 km than trust at 1 km for medical outreach projects. Changes are on a 7 point Likert scale. The interpretation clearly shows that trust in the US Military is higher farther from projects, which begs the question, what causes distrust close to program locations?

Table 26. Example Change in Logarithmic Distances

Distance (km)	Logarithmic distance Ln (km)
1	6.9
40	10.6
Difference	3.7

5.2.4 Question 4.

How can exposure to US military construction projects be effectively modeled?

This study explored various models for geographic exposure of local populations to US military construction projects. Based on the analysis of these exposure models in section 4.4, this study found logarithmic distance to be an effective measure of exposure to projects. Using logarithmic distance, this study was able to observe significant relationships between projects and trust in the US military and US government both immediately and a year after project completion. The logarithmic scale is convenient because it does not require specification of threshold distances, which favors proximal changes in distance.

5.3 Conclusions of Research

This study successfully developed models to predict village level trust in the US military, general trust in the US, satisfaction with local schools, and satisfaction with local medical services. The results of this study show a negative relationship between the 2013 US humanitarian construction and medical outreach projects and trust in the US military in 2014, which means that the further away from projects the greater the trust. Additionally, the results indicated a negative relationship between the 2014 US military humanitarian medical construction project which was in progress at the time of the 2014 survey, and general trust in the US. This study was unable to find a

significant observable relationship between US humanitarian projects of any studied class and local government legitimacy as measured in satisfaction with local schools or medical services.

There are limits to what can be concluded from this study. First, the study only established if a significant observational relationship exists, not a causal relationship. Surveys represent one of many tools used to evaluate a development program (Social Impact, 2011, p. 24). To fully understand causal relationships between developmental efforts and social outcomes surveys need to be combined with other forms of investigative data collection including institutional structural analysis and micro network analysis (Grootaert and Van Bastelaer, 2002). Additionally, the selection of project locations for this study may have skewed and limited the observable impact of US humanitarian projects. This study used all of the 2013 and 2014 projects completed by the US military. The projects were selected using external criteria, which placed projects in areas that may not have been the most ideal for winning “hearts and minds.” This section includes a subsection which discusses the the results in the context of project selection.

5.3.1 Trust in the US Military.

This study found that 2014 trust in the US military can be predicted by: logarithmic distance to 2013 US construction projects; logarithmic distance to 2013 US medical outreach missions; trust in the US military, satisfaction with income; and the Social Capital factor empowerment and political action. Both measures of logarithmic distance to US military activities had positive relationships with trust, meaning that trust goes up as distance between project and population increases. Said differently, proximity, the opposite of distance, to projects had a negative relationship with trust. Satisfaction with income and empowerment and political action also had

positive relationships with trust in the US military. Higher mean village satisfaction with income and empowerment and political action scores were observed to relate to significantly higher trust in the US military score. Pre-existing trust in the US military, as measured through a spatial image based on 2012 responses to trust in the US military, was not found to be a significant indicator of trust in the US military in 2012. Additionally, 2014 US military humanitarian activities also did not have a significant relationship to village level trust in the US military. These projects were ongoing during the survey period. In addition to trust at the local level, this study also observed a significant change in trust in the US military at the country level between 2012 and 2014. The general distribution of measured trust in the US military shifted from normally distributed to highly polarized as shown in Figure 29.

Observed change in trust in the US military appeared to be highly erratic between the 2012 and 2014 surveys. At the village level observed change in trust in the US military from 2012 to 2014 ranged from -2.8 to 0.8 on a 7 point Likert scale as shown in Figure 34. The range in value may be partially attributed to the highly polarizing effect observed at the national level, as previously shown in Figure 29. The change in observed village level trust in the US military between 2012 and 2014 may partially explain why 2012 trust in the US military was not observed to be a predictor of trust in the US military in 2014.

The results of this research suggest that trust in the US military both dropped and became polarized at the national level between 2012 and 2014. While not the focus of this study, this national level observation may be partially attributed to the US humanitarian projects conducted during the study period. This study found proximity to both the 2013 New Horizons medical outreach and construction projects, which were the focus of this study, significantly associated with lower trust in the US military when measured in 2014. This study makes several conclusions and observations

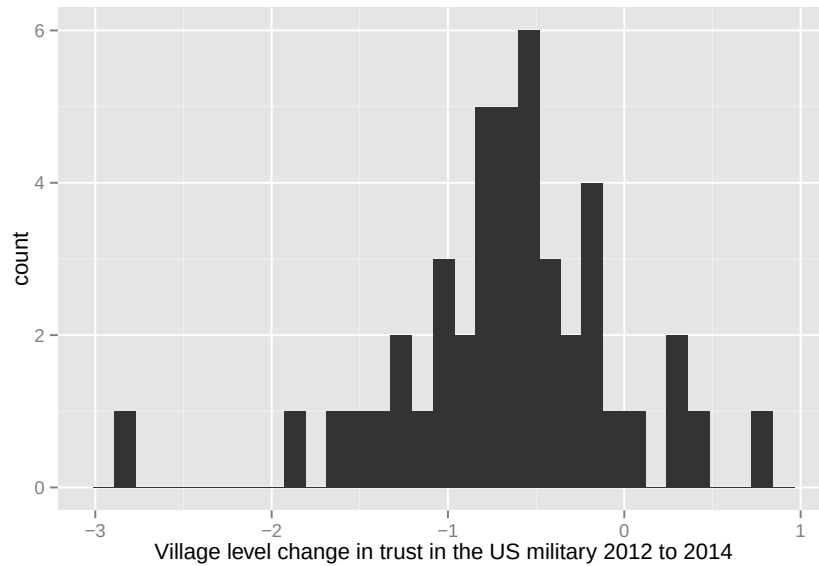


Figure 34. Distribution of Village Level Mean Change in Trust in the US Military 2012 to 2014

regarding US projects and trust in the US military:

- The results of this research suggest proximity to 2013 US humanitarian projects was related to lower measured trust in the US military in 2014.
- At the national level, the distribution of responses for trust in the US military changed from a normal distribution in 2012 to highly polarized in 2014 with a noticeable increase in “not trustworthy” responses. During the same period the US military conducted two New Horizons missions.
- The results of this study suggest economic well being, as measured in satisfaction with income, and village level Social Capital, as measured in mean empowerment and political action scores, influenced trust in the US military. This study did not established a causal relationship between these factors and trust in the US military. However, based on observations, it appears socioeconomic and Social Capital factors affect and may even be a prerequisite to trust in the

US military.

- The results of this study did not find a significant relationship between measured trust in the US military between 2012 and 2014. This suggests measured trust in the US military may not be a stable measure for gauging US project impact.

5.3.2 Trust in the US.

This study successfully modeled village level general trust in the US in 2014 based on logarithmic distance to the 2014 medical construction project and mean village household goods. This model did not find preexisting trust in the US, as measured in 2012 to be a significant predictor of trust in 2014. US humanitarian projects, both construction and medical outreach, which were conducted in 2013, as well as medical outreach projects conducted in 2014 did not have a significant relationship with trust in the US.

Several interesting observations can be made when looking at the results for trust in the US:

- The results of this research suggests economic attainment, using village mean household goods attainment, is the best predictor of mean trust in the US.
- The 2014 clinic construction project was the only category of US humanitarian projects in this study significantly related to trust in the US. This category represents only a single project, conducted in the capital city, executed during the AmericasBarometer survey. This suggests exposure to US military humanitarian projects conducted in Belize during 2013 and 2014 did not have a significant impact on measured trust in the US in 2014.
- Previously measured trust in the US in 2012 was not a significant predictor of 2014 trust. This suggests measured trust in the US may not be a stable measure

and therefore not the best measurement for gauging US project impact.

5.3.3 Satisfaction with Schools.

This study used satisfaction with schools which is a measure of performance, as a proxy for government legitimacy. 2014 satisfaction with schools was found to be significantly related to economic attainment, as measured in household goods; village access to information, as measured in the social capital information and communication factor; and preexisting satisfaction with schools, as measured in 2012. The results of this research suggest exposure to the US military humanitarian efforts in Belize conducted between 2013 and 2014 did not have a significant relationship with measured satisfaction with local schools in 2014. Measured school satisfaction exhibited a significant level of observed spatial clustering, which suggests variations in school performance can be partially attributed to location. The results of this study found economic attainment to be the best predictor of measured satisfaction with schools.

5.3.4 Satisfaction with Local Medical Service.

This study included a measure of satisfaction with local medical services to see if US humanitarian medical outreach missions or medical construction projects had an impact on local medical service performance. While this study was able to develop a model that predicted satisfaction with medical services, the only significant factor found was observed satisfaction two years prior. These results suggest that US humanitarian medical activities conducted in 2013 and 2014 did not have a significant relationship to local medical service performance measured in 2014.

5.3.5 Discussion of Project Selection and Results.

In addition to providing analysis of the effects of projects, the results of this study provide insight into humanitarian project site selection. If projects are constructed in locations where dependent variable responses are already high the potential for increasing the measure is limited. The majority of the humanitarian construction projects in the 2013 and 2014 New Horizons missions were schools. This study analyzed the selection of school projects in relation to the study's dependent variables: school satisfaction, trust in the US, and trust in the US military. Figure 35 shows mean measured dependent variable responses, both before and after projects, for villages where 2013 and 2014 New Horizons school projects were constructed relative to the distribution of responses as a whole. It is important to note that the 2013 and 2014 New Horizons projects were not planned with the specific goals of improving these measures; however, examining projects in this context provides insight as to whether these projects meet strategic goals.

This study has shown school satisfaction is a measure of school performance. If improving local school performance is an objective, one criteria for project selection should be selecting school construction sites in areas where school performance is relatively low. Figure 35a highlights the relative school performance in 2012 in locations where 2013 and 2014 projects were selected. Figure 35b shows the relative performance of these locations in 2014, after or during the US school construction. It can be seen in Figure 35a that 2 out of 5 school projects, conducted in locations where a survey was taken, were in locations where school performance was above average possibly limiting the potential for improvement.

Measured attitudes towards the US and US military should also be factors for project selection. Figure 35c and Figure 35d show the relative trust in the US for 2013 and 2014 project selection locations before and after the US intervention, re-

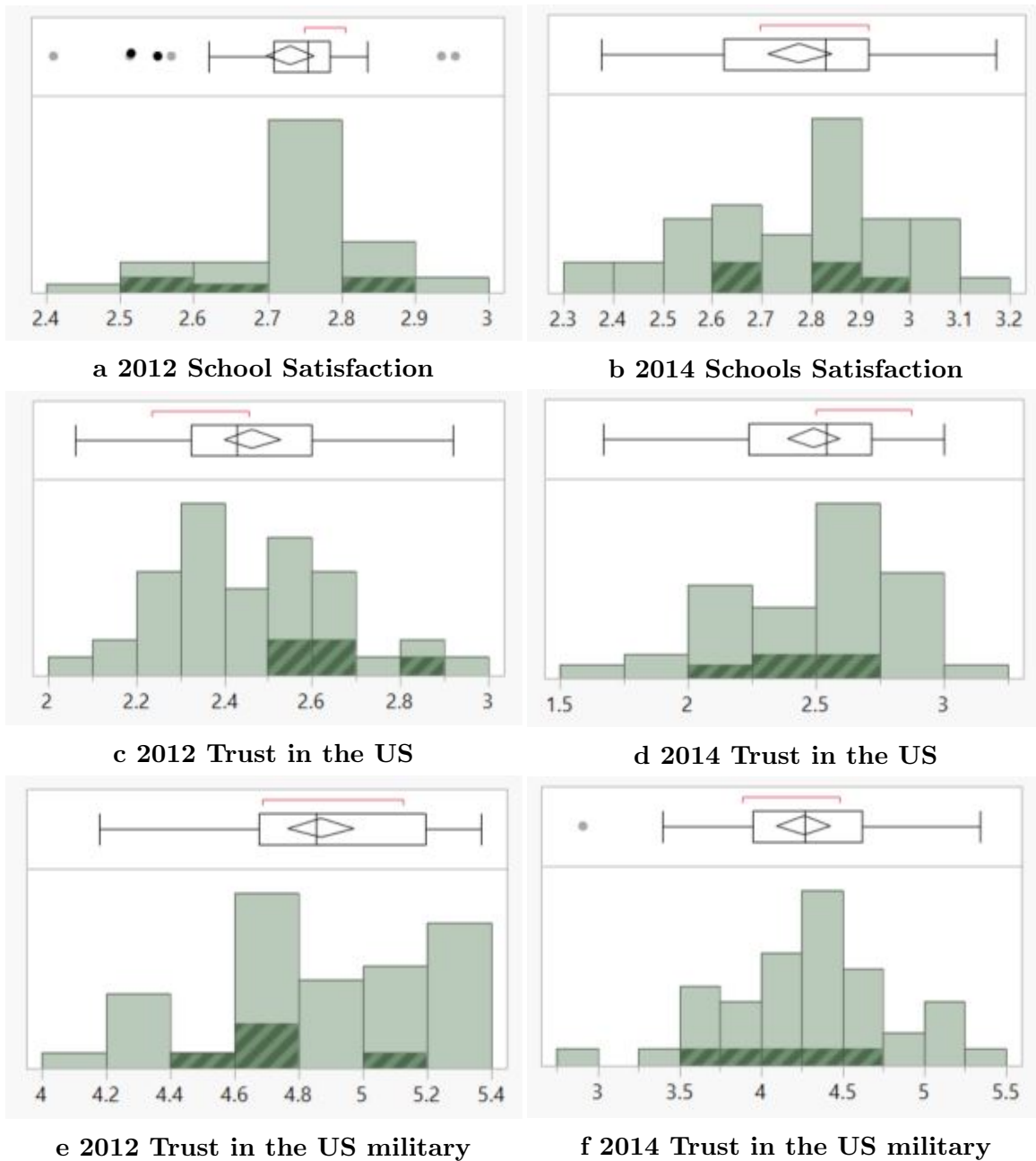


Figure 35. 2013 and 2014 School Construction Project Selection Sites Highlighted Relative to Study Measures

spectively. Figure 35c shows all school construction projects were selected in areas with above average trust in the US, possibly limiting the potential effectiveness for the projects to raise the relative profile of the US. Figure 35e and Figure 35f show project locations relative to trust in the US military before and after intervention, respectively. Inspection reveals several projects were constructed in areas with above average trust in the US military which possibility limited the potential positive effects. These observations may help to explain the limited and negative relationships associated with US projects that the study found. Further, they provide insight for developing criteria for future humanitarian project selection.

5.3.6 Socioeconomic Control Effects on Study Measures.

This research suggests that socioeconomic development factors play a role in the effectiveness and perception of US projects. Economic attainment, which was measured using satisfaction with income and household goods attainment, was a substantial factor in the models for trust in the US Military, trust in the US, and satisfaction with schools. Only one model, satisfaction with medical services, did not have economic attainment as a significant factor. In the models, economic attainment indicators were more dominant than proximity to US projects or measured opinion two years prior. These results suggest that in order for US projects to be effective, a certain level of economic attainment must be achieved and maintained.

5.3.7 Conclusions on Overall Impact of US Humanitarian Projects.

The results of the study found the US humanitarian activities conducted during the 2013 and 2014 New Horizons missions did not have a significant relationship with measures of local government performance. Exposure to some classes of projects were significantly related to drops in trust in the US military and US government. These re-

sults can partially be explained by the lack of deliberate planning in selecting projects. Because the measures studies in this research were not included in specific project location planning, projects were often conducted in areas with pre-existing high results. This limited the statistical visibility and potential effectiveness for projects to raise these measures. Finally, the results of this study suggest US project effectiveness may be contingent on the economic attainment of local populations.

5.4 Significance of Research

Several important outcomes can be derived from this research. Broadly speaking, the methodology used was designed to measure the effectiveness of US military programs at the local level. By utilizing publicly available data, project impacts can be measured over time and space without increasing the need for on site evaluations; which fulfills one of the important, yet difficult to attain mandates for HCA projects. Not only can project evaluations be completed more easily, but geospatial analysis methods used in this project can help to provide a picture of the operational environment for US military planners, with the future goal of picking projects based on chosen criteria and desired outcomes.

Specifically, this research discovered a relationship with project locations and a population's trust in the US military. The results indicate that a population's trust in the US military may decrease after project completion. While the scope of this study did not include causality, the likelihood that a negative relationship exists should not be overlooked, as this finding directly relates to one of the core tenants of the HCA program, which is to "win hearts and minds" of populations.

A data revolution is happening in development. It is evident in the UN Sustainable Development Goals (SDG) that focus on the importance of data collection (United Nations, 2015). This project used readily available data to evaluate and analyze the

perception of the US military based on projects completed by the US military, and the results were not necessarily favorable. There is a need for development planners to use available data to determine where, when, and how future development projects should be completed to gain the most out of the time and money that are spent in the attempt to gather good will.

5.5 Recommendations for Action

Based on the results and analysis of this research effort, this thesis makes several recommendations for US military humanitarian operations planning and evaluations.

First, this research validates the feasibility and benefits of incorporating public opinion surveys into the US military led humanitarian project evaluation program. Public opinion surveys provide an objective way to examine the relationship between projects and population outcomes. Often, as is the case with the AmericasBarometer survey series, data is already being collected and may be freely available. This may reduce the amount of on the ground data collection required by the US military; saving both time and money, as well as, reducing the impacts and possible bias associated with data collected specifically to evaluate US military projects. Survey data collected at the national level can still yield informative and actionable local level data with appropriate design and spacial resolution. The results of the research also show the usefulness of using spatial analysis on public opinion data to better understand the operational environment. This study shows that examination and analysis of spatial public opinion data can predict local government performance and attitudes towards the US at a local level without any on the ground data collection; thus providing an accurate way to passively collect operationally relevant information at the local level.

The result of this study suggest that the impact of US projects on attitudes toward the US government and US military may not be as intended. As development

and humanitarian objectives become a larger part of US military operations, the wider effect of US military led humanitarian and development projects needs to be understood. DoD agencies should continue to research the effects of US military participation in development activities in order to validate the DoD's capability to take on these new roles.

Based on the finding, this study recommends the incorporation of strategic population based measures of effectiveness (MOE) into US humanitarian and development program charters. This research validates that popular opinion measures are measurable and can accurately represent desired outcomes. Inclusion of these types of measures provide the basis for a more holistic project selection and siting process which incorporates specific projects with strategic outcomes. Further, establishing measurable popular opinion based targets allows for efficient evaluation and analysis using data which may already be collected. Finally, incorporating MOEs into DoD humanitarian and development programs may provide insight for funding decisions (US Agency for International Development, 2011, p. 6; Rand Corporation, 2011, p. 9).

5.6 Recommendations for Future Research

The results of this research effort highlight several areas where future research should be undertaken. First, there is a need to examine the effects of canceled US military humanitarian projects on targeted populations. Examination of the available data and literature reveals that US military humanitarian projects are often canceled well into the planning process. Literature, and the experience of this study's author, also validate that even when planners communicate that projects under consideration may not actually be executed, canceled projects can have a negative effect on populations (Piombo, 2010, p. 8). Another area for future research found by this

study is an analysis of the effects of development projects carried out by the military compared to those carried out by civilian and non-government agencies. US military development efforts often have a different and short term outlook when compared to those being conducted by civilian agencies. Further, the mere fact that the DoD is conducting the project may illicit a different response from the population, which could possibly alter the outcome (Piombo, 2010, p. 11).

