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THE ACUMEN FUND AND DEVELOPMENT INDICATORS
LOW-COST BEDNETS AND IMPACT ON HEALTH IN TANZANIA


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# Abstract

Development economics explores methods for relieving the tensions of poverty in hopes of growing economies. Foreign direct investment and microfinance have been heralded in recent studies for these methods' abilities to promote growth. However, foreign direct investment focuses upon large-scale businesses while microfinance focuses upon individual and household needs. Instead, the impact investing sector focuses upon making investments in businesses that provide basic services for the poor. The Acumen Fund, a philanthropic fund founded in 2001, is among the pioneers in this field. A significant investment made by the Acumen Fund with A to Z Textile Mills in the Arusha region of Tanzania enables this business to produce long-lasting and low-cost, insecticide-treated nets, which prevents the spread of malaria.

In this paper, I will first provide background information on the impact investing sector's market trends and potential outcomes of investing in entrepreneurs. I will then detail the objectives of the Acumen Fund and review the history of A to Z Textile Mills, Tanzania and the impact of health and malaria upon the poor. Finally, using data from the Living Standards Measurement Survey, I will analyze changes in mortality rates across regions. My hypothesis is that, over-time, reported mortality rates from illness among children and infants will drop most significantly in regions closest to A to Z Textile Mills and will not be impacted in the furthest regions; there will be an interaction between time and distance. I will also analyze these results, controlling for the distance to the nearest health facility, distance to a public road, and inherent regional differences. Ultimately, I will discover that there is a significant interaction between distance and time, but that this interaction is opposite of my hypothesis. I will then discuss possible implications and causes of the decreased effect of distance upon health indicators across regions in Tanzania and suggest potential opportunities for research in the future.

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# Introduction

In an article titled "More Money than Sense," The Economist stated that "lack of money can no longer be blamed for the poor world's health problems." In June, 2007 the G8 agreed to provide $8 billion to the Global Fund to fight the spread of several diseases that are the main causes of mortality in developing countries, including AIDS, tuberculosis and malaria. However, as the article indicates, this funding cannot yet reach the poor because of the shortage of health services and providers. Furthermore, the public tends to focus upon short-term goals making it difficult to find innovative solutions to health problems, or to take full advantage of the private sector in developing countries (The Economist, 2007).

In the past ten years the Acumen Fund, a philanthropic venture-capital fund, has challenged this paradigm and invested directly in small growing businesses in developing countries. These businesses find innovative ways to provide basic services, such as health care, to the poor. While the impacts of foreign direct investment and microfinance have been widely researched in development economics, neither directly affects the sectors the Acumen Fund targets. FDI directly impacts large-scale business and microfinance serves individuals and households, whereas the Acumen Fund invests strictly in entrepreneurs who serve the impoverished.

The first part of my paper will explore the scope of the impact investing sector. Impact investments, such as those made by the Acumen Fund, are a unique asset class identified by J.P. Morgan Global Research. These investments in often small growing businesses in developing areas require unique skills and look to make a social as well as financial return. Then I will explore the rationale and impact of investing in entrepreneurs. Then I will provide background information on the Acumen Fund and detail the history of A to Z Textile Mills, the recipient of an Acumen Fund investment. Finally, given that the investment I would like to analyze is in Tanzania, I will provide a country profile and information on the health indicators in the country.

By analyzing health indicators across regions, such as infant and child mortality rates as well as death rates due to illness, I will determine whether the Acumen Fund's unique investment achieves the economic impact the organization intends. To analyze this impact, I will examine the changes in health indicators across regions in Tanzania before and after its first investment in a local business, A to Z Textile Mills. This firm produces long-lasting insecticide treated nets to protect users from malaria. Analyzing child and infant mortality specifically will indicate the impact of these nets upon the surrounding regions because malaria is a leading cause of children's deaths in Tanzania (World Health Organization, 2011).

## Impact Investing Sector

The impact investing sector is characterized by funding of programs that achieve social or environmental benefits.  Additionally, this sector seeks to achieve financial returns for investors, including both large multinational corporation investments as well as microfinance funding. By definition, the Acumen Fund is an impact investor. However, unlike most other impact investments, the Acumen Fund seeks to re-invest profits gained back into future entrepreneurs and small growing businesses. Recent research of the impact investing market, however, sheds light onto the potential of the Acumen Fund's investments.

J.P. Morgan Global Research (2010) identified impact investment as an emerging asset class because managing these funds requires unique investment skills. Additionally these skills are best managed by an organizational structure and supported through education and industry associations which adopt metrics and standards to track improvement. Impact investors provide capital, with the intent that there will be positive social impact as well as financial returns.  These investing organizations require complex structures, political insights and collaboration between organizations (O'Donohoe, Leijonhufvud, Slatuk, Bugg-Levine, & Brandenburg, 2010). To develop industry infrastructure the Global Impact Investing Network was founded in 2009 and has since developed standards and metrics for the industry.

In the Global Impact Investing Network (GIIN) report in 2011, a total of 2,394 organizations and microfinance institutions provided data for this report. The GIIN uses the IRIS (Impact Reporting and Investment Standards) initiative to standardize performance metrics such as social, environmental and financial outcomes. This report intended to add value and confirm case study analysis of impact investments, assess performance across the industry and encourage use of the IRIS.  The GIIN found that a total of 1,941 of these organizations provided financial services, 438 of which are represented in Sub-Sahara Africa; most of these are represented by microfinance institutions.

The GIIN found that these impact investors tended to be financially profitable, but reported profitability varied within agriculture, energy, financial services and health sectors. However, data is still limited on the social profitability of these organizations. The GIIN analyzes organizations based upon their stated social and environmental objectives. Overall, of the 161 impact investing organizations that stated any social impact objective, 76% were financially profitable. Organizations with objectives of capacity building and employment generation, like the Acumen Fund, were the most profitable.

The Aspen Network of Development Entrepreneurs (ANDE) identified core IRIS metrics that members are required to track. These metrics focus on operational impact upon business growth, the impact of the organization's portfolio of investments and sector-specific indicators that relate to the organization's objective. By tracking these metrics, ANDE members are held accountable for their impact upon the performance of small and growing businesses in developing countries. The IRIS initiative, however, has yet to be implemented across the impact investing industry. Until further data is provided, the exact efficacy of these organizations remains undefined.

J.P. Morgan Global Research also identified the Bottom of the Pyramid (BoP) in emerging economies as a potential market opportunity. BoP is loosely defined as the poorest segments of society. Prahalad (2004) also identifies the BoP as the some 4 to 5 billion people living on less than $2 a day. He suggests that entrepreneurs providing affordable goods and services that meet the unique needs of the poor could become extremely profitable while simultaneously reducing poverty. Different researchers identify

different income parameters and different population sizes, and therefore disagree whether or not there is a true consumer market in this population.

J.P. Morgan Global Research (2010) identifies the BoP as an under-accessed market, because of several factors that challenge typical business practices. First, BoP markets require higher external investment, increasing the costs of transactions and barriers to trade. This ultimately causes BoP consumers to suffer by paying a higher price for lower quality products than their wealthier market counterparts. The researchers' ultimate conclusion is that entrepreneurs that can provide higher quality products at a lower cost to the BoP consumers will experience high profitability. Organizations similar to A to Z Textile Mills, which provide low-cost high-quality products to the poor, are filling this market.

Karnani (2006) argues that the poor cannot be engaged as consumers, but rather as producers. He suggests the high costs of a large company serving this market will be greater than the potential revenues. He also suggests the BoP population is actually much smaller than Prahalad suggests. Karnani points to the creation of jobs and efficient markets as positive outcomes of engaging the poor as producers. However, there is evidence that those who live under $2 a day do not have the capacity to engage in venture businesses because they do not have the technical skills to conduct business (Karnani, 2006). The Acumen Fund may be able to provide the capital investment and advisory management necessary to engage the poor in these business ventures. Additionally, providing employment opportunities and wages enables the poor to be engaged as consumers of high quality and low-cost products.

## Entrepreneurship

Acumen Fund focuses its efforts on investing in small growing businesses and entrepreneurs. Investment in entrepreneurship can increase economic growth given several economies have experienced marked growth with the advent of foreign direct investment.

The Acumen Fund, by investing in small growing businesses, also invests in entrepreneurship in developing economies. Entrepreneurship may likewise affect the growth of economies. In 1934,

Schumpeter identified the entrepreneur as a significant force behind economic development. The entrepreneur creates new technology that will make previous innovations obsolete, thus driving development. With this type of economic development entrepreneurship can cause several small firms to prosper where as managed innovation by large firms would cause industries to dominate an economy.

Few of new entrepreneurial firms in lesser developed countries (LDC) will experience high growth and significantly add to the economy. Prevalence of small firms may suggest a large informal sector in a developing country (van Stel et al., 2005). In fact, van Stel et al. found that total entrepreneurship activity in a LDC tended to have a negative effect on GDP growth whereas in a relatively rich country, it had a positive effect. This may be explained by Schumpeter (1950) who suggested while some growth may be attributed to the entrepreneurship of small firms, innovation of large firms also causes significant growth.

However, van Stel et al. (2005) stress that this does not imply entrepreneurship should be discouraged in developing countries. The findings may suggest that LDCs need larger firms to employ more labor, or that entrepreneurs in LDCs have less human capital accumulation than those in developed countries. Total economic activity in developing countries may be largely comprised of shopkeepers or small business owners that are self-employed because there are limited alternative opportunities. The Acumen Fund, by investing in small growing businesses, may enable these entrepreneurs to experience high growth and provide assistance and oversight to supplement the entrepreneurs' human capital. Ultimately, the support provided by the Acumen Fund is intended to allow small businesses to become larger and employ more laborers; therefore, encouraging human capital development.

Valliere and Peterson (2009) argue that previous research does not account for differences between entrepreneurship; such as the differences between a self-employed shopkeeper in a LDC and a business owner in a developed country. This research confirms that the high level of total entrepreneurial activity in LDCs can be attributed to necessity entrepreneurship, or self-employment as a result of limited alternative opportunities.

Businesses that expect to employ 20 employees in 5 years, are relatively small, have high access to resources and low access to financial resources are defined as high-expectation entrepreneurship by the Global Entrepreneurship Monitor research. High-expectation entrepreneurship activity is most associated with economic growth in developed countries (Valliere and Peterson, 2009). While entrepreneurship has positive effects on growth of LDCs, the entrepreneurs' access to the formal economy is a major determinant of growth. Valliere and Peterson (2009) suggest that there is a threshold level of access necessary for entrepreneurs to exploit capital development, which may be limiting high-expectation entrepreneurship in LDCs. The Acumen Fund may give entrepreneurs in LDCs this access.

