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Determinants of Manufacturing Firm's Location in Kenyan Counties

Marang'a Wambugu

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THE KENYA INSTITUTE FOR PUBLIC POLICY RESEARCH AND ANALYSIS (KIPPRA)

YOUNG PROFESSIONALS (YPs) TRAINING PROGRAMME

Determinants of Manufacturing Firm's Location in Kenyan Counties

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Private Sector Development Division
Kenya Institute for Public Policy
Research and Analysis

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Abstract

Establishment of manufacturing firms in a given location is expected to create employment and reduce poverty. Kenyan counties are no exception; for them to continuously address existing unemployment and high poverty levels, they have to attract manufacturing firms. However, all counties are not endowed the same way, leading to variations in the number of manufacturing firms located in each county. This study investigates the determinants of location of manufacturing firms in Kenyan counties. It uses negative binomial regression model and has found that insecurity level, agglomeration economies, availability of water, availability of roads, and cost of land determine the location of manufacturing firms in Kenyan counties.

The study recommends enhancement of local partnership between the national and county governments as a way of reducing crime. County leadership should establish systems of monitoring the effects of crime on existing and prospective manufacturing firms and other investments. Secondly, Water Service Providers (WSPs) should consider supplying industrial water at subsidized rates, and in county areas where such WSPs are inadequately covered, firms should be allowed to directly tap industrial water from sources within the counties. Further, counties should fund projects involving water-piping, drilling of boreholes and construction of dams. Thirdly, when firms want to locate in an interior part of a county, construction of roads to such parts should be prioritized. In addition, regular repairs to existing roads leading to plants should be done as well as maintenance of major roads connecting different counties in order to increase accessibility to the external market. Further, provision of industrial packs with improved infrastructure around them would boost agglomeration economies for manufacturing firms and other investments. Lastly, since the cost of land in counties may not come down any soon, leasing of industrial land to firms at a lower cost would attract and retain firms. It is envisaged that these recommendations would positively inform county leadership and, if eventually actualized, counties would be on the right path towards addressing unemployment and poverty.

Abbreviations and Acronyms

CBK	Central Bank of Kenya
CDM	Count Data Model
CLM	Conditional Logit Model
DCM	Discrete Choice Model
EPZ	Exports Processing Zone
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GoK	Government of Kenya
ISIC	United Nations Standard Industrial Classification
KNBS	Kenya National Bureau of Statistics
MFs	Manufacturing Firms
MCE	Minimum Chi Square
MLE	Maximum Likelihood Estimate
NIPF	National Industrial Policy Framework
NBM	Negative Binomial Model
PRM	Poisson Regression Model
SEZ	Special Economic Zone

Table of Contents

1. Introduction

1.1 Background

Currently, there are wide variations in the number of manufacturing firms[1] (MFs) located in various Kenyan counties, with some counties[2] being the preferred choice by over 100 firms, while others have not attracted any firm (Kenya National Bureau of Statistics-KNBS, 2009). These variations are further confirmed by the National Industrial Policy Framework-NIPF (2011 to 2015), which indicates that manufacturing firms in Kenya have largely been concentrated in a few peri-urban and urban areas, especially along the Mombasa–Kisumu highway, resulting in disparity and unequitable regional development. This is an indication that there may be barriers within some counties that make them not attractive to firms as their preferred location for investment. Stated otherwise, there are some location factors that lead to variation in the number of manufacturing firms located in Kenya.

Counties as locational units emerged following the enactment of a new constitution in year 2010. They are 47 in Kenya, and of varying sizes. The creation of these counties was informed by the need to devolve[3] some government services and power to the grassroots as opposed to the previously centralized system that constituted only the national government. According to part 2 of the Fourth Schedule of the Constitution of Kenya, county governments are empowered and mandated to address the following issues: agricultural issues, trade development and regulation, county planning and development, county public works and services, county health services, cultural activities and public amenities, county transport, animal control and welfare, control of pollution, pre-primary education and village polytechnics, as well as coordinating the participation of communities in governance. With the mandate to handle this wide spectrum of functions, and given that counties will raise own revenue as well as receive funds from the national government pursuant to article 202(1) and 203(2) of the Constitution of Kenya (2010), then they should be able to chart forward their economic agenda.

[1] Manufacturing firms constitute all categories of firms (small, medium and large) involved in various manufacturing activities as captured in the manufacturing firms' census conducted by KNBS in 2009. The classification of manufacturing activities done by these firms is as per ISIC- Revised 4.

[2] Counties as locational units in Kenya are as elaborated in the First Schedule of the Constitution of Kenya 2010 pursuant to Article 6(1). They, however, comprise several administrative districts, which previously existed long before year 2010.

[3] See objects and principles of devolution as captured in Article 174 and 175 of the Constitution of Kenya.

1.1 Overview of Kenya's Industrial Policy

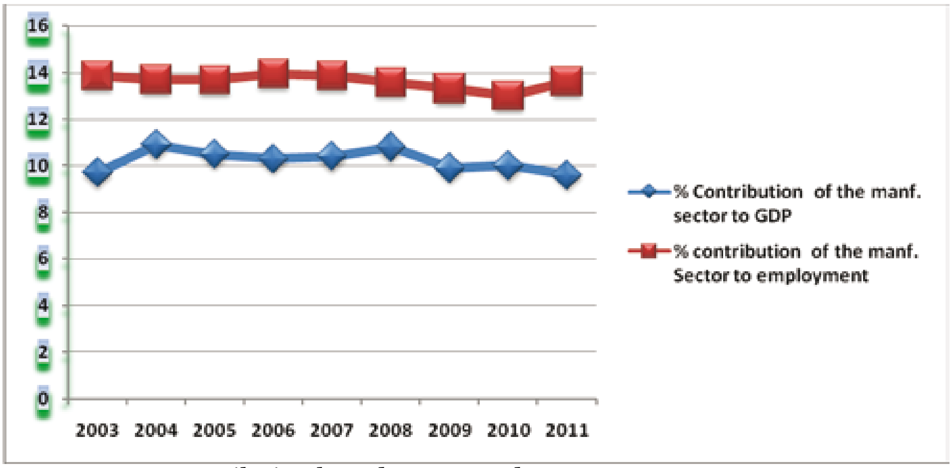
In Kenya, policy makers recognize the immense potential of the manufacturing sector. According to NIPF 2011-2015, industrial policies in Kenya have evolved through three distinct policy orientations, starting with the import substitution policy that was embraced soon after independence in 1963, followed thereafter by an export-led policy orientation and, ultimately, industrial development policies inspired by the Structural Adjustment Programmes (SAPs) that dominated much of the 1990s. From year 2000, industrial policies tend to be based on the government policy priorities as spelt out in the two major policy documents, namely the Economic Recovery Strategy (ERS) for Wealth and Employment Creation (2003-2007), Kenya Vision 2030, and most recent the NIPF 2011-2015. One key feature of the Kenya Vision 2030 and NIPF is the push for the growth of industrial manufacturing clusters in Kenyan regions as a way of enhancing regional growth and employment. Further, the two policy documents assert that growth of the sector is important for alleviating unemployment and spearheading economic growth.