Another area for future research which this study effort lends itself to is the development of a project selection decision tool. The results of this study show that strategic MOEs can be measured before and after project activities. Knowing the preexisting state of public opinion in a strategic area of influence would allow the development of a multi-criteria decision tool which incorporates both measures of public opinion and tactical training objectives into project selection and siting.

A final suggestion for future research is the opportunity to develop a model through simulation which can predict the level of developmental intervention required for specific outcomes to be reached. Spatial analysis of the AmericasBarometer and other similar data sets allow for a better understanding of how social science phenomena behaves using citizens at the local level. Continued analysis of the effects of exposure to US military projects will provide additional fidelity help determine how specific populations might react to an intervention. Better understanding how projects and populations interact would allow analysis of what level and type of intervention would be required to reach a target level of development (Goodchild et al., 2000, p. 149).

5.7 Summary

Understanding the relationship between US military humanitarian projects and population based public opinion measures is critical to DoD agencies to become ef-

fective in carrying out development efforts as part of wider military operations. This study has shown that spatial analysis of publicly available wide area survey data can yield practical data for selecting and evaluating development projects. Additionally, this research shows the importance of providing objective measures, which may identify the unintended consequences of US military development efforts. DoD agencies conduct humanitarian and development missions for a variety of reasons, ranging from purely humanitarian to those which are tactically relevant to current operations. A better understanding to how projects and populations interact is essential to know the full effects of these efforts and enable planning for success.

Appendix A. Social Capital Measures

Social Capital Measures

Social Capital: Groups and Networks.

This study combined four questions from the 2014 AmericasBarometer survey into a composite groups and networks measure. The questions included in the groups and network composite measure asked for participation frequency in:

- Meetings of a parents association at school
- Meetings of a community improvement committee or association
- Meetings of a political party or political organization
- Meetings of an associations or groups of women or home makers

The composite groups and network variable was created by taking the sum of the participation rate for each individual. The composite groups and network variable at the surveyed individual is summarized in Figure 36. These results were then aggregated at the village level, creating a groups and networks score for each surveyed location. The aggregated groups and networks variable is summarized in Figure 37.

The aggregated groups and networks variable shows there is clear stratification in civic participation between villages. At the village level, total participation averaged range from 0.75 to 5.8. The mean groups and networks score was 2.2 and the standard deviation was 0.95. On the lower end, this score can be interpreted as, on average village occupants participated less than twice a year in any of the measured activities. On the high end, a score of 5.8 can be interpreted as villages where citizens on average participated in either one type of group at least weekly or participated on average in multiple group types at least once a month. Literature suggests that villages with

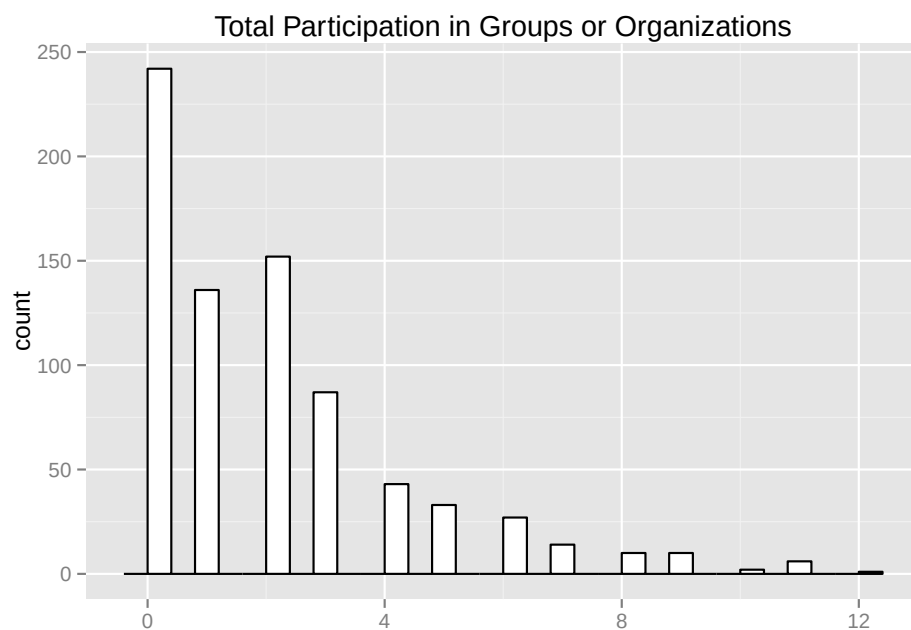


Figure 36. 2014 Citizen participation rate

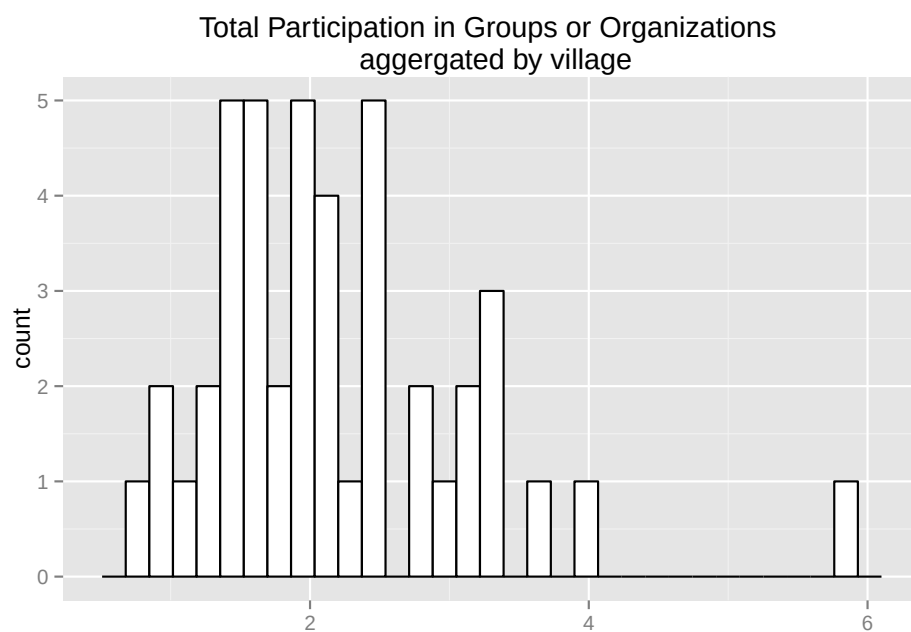


Figure 37. 2014 Citizen participation rate aggregated by village

higher groups and networks scores are better positioned to develop Social Capital and have a positive affect on development outcomes.

Social Capital: Trust and Solidarity.

The second Social Capital factor examined in this study was the level of trust and solidarity at each survey location. This measure was created by consolidated measures of trust in different institutions for each individual and then aggregated these data at the village level. The following measures of trust, on a 1–7 Likert scale, were included in the development of this measure:

- **B2:** Respect for the political institutions of Belize
- **B3:** Citizens basic rights are well protected by the political system of Belize
- **B4:** Pride living under the political system of Belize
- **B6:** Belief one should support the political system of Belize
- **B10A:** Trust in the justice system
- **B12:** Trust in the Belize Defense Force (BDF)
- **B13:** Trust in the National Assembly (House of Representatives and Senate)
- **B21:** Trust in the political parties
- **B21A:** Trust in the Prime Minister
- **B47A:** Trust in national election system
- **N9:** Belief that current administration combats (fights) government corruption
- **N11:** Belief that the current administration improves citizen safety

- **B18:** Trust in the Police Department
- **B32:** Trust the City/Town/Village council

The answers given for measures of trust in different institutions are summarized in Figure 38. These answers were used to create a mean trust and solidarity score for each individual. A summary of mean trust and solidarity scores for individuals is shown in Figure 39. These measures were then aggregated at the village level, creating a trust and solidarity score for each survey location. The village level trust and solidarity score is summarized in Figure 40.

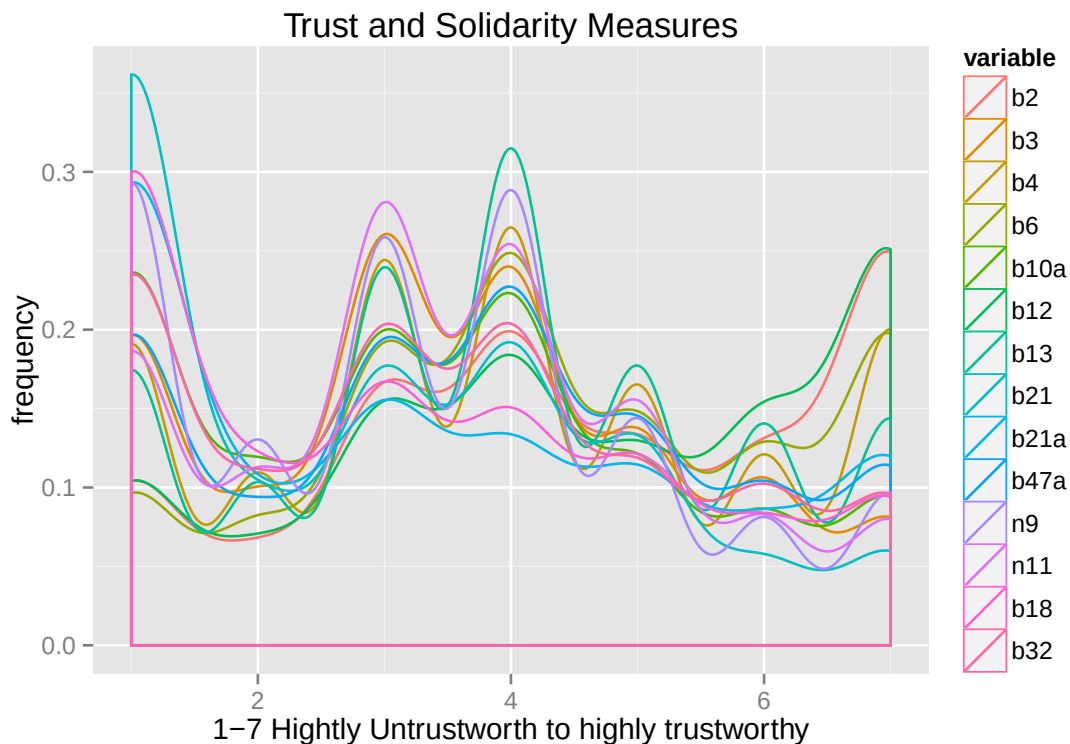


Figure 38. 2014 Citizen Trust and Solidarity Questions

Village score for trust and solidarity ranged from 3.1 to 4.5, on a 7 point Likert scale. The mean score was 3.7 with a standard deviation of 0.26. Trust and solidarity is considered the cognitive dimension of Social Capital. Villages with higher trust

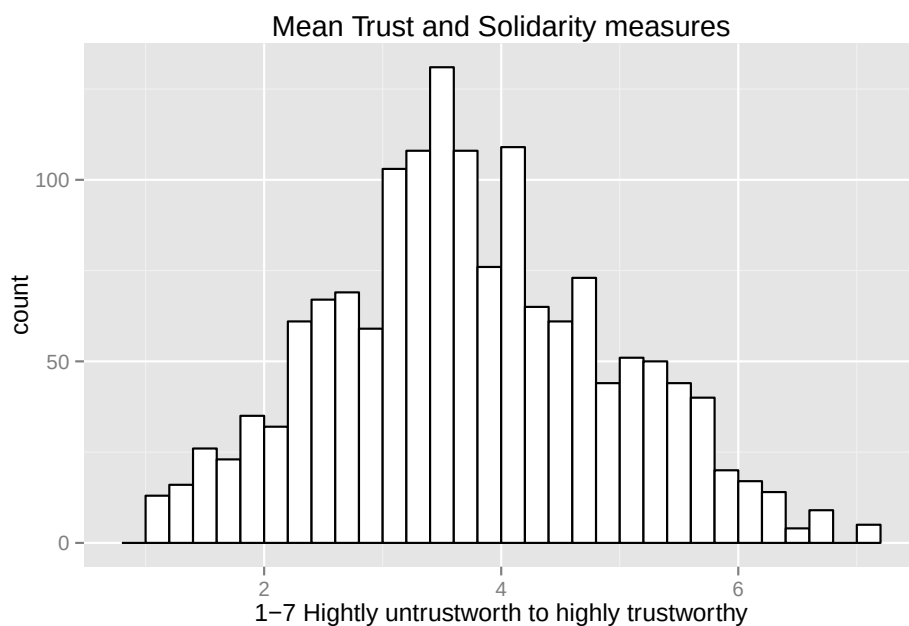


Figure 39. 2014 Mean Citizen Trust and Solidarity Score

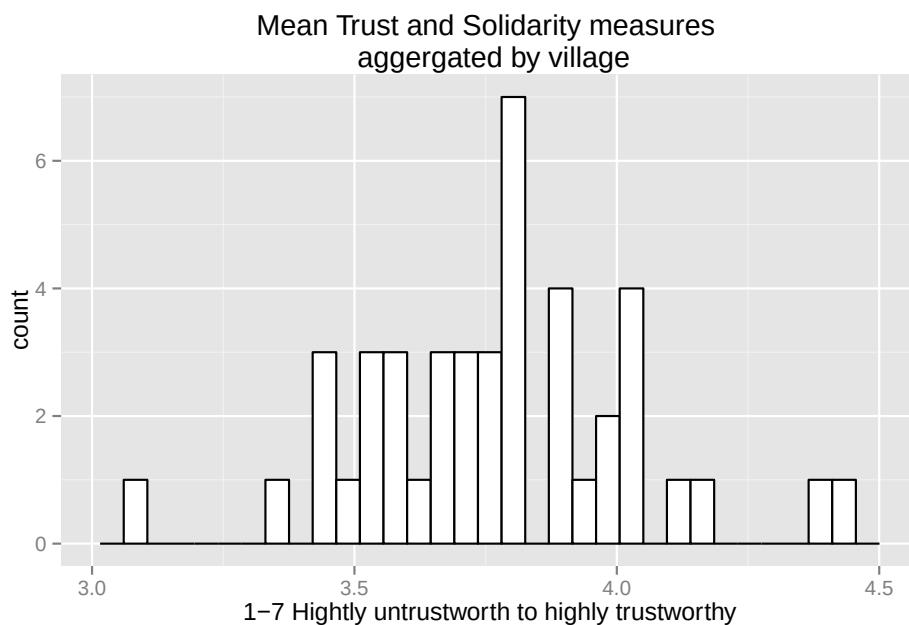


Figure 40. 2014 Mean Citizen Trust and Solidarity Score aggregated by village

and solidarity scores are expected to be positioned to develop Social Capital which leads to better development outcomes.

Social Capital: Collective Action and Cooperation.

This study created a composite variable for the collective action and cooperation dimension of Social Capital for each village. Collective action and cooperation represent a measure of how well Social Capital works in a community. This measure was created by combining the responses to specific collective action and cooperation questions into an individual level Z-score standardized score. The individual scores were then aggregated into village level mean scores.

The mean value for Z-score standardized answers for the following questions constituted the collective action and cooperation score:

- In order to solve your problems have you ever requested help or cooperation from a local public official or local government: for example, a mayor or municipal councilperson?
- Have you sought assistance from or presented a request to any office, official or councilperson of the city/town/village within the past 12 months?
- In the last 12 months have you tried to help solve a problem in your community or in your neighborhood?
- Have you attended a town meeting, city council meeting or other meeting in the past 12 months?

For each observation the responses were converted to a Z-score and averaged. The individual level collective action and cooperation scores are summarized in Figure 41. A survey location level social cohesion and inclusion score, summarized in Figure 42, was created by aggregating the individual scores at the village level.

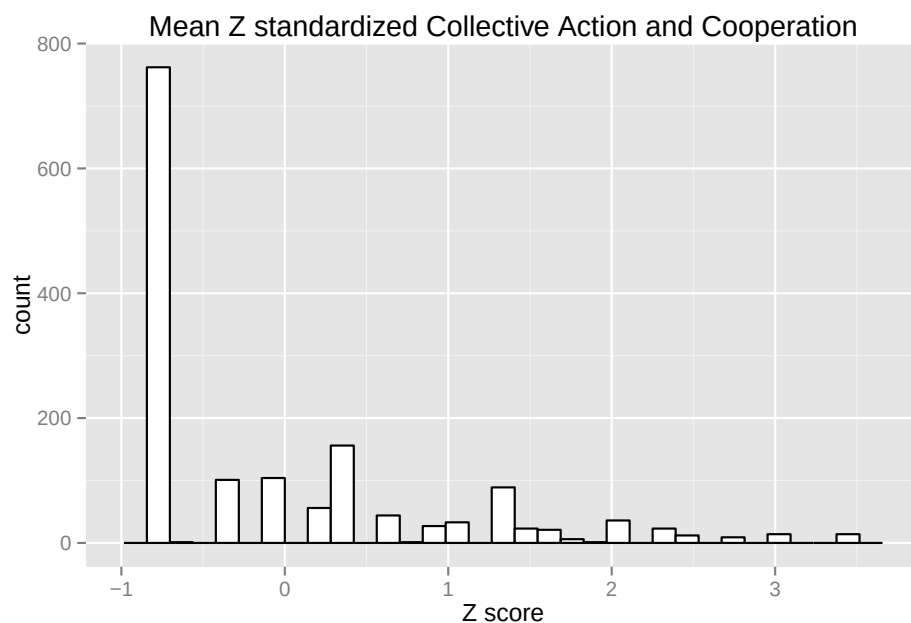


Figure 41. 2014 Z standardized Collective Action and Cooperation Score

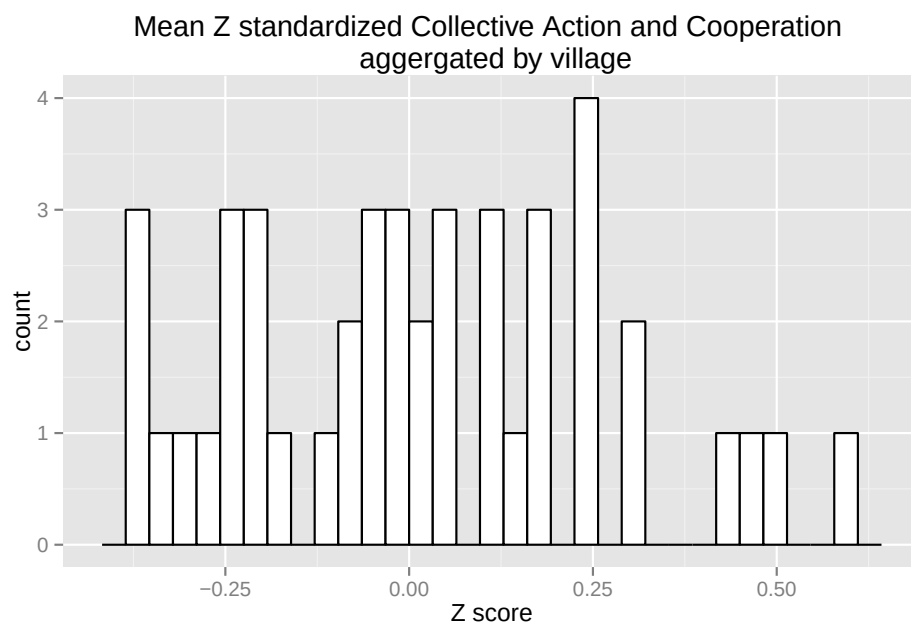


Figure 42. 2014 Z standardized Collective Action and Cooperation Score aggregated by village

Examination of the individual level collective action and cooperation scores in Figure 41 shows that the a large percentage of the population of Belize did not take part in any form of measured collective action. The aggregated data set, then, can be interpreted as the measure of what fraction of the population of that village which took some sort of collective action measure during the survey period. Collective action and cooperation can be seen as a measure of confidence in local institutions. Citizens who expect more from their governments are more likely to band together and seek action from the authorities (Kruks-Wisner, 2011). This measure, therefor, can be seen as a measure of expectation which should influence measured satisfaction (Van Ryzin, 2004).