## Background Information: The Acumen Fund

Incorporated in 2001 with seed money from the Rockefeller Foundation, Cisco Systems Foundation and private donations, the Acumen Fund was founded in order to alleviate the tensions of poverty by investing in social entrepreneurs and emerging leaders. These investments focus upon finding solutions to poverty and creating affordable health, water, housing and energy (Acumen Fund, 2011). Investments are made to maximize social outcomes by using patient capital. Patient capital is defined as a long-term investment, which tolerates risks, provides management support and actively seeks partnerships with government, corporations and other organizations (Acumen Fund, Inc., 2010).

Acumen Fund evaluates its impact and progress through an internally developed system, the Best Available Charitable Option (BACO), which compares investments with real and hypothetical alternatives (London, 2008). Combined with financial, operational, social and environmental metrics, BACO helps the Acumen Fund compare social impact between the organization and alternative options. In coordination with the Global Impact Investing Network (GIIN), an organization dedicated to increasing the effectiveness of the impact investing sector, the Acumen Fund records financial, operational and social data based upon the Impact Reporting and Investment Standards (IRIS) (Global Impact Investing Network, 2011).

Starting with investments in 2001 of $1.1 million, Acumen Fund to date has invested a cumulative $69 million and formed partnerships to accumulate a total of $206 million of third party investments in Acumen Fund sponsored companies. In total this supports 63 social enterprises across four geographic regions; India, Pakistan, East Africa and as of 2012, West Africa. The company intends to grow even further, setting goals to expand its cumulative investments to $150 million and expand to an additional 7 countries by 2015 (Acumen Fund, 2012). Its current investment portfolio breaks down its investments based upon region and sector, including health, water, housing, energy and agriculture (See Figure 1).
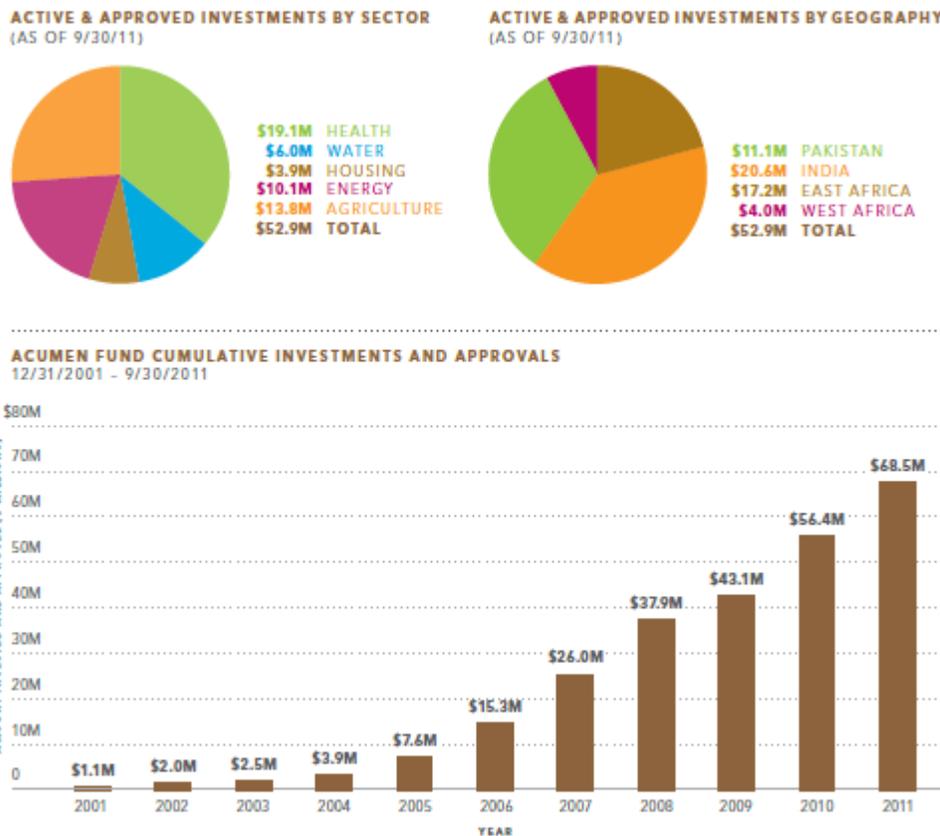


**Figure 1: Acumen Fund Portfolio Investments taken from Acumen Fund Ten-Year Report (Acumen Fund, 2012)**

In total, $24 million has been invested in 24 companies within East African countries. These countries include Kenya, Uganda, Rwanda and Tanzania. Despite economic growth, these countries are the poorest economies in the world. 75% of these countries' populations live in rural areas acting as small-farm owners. Of those in urban areas, several suffer from poor living conditions (Acumen Fund, 2011). One of the longest term investments the Acumen Fund maintains was initiated with a $325,000 investment

made in 2003 to A to Z Textile Mills in the Arusha region of Tanzania. To date, $1 million has been invested in total in A to Z Textile Mills and the company now produces 29 million bed nets annually, representing 50% of the global production of anti-malarial olyset treated bed nets (Acumen Fund, 2012). This investment was intended to provide both employment opportunities and health services to the poor. By analyzing health indicators across regions in Tanzania, I may determine the extent of this investment's ability to provide affordable health services to the poor.

## A to Z Textile Mills: Company Profile

A to Z Textile Mills specializes in producing long-lasting anti-malaria bed nets. This company provides affordable insecticide-treated nets to the poor. Bed nets are one of the most effective methods of preventing malaria, and the olyset chemical A to Z Textile Mills uses to treat these bed nets further ensures to kill mosquitoes without harming children. To date, the company is one of the largest employers in Tanzania, employing 7,000 people. The advantage of these long-lasting insecticide treated bed nets are that they last about 5 years without needing to be retreated, and their production costs approximately $2 less per bed net than the next best alternative. Typical nets require retreatment every 6 months. Very few households retreat their nets on a regular basis, and would largely benefit from a long-lasting insecticide treated net. The olyset chemical used in A to Z Textile Mills products kills mosquitoes on contact, and is safer than DDT typically used as insecticide treatment. Given the increasing resistance of malaria to cheap pharmaceutical drugs, the nets provide an easy alternative (Karugu & Mwendwa, 2007).

A to Z Textile Mills is able to produce their nets $2 cheaper than the next best alternative due to its unique partnership with the Acumen Fund, Exxon Mobil and Japan's Sumitomo Chemical Company. Figure 2 shows cost comparison for other insecticide-treated nets. Only Vestergaard Frandsen is able to provide a cheaper net today, however it does not have as long as lifetime as the A to Z Textile Mills olyset net.

| 190 x 180 x 150 (L x W x H) ≥ 100 denier | | | LONG TERM ARRANGEMENT FIXED UNIT PRICES BASED ON INCOTERM FCA PORT/AIRPORT OF ORIGIN | | | | | |
|---|---|---|---|---|---|---|---|---|
| Supplier name | Product | Product Type | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
| BASF | Interceptor® | Alpha-cypermethrin coated on polyester | Product not on market | Product not on market | USD5.16 | USD4.68 | USD4.68 | USD4.68 |
| Bestnet | Netprotect® | Deltamethrin incorporated into polyethylene | Product not on market | Product not on market | Product not on market | USD5.26 | USD4.99 | USD3.99 |
| Clarke | Duranet® | Alpha-cypermethrin incorporated into polyethylene. | Product not on market | Product not on market | USD5.10 | USD5.18 | USD4.60 | USD4.55 |
| NetHealth / A to Z Textile Mills | Olyset® | Permethrin incorporated into polyethylene | No proposal submitted | No proposal submitted | No proposal submitted | USD4.85 | EUR3.30 | USD4.25 |
| Sumitomo Chemical | Olyset® | Permethrin incorporated into polyethylene | Supplier has not agreed to the publication of prices | | | | | |
| Tana Netting | DawaPlus® 2.0 | Deltamethrin coated on polyester. | | Product not on market | Product not on market | Product not on market | USD4.81 | USD4.99 |
| | PermaNet® 2.0 | Deltamethrin coated on polyester. | USD4.76 | USD4.76 | USD4.76 | USD4.76 | USD4.427 | USD3.781 |
| Vestergaard Frandsen | PermaNet® 3.0 | Combination of deltamethrin coated on polyester with strengthened border (side panels) and deltamethrin and PBO incorporated into polyethylene (roof) | Product not on market | Product not on market | Product not on market | Product not on market | USD5.70 | USD5.20 |
| Yorkool | Yorkool® | Deltamethrin coated on polyester. | Product not on market | Product not on market | Product not on market | Product not on market | Product not on market | USD4.40 |

**Figure 2: Net Price data taken from UNICEF (UNICEF, 2012)**

Using the olyset technology developed by Sumitomo as a foundation, World Health Organization scientist Pierre Guillet developed a partnership with Exxon Mobil's Medical Director for Global Issues and Projects, Steven Phillips (Karugu & Mwendwa, 2007). Guillet proposed that with plastic donations from Exxon Mobil and provision of the olyset technology from Sumitomo, an African manufacturer could produce affordable and long-lasting nets. Acumen Fund made its initial investment of $325,000 in 2003 to enable A to Z Textile Mills, established as a net manufacturer in 1966, to become this African manufacturer. The company focuses upon innovation, productivity and utilizes a work-force of predominately low-skilled female laborers to keep costs low (Karugu & Mwendwa, 2007).

According to the United Nations Development Programme report in 2007, A to Z Textile Mills sells the nets to both large non-governmental organizations or development agencies, and the local market on a commercial basis. Local consumers can place pre-orders or they can purchase ready-made products through regional salesmen. Additionally, the company has expanded its production to provide variety of colors, sizes and functions including door covers and curtains (Karugu & Mwendwa, 2007). Analyzing health indicators in Tanzania across time will help identify the partnership and investment's impact on the local populations.

# Country Profile: United Republic of Tanzania

**History**: The United Republic of Tanzania was formed in 1964 with the union of Tanganyika and Zanzibar. Tanganyika, represents the mainland and the majority of the combined territories' total area. However, the island territories of Zanzibar and Pemba have completely separate government administration. Despite the Dodoma region representing the capital of Tanzania, Dar es Salaam maintains most of the government administration and is the largest city



**Figure 3: Map of Tanzania Regions (Brinkhoff, 2011)**

(Tanzania, 2012). In total the mainland of Tanzania is comprised of 20 regions.