Despite the implementation of ERS which, among other issues, emphasized employment creation, unemployment has continued to persist as evidenced in Figure 1.1. Further, despite the prescription by Kenya Vision 2030 and NIPF on the need for industrial clusters in Kenyan regions in order to influence regional employment and growth, huge variations in terms of location of manufacturing firms still exist as evidenced in Figure 1.2. Consequently, given that the two critical policy documents were formulated before the operationalization of county governments, then there is need for continuous policy review in order to address the emerging policy needs necessitated by operationalization of the devolved system of government.

1.2 Performance of Manufacturing Sector in Kenya's Economy

Creation of employment by manufacturing sector arises since production of manufactured goods requires direct employment of workers in plants as well as indirect employment accruing from provision of firm inputs from producers of raw materials and suppliers of services as well as in the distribution chain of the final goods. This is further concurred by Bigsten *et al.* (2010) who assert that such growth is critical in generating jobs for the rapidly growing labour force and transforming the economy into a high-capital economy. However, the contribution of the manufacturing sector in Kenya to economic growth and employment has not been very impressive (Figure 1.1). Contribution to GDP has stagnated around 10 per cent for a relatively long period, while contribution to employment creation

Figure 1.1: Manufacturing sector contribution to GDP and employment



Source: Own compilation based on KNBS data

has stagnated around 13 per cent (KNBS, various). For the period 2007 to 2011, the average contribution of manufacturing sector to GDP was 10.0 per cent, while the average contribution to total wage employment was 13.4 per cent, with a total of 201,495 persons directly employed in large scale firms as at the end of year 2011 (KNBS, 2012). The main industries contributing to Kenya's manufacturing sector performance are food manufacturing, beverages and tobacco, textile and clothing, leather, furniture, petroleum, paper and metal products (KNBS, 2012).

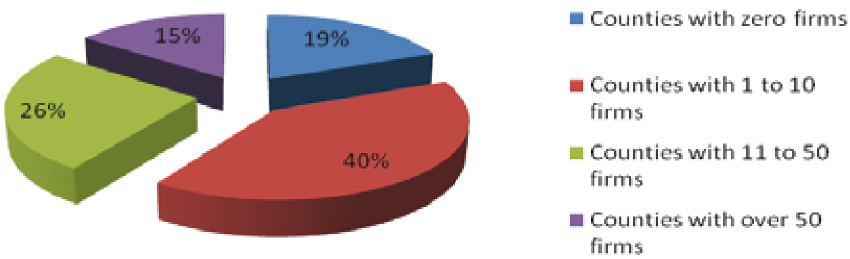
1.3 Location of Manufacturing Firms across Kenyan Counties

According to Manufacturing Firms' Census of 2009, there are a total of 2,097 firms located and distributed across 47 counties and performing various types of manufacturing activities (Figure 1.2 and 1.3).

Among the counties where there is no single manufacturing firm are Tana River, West Pokot, Samburu, Turkana, Wajir, Busia, Nyamira, Lamu and Isiolo. Nairobi county has the largest number of firms,with 1,053 firms. Other counties that have attracted over 50 firms are Kiambu with 189 firms, Mombasa with 126, Murang'a with 128, Kirinyaga with 91, Nyeri with 62 and Nakuru with 84 firms. The rest of the counties have between 1 and 49 firms.

Why do disparities in regard to location of manufacturing firms exist across counties? Before delving on the probable answer to this question, it is important to foremost appreciate that for centuries, geographic space has been a factor in economic models (von Thunen, 1826). Further, as indicated by Combes *et al.* (2008), economists and geographers have always considered economic space

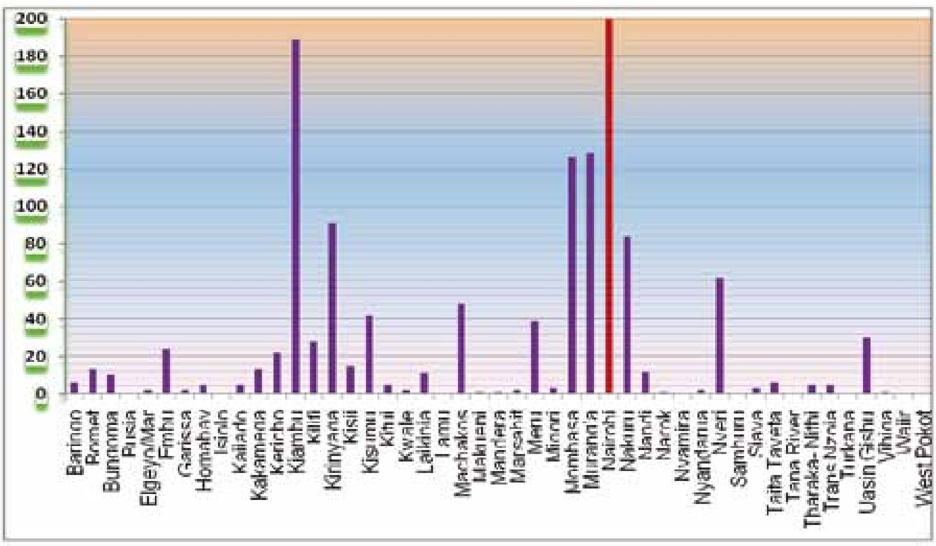
Figure 1.2: Percentage (%) distribution of manufacturing firms across Kenyan counties



Source: Own compilation based on KNBS data on MF's census of 2009

as an outcome of a system of countervailing forces, leading to the economic landscape being characterized by disparities of varying degrees. It is evident that Kenyan regions are not endowed the same way, hence they exhibit various disparities (Government of Kenya, 2011; Ng'ang'a and Njenga, 2010), which may be impacting on the number of firms attracted across counties. As shown in Figure 1.4, it is evident that some of these disparities may be impacting on the number of firms located in various counties.