Social Capital: Information and Communication.

This study utilizes a survey location level information and communication as a second measure of how Social Capital operates at the village level. The score was intended to measure citizen access to information and general knowledge. It was created by combining the answers to the following questions into an individual score, which was then consolidated at the village level:

- how often do you use the internet?
- About how often do you pay attention to the news, whether on TV, the radio, newspapers or the internet? How long is the prime ministerial term of office in Belize?"

The responses for each question were z-score standardized and average creating the individual level information and communication score summarized in Figure 43. Individual scores were then aggregated by location creating the village level information and communications score summarized in Figure 44.

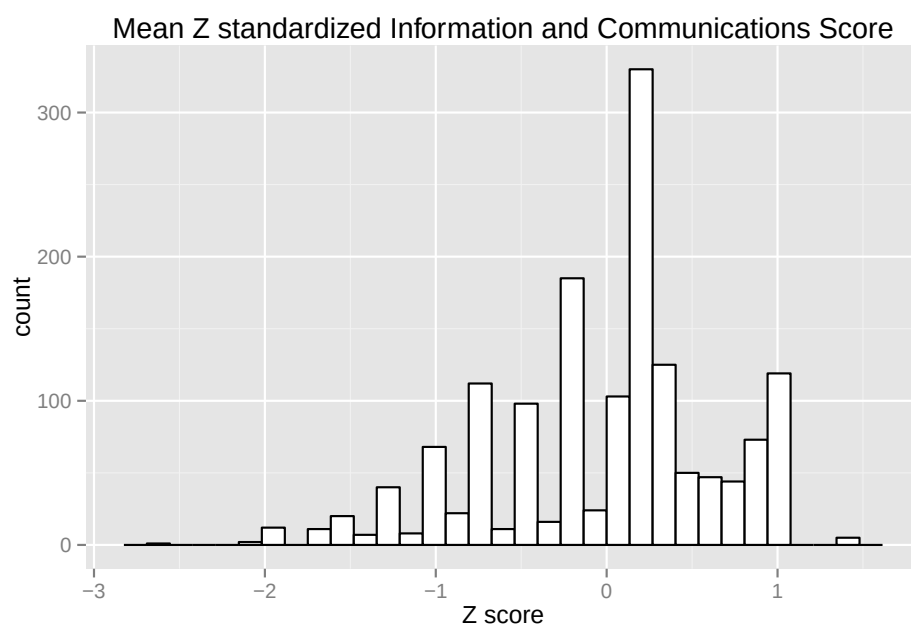


Figure 43. 2014 Z standardized Information and Communication Score

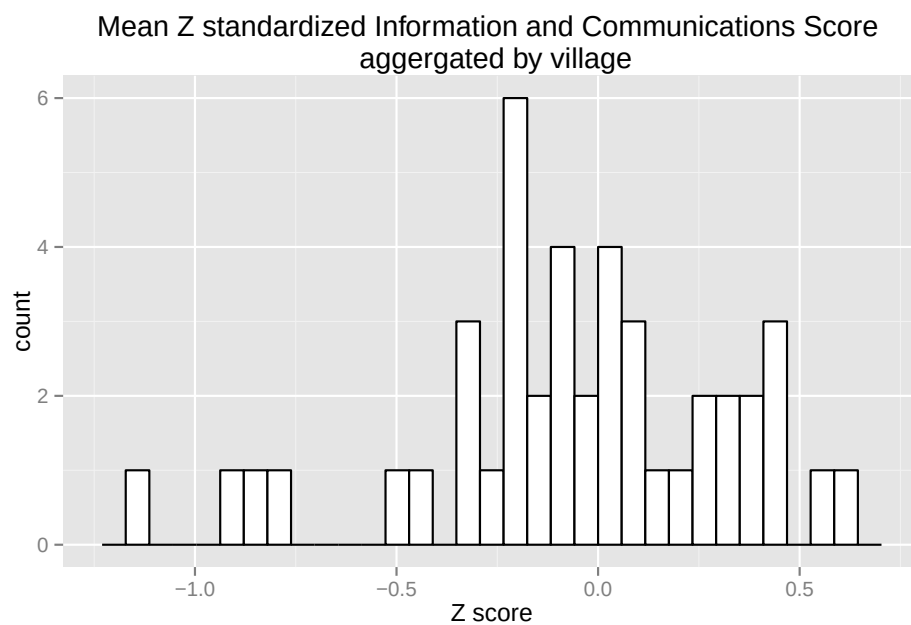


Figure 44. 2014 Z standardized Information and Communication Score aggregated by village

The village level information and communications scores summarized in Figure 44 show the relative level of access to information within different villages. Villages with higher scores would be expected to have more informed citizens. Literature establishes a link between access to information and improved Social Capital and development outcomes.

Social Capital: Social Cohesion and Inclusion.

Social cohesion and inclusion represents one of two Social Capital outcome factors; the other being empowerment and political action. Survey participants were asked to give the level with which they agreed or disagreed with several measures of attitudes towards outsiders, minorities, and deserters. Each answer was on a 1 – 10 scale with 1 being strongly disagree or disapprove and 10 being strongly agree or approve. The following questions were incorporated into the social cohesion and inclusion measure:

- **E5:** Of people participating in legal demonstrations. How much do you approve or disapprove?
- **E15:** Of people participating in the blocking of roads to protest how much do you approve or disapprove?
- **E3:** Of people participating in a group working to violently overthrow an elected government. How much do you approve or disapprove?
- **E16:** Of people taking the law into their own hands when the government does not punish criminals. How much do you approve or disapprove?
- **D1:** There are people who only say bad things about the Belizean form of government, not just the incumbent government but the system of government. How strongly do you approve or disapprove of such peoples right to vote?

- **D2:** How strongly do you approve or disapprove that such people be allowed to conduct peaceful demonstrations in order to express their views?
- **D3:** Still thinking of those who only say bad things about the Belizean form of government, how strongly do you approve or disapprove of such people being permitted to run for public office?
- **D4:** How strongly do you approve or disapprove of such people appearing on television to make speeches?
- **D5:** And now, changing the topic and thinking of homosexuals, how strongly do you approve or disapprove of such people being permitted to run for public office?

The frequency of responses to the individual questions is summarized in Figure 45. These individual responses were then averaged to give a social cohesion and inclusion score for each individual, as summarized in Figure 46. Individual scores were then aggregated at the village level, as summarized in Figure 47.

Village level social cohesion and inclusion scores ranged from 3.3 to 6.2 with a median value of 4.6 and a standard deviation of 0.72 on a 10 point Likert scale. These values can be interpreted as there being strong stratification between villages in regards to attitudes towards outsiders and dissidents. The literature suggests that social cohesion and inclusion is both an indicator of a the level of Social Capital within a population as well as being precursor to more advanced democratic processes. Villages with relatively high social cohesion and inclusion should have higher levels of development outcomes.

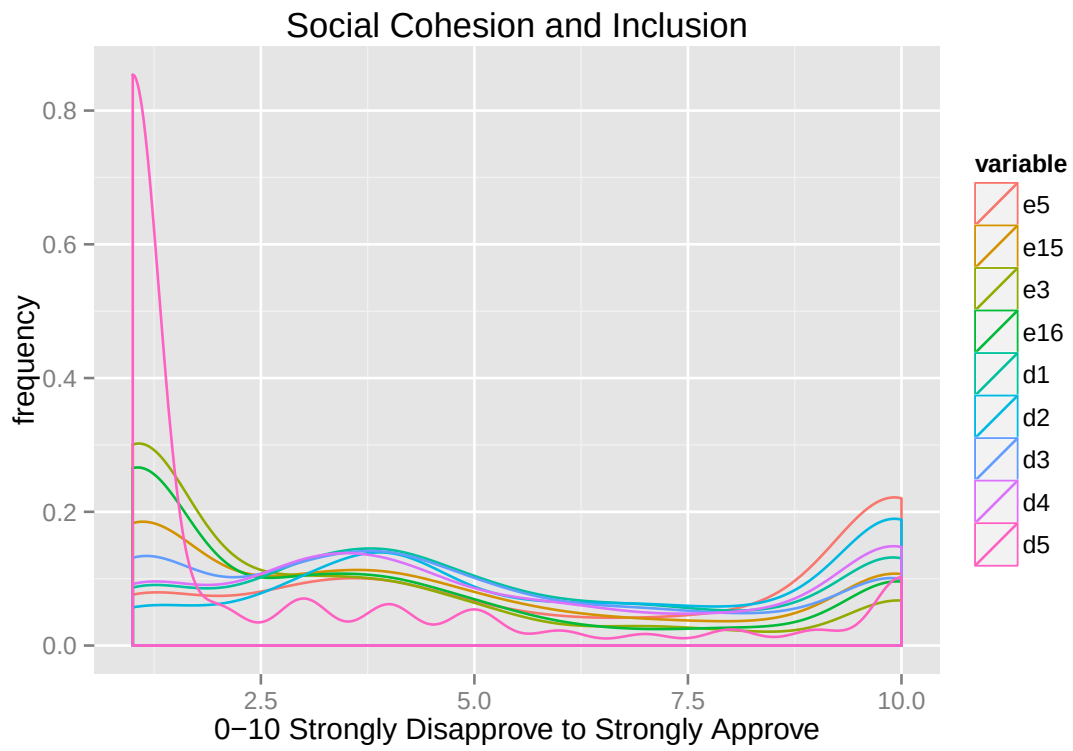


Figure 45. 2014 Specific Measures of Social Capital and Inclusion

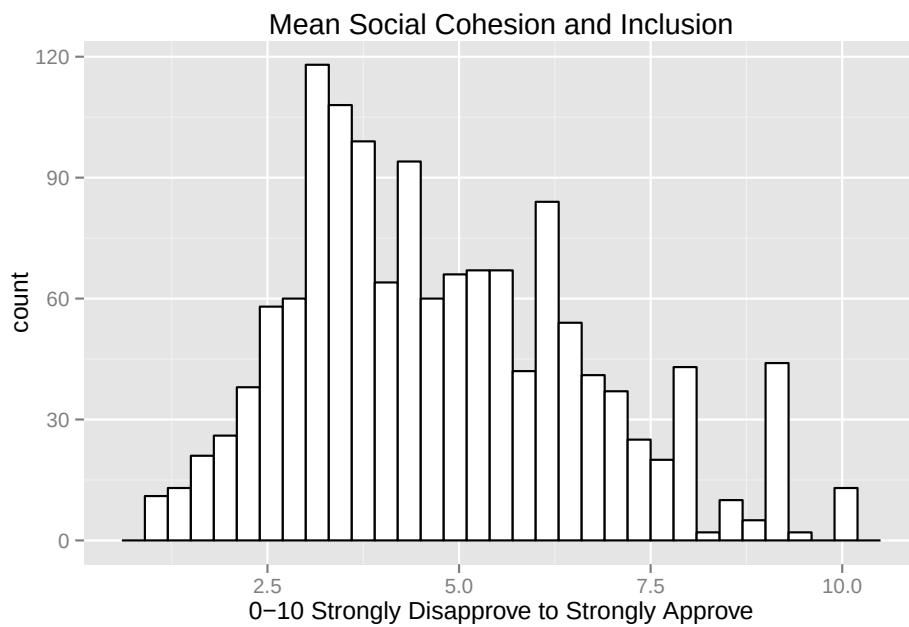


Figure 46. 2014 Mean Citizen Social Capital and Inclusion

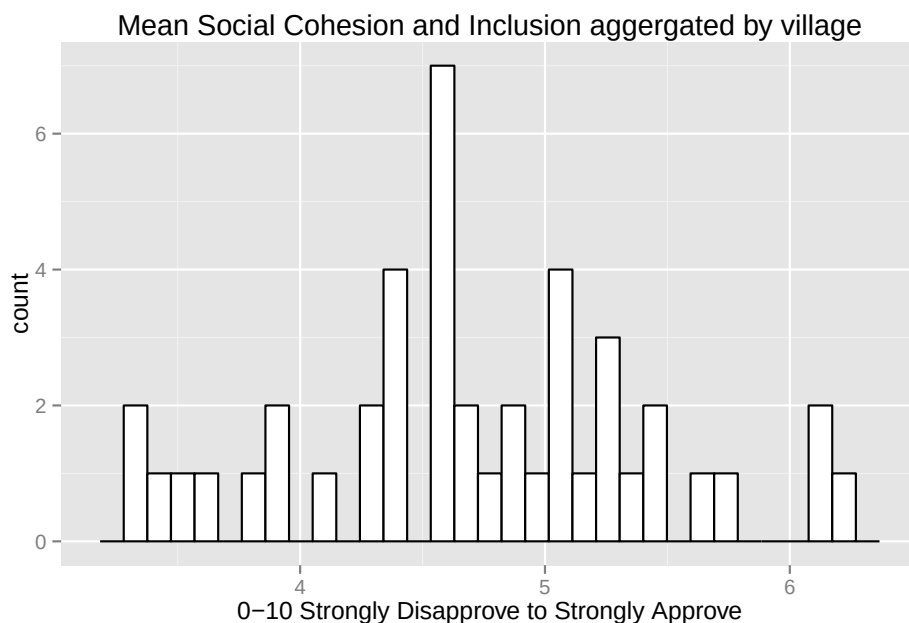


Figure 47. 2014 Mean Citizen Social Capital and Inclusion aggregated by village

Social Capital: Empowerment and Political Action.

This study developed a village level empowerment and political action score as a second measure of social capital outcome. The measure was developed by combining several surveyed measures of empowerment and political action as the individual survey level and then aggregating the data at the survey location level. The specific questions included in this measure were:

- In general how satisfied are you with your life?
- Do you think that the country's current economic situation is better than, the same as or worse than it was 12 months ago?
- Do you think that your economic situation is better than, the same as, or worse than it was 12 months ago?
- In the last 12 months, have you participated in a demonstration or protest

march?

- When there is a lot of crime a military take-over of the state would be justified.
- When there is a lot of corruption a military take-over of the state would be justified.
- Do you believe that when the country is facing very difficult times it is justifiable for the Prime Minister of the country to close the National Assembly (House of Representatives and Senate) and govern without the National Assembly (House of Representatives and Senate)?
- Those who govern this country are interested in what people like you think. How much do you agree or disagree with this statement?
- You feel that you understand the most important political issues of this country. How much do you agree or disagree with this statement?
- Democracy may have problems, but it is better than any other form of government. To what extent do you agree or disagree with this statement?
- In general, would you say that you are very satisfied, satisfied, dissatisfied or very dissatisfied with the way democracy works in Belize?
- Which of the following statements do you agree with the most: For people like me it doesn't matter whether a government is democratic or nondemocratic, or democracy is preferable to any other form of government, or under some circumstances an authoritarian government may be preferable to a democratic one.
- Are you registered to vote?
- Did you vote in the last general elections of 2012?

- Do you currently identify with a political party?
- How much interest do you have in politics: a lot, some, little or none?

At the individual level, each response was Z-score standardized so that a composite variable could be created. The individual level empowerment and political action Z-score measure is summarized in Figure 48. A village level score was created by aggregating the individual Z-scores by location. The village aggregate empowerment and political action score created for this study is summarized in Figure 49.

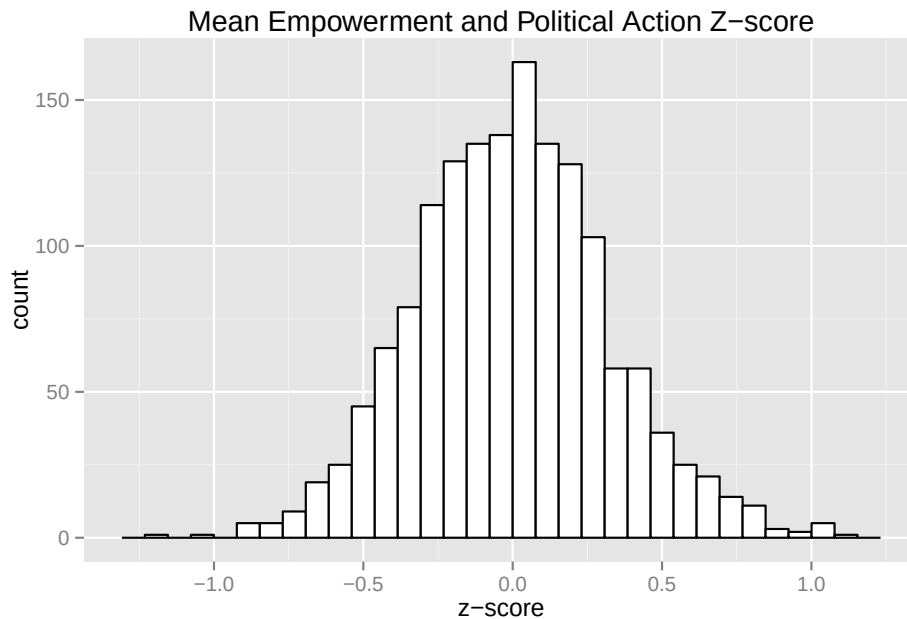


Figure 48. 2014 Mean Citizen Empowerment and Political Action Z Score

Village level empowerment and political action scores ranged from -0.17 to 0.26 with a median of 0.00 and a standard deviation of 0.08. These scores were based on the calculated Z-scored for specific questions after they had been averaged at the individual level and then further aggregated at the village level. The scores can be interpreted as the mean value of the 14 questions pertaining to empowerment and political action responses by everyone surveyed within each specific village. Exami-

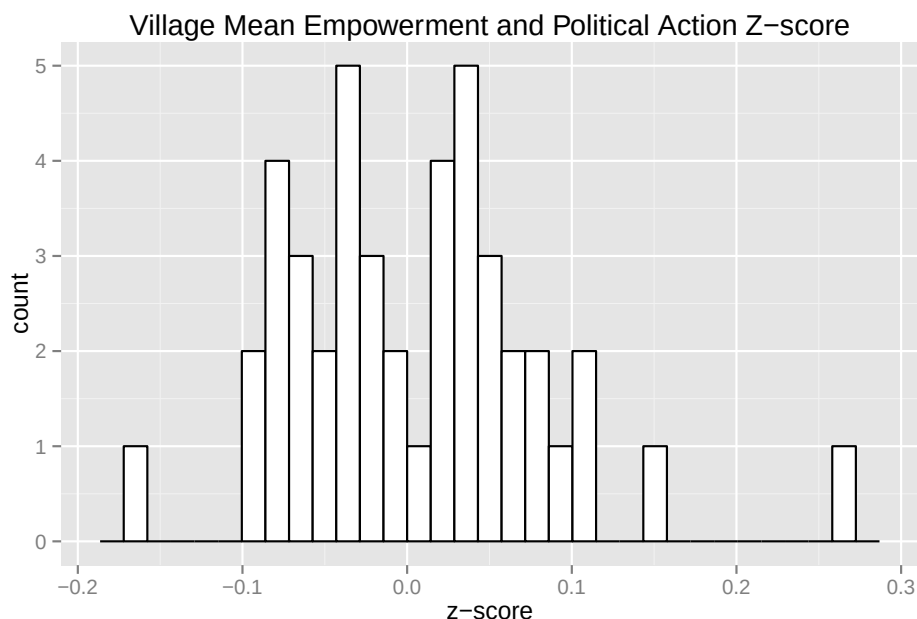


Figure 49. 2014 Mean Citizen Empowerment and Political Action Z Score aggregated by village

nation of the distribution of village level empowerment and political action scores in Figure 49 shows several distinct groupings of village scores which can be interpreted as there being several distinct levels of Social Capital outcome. Villages with relatively higher levels of empowerment and political action are expected to have higher levels of development achievement.