Inequality and poverty has been a long-standing issue in Tanzania. In 1967, the Arusha Declaration by President Julius K. Nyerere initiated the political policy of *Ujumaa*, which literally means 'familyhood.' This policy was a form of socialism based upon three assumptions of respect, common property, and obligation to work (Hyden, 1980). This policy intended to relieve some of the tensions of poverty experienced by Tanzania. Often income inequality and poverty become a political focus to avoid instability and increase national cohesion (Mkenda, Luvanda, Rutasitara, & Naho, 2004). However, according to research, this economic disparity may be evident across regions due to political administration and religious differences.

Tanzania remains one of the world's poorest economies in terms of GDP per capita. In 2010, GDP per capita was approximately $1433 in current US$. In 2007, 88% of the population lived on less than $2 per day, and 68% existed on less than $1.25. Although high, these head count ratios have improved

significantly since 1992. Additionally, the poverty gap, representing the mean shortfall from the poverty line, has also decreased. These indicators are detailed in Table 1.

**Table 1: Poverty Indicators (The World Bank, 2011)**

| Year | Poverty HCR ($1.25/day) | Poverty HCR ($2/day) | Poverty gap at Poverty Line |
|------|-------------------------|----------------------|------------------------------|
| 1992 | .73 | .91 | .12 |
| 2000 | .89 | .97 | .11 |
| 2007 | .68 | .88 | .10 |

There is still great income inequality with a Gini coefficient of 0.336 in 2007. In 2007 there is a significant difference between the share of income in the first and fifth quintiles of the population (Refer to Figure 4). Income distribution remains relatively unequal (The World Bank, 2012).
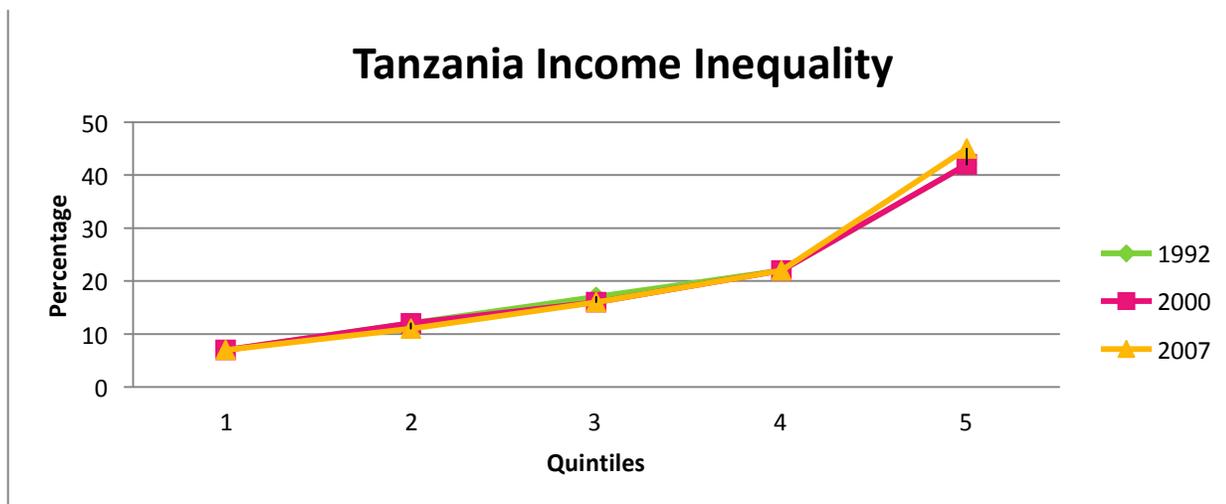


**Figure 4: Percentage of Income held by each quintile (The World Bank, 2011)**

However, this income inequality may reflect the unequal distribution of wealth across regions. A study in 2004 sought to analyze the level of poverty across regions in Tanzania. Researchers sought to rank regions based upon their poverty levels. This study used head count ratios and Gini Coefficients in conjunction with Adult Equivalence scales to determine the poverty level of each region. Adult

equivalence scales assign weights to segments of the population based upon gender and age. However, these scales can vary in aspects they consider, and use of one scale as opposed to another can alter the poverty rankings. Additionally, this study revealed that there was variation in the ranking depending upon the poverty index used (Mkenda, Luvanda, Rutasitara, & Naho, 2004).

Tanzania remains largely dependent upon agriculture. In 2006, agriculture production was 30% of GDP, 64% of merchandise exports yet employed 75% of the labor force (Figure 5). Additionally, 90% of the labor force was identified as self-employed. However, the country recently experienced 7% GDP growth rates due to increases in gold production and tourism. Services, such as tourism, now comprise 47% of the GDP, making it the largest sector (Refer to Figure 6).
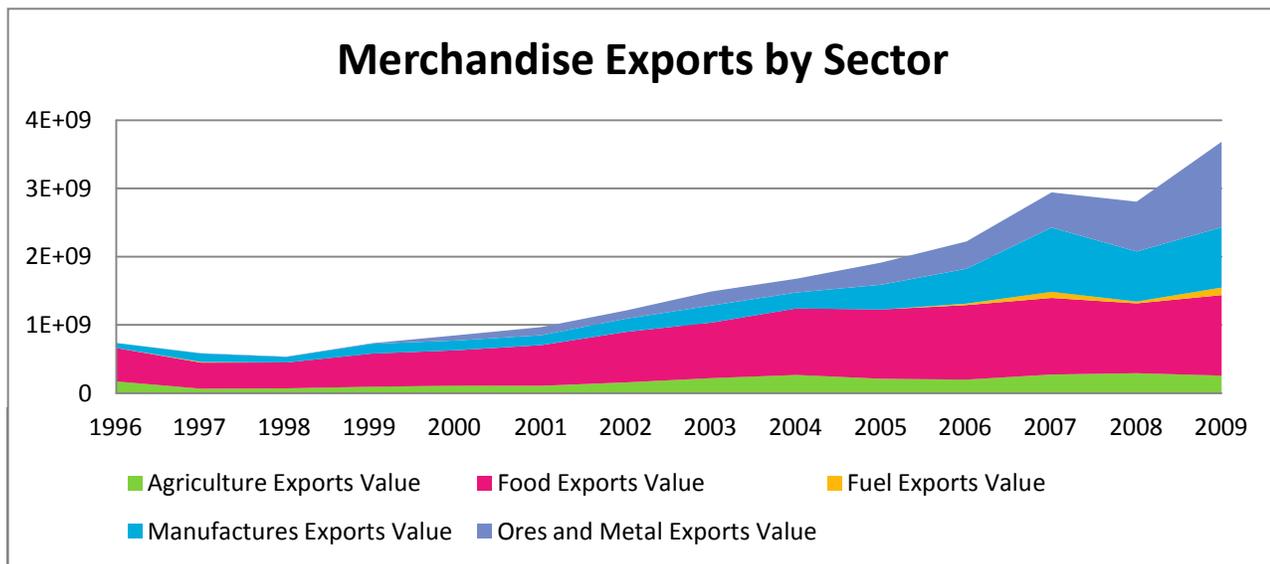


**Figure 5: Value of Market Exports (The World Bank, 2011)**

## GDP by Sector
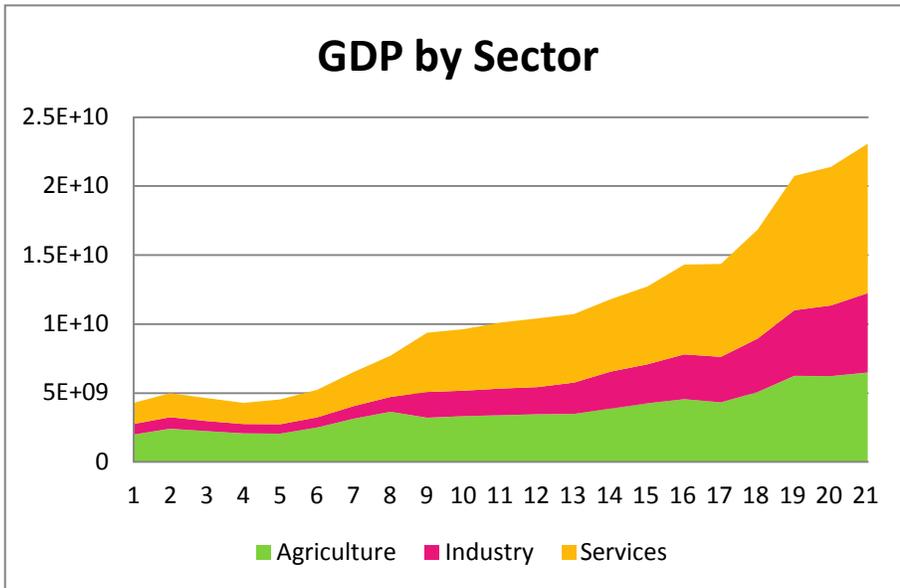
**Figure 6: Sector percentage of GDP (The World Bank, 2011)**

Tanzania receives much support from external sources, including the World Bank and the International Monetary Fund. In 2008, Tanzania received $698 million, the world's largest Millennium Challenge Compact grant. In 2009, the net official development assistance and aid received equaled about 14% of GDP (Refer to Figure 7) (World Bank Data, 2011).