Figure 1.3: Number of manufacturing firms in every county (2009)



Source: Own compilation based on KNBS data on Manufacturing Firm's Census of 2009

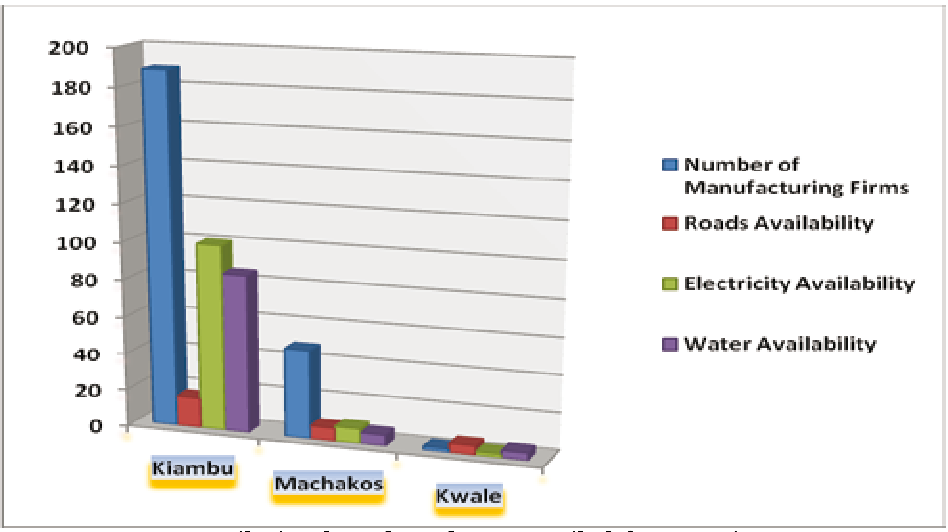
Figure 1.4 illustrates Kiambu County as one of the counties that has been chosen to represent those with a large number of manufacturing firms. Machakos County, on the other hand, represents counties with mid level number of firms, while Kwale represents those with very few firms.

1.4 Problem Statement

Following the promulgation of the Constitution of Kenya (2010), county governments have emerged as the new units of devolution. One of the objectives of devolution was to promote equitable social economic development and provide proximate, easily accessible services throughout Kenya (Constitution of Kenya, 2010). To achieve the objectives of devolution, counties have been mandated to set their own development agenda by handling various functions geared towards addressing social economic challenges that affect them. As elaborated in Kenya's Vision 2030, some of the key social economic challenges affecting all Kenyan regions are unemployment and poverty. To tackle these challenges, Kenya's Vision 2030 prescribes the need to have a robust manufacturing sector, which involves nurturing of region-specific manufacturing clusters since different Kenyan regions are suitable for different manufacturing activities.

However, despite the prescription by Kenya's Vision 2030, there are huge variations in the number of manufacturing firms located in various Kenyan

Figure 1.4: An analysis of the number of manufacturing firms and a few locational characteristics



Source: Own compilation based on data compiled from various sources as at year 2009 counties as has been elaborated in Figures 1.2 and 1.3. Nairobi has attracted the highest number of firms (1,053), followed by Kiambu (186), while 9 counties have been unable to attract even a single firm. This scenario clearly shows huge variance and disparity.

Therefore, the key concern is why are there such huge variations in the number of manufacturing firms located across Kenyan counties. Further to this concern, it is equally puzzling that a quick analysis of the Manufacturing Firms' Census conducted in year 2009 reveals that 83 per cent of the counties have attracted less than the mean[4] of 44 firms per county. Secondly, given that counties are new units in Kenya, there is likelihood of a knowledge gap on how various location characteristics may be impacting on the number of firms in a given county. Therefore, this study sought to investigate and address these concerns and the existing knowledge gap.

1.5 Objectives of the Study

The objectives of this study are to:

(i) Establish the extent of variation in the number of manufacturing firms located across counties;

(ii) Determine the factors that influence the location of manufacturing firms across counties;

(iii) Ascertain the extent by which various factors influence the location of manufacturing firms across counties; and

(iv) In reference to the findings of i, ii and iii above, make appropriate policy recommendations.

1.6 Research Questions

The study seeks to answer the following pertinent research questions:

(i) To what extent does the number of manufacturing firms located in Kenyan counties vary?

(ii) What are the locational factors that determine the location of manufacturing firms in counties?

(iii) To what extent do these locational factors influence the location of manufacturing firms?

[4] This is own compilation based on aggregated data for the previous districts that constitute a single county.

(iv) What are the policy implications for counties that would want to attract and retain manufacturing firms?

1.7 Justification and Relevance

Development of manufacturing base in counties can be an important intervention towards addressing unemployment and poverty, especially by enhancing the growth of manufacturing sector clusters in all Kenyan regions (Government of Kenya, 2007). The growth of the sector is anchored on the need for development of industrial enablers throughout the country, which are to serve as seedbeds of Kenya's industrial takeoff (Kenya's Vision 2030) and ultimately propel the nation to be the preferred choice of basic manufactured goods in East and Central African markets. Towards this end, it is important to increase the number of manufacturing firms all over the counties whereby, as a starting point, it will be critical to understand the reasons behind existence of the current uneven distribution and location of such firms across counties.

Policy recommendations emanating from this study would be important in advising county governments on how to optimize county locational advantages and/or nurture county locational disadvantages, in order to attract firms to locate in such counties. Further, the national government will also find this study relevant while exploring avenues for supporting county governments to attract firm investments. Lastly, it is hoped that this study will help reduce the knowledge gap in relation to locational characteristics that induce manufacturing firms to locate in any given county.

2. Literature Review

As expressed by Arauzo and Manjón (2011), studies on location decisions of manufacturing firms are very heterogeneous in terms of the theoretical approaches used, independent variables chosen and their measurements, methodologies used, and spatial areas considered. In this section, therefore, synthesis of literature has taken into account this heterogeneity before finally giving an overview on what has been adopted for this study.