Socioeconomic Demographic Variables

In addition to Social Capital factors, this study utilized socioeconomic demographic measures as co-variate factors for analysis of effects on the study dependent variables. Specific demographic factors considered were ideology, income, satisfaction with income, household goods, and number of children. This section goes over the development and summarized the demographic variables included in this study.

The AmericasBarometer survey included a question for self reported ideology on

a 1 to 10 scale with 1 being far left and 10 being far right. Figure 50 summarizes the distribution of responses to self reported ideology at the individual level. Figure 51 shows a distribution of ideology aggregated at this village level. The aggregated measure was included in regression model development to control for any negative effect of extreme ideology on attitudes towards local US institutions.

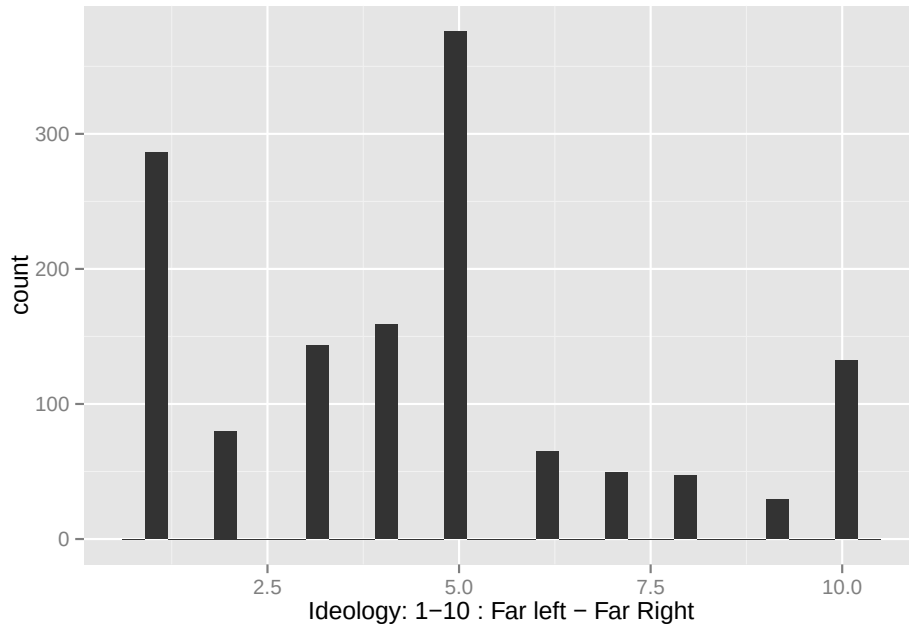


Figure 50. Individual responses for Ideology

In addition to underlying attitudes literature finds that economic attainment is required for positive developmental and democratization outcomes. This study included self reported monthly income as a measure of economic attainment and affluence. Figure 52 shows the distribution of monthly incomes in Belize. These data were aggregated at the village level, summarized in Figure 53, and included in analysis. Examination reveals that, at the village level, mean income stratified into distinct groupings across a wide range of income categories. This variable is included in this study to control for any interaction this stratification of relative prosperity plays on US project perceived or actual impact.

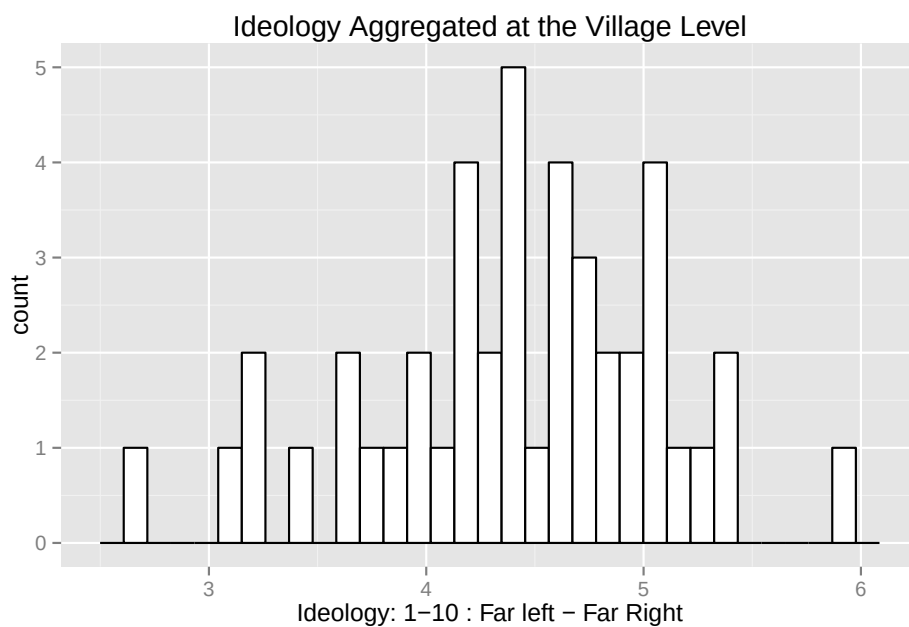


Figure 51. Village level responses for Ideology

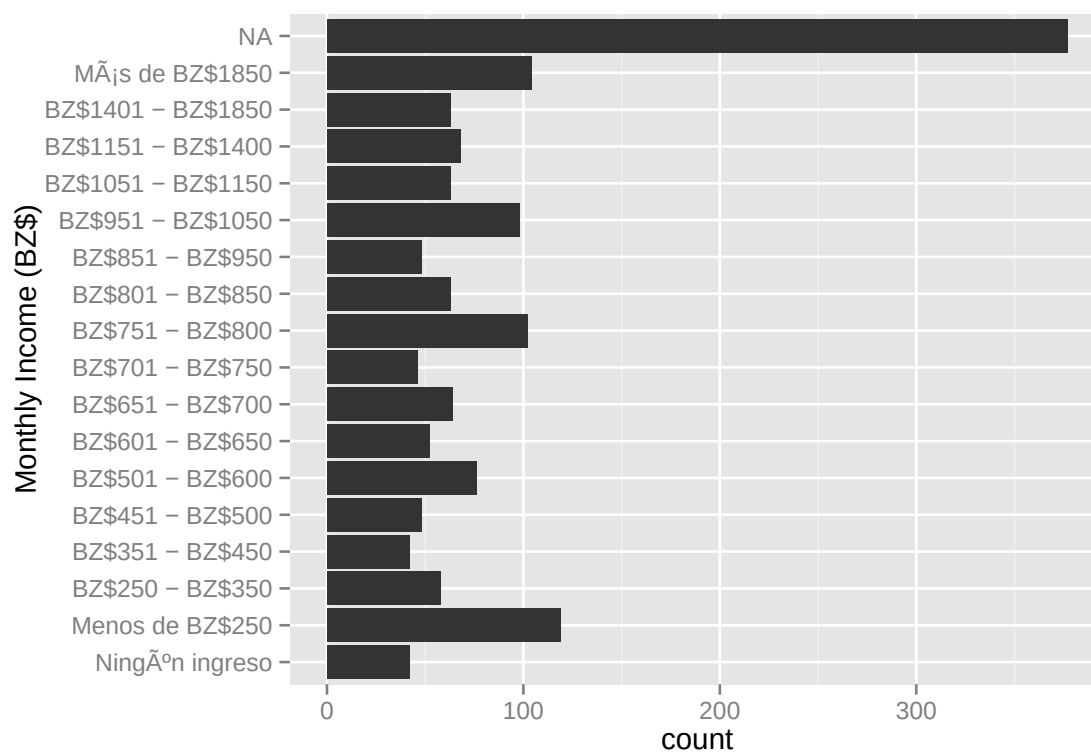


Figure 52. Individual Monthly Income

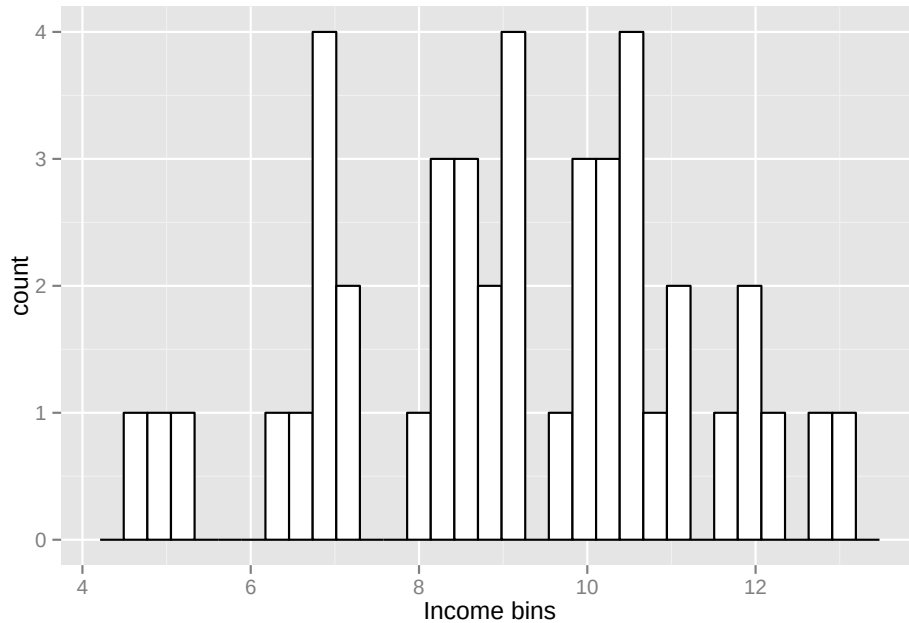


Figure 53. Village Level Monthly Income

An additional measure of perceived prosperity is satisfaction with income. Respondents were asked if their income meet their needs and if they could save on it; responses are summarized in Figure 54. This analysis utilized this measure to create a measure of relative prosperity. The measure was recoded and aggregated at the village level to determine the ratio of respondents at any one location with sufficient income to save money. Figure 55 shows the distribution of village scores based on the ratio of respondents who felt they could save money off their income. Examination reveals a stark contrast in this savings rate between villages where a sizable amount of villages had a near zero rate of respondent who said they could save. Other villages has as many as 38% of those surveyed report having sufficient income for savings. This study included this variable to control for expected impact on perception and effectiveness of US and local from the high contrast of relative affluence.

As a further measure of prosperity, this study includes a constructed measure of consumer and household goods attainment. Not all citizens need necessary be

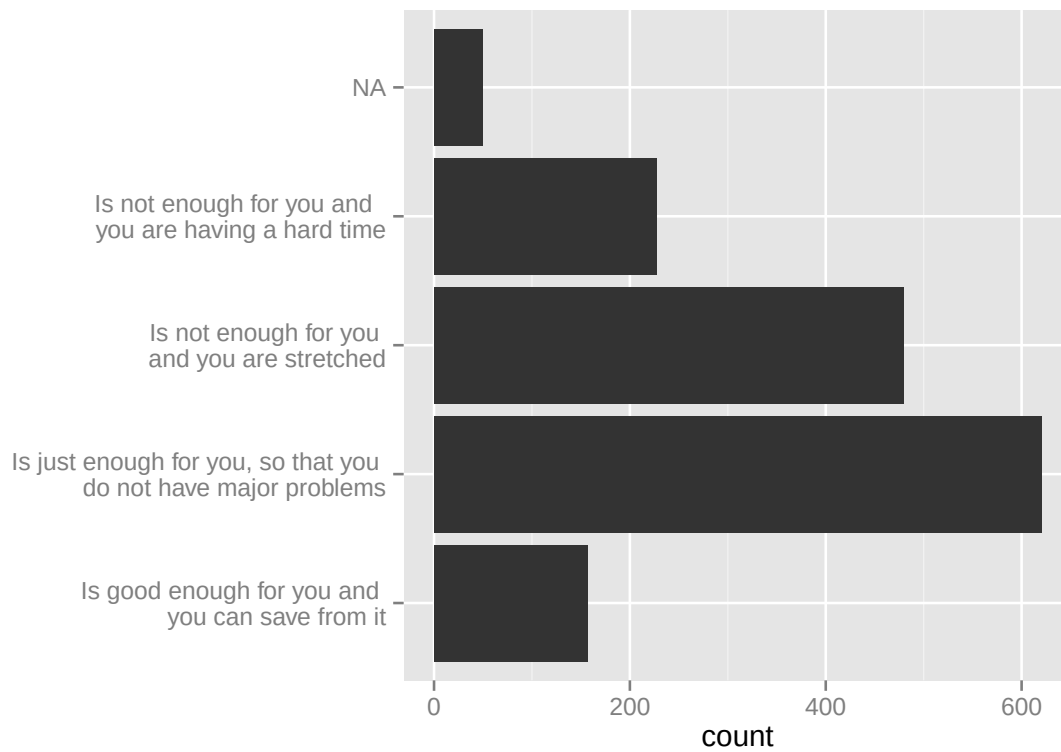


Figure 54. Individual Level Satisfaction with Income

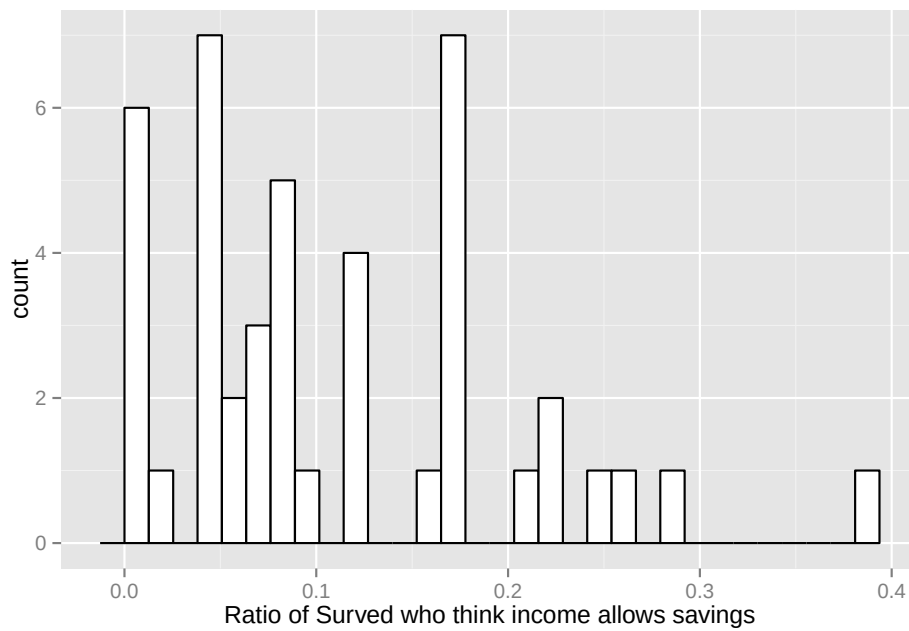


Figure 55. Village Level satisfaction with income

employed to be relatively affluent; this measure serves as an alternative to income and satisfaction with income for measuring affluence. The AmericasBarometer survey polled if survey takers had the common items, listed in Table 11, in their homes. This study assigned a 1 if the item was reported in the home and a 0 if it was not. These values were then summed for each individual. The distribution of this total house holdgoods items measure at the individual level is summarized in Figure 56. This measure was then aggregated at the village level providing a measure of mean affluence based on location. The distribution of the aggregated household goods measure is provided in Figure 57. Examination of the distribution of household goods at the individual and village level reveals that while individual household goods are evenly distributed across Belize definitive stratification exists between specific villages. This study hypothesizes that variation in household goods attainment may affect development perceptions and outcomes.

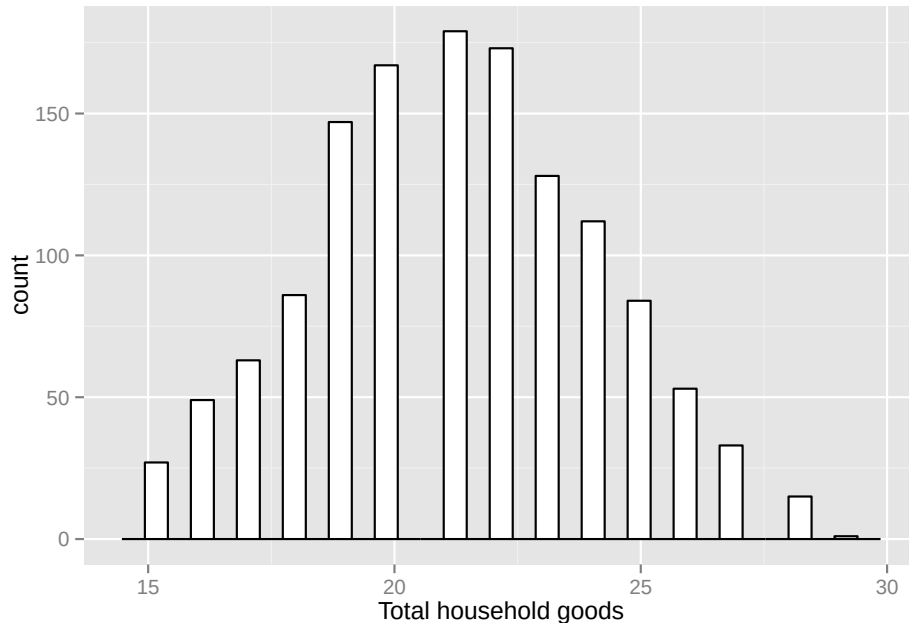


Figure 56. Individual Household Goods

The final demographic control variable included in this study is the number of

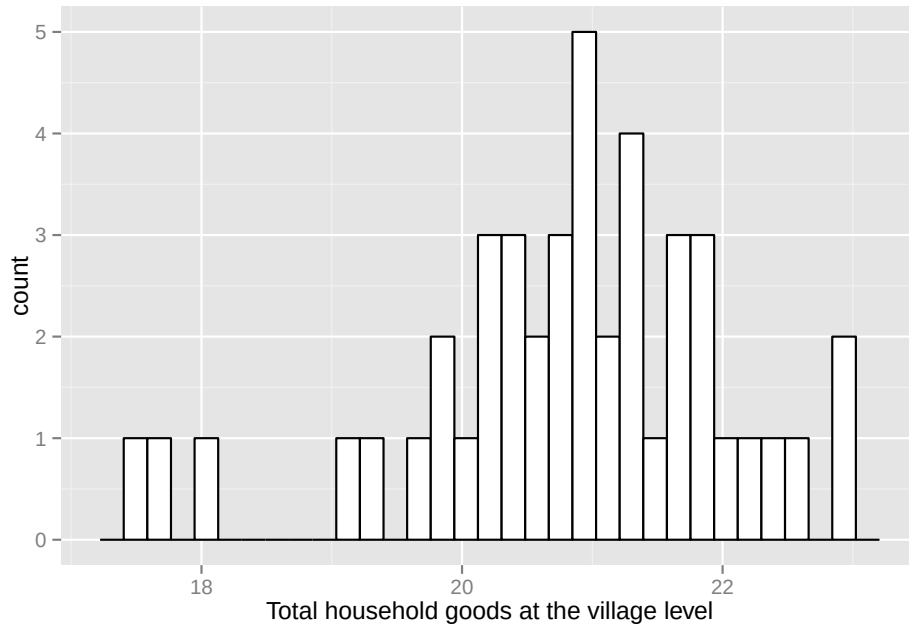


Figure 57. Village Level Household Goods

children reported by each survey taker. Figure 58 shows the distribution of reported number of children at the individual level. Figure 59 shows the distribution of mean number of children aggregated at the village level. Examination of the village level distribution of mean number of children reveals several distinct groupings of villages based on the mean number of children. This study included Number of children in this study as a possible control for opinions towards schools or medical care.