## Development Assistance and Aid as a Percentage of GDP
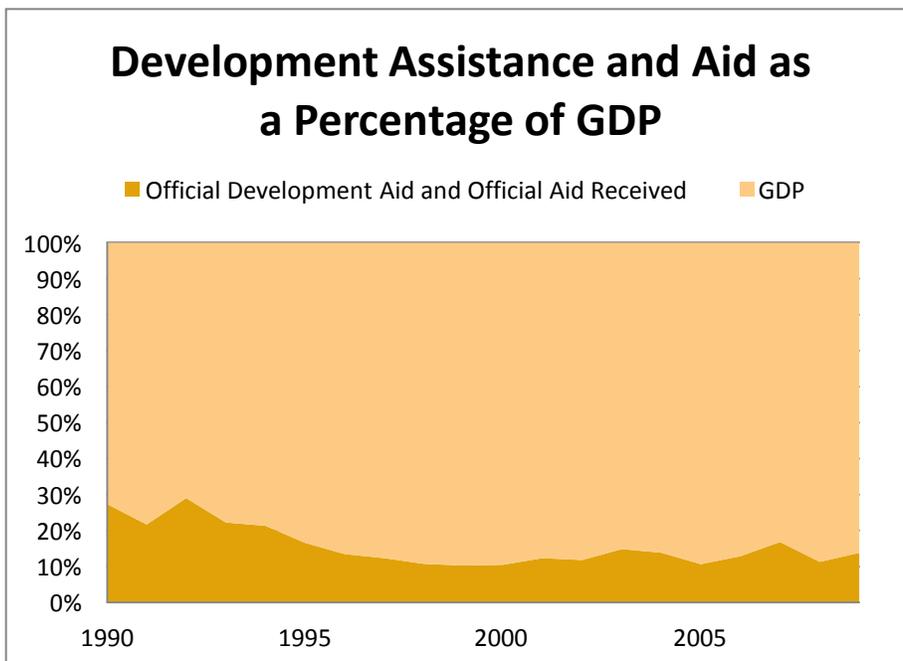
**Figure 7: Dark Green represents Aid as a percentage of GDP (The World Bank, 2011)**

Overall, health indicators show that there is moderate improvement in Tanzania over the past two decades. The most significant improvements are within the past 10 years. In 1990, the life expectancy at birth was only 51, and in 2009 it was 57 years old. In 1997, the mortality rate for females was 409 deaths per 1,000 female adults. By 2009 the mortality rate was 354. Likewise, male mortality rate decreased from 452 in 1997 to 373 deaths per 1,000 in 2009. With economic growth, health expenditure per capita also increased. In 1995 only 7 US$ per person was spent on healthcare. By 2009, healthcare expenditures per capita were 25 US$. Nutrition also improved with economic growth. While 68% of the population lives on less than $1.25 per day in 2006, in 2008 only 34% of the population was identified as undernourished. Another drastic improvement in development indicators is the reported increase in use of insecticide treated bed nets. In 1999, only 2% of the population under 5 used bed nets to prevent malaria, while in 2010 this number reached 64% (Refer to Figure 8).
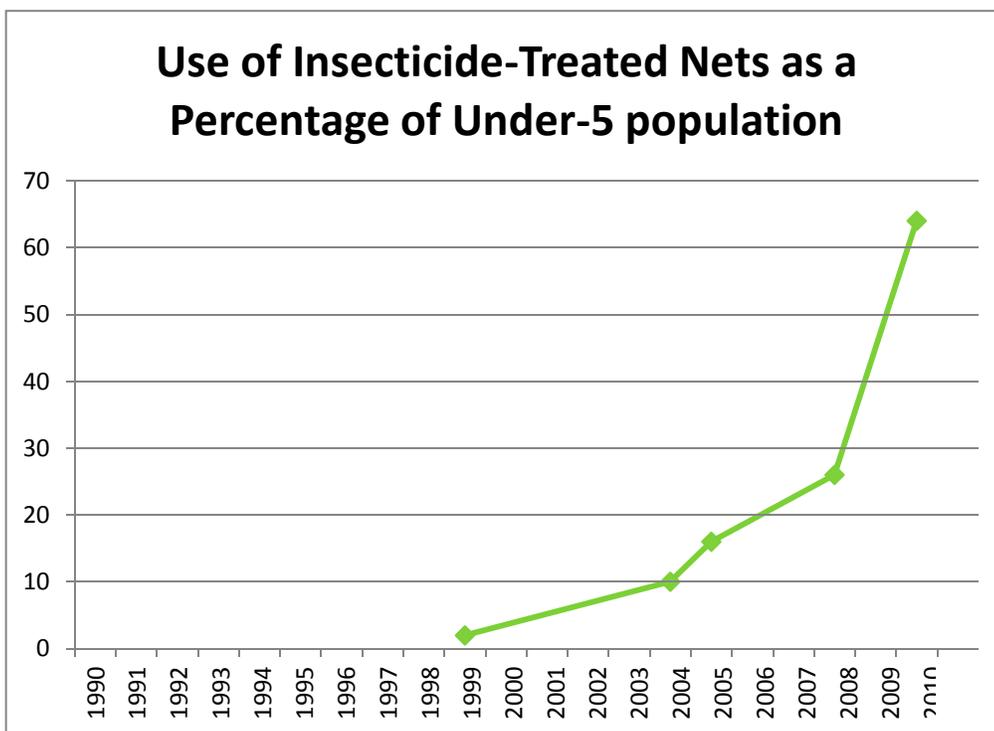


**Figure 8: ITN use by children under 5 (The World Bank, 2011)**

## Health, Malaria and Bed Nets

In 2000 the United Nations Millennium Summit agreed to achieve eight Millennium Development Goals in order to seek an end to world poverty by 2015. Three of these goals pertain directly to health. This is because improving the health of the poor can be relatively cheap and yields huge benefits to productivity. The most common health problems include nutrient deficiency and the spread of diseases such as HIV and malaria. Duflo and Banarjee (2007) note that while the poor tend to not report extremely high levels of illness, they do report high levels of stress due to health problems (Banarjee & Duflo, 2007).

Banarjee and Duflo note in *The Economic Lives of the Poor* that many countries are improving health by establishing more health centers and better public services, such as water sanitation. However, the researchers also note that disparities persist between the medical training of health care providers in rural and urban areas. Banarjee and Duflo use infant mortality as a measure of these differences in health care and sanitation. These numbers across several countries, including Tanzania, are shockingly high, and are probably higher than reported given that children that die as infants are often forgotten (Banarjee & Duflo, 2007). Wagstaff (2003) found large differences between the survival rates of children living on less that $1 a day correlated to the amount of health spending per capita. Therefore, infant and child mortality are good measures of health and will be used in my analysis.

Across Africa, reported deaths from malaria seem to remain just below 100 deaths per 100, 000 (World Health Organization, 2011).  Looking at this metric across time, the reported deaths seem to increase. However, this may indicate that reporting mechanisms are improving and capturing more data across time rather than a general increase in deaths due to malaria. Figure 9 shows annual reports of deaths due malaria.
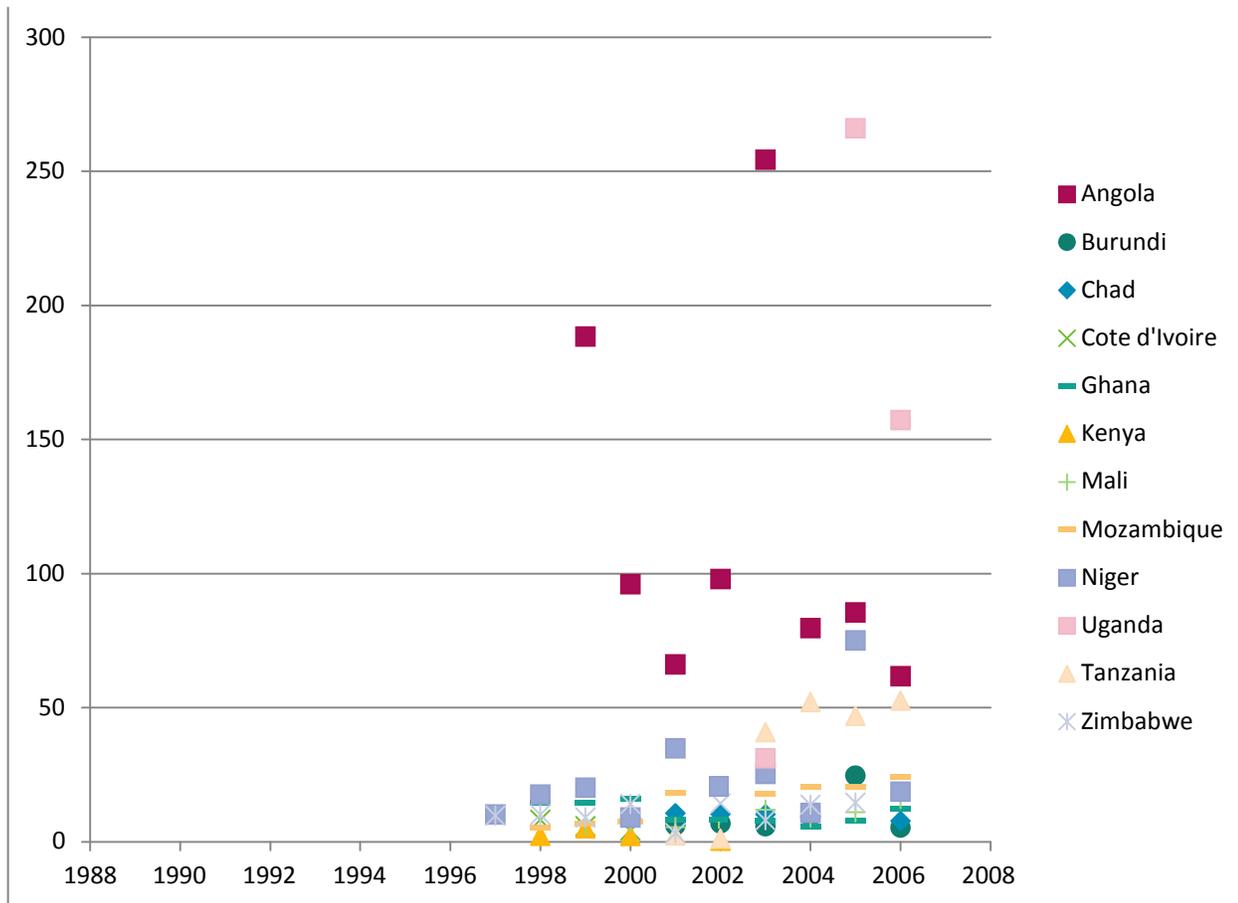
**Figure 9: Deaths per 100,000 due to Malaria (World Health Organization, 2011)**