2.1 Theoretical Approaches

Industrial location analysis is anchored on location theory, which finds its roots in the works of Weber (1929), Isard (1956) and most recently by economic geographers and other scholars such as Hayter (1997) and Combes *et al*. (2008), among others. According to Hayter (1997), the main theoretical approaches in regard to location theory are the neoclassical, behavioural and institutional approaches.

Under the neoclassical theory, the decision setting involves rational agents choosing optimally a site among a set of finite alternatives (Hayter, 1997). This implies that factors that attract firms in a given location are those affecting expected benefits derived from the decision to locate in a particular site, and involves quantitative location characteristics such as land costs, transportation costs, agglomeration economies, human capital characteristics, among others (Hayter, 1997; Arauzo and Manjón, 2011).

The behavioural approach is distinguished from neoclassical approach since it calls into question the assumptions of rationality and perfect information, arguing that firms have limited knowledge to take their location decisions in a world of uncertainty (Figueiredo, Guimarães and Woodward, 2002; Hayter, 1997; Arauzo and Manjón, 2004). The behavioural approach, therefore, is concerned with internal factors such as firms own circumstances, for example firm size, age, entrepreneurial ability, relations with consumers, among others. These can influence firm's location decisions (Figueiredo, Guimarães and Woodward, 2002; Hayter, 1997; Arauzo and Manjón, 2004).

Lastly, the institutional approach argues that firms are not isolated agents, but operate within the framework which has regional systems, governments, clients, competitors and other public institutions (Arauzo, 2005; and Hayter, 1997). Therefore, these other institutions make decisions that potentially modify the attractiveness of sites. Empirical evidence on this is provided by studies by Bartik (1985), Woodward (1992) and List and McHone (2000).

2.2 Empirical Literature

Various empirical studies have used different variables, various methodological approaches, different variable measurements, different units of locations, and even their findings have been different.

The broad categories of locational variables that attract manufacturing firms include: infrastructural characteristics, input market characteristics, output market characteristics, labour characteristics, and agglomeration economies (Badri, 2007; Arauzo and Manjón, 2004 and 2007; Cieslik, 2005; Samik and Sanjoy, 2005; Guimaraes *et al*., 2004; and Holl, 2004). Infrastructural characteristics include cost of various means of transport, availability and cost of various means of communication, availability and cost of warehousing and storage facilities, accessibility and cost of electric power, accessibility and cost of water, and availability of financial institutions and related financial costs. Input market characteristics include proximity, cost and size of raw materials, and availability and cost of land. Output market characteristics are size of output market, distance and cost of transportation to the output market, and preferences and potentiality for future expansion of output market. Labour characteristics are availability of labour, and cost and skills of the labour force, while agglomeration economies comprise of urbanization and localization economies.

Since various empirical studies have used different variables, literature on variable measurements has been restricted to only those discussed in this paper. In relation to agglomeration economies, focus on manufacturing firms per square area has been adopted by Rosenthal and Strange (2003), Guimaraes, Figueiredo and Woodward (2002), Bartic (1989) and Guimaraes (2004). McNamara (2009) divided the number of manufacturing firms with total number of business establishments in a county, while Lambert *et al.* (2006) used the percentage of those employed in manufacturing firms per county. Cieslik (2005) used number of firma, while Otsuka (2008) and Henderson and MacNamara (2000) measured agglomeration economies by the number of manufacturing firms in a region divided by regional population. Finally, Arauzo and Manjón (2011) used number of workers in the industrial sector divided by area. In regard to roads availability, Cieslik and Ryan (2005) and Fernandez and Sharma (2012) used total length of the roads, while Coughlin and Segev (2000) used road length divided by area. In regard to measuring the cost of land, Figueiredo, Guimarães and Woodward (2002) used population density, Lambert and McNamara (2009) used county area, while McNamara and Kriesel (1991) used price per acre of land. Muluvi (2011) used choice variable to proxy access to land as a factor under business environment. Concerning insecurity, Fernandez and Sharma (2012) used per capita murder rate as a determinant of clusters in Indian manufacturing.

In terms of empirical results, availability of road infrastructure influences firms' location decisions (Cieslik, 2005; Coughlin and Segev, 2000; Holl 2004; and Coughlin *et al.*, 1991). Secondly, land availability has been found to influence firms' location decisions (Bartik, 1985; Papke, 1991; Woodward, 1992 and Figueiredo, Guimarães and Woodward, 2002). Further, agglomeration economies have also been found to influence industrial location (Arauzo and Manj´on, 2004; Autant, 2006; Basile, 2004; Guimaraes *et al.*, 2000 and 2004; Woodward, 1992; and Arauzo, 2005). Studies by Coughlin *et al.* (1991), Woodward (1992), Arauzo and Manjón (2004), Barbosa, Paulo and Douglas (2004) and Cieslik (2005) found labour availability as a determinant of firms' location decisions. A study by Carlton (1983) found energy price as a significant determinant of industrial location. Studies by Guimaraes *et al.* (2000), Woodward (1992), Holl (2004), List (2001) and Lambert and McNamara (2009) found that product market influences firms' location decisions. Availability of raw material was found to influence firm's location decisions by Goetz (1997), and Henderson and McNamara (1997 and 2000).

In regard to the choice of models used in industrial location, Discrete Choice Models (DCM) and Count Data Models (CDM) have been used extensively. According to Arauzo and Manj´on (2004), Becker and Henderson (2000) and Guimaraes *et al.* (2004), the two models are consistent with the idea of firms choosing optimal locations subject to standard constraints. Under CDM, the unit of analysis is the location, and the concern is the factors of that location that may affect location decisions. Under DCM, the unit of analysis is the firm and the main concern is how certain characteristics of the firm, such as size, affect location decisions (McFadden, 1974, Manj´on and Arauzo, 2007). Under CDM, studies by Cieslik and Ryan (2005), Manj´on and Arauzo (2007), Barbosa, Paulo and Douglas (2004) and Otsuka (2008) have used Poisson Regression Models (PRMs), while studies by Coughlin and Segev (2000), Cieslik (2005), Holl (2004), Henderson and McNamara (2000) and Arauzo (2008) used Negative Binomial Models (NBMs). Under DCM, studies by Bartik (1985), Woodward (1992), Guimaraes *et al.* (2002; 2004), McNamara and Kriesel (1991) used Conditional Logit Model (CLM). Studies by Goetz (1997) and Henderson and McNamara (1997) used Ordinary Least Square (OLS) technique.