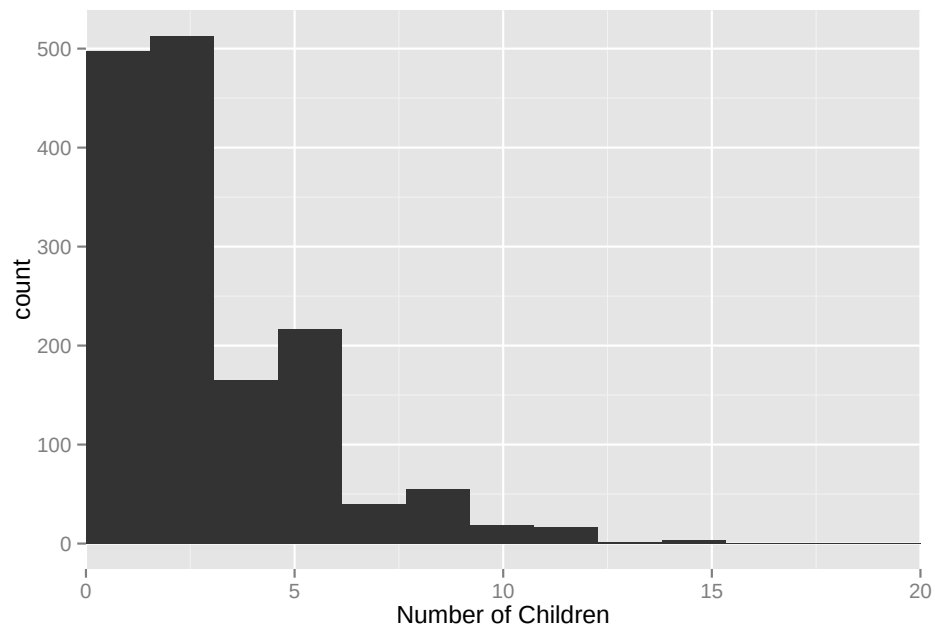


Figure 58. Individual Number of Children

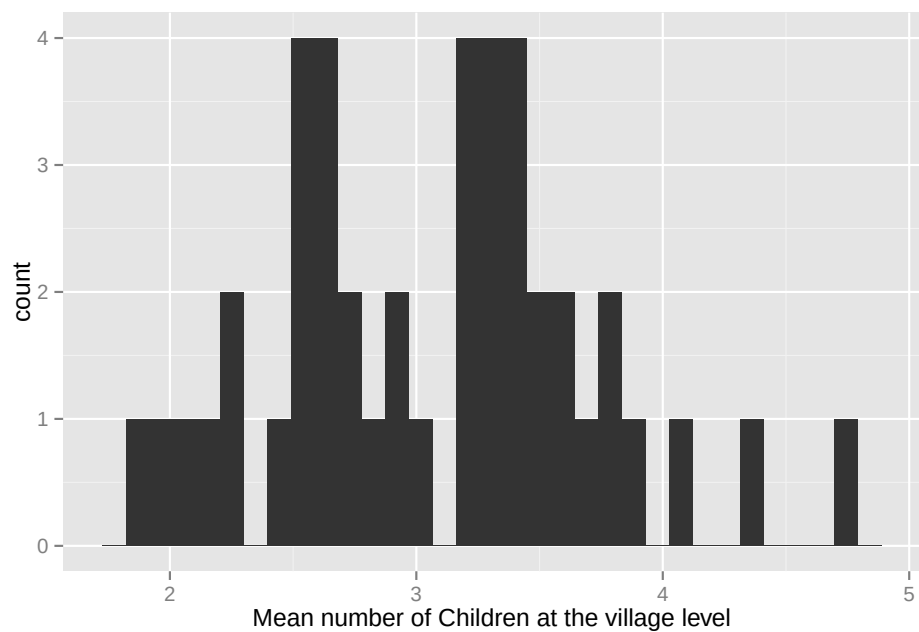


Figure 59. Village Level Number of Children

Appendix B. Statistical Test Results

Trust in the US Military Model

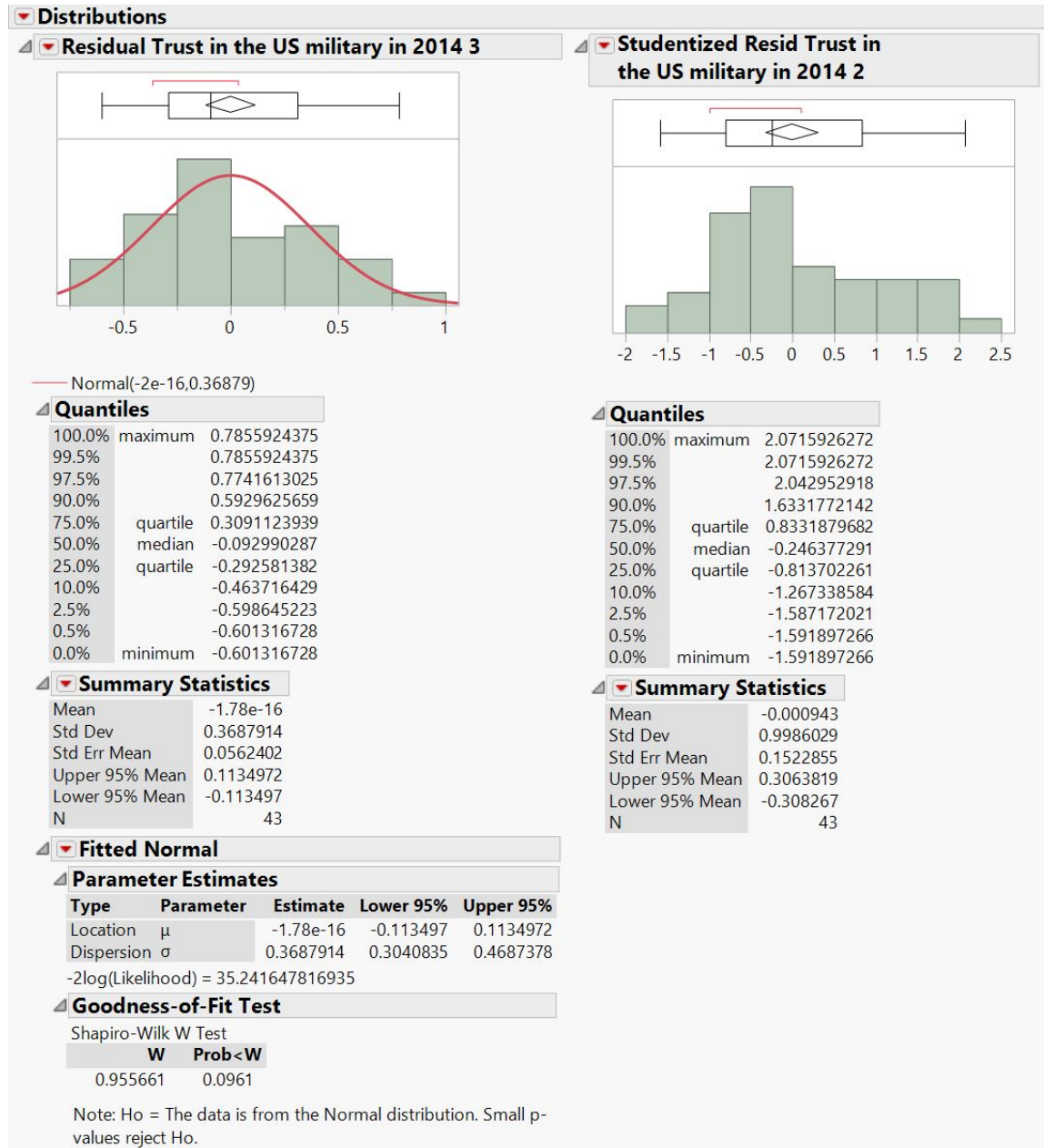


Figure 60. Distribution of Residuals for Trust in the US military Model

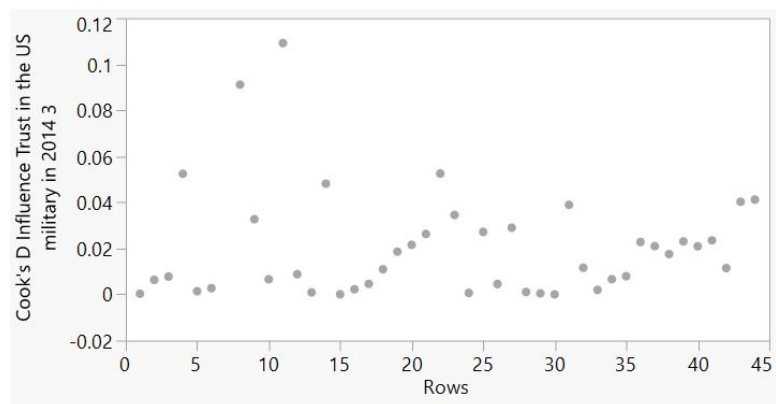


Figure 61. Cooks D Test for Influential Data Points for Trust in the US military Model

Table 27. Trust in the US Military Model Breusch Pagan Test

$$T.S. = (SSR/2) / (SSE/N)^2$$

Model error

5.712

Residual model SS

0.0491

DF

4

T.S.

0.012

P-value

0.9910

Trust in the US

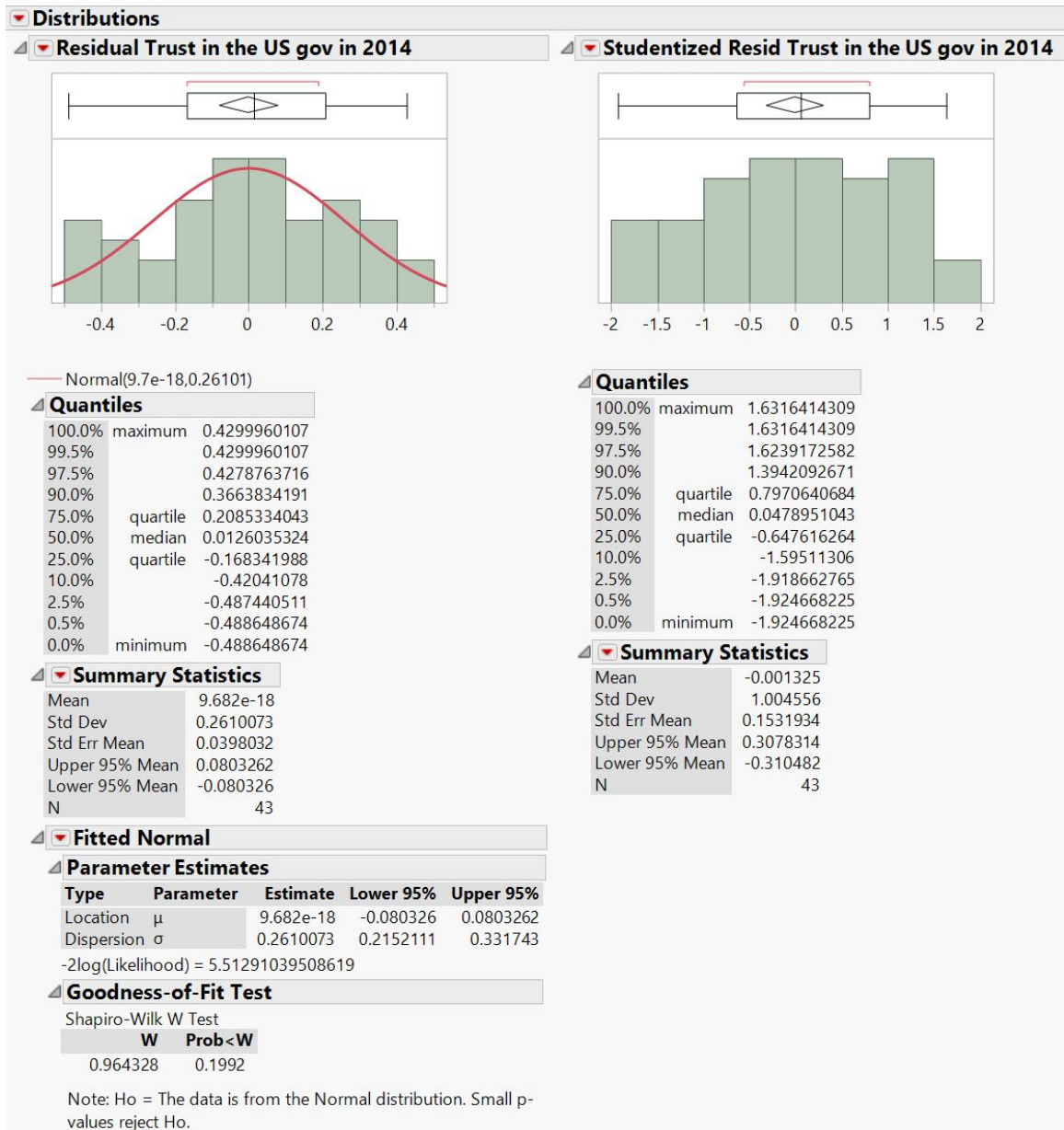


Figure 62. Distribution of Residuals for Trust in the US Model

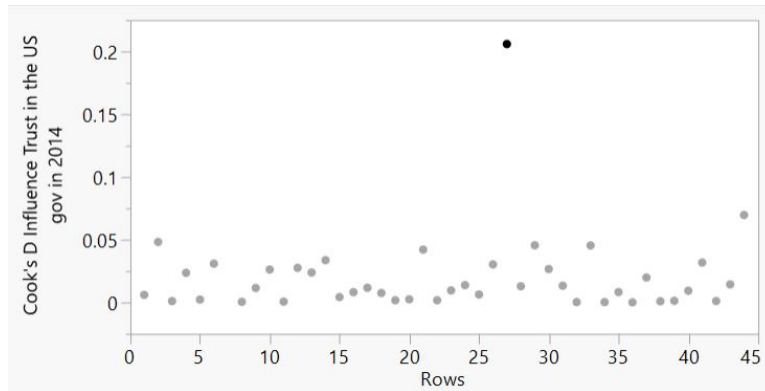


Figure 63. Cooks D Test for Influential Data Points for Trust in the US Model

Table 28. Trust in the US Model Breusch Pagan Test

$$T.S. = (SSR/2) / (SSE/N)^2$$

Model error

2.861

Residual model SS

0.00521

DF

2

T.S.

0.00127

P-value

0.9991

Satisfaction with Local Schools

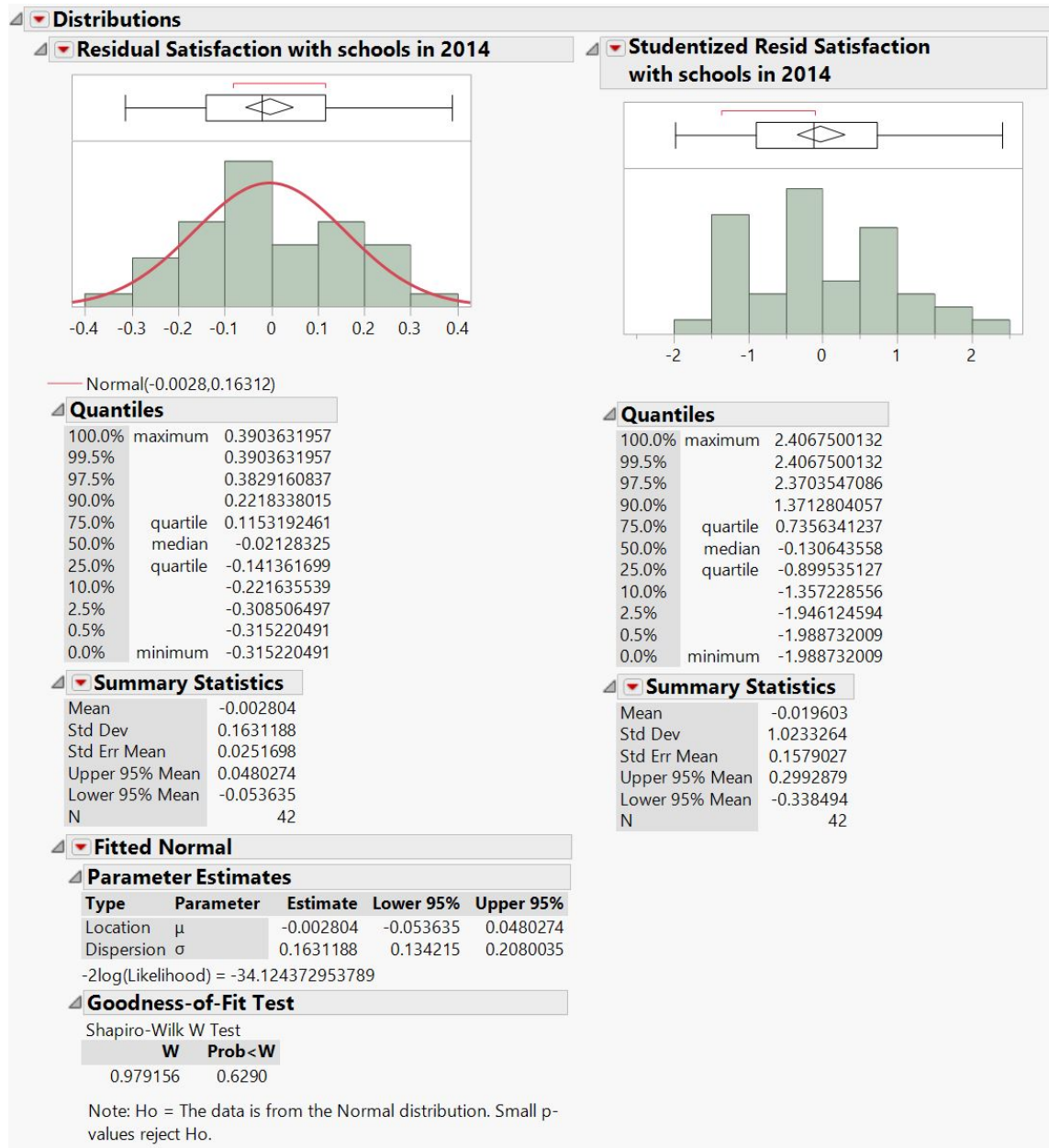


Figure 64. Distribution of Residuals for Satisfaction with Local Schools Model

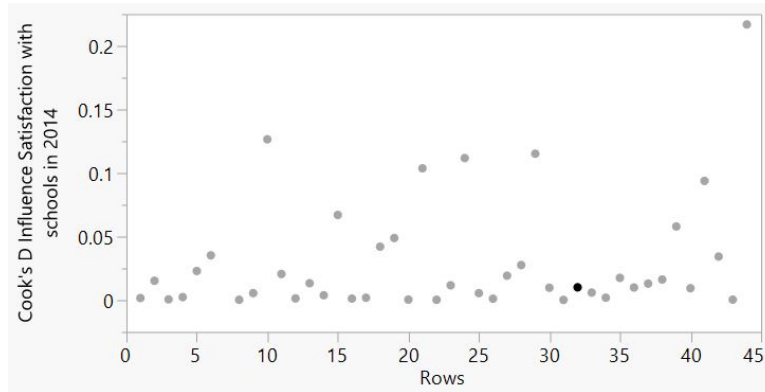


Figure 65. Cooks D Test for Influential Data Points for Satisfaction with Local Schools Model

Table 29. Satisfaction with Local Schools Model Breusch Pagan Test

$$T.S. = (SSR/2) / (SSE/N)^2$$

Model error

1.090

Residual model SS

0.00716

DF

3

T.S.