The World Health Organization (WHO) reported in 2008 that malaria is the second leading cause of death in children younger than 5 years of age in Tanzania. The leading cause of death is listed as 'other,' suggesting that most children may have died from an undiagnosed cause. Additionally, less than 50% of the rural population is using improved drinking-water sources, and less than 50% of the poorest quintile of the population has births attended by a health provider (World Health Organization, 2011). In Tanzania, the majority of the regions have at least 1 case of malaria per 1000 people. Figure 10 below depicts the distribution of malaria cases per 1,000 (World Health Organization, 2011)
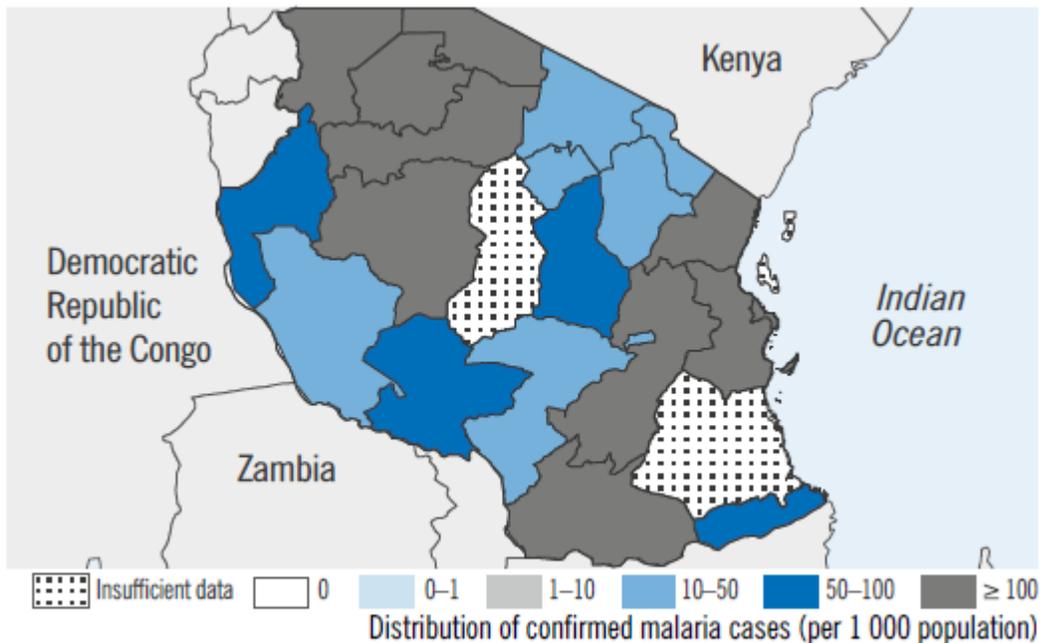
Figure 10: Distribution of Cases of Malaria across Tanzania

The WHO recognizes areas of 1 or more cases per 1000 as high transmission areas. In the WHO 2011 report on malaria, 73% of the population existed in a high transmission area (World Health Organization, 2011). According to this report insecticide-treated nets (ITN) represented the greatest expenditure on interventions in 2010. This suggests reductions in ITN cost could have a huge impact.

A study conducted in Orissa, India, in 2011 shows that free distribution of ITNs increases use the previous night to 47% from 16% in areas where ITNs are sold. However, this same study showed that regardless of distribution method, malaria prevalence seemed unaffected. This may be due to the fact that ITN coverage remains insufficient in malarious areas. Ownership in these areas remains remarkably low, despite the fact that regular use of ITNs is the most effective preventative treatment for malaria (Tarozzi, Mahajan, Blackburn, Kopf, Krishnan, & Yoong, 2011).

Free distribution of ITNs, however, requires a huge cost to either government or non-government organizations. This may be why WHO does not recommend free distribution of ITNs in Tanzania to prevent the spread of malaria. Tarozzi et al (2011) also found, that without a price subsidy, 52% of sample households purchased at least one ITN. This study found that even a micro-finance subsidy given to reduce the cost of the ITNs can increase previous night use of ITNs by about 20%. Given that A to Z

Textile Mills is able to produce longer-lasting ITNs at a lower cost, a decrease in price will enable more households to purchase at least one ITN and increases the use of ITNs. Insecticide treated nets also represent the largest cost of malaria treatments in Tanzania. Therefore, a lower cost to this option may also have huge implications for treatment across all regions in Tanzania.

## Research

Now, I will analyze the impact of the Acumen Fund upon health indicators in Tanzania. My hypothesis is that the effect of distance from A to Z Textile Mills will strengthen over time as the impact of the Acumen Fund grows. As A to Z Textile Mills expands production with the investment from the Acumen Fund in 2003, their low-cost insecticide treated nets may impact health indicators such as regional death rates such as infant mortality, child mortality and deaths due to illness.

## Overview of the Living Standards Measurement Study

For this analysis, I will use data from the World Bank's Living Standards Measurement Study. This data is made publically available through the World Bank website. The Living Standards Measurement Study (LSMS) surveys households within developing countries to improve the quality and expand the type of the data collected. This data helps policymakers and researchers understand poverty and income inequality. Questions cover a wide range of topics, from health and nutrition to labor, consumption, entrepreneurship and agriculture (The World Bank, 2008).

Survey teams of a supervisor and several interviewers work with government institutions to identify, design, implement and analyze surveys. This ensures that statistical offices within the country can sustain a data-collection system. LSMS modules, sets of questions that measure specific development indicators, are altered to best suit the country and sample of the population. Issues such as illiteracy can cause huge inaccuracy in diary reporting, recall questions and household characteristics such as poverty can cause variations in reporting as well (Beegle, De Weerdt, Friedman, & Gibson, 2010).

Two specific studies were conducted in Tanzania to test the effectiveness of different survey methods for labor and household data statistics. Researchers found significant variations in labor measurements based upon the detail of the questionnaire and whether labor information was given by self-report or reported by another household member. In a shorter survey module female labor participation was 7% lower than that reported in a longer survey. When a proxy is used to report labor, the difference can be 13% lower for male laborers and 8% lower for female laborers. The combination of a proxy and a short survey causes under-reporting of about 10% (Bardasi, Beegle, Dillon, & Serneels, 2010).

Likewise, significant variations occurred given different survey modules for household consumption. Beegle et al (2010) found that dependent upon the length of recall and the household characteristics there could be significant differences between reported consumption. Participants were asked to either use a diary to record consumption, or recall their consumption over various time frames. Although costs are reduced when using recall or a household diary, consumption is most accurate when participants use a personal diary. Typical recall methods require participants to report the number of months they consume and the typical consumption. This method causes the most error, perhaps skewing inequality measures, and costs the most time. Several measures of poverty use consumption as a key indicator (Beegle, De Weerdt, Friedman, & Gibson, 2010). Therefore, it is essential to consider these potential obstacles in the data collection method in my analysis.

## Tanzania Living Standards Measurement Study
### Human Resource Development Survey 1993: In 1993, the LSMS focused on human
resource development indicators including health and education. Information on housing, water access, farming, health facilities and health expenditures was collected for 5,185 households. Data comprises all 20 mainland regions in Tanzania and over 12,000 respondents. Additionally, this survey collects data on consumption indicators. The survey utilized a week-long recall period for consumption questions; participants were asked what food their household consumed in a typical week. The phrasing of this

question also addressed the issue of seasonality in consumption, given many participants grow produce and raise livestock. Information on the respondent, including his or her relationship to the head of the household, age and education level, were recorded to improve analysis of data collected from a proxy or given through self-report (The World Bank, 1996).

The LSMS in 1993 sampled 220 of the 222 National Master Sample clusters in accordance with the Bureau of Statistics framework. Using these sample clusters enables researchers to estimate population values at both the national and regional level. These regions included 98 rural areas and 122 urban areas. Each of the 20 mainland districts was broken down into rural and urban households, except Dar es Salaam, which only represented urban households. In each cluster, 20 to 22 households were targeted and given a weight, based upon the National Master Sample weight and the sample size of the village. After sampling, some re-interviewing was necessary to correct for interviewers' misinterpretation of in-kind income. Otherwise, subsistence farmers without other economic activity would be recorded with no income.

**Tanzania National Panel Survey 2008:** The National Panel Survey covers a wide variety of development indicators. These measurements include several of the Human Development Survey modules, such as health, housing, water, farming and consumption. The National Panel Survey expands upon these indicators and includes measurements of employment, labor and community data. The survey in 2008, was slightly smaller than 1993; it surveyed 3,280 households. This reduced number of households, was determined to be adequately large enough to determine national data. However, the smaller sampling across regions reduces the statistical significance of regional data. Similar to the Human Development Survey, this data was collected using National Master Sample clusters. However, due to sampling design to select samples with variation in key indicators, there is an increased likelihood for a household to be from an urban area (The World Bank, 2008). Unlike the measurements in the 1993 Human Development Survey, there is no reported misinterpretation by the interviewers. Therefore, the only data cleaning necessary was incorrect recording of measurements.

## Data Analysis

The Living Standards Measurement Surveys (LSMS) from both 1993 and 2008 collect household level information across regions in Tanzania. Before using any of the information I first cleaned the data so that coding was consistent across the 1993 and 2008 studies. In the first step of this study, I used each household's identifying number to determine the region of the household and therefore compare information across regions. I used the direction feature of Google Maps to then determine the driving distance in kilometers between the center of Arusha, the region of the initial investment, and the center of other regions. Given that A to Z Textile Mills uses local sales representatives and fills orders to local shops, shipment is likely to be handled by the company and done via land transport. Additionally, I isolated reported distance in kilometers to the closest health facility for each household and also compared the average distance from this health facility across regions. I also isolated average distance to market since nets would be predominantly sold in the market. However, I found this metric was highly correlated to distance to health facility when I checked the covariates. Since my research would like to explain the impact of nets on health indicators, I chose to discard distance to market. I also used the survey data to find the average distance to public roads across regions to account for any differences in transportation of the nets across regions. Finally, Mkenda (et al., 2004) had found that political differences across regions influenced poverty severity and distribution of wealth; therefore, I utilized the researchers' poverty severity index to account for differences across regions (Mkenda, Luvanda, Rutasitara, & Naho, 2004).

Using this survey report data, I isolated reported infant deaths, child deaths and deaths due to illness. Then employing the reported number of members of each household, I determined the number of people surveyed in each region. With this information I was able to calculate the death rate, infant mortality rate, child mortality and rate of deaths due to illness for each regional sample. Since I only have two time samples, time became a dummy variable such that $t$ in 1993 was set equal to 1 and $t$ in 2008 was set equal to 0. I then conducted initial analysis to determine the correlation of the independent variables.

Utilizing the independent variables of time, distance, facility distances, distance to public road and finally, poverty severity I was able to analyze the dependent variables of mortality rates.

I compared this information across regions using a general linear model (GLM). This model can be represented as follows:

$$Y = \beta_0 + \beta_1 t + \beta_2 d + \beta_3 (d*t) + e$$

Where $Y$ represents the death rate, $t$ is a variable for time, $d$ represents distance and $e$ is the error term. I ran this regression for the rate of deaths due to illness, infant mortality and child mortality (Table 2).