Further, various empirical studies have used various dummy variables to capture regional effects. Arauzo and Manj´on (2011) used a dummy variable for shore lines in order to determine whether industrial location favoured coastal regions. Henderson and McNamara (2000) used a dummy variable to capture the effect of a city on industrial location, while Figueiredo, Guimarães and Woodward (2002) included a dummy variable to account for state level characteristics.

Finally, studies by Woodward (1992) in USA, Arauzo and Manj´on (2004) in Spain, Arauzo (2008) in Spain, Becker and Henderson (2000) in USA, Coughlin and Segev (2000) in USA, List (2000) in USA and Guimaraes (2004) in USA have considered counties as their location for analysis. Studies by Holl (2004) in Portugal, and Arauzo and Manj´on (2007) in Spain have studied municipalities while studies by Bartik (1985) in US, Coughlin *et al.* (1985) in US, Basile (2004) in Italy considered states as the locations. Finally, a study by Figueiredo, Guimarães and Woodward (2002) in Spain used districts as the location of analysis.

2.3 Overview of Literature

Owing to the fact that this study lays more emphasis on locational characteristics of Kenyan counties, the most appropriate theoretical approach to inform the conceptual framework is the neoclassical approach, since it focuses on locations as the unit of analysis. Due to lack of firm level data on firms' behavioural characteristics across all counties, the behavioural approach cannot be focused upon. Further, given that the institutional approach may require the presence of operational county governments, then focusing on this theoretical approach cannot be feasible for the Kenyan case as at now. It is important that future studies should try and focus on these approaches.

It is evident that empirical research on industrial location in African economies is not extensive, an indication of knowledge gap especially for a country such as Kenya, which has now embraced a devolved government system. Secondly, insecurity level and availability of water has not been extensively considered in many studies, probably because western countries where the majority of such studies have been done have limited internal security and water challenges. This, therefore, serves as a motivation to include the two variables in this study, given that they are a major concern in Kenya (RPED, 2004) and also the two are hypothesized to influence location decisions (Badri, 2007). Land and roads infrastructure are major concerns in Kenya, and therefore it will also be critical to investigate whether they impact on industrial location. Further, this study will investigate whether agglomeration economies play any role in firm location.

Lastly, given that firm level data on industrial location determinants for all counties is unavailable, this study has chosen to use CDM in the analysis as detailed in section 3.2.

3. Methodology

3.1 Conceptual Framework

The conceptual framework for this study is drawn from the neoclassical theoretical approach, which focuses on geographical location as the unit of analysis. Location theory is concerned with the geographic location of economic activity and is often used as a framework for analyzing the firms' establishments in various locations and location decisions of manufacturing firms (Barbosa, Paulo and Douglas, 2004; Manj´on and Arauzo, 2007; Lambert and McNamara, 2008; Otsuka, 2008 and Brown *et al.*, 2009). Consequently, a location model is used to provide a conceptual basis for specifying the manufacturing firms' establishment (Goetz, 1997; Henderson and McNamara, 1997 and 2000; Guimaraes *et al.*, 2004; Samik and Sanjoy, 2005; and Brown *et al.*, 2009).

According to Weber (1929), Isard (1956) and Hayter (1997), the ability of a given location to attract manufacturing firms will depend on the characteristics of the location relative to the levels of the same characteristics in another location, an indication that the number of firms attracted in a given location may be consistent with the location's comparative advantage. Further, Weber (1929) opined that optimal location selection by a firm is a trade-off between transport costs of inputs to production facilities and outputs to product markets. Under location theory, various locations characteristics affect firms' establishments in those locations. As has been expounded in literature, location characteristics that attract manufacturing firms are enormous but some factors are, however, least investigated depending on problems affecting various geographic locations. However, this study has conceptualized that the following characteristics affect the number of firms attracted in Kenyan counties. The justification for their choice is elaborated in Table 3.1.

3.2 Empirical Model Specification

From the illustration on conceptual framework, it is evident that the dependent variable is count (non-negative integer including zero) in nature. Owing to the fact that it would be critical for this study to capture the nine Kenyan counties with zero counts, then Count Data Model (CDM) becomes more applicable in this study as compared to Discrete Choice Model (DCM) and OLS technique.[5] Under

[5] The OLS estimator is inappropriate for count data since it specifies a conditional mean function that may take negative values and a variance function that is homoskedastic (Cameron and Trivedi, 1998). Further, if the conditional mean function is in fact exp(xβ), the OLS estimator is inconsistent for β and the computed OLS output gives the wrong asymptotic variance matrix.

CDM, zero observations contribute to the likelihood function (Lambert *et al.*, 2006; Mullahy 1997; Cameron and Trivedi 1998). Drawing from Guimaraes *et al.* (2003) and Greene (1994), it will therefore be appropriate for this study to avoid DCM since the likelihood function is always zero for those locations that have not attracted[6] any firm. The advantage of CDMs rests on the assumption of a discrete probability distribution for the count variables, followed by the parameterization of the mean of the discrete distribution as a function of explanatory variables (Winkelmann, 2008; Lambert *et al.*, 2006; and Cameron and Trivedi, 1998).

Under CDM, the manufacturing firms' location decisions can be empirically examined by calculating how changes in location characteristics affect the number of firms attracted in location *j* in a given period of time (Arauzo, 2005 and 2008). Although, several types of discrete probability distributions may be considered in modelling count data, the workhorse discrete distributions are the Poisson and the Negative Binomial (NB) distributions (Winkelmann, 2008; Cameron and Trivedi, 1998). Poisson distribution is a discrete probability distribution for the counts of events that occur randomly in a given interval of time or space, whereby the mean and the variance are assumed to be equal. Letting *Y* be a random variable with discrete distribution, then *Y* has a Poisson distribution with parameter λ, written as Y (λ) Poisson if and only if the probability function is as follows:

$$P(Y=k)=\frac{e^{-\lambda}\lambda}{k!} = 0, 1, 2, \ldots \quad (1)$$

Whereby the expected value of *Y* is given as:

$$E(Y) = \lambda = Var(Y) \quad (2)$$

Consequently, PRM is derived from the Poisson distribution by allowing the intensity parameter λ in equation 2 to depend on covariates (regressors) (Cameron and Trivedi, 1998). The advantage of the Poisson Regression Model (PRM) and Negative Binomial Models (NBM) is that they explicitly recognize the non-negative integer character of the dependent variable (Winkelmann, 2008; Lambert *et al.*, 2006; Cameron and Trivedi, 1998; and Greene, 1994). Following Lambert *et al.* (2006), Arauzo (2005 and 2008), Alanon *et al.* (2007), Autant-Bernard (2006) and Basile (2004), this study applies equation 2 into manufacturing firms' location analysis by assuming that the number of firms (y_i) observed in location *i* (county *i*) is drawn from Poisson distribution with parameter λ_i related to a vector of explanatory variables (x_i) that represents a set of location (county) characteristics. λ_i is defined as an exponential function of a linear index of (x_i) in order to account for observed heterogeneity (observed differences among sample members), that is $\lambda = \exp(\beta_1+\beta_{2x2}+\ldots+\beta_{kxk})$ (Winkelmann, 2008 and Long and Freese, 2001). This

[6] In nine Kenyan counties, there is no single manufacturing firm that has located there (KNBS, 2010).

exponential form ensures that λ_i remains positive for all possible combinations of explanatory variables (x_i). Consequently, the expected value of manufacturing firms (y_i) in county *i* is given as:

$E[y_i/x_i] = Var[y_i/x_i] = \lambda_i = e^{\beta' x_i}$ ....(3)

According to Cameron and Trivedi (1998), in the log-linear version of the model, the mean parameter as equal to the variance is parameterized as $\lambda_i = \exp(\beta' x_i)$ to ensure $\lambda_i > 0$ implying that:

$\ln\lambda_i = \beta' x_i$ ....(4)

However, as explained by Winkelmann (2008), Cameron and Trivedi (1998) and Greene (1994), as in standard regression analysis, modelling of count data requires supplementing estimation with additional tests in order to determine whether the fitted model is adequate and a specific deficiency of any initially entertained model can be removed by progression to a less restrictive model. Consequently, this calls for conducting mis-specification tests before final adoption and generations of estimates using equation 3.

3.2.1 Mis-specifications tests in regard to Poisson distribution assumptions

The mis-specification tests are anchored on various assumptions of Poisson distribution and are therefore designed to highlight inadequacy of the maintained model.

Foremost, the key assumption of the Poisson model is that the mean and variance are equal (equidispersion) (Mullahy, 1997; Cameron and Trivedi, 1998; and Winkelmann, 2008). Owing to overconcentration of firms in some counties as elaborated in Figure 3.1 and Table 3.1, the variance for the dependent variable is greater than the mean, leading to failure of assumption of equidispersion, a problem called over-dispersion.[7] Over dispersion arises from the existence of unobserved heterogeneity in conditional mean parameter (Mullahy, 1997; Cameron and Trivedi, 1998; and Winkelmann, 2008) and implies that inferences from Maximum Likelihood Estimates (MLEs) are no longer valid.

From Table 3.1, given that the variance for the dependent variable is 24,171.94 and exceeds the mean of 44.62 by a huge figure of 24,127.82, the use of a PRM becomes inappropriate, hence the initial justification for the use of a compound Poisson distribution like NB distribution.

[7] It is worth noting that failure of the Poisson assumption of equidispersion has similar qualitative consequences to failure of the assumption of homoskedasticity in the linear regression model (Cameron and Trivedi, 1998).

Table 3.1: Detailed summary statistics for the dependent variable (manufacturing firms)

	Percentiles	**Smallest**		
1%	0	0	-	-
5%	0	0	-	-
10%	0	0	Observations	47
25%	1	0	Sum of Weight	47
50%	5		Mean	44.61702
		Largest	Std. Deviation	155.4733
75%	28	126		
90%	91	128	Variance	24171.94
95%	128	189	Skewness	6.006992
99%	1,053	1,053	Kurtosis	39.33019

The second assumption of the Poisson involves an excess of zero (Winkelmann, 2008; Cameron and Trivedi, 1998; Greene, 1994). In case of excess zeros, zero inflated NBM and/or zero inflated Poisson model are used, since they assume a degenerate distribution whose mass is concentrated at zero (Manj`on and Arauzo, 2007; Winkelmann, 2008; Cameron and Trivedi, 1998). However, in this study, this assumption is not violated. This is so because zero inflated NBM requires theoretical underpinning that some locations are ineligible for a response (Winkelmann, 2008). This is not feasible in Kenya, since there is no theoretical underpinning or any form of restriction that any given county is eligible for a non-zero response in terms of location of manufacturing firms. The only apparent scenario is that in nine Kenyan counties, the response has not yet occurred.

3.2.2 Remedy to violation of Poisson assumption(s)

The NBM is a generalization of the Poisson, where the variance of the distribution is allowed to be different from the mean and is motivated by desire for a greater flexibility to account for frequently observed overdispersion in data and to provide for a better fit (Cameron and Trivedi, 1998). The implication for the unobserved individual heterogeneity is that the true mean is not perfectly observed. Consequently, beyond NBM accounting for the observed heterogeneity (observed differences among sample members), just like the PRM, it also allows for multiplicative unobserved heterogeneity into the conditional mean (Long and Freese, 2001) by assuming that:

$E\,[y_i / x_i, \varepsilon^i] = e^{[(\beta' xi) + \varepsilon i]} = \lambda_{i\varepsilon i}$ ....(5)

where ε_i has gamma distribution with unitary mean and constant variance α (Long and Freese, 2001; Cameron and Trivedi, 1998; and Winkelmann, 2008). Thus, the expected value of y^i in the NBM is exactly the same as in the Poisson model, but variance differs and exceeds the mean as indicated below:

$var[y_i/ x_i]= E[y_i/x_i][1+\alpha E (y_i/x_i)]$ ....(6)

Consequently, owing to overdispersion and the fact that all Kenyan counties are eligible for a count, then drawing from equation 3, this study has used the NBM fully specified below:

$lny_i=\omega+\beta_1 INSECURITY_i+\beta_2 AGGLOMERATION_i+\beta_3 WATERACCESS_i+ \beta_4 ROADS AVAILABILITY_i+\beta_5 COSTOFLAND_i +\beta_6 REGIONALDUMMY_i+\varepsilon_i$........................(7)

The dependent variable $(y_i)^8$ in equation 5 is the count of manufacturing firms observed in county *i,* and which is drawn from NB distribution with parameter λ_i defined as in equation 3, and which is related to the observed county characteristics on the right hand side as well as to the unobserved heterogeneity in various counties given by ε_i. The independent variables have been described in details in Table 3.1, including their measurements, expected sign and specific justification for their use.