0.0271

P-value

0.9800

Satisfaction with Local Medical Services

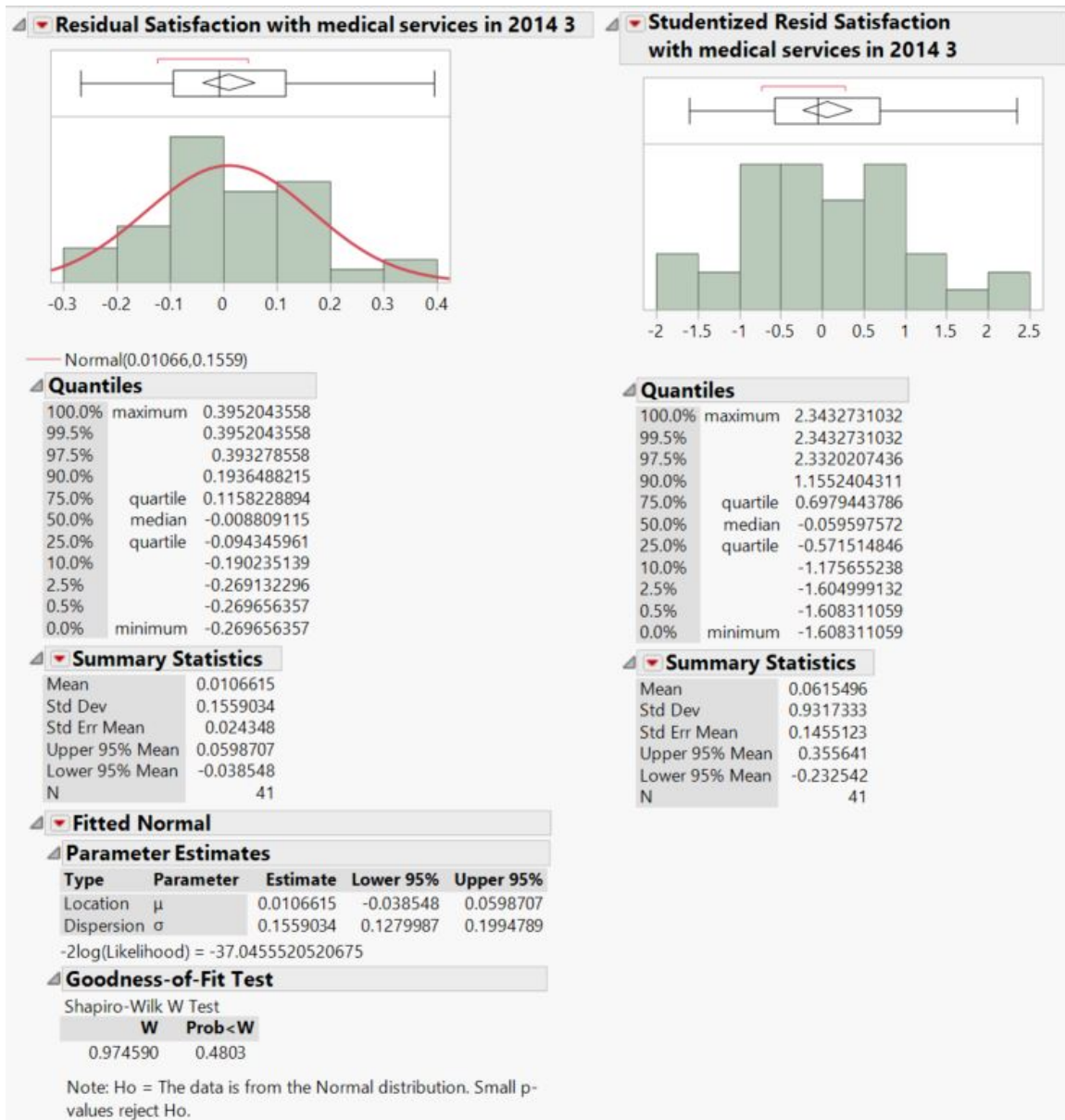


Figure 66. Distribution of Residuals for Satisfaction with Local Medical Services Model

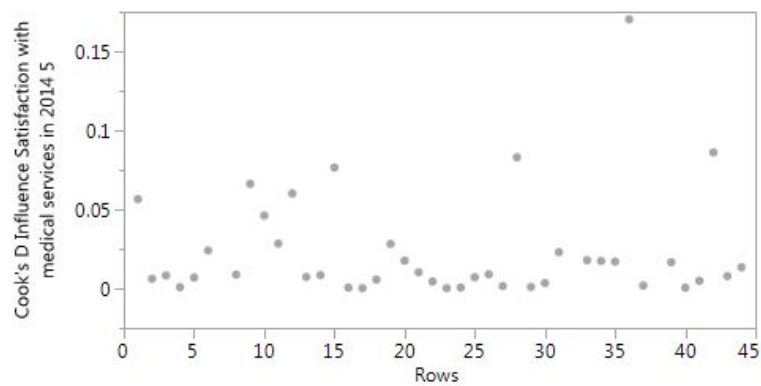


Figure 67. Cooks D Test for Influential Data Points for Satisfaction with Local Medical Services Model

Table 30. Satisfaction with Medical Services Breusch Pagan Test

$$T.S. = (SSR/2) / (SSE/N)^2$$

Model error

0.9672204

Residual model SS

0.0000002

DF

1

T.S.

1.06893E-07

P-value

0.999999932

Appendix C. R Statistics Software Code Scripts

2014 Variable Recoding

```
# 2014 Master Recoding File
# Load Raw AmericasBarometer 2012 and 2014 Belize Survey as
  Lapop2012 and Lapop2014
# Creating Social Capital Empowerment and Political Action
  Variables (EPA)
lapop2014$EPA1 <- as.numeric(lapop2014$ls3)
# test for numeric values
mean(lapop2014$EPA1, na.rm=TRUE)
hist(lapop2014$EPA1)
# Recode EPA1 variable reverse
lapop2014$EPA1 <- (5 - lapop2014$EPA1)
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA1 <- scale(lapop2014$EPA1, center = TRUE,
  scale = TRUE)
hist(lapop2014$Z.EPA1)
# Creating EPA2 from SOCT2
lapop2014$EPA2 <- as.numeric(lapop2014$soct2)
# test for numeric values
mean(lapop2014$EPA2, na.rm=TRUE)
# Recode EPA2 variable reverse
lapop2014$EPA2 <- (2 - lapop2014$EPA2)
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA2 <- scale(lapop2014$EPA2, center = TRUE,
```

```

    scale = TRUE)
hist(lapop2014$Z.EPA2)
# Creating EPA3 from IDIO2
lapop2014$EPA3 <- as.numeric(lapop2014$idio2)
# test for numeric values
mean(lapop2014$EPA3, na.rm=TRUE)
# Recode EPA3 variable reverse
lapop2014$EPA3 <- (2 - lapop2014$EPA3)
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA3 <- scale(lapop2014$EPA3, center = TRUE,
    scale = TRUE)
hist(lapop2014$Z.EPA3)
# Creating EPA4 from PROT3
# In the last 12 months, have you participated in a
  demonstration or protest march?
lapop2014$EPA4 <- as.numeric(lapop2014$prot3)
# test for numeric values
mean(lapop2014$EPA4, na.rm=TRUE)
# Recode EPA4
lapop2014$EPA4[lapop2014$EPA4 == 2] <- 0
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA4 <- scale(lapop2014$EPA4, center = TRUE,
    scale = TRUE)
hist(lapop2014$Z.EPA4)
lapop2014$EPA4 <- -1 * lapop2014$EPA4
lapop2014$Z.EPA4 <- -1 * lapop2014$Z.EPA4

```

```

# Creating EPA5 from JC10
# Coup justified when there is a lot of crime
lapop2014$EPA5 <- as.numeric(lapop2014$jc10)
# test for numeric values
mean(lapop2014$EPA5, na.rm=TRUE)
# Recode EPA5
lapop2014$EPA5 <- (lapop2014$EPA5 - 2)
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA5 <- scale(lapop2014$EPA5, center = TRUE,
    scale = TRUE)
hist(lapop2014$Z.EPA5)
# Creating EPA6 from JC13
# Coup justified When there is a lot of corruption
lapop2014$EPA6 <- as.numeric(lapop2014$jc13)
# test for numeric values
mean(lapop2014$EPA6, na.rm=TRUE)
# Recode EPA6
lapop2014$EPA6 <- (lapop2014$EPA6 - 2)
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA6 <- scale(lapop2014$EPA6, center = TRUE,
    scale = TRUE)
hist(lapop2014$Z.EPA6)
# Creating EPA7 from JC15A
# Do you believe that when the country is facing very
    difficult times it is
#justifiable for the Prime Minister of the country to close

```

```

    the National Assembly
#(House of Representatives and Senate) and govern without the
    National Assembly
#(House of Representatives and Senate)?
lapop2014$EPA7 <- as.numeric(lapop2014$jc15a)
# test for numeric values
mean(lapop2014$EPA7, na.rm=TRUE)
# Recode EPA7
lapop2014$EPA7 <- (lapop2014$EPA7 - 2)
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA7 <- scale(lapop2014$EPA7, center = TRUE,
    scale = TRUE)
hist(lapop2014$Z.EPA7)
hist(as.numeric(lapop2014$jc15a))
# Creating EPA8 from EFF1
# Those who govern this country are interested in what people
    like you think. How much do you agree or disagree with
    this statement?1-7 Liker
# 1 disagree 7 agree
lapop2014$EPA8 <- as.numeric(lapop2014$eff1)
# test for numeric values
mean(lapop2014$EPA8, na.rm=TRUE)
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA8 <- scale(lapop2014$EPA8, center = TRUE,
    scale = TRUE)
hist(lapop2014$Z.EPA8)

```

```

# Creating EPA9 from EFF2
# You feel that you understand the most important political
  issues of this country. How much do you agree or disagree
  with this statement?1-7 Likert
lapop2014$EPA9 <- as.numeric(lapop2014$eff2)
# test for numeric values
mean(lapop2014$EPA9, na.rm=TRUE)
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA9 <- scale(lapop2014$EPA9, center = TRUE,
  scale = TRUE)
hist(lapop2014$Z.EPA9)
# Creating EPA10 from ING4
# Changing the subject again, democracy may have problems,
  but it is better than any other form of government. To
  what extent do you agree or disagree with this statement?
  1-7 Likert
lapop2014$EPA10 <- as.numeric(lapop2014$ing4)
# test for numeric values
mean(lapop2014$EPA10, na.rm=TRUE)
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA10 <- scale(lapop2014$EPA10, center = TRUE,
  scale = TRUE)
hist(lapop2014$Z.EPA10)
# Creating EPA11 from pn4
# In general, would you say that you are very satisfied,
  satisfied, dissatisfied or very dissatisfied with the way

```

```

democracy works in Belize?

lapop2014$EPA11 <- as.numeric(lapop2014$pn4)
# test for numeric values
mean(lapop2014$EPA11, na.rm=TRUE)
# Recode EPA1 variable reverse
lapop2014$EPA11 <- (5 - lapop2014$EPA11)
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA11 <- scale(lapop2014$EPA11, center = TRUE,
    scale = TRUE)
hist(lapop2014$Z.EPA11)
# Creating EPA12 from DEM2
# Now changing the subject, which of the following statements
    do you agree with the most:
lapop2014$EPA12 <- as.numeric(lapop2014$dem2)
hist(lapop2014$EPA12)
lapop2014$EPA12[lapop2014$EPA12 == 1] <- 0
lapop2014$EPA12[lapop2014$EPA12 == 2] <- 1
lapop2014$EPA12[lapop2014$EPA12 == 3] <- -1
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA12 <- scale(lapop2014$EPA12, center = TRUE,
    scale = TRUE)
hist(lapop2014$Z.EPA12)
# Creating EPA14 from vb1
# Are you registered to vote?
lapop2014$EPA14 <- as.numeric(lapop2014$vb1)
# test for numeric values

```

```

mean(lapop2014$EPA14, na.rm=TRUE)
# Recode EPA14
lapop2014$EPA14[lapop2014$EPA14 == 2] <- 0
lapop2014$EPA14[lapop2014$EPA14 == 3] <- 1
hist(lapop2014$EPA14)
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA14 <- scale(lapop2014$EPA14, center = TRUE,
  scale = TRUE)
hist(lapop2014$Z.EPA14)
# Creating EPA15 from vb2
# Did you vote in the last general elections of 2012?
lapop2014$EPA15 <- as.numeric(lapop2014$vb2)
# test for numeric values
mean(lapop2014$EPA15, na.rm=TRUE)
# Recode EPA15
lapop2014$EPA15[lapop2014$EPA15 == 2] <- 0
hist(lapop2014$EPA15)
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA15 <- scale(lapop2014$EPA15, center = TRUE,
  scale = TRUE)
hist(lapop2014$Z.EPA15)
# Creating EPA16 from vb10
# Do you currently identify with a political party?
lapop2014$EPA16 <- as.numeric(lapop2014$vb10)
# test for numeric values
mean(lapop2014$EPA16, na.rm=TRUE)

```

```

# Recode EPA16
lapop2014$EPA16[lapop2014$EPA16 == 2] <- 0
hist(lapop2014$EPA16)
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA16 <- scale(lapop2014$EPA16, center = TRUE,
  scale = TRUE)
hist(lapop2014$Z.EPA16)
# Creating EPA17 from pol1
# How much interest do you have in politics: a lot, some,
  little or none?
lapop2014$EPA17 <- as.numeric(lapop2014$pol1)
# test for numeric values
mean(lapop2014$EPA17, na.rm=TRUE)
# Recode EPA17 variable reverse
lapop2014$EPA17 <- (5 - lapop2014$EPA17)
hist(lapop2014$EPA17)
#generate z-scores for variable using the scale() function
lapop2014$Z.EPA17 <- scale(lapop2014$EPA17, center = TRUE,
  scale = TRUE)
hist(lapop2014$Z.EPA17)
# Mean standardized EPA score
lapop2014$Z.EPA.mean<-rowMeans(lapop2014[,c("Z.EPA1", "Z.EPA2",
  "Z.EPA3", "Z.EPA4", "Z.EPA5", "Z.EPA6", "Z.EPA7", "Z.EPA8",
  "Z.EPA9", "Z.EPA10", "Z.EPA11", "Z.EPA12", "Z.EPA13",
  "Z.EPA14", "Z.EPA15", "Z.EPA16", "Z.EPA17" )], na.rm=TRUE)
hist(lapop2014$Z.EPA.mean)

```

```

#Standardized SocialCI
# Create socialCI
## 2012 SocialCI was created by averaging the socialCI
measures in SPSS
summary(lapop2014$e5)
lapop2014$SocialCI <- rowMeans(lapop2014[,c("e5" , "e15" , "
e3" , "e16" , "d1" , "d2" , "d3" , "d4" , "d5")], na.rm =
FALSE)
hist(lapop2014$SocialCI)
lapop2014$Z.SocialCI <- scale(lapop2014$SocialCI, center =
TRUE, scale = TRUE)
hist(lapop2014$Z.SocialCI)
# Mean Social Capital Output
lapop2014$Z.SCO <- rowMeans(lapop2014[,c("Z.EPA.mean", "Z.
SocialCI")], na.rm=TRUE)
hist(lapop2014$Z.SCO)
# Recoding demographic variables
# Creating DVAR1: Sex from Q1
# 1 for female
lapop2014$DVAR1 <- as.numeric(lapop2014$q1)
# sumerize and test for numeric
summary(lapop2014$DVAR1)
mean(lapop2014$DVAR1, na.rm=TRUE)
# Recode into female = 1, male = 0
lapop2014$DVAR1 <- lapop2014$DVAR1 - 1
hist(lapop2014$DVAR1)

```

```

# Creating DVAR2: age from Q2Y
# years old based on birth year
lapop2014$DVAR2 <- as.numeric(lapop2014$q2y)
# sumerize and test for numeric
summary(lapop2014$DVAR2)
mean(lapop2014$DVAR2, na.rm=TRUE)
# Recode into age in years
lapop2014$DVAR2 <- 2015 - lapop2014$DVAR2
hist(lapop2014$DVAR2)
#Creating DVAR3: Ideology from l1
lapop2014$DVAR3 <- as.numeric(lapop2014$l1 , na.rm=TRUE)
hist(lapop2014$DVAR3)
summary(lapop2014$DVAR3)
mean(lapop2014$DVAR3, na.rm=TRUE)
#OCUP1A - type of work
summary(lapop2014$ocup1a)
mean(lapop2014$DVAR4, na.rm=TRUE)
#Q10New DVAR5 - household income
lapop2014$DVAR5 <- as.numeric(lapop2014$q10new , na.rm=TRUE)
summary(lapop2014$DVAR5)
hist(lapop2014$DVAR5)
#Q10D DVAR7- salary good enough
#based on box plot only ones who can save are higher
lapop2014$DVAR7 <- as.numeric(lapop2014$q10d , na.rm=TRUE)
lapop2014$DVAR7[lapop2014$DVAR7 == 2] <- 0
lapop2014$DVAR7[lapop2014$DVAR7 == 3] <- 0