**Table 2: Rate of Illness Deaths in Sample**

| Rate of Illness Deaths | Value | Standard Error | t-value | P |
|---|---|---|---|---|
| Intercept | 9.18478 | 2.23867 | 4.10 | 0.0002 |
| Distance | 0.00055 | 0.00297 | 0.19 | 0.8540 |
| Time | -4.59883 | 3.16690 | -1.45 | 0.1550 |
| Distance and Time | 0.00892 | 0.00420 | 2.12 | 0.0410 |

This regression showed a significant interaction of distance and time. Over time, there is a very slight positive relationship between the rate of deaths due to illness and distance. In terms of my regression, the equation would be as follows:

$$Y = 9.18478 + 0.00055d - 4.59883t + 0.00892z + e$$

Therefore, in 2008:

$$Y = 9.17478 + 0.00055d + e$$

In, 1993:

$$Y = 4.58595 + 0.00947d + e$$

And the significance of the interaction of distance and time suggests the difference between these equations is significant. Looking at the graph of this data, it seems to suggest that in 2008 there seems to be little effect of distance on deaths due to illness (Figure 11). The linear regression of the rate of deaths due to illness over distance (km) in 2008 appears to be a relatively flat line.
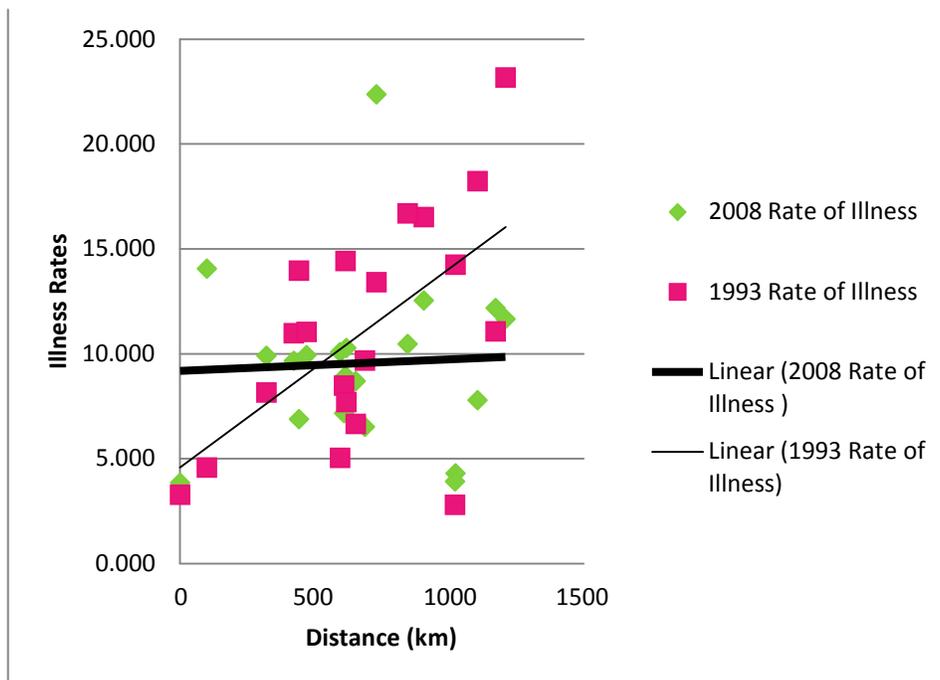
**Figure 11: Comparison of 1993 Rate of Illness regression to 2008 Rate of Illness.**

Considering the rates of infant and child mortality, there does not appear to be a significant effect of distance over time. This is depicted in the tables below.

**Table 3: Child Mortality**

| Rate of Child Deaths | Value | Standard Error | t-value | P |
|---|---|---|---|---|
| Intercept | 2.39683 | 1.03142 | 2.32 | 0.0259 |
| Distance | 0.00243 | 0.00137 | 1.77 | 0.0845 |
| Time | -1.28429 | 1.45865 | -0.80 | 0.3844 |
| Distance and Time | 0.00021 | 0.00193 | 0.11 | 0.9105 |

**Table 4: Infant Mortality**

| Rate of Infant Deaths | Value | Standard Error | t-value | P |
|---|---|---|---|---|
| Intercept | 1.55539 | 1.49030 | 1.04 | 0.3036 |
| Distance | 0.00137 | 0.00198 | 0.69 | 0.4923 |
| Time | 0.05009 | 2.10760 | 0.02 | 0.9812 |
| Distance and Time | 0.00324 | 0.00280 | 1.16 | 0.2551 |

The second part of my analysis considers the average distance from the closest health facility. Over time, it is reasonable to assume that more health facilities would begin operation in areas. The increasing prevalence and accessibility of health facilities may also affect these health indicators. Therefore, it seems

logical to add average distance to health facility. Again, the only significant result occurs when considering the rate of deaths due to illness.  Adding in $f$ to represent the facility distance, the equation becomes as follows:

$$Y = \beta_0 + \beta_1 d + \beta_2 t + \beta_3 (d*t) + \beta_4 f + e$$

**Table 5: Rate of Deaths to Illness**

| Rate of Illness Deaths | Value | Standard Error | t-value | P |
|---|---|---|---|---|
| Intercept | 9.31852 | 2.16525 | 4.30 | 0.0001 |
| Distance | 0.00051 | 0.00287 | 0.18 | 0.8501 |
| Time | -2.29764 | 3.29689 | -0.70 | 0.4905 |
| Facility Distance | -0.04554 | 0.02426 | -1.88 | 0.0689 |
| Distance and Time | 0.00001 | 0.00410 | 2.44 | 0.0201 |

The average distance to facility does appear to have a slight negative effect upon the deaths due to illness. This suggests that the rate of deaths due to illness may slightly decrease as average distance to the closest health facility increases.

In 2008 the equation is as follows:

$$Y = 9.31852 + 0.00051d - 0.04554f + e$$

And in 1993:

$$Y = 7.02088 + 0.00052d - 0.04554f + e$$

The significance of the interaction of distance and time suggests again that the differences in these two equations are significant. Again, however, there is only a very slight positive relationship between the interaction of distance and time and deaths due to illness.

**Table 6: Rate of Child Mortality**

| Rate of Child Deaths | Value | Standard Error | t-value | P |
|---|---|---|---|---|
| Intercept | 2.46071 | 0.99385 | 2.48 | 0.0189 |
| Distance | 0.00241 | 0.00132 | 1.89 | 0.0758 |
| Time | -0.18521 | 1.51328 | -0.12 | 0.9033 |
| Facility Distance | -0.02175 | 0.01113 | -1.95 | 0.0588 |
| Distance and Time | 0.00074 | 0.00188 | 0.39 | 0.6968 |

**Table 7: Rate of Infant Mortality**

| Rate of Infant Deaths | Value | Standard Error | t-value | P |
|---|---|---|---|---|
| Intercept | 1.66376 | 1.40607 | 1.18 | 0.2447 |
| Distance | 0.00134 | 0.00186 | 0.72 | 0.4756 |
| Time | 1.91484 | 2.14094 | 0.89 | 0.3772 |
| Facility Distance | -0.03690 | 0.01575 | -2.34 | 0.0250 |
| Distance and Time | 0.00412 | 0.00266 | 1.55 | 0.1312 |

The third part of my analysis considers the impact of access to public roads. This data is obtained from the Living Standards Measurement Survey (The World Bank, 1996). Again, the only significant interaction occurred within the deaths due to illness data. A variable for the access to public roads, $p$, causes the equation to become:

$$Y = \beta_0 + \beta_1 d + \beta_2 t + \beta_3(d*t) + \beta_5 p + e$$

There was not a significant effect of the distance to public road variable. However, there was still a significant interaction of distance and time.

**Table 8: Rate of Deaths due to Illness considering access to Public Roads**

| Rate of Illness Deaths | Value | Standard Error | t-value | P |
|---|---|---|---|---|
| Intercept | 6.62927 | 3.02608 | 2.19 | 0.0959 |
| Distance | -0.00039 | 0.00304 | -0.18 | 0.8982 |
| Time | -4.60122 | 3.14232 | -1.46 | 0.1520 |
| Public Road | 0.03273 | 0.02630 | 1.24 | 0.2216 |
| Distance and Time | 0.00892 | 0.00417 | 2.14 | 0.0397 |

The final part of my analysis considers the effect of the poverty severity index across regions found by the United Nations Development Programme research study (Mkenda, Luvanda, Rutasitara, & Naho, 2004). According to this research, community level influences such as politics and services influence these differences in poverty across regions in Tanzania. Therefore this variable, $\gamma$, may capture the influences of these regional differences. Adding this variable transforms the equations such that:

$$Y = \beta_0 + \beta_1 d + \beta_2 t + \beta_3(d*t) + \beta_6 \gamma + e$$

Again, the only significant interaction still occurs within the data for deaths due to illness. However, the poverty variable is also not significant and does not influence the effect of health indicators across regions.

**Table 9: Rate of Deaths due to Illness considering regional poverty severity index**

| Rate of Illness Deaths | Value | Standard Error | t-value | P |
|---|---|---|---|---|
| Intercept | 11.23469 | 3.66628 | 3.06 | 0.0042 |
| Distance | -0.00005 | 0.00311 | -0.02 | 0.9860 |
| Time | -4.60122 | 3.18894 | -1.44 | 0.1579 |
| Poverty | -0.31690 | 0.44754 | -0.71 | 0.4836 |
| Distance and Time | 0.00892 | 0.00423 | 2.11 | 0.0425 |

## Discussion

Looking at the results from the general linear model regressions, it appears that in 1993 there was a more direct positive correlation between distance and health indicators across regions than the relationship between distance and health indicators in 2008. Despite attempts to capture differences between regions by utilizing the poverty severity index (Mkenda, Luvanda, Rutasitara, & Naho, 2004) and access to public roads (The World Bank, 2008) there seemed to be little impact of these inherent differences between regions. Additionally, greater access to health facilities seems to have a significant effect upon the health indicators of a region. This makes intuitive sense as greater access would enable better provision of health services and decrease death rates in a region overall.

However, the significant difference in the correlation between distance from Arusha and health indicators across time still raises interesting questions. The interaction is in the exact opposite direction of my original hypothesis; the effect of distance over time should increase as A to Z Textile Mills expands their production. In fact, the exact opposite occurred; the effect of distance over time decreased as A to Z Textile Mills expanded production. Postulating the causes of this interaction reveals several possibilities. Considering these possibilities may explain these results.

To start, there may be inherent differences within the surveying and reporting methods used between 1993 and 2008 (Grosh & Glewwe, 2000). As these surveying and reporting practices became

more refined and standardized over time, there may be some irresolvable differences in the data (The World Bank, 2011). Additionally, over time, more health facilities are accessible in all regions. This may suggest that more cases of deaths due to illness, infant and child deaths would be reported and diagnosed accurately. However, one would not expect to see such a strong and significant interaction of time and distance if either or even both situations were true.