3.3 Data Type and Sources

The study has used cross-sectional data gathered from various sources as elaborated in Table 3.3.

Table 3.3: Data sources

Variable	Data source and year
Manufacturing firms	KNBS (Manufacturing Firm's Census, 2009)
Insecurity level	KNBS (Statistical Abstract and submitted provincial reports, 2009)
Agglomeration	KNBS (Manufacturing Firm's Census, 2009)
Water availability	KNBS (National Population and Housing Census, 2009)
Roads availability	Ministry of Roads
Cost of land	KNBS (National Population and Housing Census, 2009)

Table 3.2: Variable measurements

Variables	Measurement & Exp. Sign	Justification for the choice of variable and the measurement adopted
INSECURITY: county insecurity level	Number of reported criminal incidents to the police, divided by county population (per capita crime). The expected sign is negative.	According to Kenya's Vision 2030, unfavourable business environment, including incidences of insecurity, affects the manufacturing sector. Insecurity level impacts on firm's cost structure and also affects human capital choice of locations (RPED, 2004). The measurement has been chosen because it captures all types of crime. This study has gone beyond the study by Fernandez and Sharma (2012) which considered per capita murder rate to include all types of reported crimes in the counties
AGGLOMERATION: agglomeration economies	Number of MFs divided by county area. The expected sign is positive	Agglomeration is the accumulation of business activity in and around a specific geographic area whose benefits include access to external services at a lower cost (Cohen and Paul, 2005; Henderson and McNamara, 1997). Variable measurement concurs with Rosenthal and Strange (2003), Figueiredo, *et al.* (2002), Bartik (1985) and Guimaraes (2004)
WATERACCESS: water accessibility	Percentage number of households per county with access to improved water The expected sign is positive	According to Kenya's Vision 2030, water supply is critical for manufacturing sector development. Further, given that among Kenyan industries, agri- based processing has the largest share at 48.83% (KNBS, 2010), and given that sustainable agricultural production in Kenya is primarily anchored on availability of water (KNBS, 2011), then estimating the effect of this variable is of great importance. Further, it is also critical to note that agricultural issues will be handled by county governments (Constitution of Kenya, 2010). The assumption is that the higher the densities for the households with access to improved water in a given county, the more the likelihood that the county has more access to water for industrial use compared to another county whose density is low
COSTOFLAND: cost of land	Population density. The expected sign is positive	This study will follow Figueiredo, Guimaraes and Woodward (2002) and use population density to measure land costs. Firms search for sites where land costs are relatively lower (Bartik, 1985) so that they can acquire more space for current projects and future expansions (Henderson and McNamara, 1997; and Coughlin *et al*., 1991)
ROADSAVAIL: roads availability	Length of all the categories of road network in a county divided by county area. The expected sign is positive	Lack of roads may lead to high costs in access to input and product market. Road infrastructure encourages plant locations by creating access to factor and product markets (Government of Kenya, 2007; and Lambert and McNamara, 2009). The measurement adopted concurs with Cieslik and Ryan (2005) and Fernandez and Sharma (2012)
REGIONALDUMMY: dummy for different Kenyan regions	1= Counties having a city 2= Middle level counties 3= Counties predominantly semi arid	Different Kenyan regions have different manufacturing potential (GoK, 2007 and 2010). Since location factors are heterogeneous across space, then inference from single location models may miss important regional variations. There is need for clusters to compare regions. The variable measurement borrows from Henderson and McNamara (2000) and Arauzo and Manj`on (2011) for city counties and shore line regions, respectively

4. Results and Discussions

4.1 Summary Statistics

The results of summary statistics are given in Table 4.1. From Table 4.1, the number of observations is 47, implying that all the 47 Kenyan counties have been brought on board, including all the variable measurements. With regard to agglomeration economies, cost of land, insecurity level, and roads availability, the mean is closer to the minimum value, an indication that there are some extreme values/disparities between some counties on these characteristics. Given the mean measure of water accessibility is 44.54633, and that the minimum and maximum measures are 14.9891 and 75.69897, respectively, then per capita households' access to improved water does not exhibit very huge disparities across counties. While the mean of the dependent variable is 44, minimum value is 0 and the maximum value is 1,053. The implication is that the number of manufacturing firms attracted across counties exhibit substantial disparity.

4.2 Regression Results

The results for the determinants of manufacturing firms' location in Kenyan counties are as presented in Table 4.2. From the results in Table 4.2, three critical issues are evident. Foremost, the chibar^2 (01) =405.13 (this is the likelihood ratio of chi-square test that the dispersion parameter alpha is equal to zero) is large and the Prob>=chibar^2=0.000 is significant. This suggests that the dependent variable is overdispersed and is not sufficiently described by Poisson model, a further justification for the use of NBM in this study. Secondly, all counties, even those with zero observations, have been captured in the likelihood estimate of the NB regression. Secondly,

Table 4.1: Summary statistics

Variable	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
MFs	47	44.61702	155.4733	0	1053
Insecurity level	47	0. 268353	0. 2485892	0. 03315	1.52503
Agglomeration	47	5.130099	23.38772	0	151.5108
Water accessibility	47	44.54633	14.47062	14.9891	75.69897
Roads availability	47	87. 73787	90. 51038	6.66	435
Cost of land	47	405.8615	882.5898	4.1	4516
Regional dummy	47	2.297872	0.5866224	1	3

Source: Own analysis

Table 4.2: Negative binomial regression results

Variables	Coefficients	Standard errors
LR $chi^2(7)$ = 66.23; Prob > chi^2 = 0.0000; $chibar^2(01)$ = 405.13; Prob>=$chibar^2$ = 0.000; Dep. Variable = MFs; Number of obs = 47		
Variables	**Coefficients**	**Standard errors**
Constant	1.556468	1.41843
Insecurity	-2.992324*	1.194525
Agglomeration	0.03418*	0.0158144
wateravail	0.0248206*	0.0120589
roadsavail	0.0237278 *	0.0057809
Costofland	-0.0024218*	0 .0006797
regionalDummy2	-0.7962587	1.233718
regionalDummy3	-1.222784	1.377648
Notes: * implies significant at 5%		

Source: Own compilation based on NB regression results

the loglikelihood chi^2 (7) given as 66.23 has prob>chi^2 = 0.000. Thirdly, since the prob>chi^2 is significant, we reject the null hypotheses that all the regression coefficients are simultaneously equal to zero, implying that the variables used are joint determinants of the number of manufacturing firms attracted across Kenyan counties.