```

```

lapop2014$DVAR7[lapop2014$DVAR7 == 4] <- 0
summary(lapop2014$DVAR7)
#Q10E - increase in income
summary(lapop2014$q10e)
#q11
summary(lapop2014$q11)
#q12
summary(lapop2014$q12)
#Household goods DVAR8
summary(lapop2014$r3)
plot(lapop2014$r3, lapop2014$Z.SCO)
lapop2014$DVAR8 <- (as.numeric(lapop2014$r3, na.rm=TRUE) +
                    as.numeric(lapop2014$r4, na.rm=TRUE) +
                    as.numeric(lapop2014$r4a, na.rm=TRUE) +
                    as.numeric(lapop2014$r5, na.rm=TRUE) +
                    as.numeric(lapop2014$r6, na.rm=TRUE) +
                    as.numeric(lapop2014$r7, na.rm=TRUE) +
                    as.numeric(lapop2014$r8, na.rm=TRUE) +
                    as.numeric(lapop2014$r12, na.rm=TRUE) +
                    as.numeric(lapop2014$r14, na.rm=TRUE) +
                    as.numeric(lapop2014$r15, na.rm=TRUE) +
                    as.numeric(lapop2014$r18, na.rm=TRUE) +
                    as.numeric(lapop2014$r1, na.rm=TRUE) +
                    as.numeric(lapop2014$r16, na.rm=TRUE) +
                    as.numeric(lapop2014$r26, na.rm=TRUE))
summary(lapop2014$DVAR8)

```

```

##### Groups and Networks Social Capital IV
#CP6 GrpNt
summary(lapop2014$cp20)
lapop2014$GrpNt <- (as.numeric(lapop2014$cp7, na.rm=TRUE) +
                    as.numeric(lapop2014$cp8, na.rm=TRUE) +
                    as.numeric(lapop2014$cp13, na.rm=TRUE)
                    +
                    as.numeric(lapop2014$cp20, na.rm=TRUE))
summary(lapop2014$GrpNt)
hist(lapop2014$Z.SocialCI)
# Social Capital: Groups and Networking
#CP6 GrpNt
summary(lapop2014$cp20)
lapop2014$GrpNt <- ((4 - as.numeric(lapop2014$cp7, na.rm=TRUE)
                    ))+
                    (4 - as.numeric(lapop2014$cp8, na.rm=
                    TRUE))+
                    (4 - as.numeric(lapop2014$cp13, na.rm=
                    TRUE))+
                    (4 - as.numeric(lapop2014$cp20, na.rm=
                    TRUE)))
summary(lapop2014$GrpNt)
hist(lapop2014$GrpNt)
# Trust and Solidarity
#IT1
summary(lapop2014$it1)

```

```

lapop2014$TS2 <- 5 - as.numeric(lapop2014$it1, na.rm=TRUE)
summary(lapop2014$TS2)
lapop2014$Z.TS2 <- scale(lapop2014$TS2, center = TRUE, scale
= TRUE)
hist(lapop2014$Z.TS2)
#TS1.mean Combined analysis of the B and N variables -
factors
lapop2014$TS1.mean<-rowMeans(lapop2014[,c("b2", "b3" , "b4" ,
      "b6", "b10a" , "b12" , "b13", "b21" , "b21a" , "b47a", "
      n9" , "n11" , "b18", "b32" )], na.rm=TRUE)
hist(lapop2014$TS1.mean)
lapop2014$Z.TS1.mean <- scale(lapop2014$TS1.mean, center =
      TRUE, scale = TRUE)
hist(lapop2014$Z.TS1.mean)
# Collective Action Recoding
summary(lapop2014$cp4a)
summary(lapop2014$np2)
summary(lapop2014$cp5)
summary(lapop2014$np1)
#CP4a to CA1 and Z.CA1
lapop2014$CA1 <- as.numeric(lapop2014$cp4a, na.rm=TRUE)
lapop2014$CA1[lapop2014$CA1 == 2] <- 0
lapop2014$Z.CA1 <- scale(x = lapop2014$CA1, center = TRUE,
      scale = TRUE)
hist(lapop2014$Z.CA1)
#NP2 to CA2 and Z.CA2

```

```

lapop2014$CA2 <- as.numeric(lapop2014$np2, na.rm=TRUE)
lapop2014$CA2[lapop2014$CA2 == 2] <- 0
lapop2014$Z.CA2 <- scale(x = lapop2014$CA2, center = TRUE,
  scale = TRUE)
hist(lapop2014$Z.CA2)
#CP5 to CA3 and Z.CA3
lapop2014$CA3 <- as.numeric(lapop2014$cp5, na.rm=TRUE)
lapop2014$CA3 <- 4 - lapop2014$CA3
lapop2014$Z.CA3 <- scale(x = lapop2014$CA3, center = TRUE,
  scale = TRUE)
hist(lapop2014$Z.CA3)
#NP1 to CA4 and Z.CA4
lapop2014$CA4 <- as.numeric(lapop2014$np1, na.rm=TRUE)
lapop2014$CA4[lapop2014$CA4 == 2] <- 0
lapop2014$Z.CA4 <- scale(x = lapop2014$CA4, center = TRUE,
  scale = TRUE)
hist(lapop2014$Z.CA4)
summary(lapop2014$Z.CA3)
# Composite CA.mean and Z.CA.mean
lapop2014$CA.mean <- rowMeans(lapop2014[, c("Z.CA1", "Z.CA2", "
  Z.CA3", "Z.CA4")], na.rm=TRUE)
lapop2014$Z.CA.mean <- scale(x = lapop2014$CA.mean, center =
  TRUE, scale = TRUE)
hist(lapop2014$Z.CA.mean)
# Information and Communication
summary(lapop2014$www1)

```

```

summary(lapop2014$gi0)
summary(lapop2014$gi1)
summary(lapop2014$gi4)
#www1 to IC1 and Z.IC1
lapop2014$IC1 <- 5 - as.numeric(lapop2014$www1, na.ra=TRUE)
lapop2014$Z.IC1 <- scale(lapop2014$IC1, center=TRUE, scale=
  TRUE)
hist(lapop2014$Z.IC1)
#gi0 to IC2 and Z.IC2
lapop2014$IC2 <- 5 - as.numeric(lapop2014$gi0, na.ra=TRUE)
lapop2014$Z.IC2 <- scale(lapop2014$IC2, center=TRUE, scale=
  TRUE)
hist(lapop2014$Z.IC2)
#gi4 to IC4 and Z.IC4
lapop2014$IC4 <- as.numeric(lapop2014$gi4, na.rm=TRUE)
lapop2014$IC4[lapop2014$IC4 == 2] <- 0
lapop2014$Z.IC4 <- scale(x = lapop2014$IC4, center = TRUE,
  scale = TRUE)
hist(lapop2014$Z.IC4)
# IC composite variable
lapop2014$IC.mean <- rowMeans(lapop2014[, c("Z.IC1", "Z.IC2", "
  Z.IC4")], na.rm=TRUE)
lapop2014$Z.IC.mean <- scale(x = lapop2014$IC.mean, center =
  TRUE, scale = TRUE)
hist(lapop2014$Z.IC.mean)
#Dependent Variable Recoding

```

```

# DV. LocalServices from SGL1
lapop2014$DV.LocalServices <- 6 - as.numeric(lapop2014$sgl1 ,
      na.ra=TRUE)
hist(lapop2014$DV.LocalServices)
lapop2014$Z.DV.LocalServices <- scale(lapop2014$DV.
      LocalServices , center = TRUE, scale = TRUE)
hist(lapop2014$Z.DV.LocalServices)
#Mil3 to Z.Mil3 and Mil4 to Z.Mil4
summary(lapop2014$mil3)
lapop2014$mil3recode <- as.numeric(lapop2014$mil3)
summary(lapop2014$mil3recode)
lapop2014$Z.mil3 <- scale(lapop2014$mil3 , center = TRUE, scale
      = TRUE)
hist(lapop2014$Z.mil3)
lapop2014$Z.mil4 <- scale(lapop2014$mil4 , center = TRUE, scale
      = TRUE)
hist(lapop2014$mil4)
#SD2New2 to DV. LocalStreets
lapop2014$DV.LocalStreets <- 5 - as.numeric(lapop2014$sd2new2
      , na.ra=TRUE)
hist(lapop2014$DV.LocalStreets)
lapop2014$Z.DV.LocalStreets <- scale(lapop2014$DV.
      LocalStreets , center = TRUE, scale = TRUE)
hist(lapop2014$Z.DV.LocalStreets)
#SD3NEW2 local schools to DV. LocalSchools
lapop2014$DV.LocalSchools <- 5 - as.numeric(lapop2014$sd3new2

```

```

, na.ra=TRUE)
hist(lapop2014$DV.LocalSchools)
lapop2014$Z.DV.LocalSchools <- scale(lapop2014$DV.
  LocalSchools, center = TRUE, scale = TRUE)
hist(lapop2014$Z.DV.LocalSchools)
#SD6NEW2 Public health services to DV.LocalMedical and Z.DV.
LocalMedical
lapop2014$DV.LocalMedical <- 5 - as.numeric(lapop2014$sd6new2
, na.ra=TRUE)
hist(lapop2014$DV.LocalMedical)
lapop2014$Z.DV.LocalMedical <- scale(lapop2014$DV.
  LocalMedical, center = TRUE, scale = TRUE)
hist(lapop2014$Z.DV.LocalMedical)
#MIL10E Trust in the US to DV.TrustUS
lapop2014$DV.TrustUS <- 5 - as.numeric(lapop2014$mil10e, na.
  ra=TRUE)
hist(lapop2014$DV.TrustUS)
lapop2014$Z.DV.TrustUS <- scale(lapop2014$DV.TrustUS, center =
  TRUE, scale = TRUE)
hist(lapop2014$Z.DV.TrustUS)
#Urban rural recode
lapop2014$urRecode <- as.numeric(lapop2014$ur)
# recode 2 to 0
lapop2014$urRecode[lapop2014$urRecode == 2] <- 0
summary(lapop2014$urRecode)

```

Geo-referencing Code

```
library(foreign)
write.foreign(SurveyLocations2012to2014, "file_location")
db = file.choose()
write.csv(lapop2012b, file=db)
survey2012 = read.spss(db, to.data.frame=TRUE, use.value.
  labels=FALSE)
require(rgdal)
library(rgdal)
library(maptools)
db <- file.choose()
location.shape <- readShapePoints(db)
plot(location.shape)
variable.names(location.shape)
summary(location.shape@data$Name)
which(location.shape@data$Name == 4096)
location.shape@coords[31,"coords.x1"]
lapop2012b$point_x <- NA
lapop2012b$point_y <- NA
lapop2012b$point_x <- LAPOP2012wLatLong$point_x
lapop2012b$point_y <- LAPOP2012wLatLong$point_y
summary(lapop2012b$point_x)
variable.names(lapop2012b)
LAPOP2012wLatLong$pobladoMod12
lapop2012b$villageMod <- as.numeric(LAPOP2012wLatLong$
  pobladoMod12)
```

```

lapop2012b$villageMod
for(i in 1:1512)
{
  poblado_lookup <- lapop2012b[i, "villageMod"]
  lookupX <- location.shape@coords[which(location.shape@data$
    Name == poblado_lookup), "coords.x1"]
  lookupY <- location.shape@coords[which(location.shape@data$
    Name == poblado_lookup), "coords.x2"]
  lapop2012b[i, "point_x"] <- lookupX
  lapop2012b[i, "point_y"] <- lookupY
}
lapop2012$villageMod <- lapop2012b$villageMod
lapop2012$villageMod
write.table(survey2012, file location, sep=",")
#recoding modified village numbers for 2014
lapop2014$villageMod <- NA
lapop2014$villageMod <- as.numeric(raw14$poblado)
lapop2014$villageMod
lapop2014$villageMod[lapop2014$villageMod == 1012] <- 1011
lapop2014$villageMod[lapop2014$villageMod == 2011] <- 2012
lapop2014$villageMod[lapop2014$villageMod == 2013] <- 2012
lapop2014$villageMod[lapop2014$villageMod == 3011] <- 3021
lapop2014$villageMod[lapop2014$villageMod == 3012] <- 3021
lapop2014$villageMod[lapop2014$villageMod == 3013] <- 3021
lapop2014$villageMod[lapop2014$villageMod == 3022] <- 3021
lapop2014$villageMod[lapop2014$villageMod == 3023] <- 3021

```

```

lapop2014$villageMod[lapop2014$villageMod == 3024] <- 3021
lapop2014$villageMod[lapop2014$villageMod == 3025] <- 3021
lapop2014$villageMod[lapop2014$villageMod == 3026] <- 3021
lapop2014$villageMod[lapop2014$villageMod == 3027] <- 3021
lapop2014$villageMod[lapop2014$villageMod == 3028] <- 3021
lapop2014$villageMod[lapop2014$villageMod == 3032] <- 3021
lapop2014$villageMod[lapop2014$villageMod == 4000] <- 4096
lapop2014$villageMod[lapop2014$villageMod == 4012] <- 4011
lapop2014$villageMod[lapop2014$villageMod == 4041] <- 4042
lapop2014$villageMod[lapop2014$villageMod == 4043] <- 4042
lapop2014$villageMod[lapop2014$villageMod == 5012] <- 5011
lapop2014$villageMod[lapop2014$villageMod == 6092] <- 6013
lapop2014$villageMod[lapop2014$villageMod == 6015] <- 4021
lapop2014$villageMod[lapop2014$villageMod == 6093] <- 4021
for(i in 1:1533)
{

  if(lapop2014[i, "villageMod"] == 1012) {
    lapop2014[i, "villageMod"] <- 1011
    next
  }
  if(lapop2014[i, "villageMod"] == 2011) {
    lapop2014[i, "villageMod"] <- 2012
    next
  }
  if(lapop2014[i, "villageMod"] == 2013) {

```

```

    lapop2014[i, "villageMod"] <- 2012
  next
}
if(lapop2014[i, "villageMod"] == 3011 | lapop2014[i, "
  villageMod"] == 3012 | lapop2014[i, "villageMod"] ==
  3013) {
  lapop2014[i, "villageMod"] <- 3021
  next
}
if(lapop2014[i, "villageMod"] >= 3021) {
  if(lapop2014[i, "villageMod"] <= 3028) {
    lapop2014[i, "villageMod"] <- 3021
    next
  }
  next
}
if((lapop2014[i, "villageMod"] == 3032)) {
  lapop2014[i, "villageMod"] <- 3031
  next
}
if((lapop2014[i, "villageMod"] == 4012)) {
  lapop2014[i, "villageMod"] <- 4011
  next
}
if(lapop2014[i, "villageMod"] == 4041 | lapop2014[i, "
  villageMod"] == 4043) {

```

```

    lapop2014[i, "villageMod"] <- 4042
    next
}
if((lapop2014[i, "villageMod"] == 5012)) {
    lapop2014[i, "villageMod"] <- 5011
    next
}
if((lapop2014[i, "villageMod"] == 6092)) {
    lapop2014[i, "villageMod"] <- 6013
    next
}
if(lapop2014[i, "villageMod"] == 6015 | lapop2014[i, "
    villageMod"] == 6093) {
    lapop2014[i, "villageMod"] <- 4021
    next
}
}
#test code

#i <- 1
#lapop2014[i, "villageMod"]
#(lapop2014[i, "villageMod"] >= 3021 && lapop2014[i, "
    villageMod"] <= 3028)
#lapop2014[1, "villageMod"] <- 4000
#if(lapop2014[1, "villageMod"] >= 3021 & lapop2014[1, "
    villageMod"] <= 3028) {

```

```

# lapop2014[1, "villageMod"] <- 3021
#}
#lapop2014[1, "villageMod"]

#lapop2014[1, "villageMod"] <- 3011
#if(lapop2014[1, "villageMod"] == 3011 | lapop2014[1, "
  villageMod"] == 3012 | lapop2014[1, "villageMod"] == 3013)
{
# lapop2014[1, "villageMod"] <- 3021
#}
#lapop2014[1, "villageMod"]
summary(as.numeric(raw14$poblado))
summary(lapop2014$villageMod)
summary(lapop2012$villageMod)
lapop2012$villageMod <- LAPOP2012wLatLong$pobladoMod12
lapop2012$villageMod
#2012 geocoding
lapop2012$point_x <- NA
lapop2012$point_y <- NA
for(i in 1:1512) {
  poblado_lookup <- lapop2012[i, "villageMod"]
  lapop2012[i, "point_x"] <- xyLapop[which(as.numeric(xyLapop
    $Name) == poblado_lookup), "POINT_X"]
  lapop2012[i, "point_y"] <- xyLapop[which(as.numeric(xyLapop
    $Name) == poblado_lookup), "POINT_Y"]
}

```

```

lapop2012$point_x
#2014 geocoding
lapop2014$point_x <- NA
lapop2014$point_y <- NA
for(i in 1:1533) {
  poblado_lookup <- lapop2014[i, "villageMod"]
  lapop2014[i, "point_x"] <- xyLapop[which(as.numeric(xyLapop
    $Name) == poblado_lookup), "POINT_X"]
  lapop2014[i, "point_y"] <- xyLapop[which(as.numeric(xyLapop
    $Name) == poblado_lookup), "POINT_Y"]
}
lapop2014$point_x

```

Spatial-temporal Lag Variable Code

```

#Develop the spatial 2012 image for each village
#for each of the 44 villages:
#This code finds the weighted mean value for each measure in
2012.
#Values are weighted by proximity of the 2012 obsevation to
the specific village.
#The weighting has measurements taken in the same village
assigned a 1.
#Observations greater than or equal to 20 km from the village
are weighted 0.
#Observations between 0 and 20 km are weighted on a liniar
scale where 0 km is given full weight and 20 km is

```

weighted 0.