Another hypothesis may be that the distance between regions 1,000 kilometers away from Arusha, Tanzania would be much more significant than the distance between regions only 100 kilometers away. The impact of this difference could be reduced by taking the log of the distances to put more weight upon closer regions and less weight upon the further regions. Running a general linear model regression for the rate of death due to illness, however, does not reveal significant results. The regression's results are below:

| Rate of Illness Deaths | Value | Standard Error | t-value | P |
|---|---|---|---|---|
| Intercept | 5.69175 | 4.20263 | 1.35 | 0.1614 |
| logDistance | 0.63130 | 0.66616 | 0.95 | 0.3496 |
| Time | -4.94473 | 5.94342 | -0.83 | 0.4109 |
| logDistance and Time | 1.04310 | 0.94209 | 1.11 | 0.2755 |

A perhaps more likely scenario considers the history and distribution and sales of A to Z Textile Mills. A to Z Textile Mills was founded in the late 1960s and created both garments and bed nets. As one of a very few producers of nets, even untreated and low quality nets, the company may have had some impact (Karugu & Mwendwa, 2007). This may have been especially true in the late 1980s to 1990s when malaria in Africa became a highly discussed political topic (Mkenda, Luvanda, Rutasitara, & Naho, 2004). At that time, distribution and sales was solely dependent upon the abilities and scope of A to Z Textile Mills' local management in Arusha Tanzania. This may explain the strong correlation between distance from Arusha and health indicators seen in the 1993 regression. With the advent of Acumen Fund's investment, and subsequent partnership between Exxon Mobil, Somitomo, WHO and UNICEF, the insecticide treated net products improved and sales and distribution became more internationally focused. UNICEF became a buyer of last resort; they agreed to purchase nets that were not sold through A to Z

Textile Mills normal regional sales (Karugu & Mwendwa, 2007). UNICEF's wider distribution of the nets may have decreased the influence of regional differences across Tanzania by the Living Standards Measurements Survey in 2008.

This hypothesis, in particular, is appealing because it intuitively seems rational and explains many of the results of the regression. Therefore, I decided to explore the influence of the use and ownership of insecticide treated nets across countries compared to the level of national UNICEF supply use. The Institute for Health Metrics and Evaluation released annual data of ITN use and ownership across several African countries from 2000 to 2008 (Heisel & Oviatt, 2010). Comparing this information with the level of UNICEF involvement in a country by using monetary value of supply use reported in UNICEF Annual Supply Reports from 2000 to 2008 (UNICEF, 2000-2008) revealed a strong trend between ownership, use and UNICEF involvement across countries. Figures 12 and 13 indicate this relationship between the value of UNICEF supplies in a country and the percentage of the population ownership and use respectively.
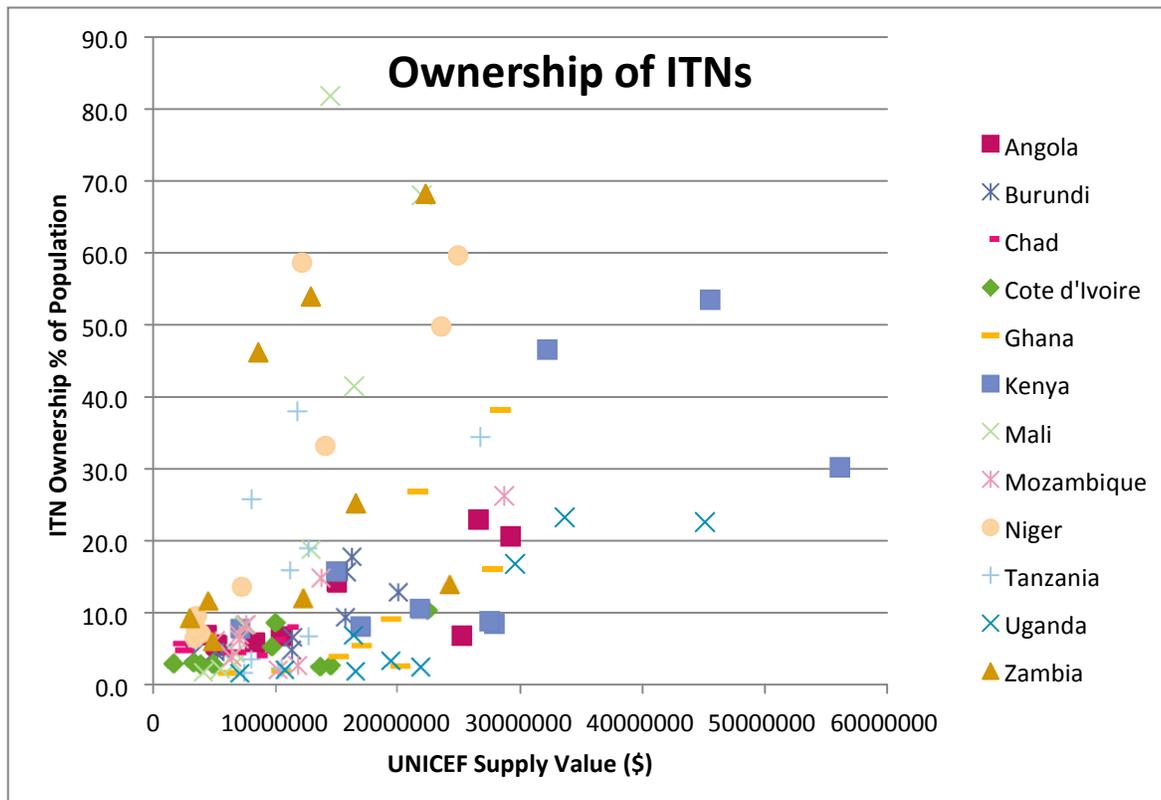


**Figure 12: Ownership of ITN in African Countries**
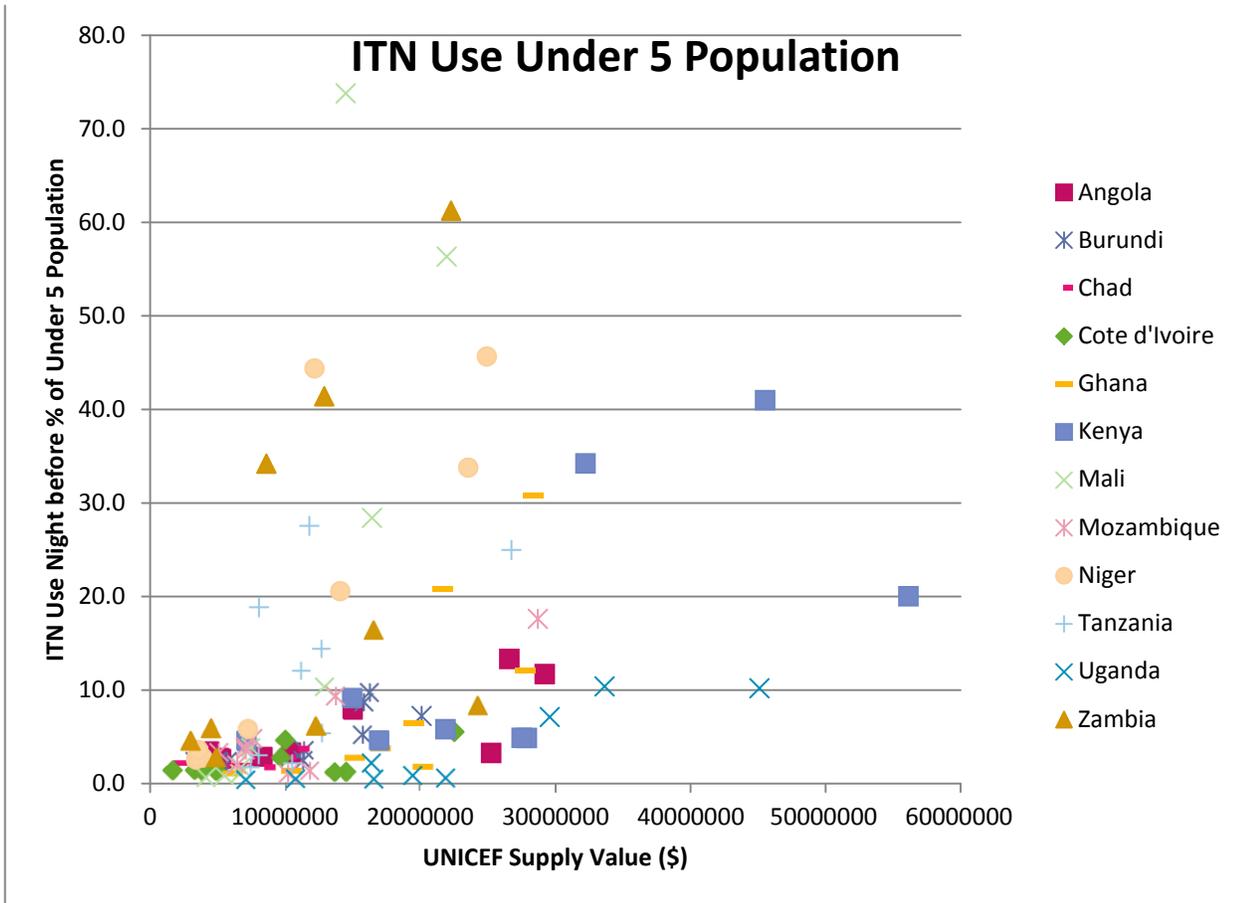
**Figure 13: ITN Use as a Percentage of the population of children under 5**

As you can see from both figures, there appears to be a general trend between insecticide-treated net use or ownership and the value of UNICEF supplies across several African countries. This is also true for Tanzania, which is included in the graphs above. Increasing levels in the value of UNICEF supplies in Tanzania increases both use and ownership of these ITNs. This may explain why in 2008, there is less correlation between distance and health indicators across regions.

## Conclusion and Future Analysis

Although my data analysis revealed that the effect of distance actually weakened between 1993 and 2008, the analysis showed that across all regions health, as measured by mortality rates, tended to improve over time. This may be due to the influx of aid and resources towards health in sub-Saharan African countries, but this general improvement in health may also be attributed to innovative small growing businesses and impact investments. Whether Acumen Fund's investment in A to Z Textile Mills had a positive health impact upon the populations of Africa is apparent – without the investment A to Z Textile Mills would likely not have been able to adopt the olyset technology from Somitomo or attract a partnership with Exxon Mobil. The significant difference in price, effectiveness and long lifespan of their nets make these a viable option in decreasing malaria and improving health in Africa. However, the extent of the impact in Tanzania remains to be determined.