*#The code calculates the weighted mean for the following
measures:*

#2012 Satisfaction with Schools

#2012 Satisfaction with local government

#2012 Satisfaction with medical services

#2012 Trust in the United States

#2012 Trust in the US Military

testVillage <- NA

testWeight <- NA

xyLapop\$mil3.12 <- NA

xyLapop\$trustUS.12 <- NA

xyLapop\$schools.12 <- NA

xyLapop\$medical.12 <- NA

xyLapop\$services.12 <- NA

for(i in 1:44) {

testVillage <- xyLapop[i, "Name"]

#tests proximity of all other variables

testWeight <- NA

testDist <- NA

testWeight <- NA

testDist <- NA

for(j in 1:1512) {

jVillage <- lapop2012[j, "villageMod"]

p1 <- c(xyLapop[xyLapop[, "Name"] == jVillage, "POINT_X"]
, xyLapop[xyLapop[, "Name"] == jVillage, "POINT_Y"])

```

      p2 <- c(xyLapop[xyLapop[, "Name"] == testVillage, "POINT_
        X"] , xyLapop[xyLapop[, "Name"] == testVillage, "POINT
        _Y"])
      testDist[j] <- distGeo(p1, p2)
    }
    testWeight <- 1 - (testDist/20000)
    testWeight[testDist == 0] <- 1
    testWeight[testDist >= 20000] <- 0
    testWeight <- testWeight/sum(testWeight)
    xyLapop$mil3.12[i] <- weighted.mean(lapop2012$mil3recode ,
      testWeight , na.rm = TRUE)
    xyLapop$trustUS.12[i] <- weighted.mean(lapop2012$DV.TrustUS
      , testWeight , na.rm = TRUE)
    xyLapop$schools.12[i] <- weighted.mean(lapop2012$DV.
      LocalSchools , testWeight , na.rm = TRUE)
    xyLapop$medical.12[i] <- weighted.mean(lapop2012$DV.
      LocalMedical , testWeight , na.rm = TRUE)
    xyLapop$services.12[i] <- weighted.mean(lapop2012$DV.
      LocalServices , testWeight , na.rm = TRUE)
  }

```

Creating Aggregated Village Level Measures Code

```

#This section will add agrigated 2013 and 2014 datapoints for
each village
testVillage <- NA
xyLapop$surveyed <- NA

```

```

xyLapop$mil3.14 <- NA
xyLapop$trustUS.14 <- NA
xyLapop$schools.14 <- NA
xyLapop$medical.14 <- NA
xyLapop$services.14 <- NA
xyLapop$DVAR1 <- NA
xyLapop$DVAR2 <- NA
xyLapop$DVAR3 <- NA
xyLapop$DVAR5 <- NA
xyLapop$DVAR7 <- NA
xyLapop$DVAR8 <- NA
xyLapop$SocialCI <- NA
xyLapop$Z.EPA.mean <- NA
xyLapop$q11 <- NA
xyLapop$q12 <- NA
xyLapop$q10e <- NA
xyLapop$grpNt <- NA
xyLapop$TS1.mean <- NA
xyLapop$Z.CA.mean <- NA
xyLapop$Z.IC.mean <- NA
for(i in 1:44) {
  testVillage <- xyLapop[i, "Name"]
  xyLapop$surveyed[i] <- sum(lapop2014$villageMod==
    testVillage)
  xyLapop$mil3.14[i] <- mean(lapop2014[lapop2014$villageMod==
    testVillage, "mil3"], na.rm = TRUE)
}

```

```

xyLapop$trustUS.14[i] <- mean(lapop2014[lapop2014$
  villageMod==testVillage,"DV.TrustUS"], na.rm = TRUE)
xyLapop$schools.14[i] <- mean(lapop2014[lapop2014$
  villageMod==testVillage,"DV.LocalSchools"], na.rm = TRUE
)
xyLapop$medical.14[i] <- mean(lapop2014[lapop2014$
  villageMod==testVillage,"DV.LocalMedical"], na.rm = TRUE
)
xyLapop$services.14[i] <- mean(lapop2014[lapop2014$
  villageMod==testVillage,"DV.LocalMedical"], na.rm = TRUE
)
xyLapop$DVAR1[i] <- mean(lapop2014[lapop2014$villageMod==
  testVillage,"DVAR1"], na.rm = TRUE)
xyLapop$DVAR2[i] <- mean(lapop2014[lapop2014$villageMod==
  testVillage,"DVAR2"], na.rm = TRUE)
xyLapop$DVAR3[i] <- mean(lapop2014[lapop2014$villageMod==
  testVillage,"DVAR3"], na.rm = TRUE)
xyLapop$DVAR5[i] <- mean(lapop2014[lapop2014$villageMod==
  testVillage,"DVAR5"], na.rm = TRUE)
xyLapop$DVAR7[i] <- mean(lapop2014[lapop2014$villageMod==
  testVillage,"DVAR7"], na.rm = TRUE)
xyLapop$DVAR8[i] <- mean(lapop2014[lapop2014$villageMod==
  testVillage,"DVAR8"], na.rm = TRUE)
xyLapop$SocialCI[i] <- mean(lapop2014[lapop2014$villageMod
  ==testVillage,"SocialCI"], na.rm = TRUE)
xyLapop$Z.EPA.mean[i] <- mean(lapop2014[lapop2014$

```

```

villageMod==testVillage,"Z.EPA.mean"], na.rm = TRUE)
xyLapop$q11[i] <- mean(lapop2014[lapop2014$villageMod==
testVillage,"q11"], na.rm = TRUE)
xyLapop$q12[i] <- mean(lapop2014[lapop2014$villageMod==
testVillage,"q12"], na.rm = TRUE)
xyLapop$q10e[i] <- mean(lapop2014[lapop2014$villageMod==
testVillage,"q10e"], na.rm = TRUE)
xyLapop$grpNt[i] <- mean(lapop2014[lapop2014$villageMod==
testVillage,"GrpNt"], na.rm = TRUE)
xyLapop$TS1.mean[i] <- mean(lapop2014[lapop2014$villageMod
==testVillage,"TS1.mean"], na.rm = TRUE)
xyLapop$Z.CA.mean[i] <- mean(lapop2014[lapop2014$villageMod
==testVillage,"Z.CA.mean"], na.rm = TRUE)
xyLapop$Z.IC.mean[i] <- mean(lapop2014[lapop2014$villageMod
==testVillage,"Z.IC.mean"], na.rm = TRUE)
}

#This section will calculate the delta of each DV at the
village level
xyLapop$delta.trustUS <- xyLapop$trustUS.14 - xyLapop$trustUS
.12
xyLapop$delta.trustUSmil <- xyLapop$mil3.14 - xyLapop$mil3.12
xyLapop$delta.schools <- xyLapop$schools.14 - xyLapop$schools
.12
xyLapop$delta.services <- xyLapop$services.14 - xyLapop$
services.12
xyLapop$delta.medical <- xyLapop$medical.14 - xyLapop$medical

```

.12

```
hist(xyLapop$delta.trustUS)
hist(xyLapop$delta.trustUSmil)
hist(xyLapop$delta.schools)
hist(xyLapop$delta.services)
hist(xyLapop$delta.medical)
```

Distance between Projects and Populations Code

```
#This section will calculate the proximity to project
locations of different types for each village.
#The nearest distance from each village to the following is
calculated:
#Distance to nearest 2014 Construction Project
#Distance to nearest 2014 School Construction Project
#Distance to nearest 2014 Clinic Construction Project
#Distance to nearest 2013 School Construction Project
#Distance to nearest 2014 Medical Clinic
#Distance to nearest 2013 Medical Clinic
xyLapop$dist.cont.14.S <- NA
xyLapop$dist.cont.14.C <- NA
xyLapop$dist.cont.14 <- NA
xyLapop$dist.cont.13.S <- NA
xyLapop$dist.med.14 <- NA
xyLapop$dist.med.13 <- NA
# For each of the 44 villages
for(i in 1:44) {
```

```

testVillage <- xyLapop[i, "Name"]
p1 <- c(xyLapop[i, "POINT_X"] , xyLapop[i, "POINT_Y"])
# finds distances to all projects
testDist <- NA
for(j in 1:24) {
  p2 <- c(ProjectLocations[j, "POINT_X"] , ProjectLocations
    [j, "POINT_Y"])
  testDist[j] <- distGeo(p1, p2)
}
xyLapop$dist.cont.14.S[i] <- min(testDist[ProjectLocations$
  School==1 & ProjectLocations$Year == 2014])
xyLapop$dist.cont.14.C[i] <- min(testDist[ProjectLocations$
  med_const==1 & ProjectLocations$Year == 2014])
xyLapop$dist.cont.14[i] <- min(testDist[ProjectLocations$
  Construction==1 & ProjectLocations$Year == 2014])
xyLapop$dist.cont.13.S[i] <- min(testDist[ProjectLocations$
  Construction==1 & ProjectLocations$Year == 2013])
xyLapop$dist.med.14[i] <- min(testDist[ProjectLocations$
  Clinic & ProjectLocations$Year==2014])
xyLapop$dist.med.13[i] <- min(testDist[ProjectLocations$
  Clinic & ProjectLocations$Year==2013])
}

```

Exposure to US Project Code

```

#Inverse Distance Calculations:
#Distance to nearest project (by type)

```

```

#Less than 5km code to 1
#Scaling recode 5-20km 1-0
#Over 20km to 0
# Distance to 2014 Schools
lapop2014$idist.const.schools.14 <- NA
lapop2014$idist.const.schools.14 <- 1 - ((lapop2014$dist.
      const.schools.14-5000)/15000)
lapop2014$idist.const.schools.14[lapop2014$dist.const.schools
      .14<5000] <- 1
lapop2014$idist.const.schools.14[lapop2014$dist.const.schools
      .14>20000] <- 0
hist(lapop2014$idist.const.schools.14)
# Distance to 2013 schools
lapop2014$idist.const.schools.13 <- NA
lapop2014$idist.const.schools.13 <- 1 - ((lapop2014$dist.
      const.schools.13-5000)/15000)
lapop2014$idist.const.schools.13[lapop2014$dist.const.schools
      .13<5000] <- 1
lapop2014$idist.const.schools.13[lapop2014$dist.const.schools
      .13>20000] <- 0
hist(lapop2014$idist.const.schools.13)
# Distance to 2014 construction
lapop2014$idist.const.14 <- NA
lapop2014$idist.const.14 <- 1 - ((lapop2014$dist.const
      .14-5000)/15000)
lapop2014$idist.const.14[lapop2014$dist.const.14<5000] <- 1

```

```

lapop2014$idist.const.14[lapop2014$dist.const.14>20000] <- 0
hist(lapop2014$idist.const.14)
# Distance to 2014 clinic construction
lapop2014$idist.const.clinic.14 <- NA
lapop2014$idist.const.clinic.14 <- 1 - ((lapop2014$dist.const
    .clinic.14-5000)/15000)
lapop2014$idist.const.clinic.14[lapop2014$dist.const.clinic
    .14<5000] <- 1
lapop2014$idist.const.clinic.14[lapop2014$dist.const.clinic
    .14>20000] <- 0
hist(lapop2014$idist.const.clinic.14)
# Distance to 2014 Medical
lapop2014$idist.med.14 <- NA
lapop2014$idist.med.14 <- 1 - ((lapop2014$dist.med.14-5000)/
    15000)
lapop2014$idist.med.14[lapop2014$dist.med.14<5000] <- 1
lapop2014$idist.med.14[lapop2014$dist.med.14>20000] <- 0
hist(lapop2014$idist.med.14)
# Distance to 2013 Medical
lapop2014$idist.med.13 <- NA
lapop2014$idist.med.13 <- 1 - ((lapop2014$dist.med.13-5000)/
    15000)
lapop2014$idist.med.13[lapop2014$dist.med.13<5000] <- 1
lapop2014$idist.med.13[lapop2014$dist.med.13>20000] <- 0
hist(lapop2014$idist.med.13)
# Inverse distances for the agergated village set

```

```

# Distance to 2014 Schools
xyLapop$idist.const.schools.14 <- NA
xyLapop$idist.const.schools.14 <- 1 - ((xyLapop$dist.cont.14.
  S-5000)/15000)
xyLapop$idist.const.schools.14[xyLapop$dist.cont.14.S<5000]
  <- 1
xyLapop$idist.const.schools.14[xyLapop$dist.cont.14.S>20000]
  <- 0
xyLapop$bdist.const.schools.14 <- 0
xyLapop$bdist.const.schools.14
xyLapop$bdist.const.schools.14[xyLapop$idist.const.schools
  .14==1] <- 1
xyLapop$bdist.const.schools.14
hist(xyLapop$idist.const.schools.14)
# Distance to 2013 schools
xyLapop$idist.const.schools.13 <- NA
xyLapop$idist.const.schools.13 <- 1 - ((xyLapop$dist.cont.13.
  S-5000)/15000)
xyLapop$idist.const.schools.13[xyLapop$dist.cont.13.S<5000]
  <- 1
xyLapop$idist.const.schools.13[xyLapop$dist.cont.13.S>20000]
  <- 0
xyLapop$bdist.const.schools.13 <- 0
xyLapop$bdist.const.schools.13
xyLapop$bdist.const.schools.13[xyLapop$idist.const.schools
  .13==1] <- 1

```

```

xyLapop$bdist.const.schools.13
hist(xyLapop$idist.const.schools.13)
# Distance to 2014 construction
xyLapop$idist.const.14 <- NA
xyLapop$idist.const.14 <- 1 - ((xyLapop$dist.cont.14-5000)/
  15000)
xyLapop$idist.const.14[xyLapop$dist.cont.14<5000] <- 1
xyLapop$idist.const.14[xyLapop$dist.cont.14>20000] <- 0
hist(xyLapop$idist.const.14)
# Distance to 2014 clinic construction
xyLapop$idist.const.clinic.14 <- NA
xyLapop$idist.const.clinic.14 <- 1 - ((xyLapop$dist.cont.14.C
  -5000)/15000)
xyLapop$idist.const.clinic.14[xyLapop$dist.cont.14.C<5000] <-
  1
xyLapop$idist.const.clinic.14[xyLapop$dist.cont.14.C>20000]
  <- 0
hist(xyLapop$idist.const.clinic.14)
# Distance to 2014 Medical
xyLapop$idist.med.14 <- NA
xyLapop$idist.med.14 <- 1 - ((xyLapop$dist.med.14-5000)/
  15000)
xyLapop$idist.med.14[xyLapop$dist.med.14<5000] <- 1
xyLapop$idist.med.14[xyLapop$dist.med.14>20000] <- 0
hist(xyLapop$idist.med.14)
# Distance to 2013 Medical

```

```

xyLapop$idist.med.13 <- NA
xyLapop$idist.med.13 <- 1 - ((xyLapop$dist.med.13-5000)/
  15000)
xyLapop$idist.med.13[xyLapop$dist.med.13<5000] <- 1
xyLapop$idist.med.13[xyLapop$dist.med.13>20000] <- 0
hist(xyLapop$idist.med.13)
# Distance to nearests any US humanitarian operation
for(i in 1:44) {
  testVillage <- xyLapop[i, "Name"]
  xyLapop$dist.any[i] <- min(c(xyLapop[i, "dist.med.13"],
    xyLapop[i, "dist.med.14"], xyLapop[i, "dist.cont.14"],
    xyLapop[i, "dist.cont.13.S"])))
}
hist(xyLapop$dist.any)
xyLapop$idist.any <- NA
xyLapop$idist.any <- 1 - ((xyLapop$dist.any-5000)/15000)
xyLapop$idist.any[xyLapop$dist.any<5000] <- 1
xyLapop$idist.any[xyLapop$dist.any>20000] <- 0
hist(xyLapop$idist.any)
#Test calculations
plot(lapop2014$idist.const.schools.13, lapop2014$delta.
  trustUSmil)
summary(lm(lapop2014$delta.trustUS~lapop2014$idist.const.
  schools.13+lapop2014$idist.const.14+lapop2014$idist.med
  .14+lapop2014$idist.med.13))
plot(lapop2014$idist.const.14, lapop2014$delta.trustUS)

```

```

summary(lm(lapop2014$delta.localSchool~lapop2014$idist.const.
schools.13+lapop2014$idist.const.schools.14+lapop2014$ed))
summary(lm(lapop2014$delta.localServices~lapop2014$idist.
const.schools.13+lapop2014$idist.const.schools.14+
lapop2014$ed+lapop2014$idist.med.14+lapop2014$idist.med
.13))
summary(lm(lapop2014$delta.localMedical~lapop2014$idist.const
.schools.13+lapop2014$idist.const.schools.14+lapop2014$ed+
lapop2014$idist.med.14+lapop2014$idist.med.13))
summary(lm(lapop2014$delta.trustUSmil~lapop2014$idist.const.
schools.13+lapop2014$idist.const.schools.14+lapop2014$ed+
lapop2014$idist.med.14+lapop2014$idist.med.13+lapop2014$
DVAR3+lapop2014$DVAR1+lapop2014$DVAR2+lapop2014$DVAR5+
lapop2014$DVAR7+lapop2014$DVAR8+lapop2014$SocialCI+
lapop2014$Z.EPA.mean))
summary(lm(lapop2014$mil3~lapop2014$idist.const.schools.13+
lapop2014$idist.const.schools.14+lapop2014$ed+lapop2014$
idist.med.14+lapop2014$idist.med.13+lapop2014$DVAR3+
lapop2014$DVAR1+lapop2014$DVAR2+lapop2014$DVAR5+lapop2014$
DVAR7+lapop2014$DVAR8+lapop2014$SocialCI+lapop2014$Z.EPA.
mean+lapop2014$urRecode+lapop2014$idist.const.schools.13*
lapop2014$urRecode+lapop2014$idist.const.schools.14*
lapop2014$urRecode))
summary(lm(lapop2014$DV.LocalSchools~lapop2014$idist.const.
schools.13*lapop2014$urRecode))
plot(xyLapop$idist.med.14,xyLapop$delta.trustUS)

```

```

summary(lm(delta.trustUS~idist.med.13+idist.med.14+idist.
  const.clinic.14+idist.const.schools.13+idist.const.schools
  .14, data = xyLapop))
summary(lm(delta.trustUS~dist.any, data = xyLapop))
plot(xyLapop$dist.any, xyLapop$delta.trustUSmil)
summary(lm(xyLapop$delta.schools~xyLapop$bdist.const.schools
  .14*xyLapop$bdist.const.schools.13))
plot(xyLapop$bdist.const.schools.13,xyLapop$delta.schools)
boxplot(xyLapop$delta.schools~xyLapop$idist.const.schools.13)
boxplot(xyLapop$schools.12~xyLapop$Name)
boxplot(lapop2014$DV.LocalSchools~lapop2014$villageMod)
boxplot(xyLapop$delta.schools~xyLapop$bdist.const.schools.13,
  main = "Change in Satisfaction with schools from 2012 to
  2014\nas a function of proximity to 2013 school
  constuction projects", xlab = "0=over 5 km\n1=project
  within 5 km")
# Creation of Logarithmic Distance Variables
#Creation of Log weighted distance to project calculations
plot(xyLapop$dist.cont.14,xyLapop$delta.trustUS,log = "x")
xyLapop$ldist.cont.13.S <- log(xyLapop$dist.cont.13.S/1000)
xyLapop$ldist.cont.14 <- log(xyLapop$dist.cont.14/1000)
xyLapop$ldist.cont.14.S <- log(xyLapop$dist.cont.14.S/1000)
xyLapop$ldist.cont.14.C <- log(xyLapop$dist.cont.14.C/1000)
xyLapop$ldist.med.13 <- log(xyLapop$dist.med.13/1000)
xyLapop$ldist.med.14 <- log(xyLapop$dist.med.14/1000)
#Attempt to model effects based on log distances

```

```

summary(lm(xyLapop$delta.trustUS~xyLapop$ldist.med.13+xyLapop$ldist.med.14+xyLapop$ldist.cont.14.C+xyLapop$ldist.cont.14.S+xyLapop$ldist.cont.13.S))

plot(lm(xyLapop$delta.trustUS~xyLapop$ldist.med.13+xyLapop$ldist.med.14+xyLapop$ldist.cont.14.C+xyLapop$ldist.cont.14.S+xyLapop$ldist.cont.13.S))

summary(lm(xyLapop$delta.trustUSmil~xyLapop$ldist.med.13+xyLapop$ldist.med.14+xyLapop$ldist.cont.14.C+xyLapop$ldist.cont.14.S+xyLapop$ldist.cont.13.S))

summary(lm(xyLapop$delta.schools~xyLapop$ldist.med.13+xyLapop$ldist.med.14+xyLapop$ldist.cont.14.C+xyLapop$ldist.cont.14.S+xyLapop$ldist.cont.13.S))

summary(lm(xyLapop$delta.medical~xyLapop$ldist.med.13+xyLapop$ldist.med.14))

summary(lm(xyLapop$delta.schools~xyLapop$ldist.cont.14.C+xyLapop$ldist.cont.14.S+xyLapop$ldist.cont.13.S))

summary(lm(xyLapop$delta.services~xyLapop$ldist.med.13+xyLapop$ldist.med.14+xyLapop$ldist.cont.14.C+xyLapop$ldist.cont.14.S+xyLapop$ldist.cont.13.S))

```

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