The results of this initial analysis reveal that while health indicators appear highly correlated to a region's distance from A to Z Textile Mills in 1993, by 2008 there appears to be an equalizing effect of the Acumen Fund's investment. This may be due to better reporting and surveying mechanisms over time, but it is equally likely that the business partnerships A to Z Textile Mills formed allowed for wider distribution of their products. Without annual LSMS data, more accurate data on surveyed household locations in Tanzania, and less variability in responses it is unlikely to determine the exact effect of Acumen Fund's investment upon health across Tanzania.

However, the impact of the Acumen Fund's investment in A to Z Textile Mills upon health and malaria metrics across African countries may be possible in the future. A more complete dataset of A to Z Textile Mills' distribution, the ownership and use of insecticide-treated nets, accurate reports of cases of malaria and  reports of deaths due to malaria will need to be collected before the extent of the impact can be assessed.  Future analysis could also increase the value of the assessment of impact of Acumen Fund's investment by comparing similar investments made by other impact investors and the impact of non-governmental organizations that also contribute to health and malaria initiatives.

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# Appendix

**Table 10: Data Sample**

| Distance | Facility | Road | Poverty | Illness | Child | Infant | Time |
|---|---|---|---|---|---|---|---|
| 423 | 4.091 | 115.679 | 7.900 | 9.662 | 4.831 | 1.208 | 1.000 |
| 0 | 3.346 | 83.798 | 8.300 | 3.854 | 1.927 | 1.927 | 1.000 |
| 100 | 0.538 | 100.845 | 4.500 | 14.056 | 3.012 | 3.012 | 1.000 |
| 442 | 3.571 | 91.533 | 3.000 | 6.885 | 0.861 | 0.000 | 1.000 |
| 615 | 5.607 | 62.101 | 4.100 | 8.946 | 2.982 | 0.994 | 1.000 |
| 730 | 0.625 | 86.424 | 3.700 | 22.364 | 6.390 | 0.000 | 1.000 |
| 653 | 0.253 | 102.103 | 3.500 | 8.694 | 4.448 | 2.831 | 1.000 |
| 1106 | 4.238 | 149.960 | 5.900 | 7.788 | 6.231 | 4.673 | 1.000 |
| 1210 | 2.120 | 149.560 | 4.000 | 11.656 | 3.681 | 2.454 | 1.000 |
| 1173 | 1.006 | 88.102 | 4.800 | 12.177 | 6.088 | 3.805 | 1.000 |
| 687 | 0.625 | 90.881 | 4.900 | 6.515 | 2.443 | 2.443 | 1.000 |
| 906 | 3.803 | 161.481 | 3.800 | 12.537 | 4.425 | 2.950 | 1.000 |
| 321 | 4.143 | 72.927 | 7.600 | 9.901 | 4.950 | 4.950 | 1.000 |
| 610 | 5.308 | 80.183 | 2.500 | 7.171 | 3.259 | 3.259 | 1.000 |
| 1024 | 1.650 | 71.087 | 3.800 | 4.301 | 4.301 | 2.151 | 1.000 |
| 1022 | 1.077 | 103.178 | 5.500 | 3.912 | 5.477 | 4.695 | 1.000 |
| 595 | 1.706 | 77.555 | 5.800 | 10.078 | 5.039 | 3.359 | 1.000 |
| 846 | 2.083 | 63.319 | 6.600 | 10.467 | 4.831 | 3.221 | 1.000 |
| 618 | 1.328 | 87.338 | 5.700 | 10.278 | 2.418 | 1.814 | 1.000 |
| 470 | 1.643 | 114.516 | 7.500 | 9.934 | 3.311 | 0.000 | 1.000 |
| 423 | 51.510 | 115.679 | 7.900 | 10.978 | 3.992 | 7.984 | 0.000 |
| 0 | 46.613 | 83.798 | 8.300 | 3.281 | 1.969 | 1.969 | 0.000 |
| 100 | 68.879 | 100.845 | 4.500 | 4.577 | 2.288 | 2.860 | 0.000 |
| 442 | 80.903 | 91.533 | 3.000 | 13.958 | 3.490 | 3.988 | 0.000 |
| 615 | 93.218 | 62.101 | 4.100 | 14.423 | 5.769 | 8.654 | 0.000 |
| 730 | 96.281 | 86.424 | 3.700 | 13.408 | 1.117 | 2.235 | 0.000 |
| 653 | 68.515 | 102.103 | 3.500 | 6.658 | 0.720 | 1.800 | 0.000 |
| 1106 | 18.556 | 149.960 | 5.900 | 18.223 | 2.278 | 6.834 | 0.000 |
| 1210 | 16.257 | 149.560 | 4.000 | 23.162 | 11.078 | 16.113 | 0.000 |
| 1173 | 76.289 | 88.102 | 4.800 | 11.065 | 1.383 | 1.383 | 0.000 |
| 687 | 136.182 | 90.881 | 4.900 | 9.673 | 0.000 | 0.000 | 0.000 |
| 906 | 110.524 | 161.481 | 3.800 | 16.511 | 3.853 | 6.054 | 0.000 |
| 321 | 17.194 | 72.927 | 7.600 | 8.152 | 0.000 | 0.000 | 0.000 |
| 610 | 46.620 | 80.183 | 2.500 | 8.484 | 3.181 | 5.302 | 0.000 |
| 1024 | 133.070 | 71.087 | 3.800 | 14.245 | 4.274 | 8.547 | 0.000 |
| 1022 | 150.738 | 103.178 | 5.500 | 2.805 | 1.403 | 1.403 | 0.000 |
| 595 | 51.940 | 77.555 | 5.800 | 5.038 | 0.000 | 0.840 | 0.000 |
| 846 | 21.708 | 63.319 | 6.600 | 16.692 | 6.070 | 8.346 | 0.000 |
| 618 | 48.814 | 87.338 | 5.700 | 7.699 | 2.566 | 2.994 | 0.000 |

```
                           Simple Statistics

Variable        N        Mean      Std Dev         Sum       Minimum     Maximum

distance       40   677.55000    331.05759       27102             0        1210
facility       40    35.82655     44.08309        1433       0.25300   150.73800
road           40    97.62850     27.95802        3905      62.10100   161.48100
poverty        40     5.17000      1.68952   206.80000       2.50000     8.30000
illness        40    10.28120      4.78962   411.24800       2.80500    23.16200
child          40     3.47740      2.17901   139.09600             0    11.07800
infant         40     3.61030      3.21048   144.41200             0    16.11300
time           40     0.50000      0.50637    20.00000             0     1.00000
```

```
                  Pearson Correlation Coefficients, N = 40
                       Prob > |r| under H0: Rho=0

           distance   facility     road    poverty    illness      child     infant       time

distance    1.00000    0.08451   0.34043   -0.37307    0.34628    0.38644    0.30899    0.00000
                       0.6041    0.0316     0.0177     0.0286     0.0138     0.0524     1.0000

facility    0.08451    1.00000  -0.04525   -0.17803    0.00792   -0.34252    0.11200   -0.76705
            0.6041               0.7816     0.2717     0.9613     0.0305     0.4914    <.0001

road        0.34043   -0.04525   1.00000   -0.04743    0.28681    0.22253    0.25907    0.00000
            0.0316     0.7816               0.7714     0.0728     0.1675     0.1065     1.0000

poverty    -0.37307   -0.17803  -0.04743    1.00000   -0.22542   -0.07422   -0.04477    0.00000
            0.0177     0.2717    0.7714                0.1620     0.6490     0.7839     1.0000

illness     0.34628    0.00792   0.28681   -0.22542    1.00000    0.54474    0.53661   -0.15275
            0.0286     0.9613    0.0728     0.1620                0.0003     0.0004     0.3467

child       0.38644   -0.34252   0.22253   -0.07422    0.54474    1.00000    0.66911    0.26392
            0.0138     0.0305    0.1675     0.6490     0.0003               <.0001     0.0999

infant      0.30899    0.11200   0.25907   -0.04477    0.53661    0.66911    1.00000   -0.35425
            0.0524     0.4914    0.1065     0.7839     0.0004    <.0001                0.0249

time        0.00000   -0.76705   0.00000    0.00000   -0.15275    0.26392   -0.35425    1.00000
            1.0000    <.0001     1.0000     1.0000     0.3467     0.0999     0.0249
```

**Figure 14: Simple Regression and Correlation of Variables**

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**PERMANENT**
2556 Washington Drive
Gilbertsville, PA 19525

## EDUCATION

**The Pennsylvania State University – Schreyer Honors College**
**The College of Liberal Arts – Paterno Fellowship**                University Park, PA
Bachelor of Science in Economics and Minor in Psychology                Anticipated May 2012

## EXPERIENCE

**PEER Network**                                                        State College, PA
Project Specialist                                                      01/12-Present
- Interview prospect member organizations about current planned giving practices
- Evaluate survey results for trends and gaps in prospect organizations' practices
- Create products and fundraising resources to meet needs of prospects

**Penn State University, Office of University Development**             University Park, PA
Annual Giving Intern                                                    01/11-01/12
- Developed a communication strategy for the President's Club, an annual giving society
- Researched and contacted prospects for membership in the President's Club
- Analyzed past appeals for functionality and potential improvements in upcoming fiscal year

**Foxdale Village**                                                     State College, PA
Development Intern                                                      08/11-12/11
- Prepared and drafted educational materials about estate planning and giving opportunities
- Served on the Development Committee, reviewing the correct use of endowments and gifts
- Research prospects using DonorPerfect donor database

**Penn State University, Office of University Development**             University Park, PA
Development Communications Intern                                       05/10-12/10
- Composed and edited proposals for planned giving, annual and major donors
- Participated in Advancement Resources: The Art and Science of Donor Development
- Created a volunteer manual for the Penn State Parent's Fundraising Council

## RELATED ACTIVITIES

**Senior Class Gift Committee**
Overall Chairperson                                                    03/11- Present
- Lead committee in determining and pursuing year long goals for 2012
- Evaluated past giving history and programs for future campaign initiatives
- Structured and implemented year long fundraising campaign for the Class Gift

**Penn State Crew Team**
Vice President                                                         03/09 – Present
- Collaborate with corporate representatives to ensure program branding and image
- Designed materials for first major giving campaign to solicit gifts from alumni
Fundraising Officer                                                    03/08-03/09
- Doubled fundraising revenues through innovative fundraising system
- Coordinated over 80 student volunteers in conjunction with Athletics staff