From the results, insecurity level, agglomeration economies, water accessibility, availability of roads and cost of land are all significant determinants of manufacturing firms' location in Kenyan counties at 95 per cent confidence level. Findings on insecurity are consistent with RPED (2004) and Fernandez and Sharma (2012), while findings on agglomeration economies concur with those of Rosenthal and Strange (2003) and Guimaraes (2004). Further, findings on roads availability concur with Cieslik and Ryan (2005), Fernandez and Sharma (2012) and RPED (2004). Findings on water access reinforce Kenya's Vision 2030, which states that water supply is critical for manufacturing sector development. Findings on cost of land are consistent with Figuerendo *et al* (2002) and McNamara and Kriesel (1991).

4.2.1 Interpretation of the regression results

Taking the case on insecurity, for a unit increase in insecurity, the log of expected counts of the manufacturing firms is expected to decrease by -2.992, which is equivalent to a 95 per cent decrease in the expected counts of the firms, *ceteris paribus*. Secondly, for a unit increase in agglomeration economies, the log of expected counts of the firms is expected to increase by 0.03418, which is equivalent to a 3.5 per cent increase in the expected counts of the firms. Thirdly, for a unit increase in water availability, the log of expected counts of the firms is expected to increase by 0.02482, which is equivalent to a 2.5 per cent increase in the expected counts of the firms. Further, for a unit increase in roads availability, the log of expected counts of the firms is expected to increase by 0.0237, which is also equivalent to a 2.4 per cent increase in the expected counts of the firms Finally, for a unit increase in cost of land, the log of expected counts of the firms is expected to decrease by 0.00242, which is also equivalent to 0.2 per cent decrease in the expected counts of the firms.

Although the results reveal that there is no statistically significant difference between the two regions analyzed and the city region, it is worth noting that the implication for this is that arid and semi-arid counties should consider promotion of manufacturing as an economic and development strategy, and not view it as a strategy favouring developed regions such as cities.

5. Conclusion and Policy Recommendations

5.1 Conclusion

This study sought to investigate the location factors that influence the number of manufacturing firms attracted across Kenyan counties. By using Negative Binomial Regression technique, the study has found that insecurity level, agglomeration economies, availability of water, availability of roads, and cost of land affect the number of firms attracted across Kenyan counties. However, some variables under institutional theoretical approach, such as business permit charges which are theorized to impact on firms' location decisions and which will be within the scope of county governments to handle as per the Constitution of Kenya 2010, have not been captured, since such county data is not currently available. These findings are therefore important for county's development agenda, especially if the focus is to increase the number of firms located in counties as a key strategy of employment creation and poverty reduction.

5.2 Policy Recommendations

There are no inherent barriers, whether legal, theoretical or empirical that can make any county (arid or semi-arid) not to be a location destination for a manufacturing firm. The only existing scenario is that the Kenyan economic space has always remained an outcome of a system of countervailing forces, leading to variations in the degree of economic activities. Thus, some counties have attracted only a few manufacturing firms. Therefore, all counties should proactively consider attracting manufacturing firms as an economic and development strategy. As a starting point, county leadership needs to support the key industrial enablers at the county level by focusing on their locational advantages, as they still minimize the effects of the locational disadvantages.

Availing industrial land and ensuring speedy access of the same

Since it is highly unlikely that the cost of land will come down, the county leadership should consider leasing of land to manufacturing firms at a lower cost as an alternative. If this is not done, such manufacturing firms may be obliged to locate in counties exhibiting more flexibility on land availability at a subsidized cost. Further, county leadership should focus on reducing land transaction costs associated with unclear and/or bureaucratic land acquisition procedures in order to attract manufacturing firms.

Establishment of industrial parks and supporting existing industrial agglomeration sites

Given that counties have been mandated to handle trade issues and county planning (Constitution of Kenya, 2010), they should develop industrial parks as models resembling Export Processing Zones (EPZs) and /or Special Economic Zones (SEZs) to agglomerate firms and thus reap the benefits of agglomeration. Rural counties where the level of agglomeration economies is low but land is cheap and available, can capitalize on establishing such parks as a way of attracting manufacturing firms. County leadership should support locations where firms have agglomerated through infrastructural support in order to further reduce the operating costs of firms. Provision of external services to existing firms and other investments should be supported preferably at a subsidized cost. Also, designating special sites and providing infrastructural support would attract firms to agglomerate around such sites.

Increasing water availability, accessibility and affordability

Given that 48.83 per cent of manufacturing firms in Kenya are involved in agri-based processing and that sustainable agricultural production in Kenya is primarily anchored on availability of water, then increasing water access in counties will go a long way in supporting agri-based processing. This can be done by ensuring that Water Service Providers (WSPs) supply industrial water at subsidized rates so as to reduce costs for firms. In areas where such WSPs are inadequately covered, manufacturing firms can also be allowed to directly tap industrial water from sources within the counties. Further, counties can fund projects involving water-piping, drilling of boreholes and construction of dams.

Increasing roads connectivity

Counties have now been mandated to handle county public works, hence channelling funds to projects that can increase local roads connectivity is a positive strategy for attracting manufacturing firms and other investments. The national government through its various authorities should sustain road construction and repairs. Given that county governments are now mandated to handle county internal roads, then such roads should be more cost effective, of high quality as well as easy to maintain and rehabilitate. Where manufacturing firms want to locate in an interior point where no roads are available, county governments can assist in road construction to create access. Maintenance of major roads will also enhance market access and reduce transportation costs. Further, support of other transport means easing pressure on roads should be encouraged.

Addressing security concerns

County leadership should initiate, complement and support community policing initiatives and hold public security forums in order to reduce incidents of crime, thus boosting the confidence of manufacturing sector investors. Consequently, support to youth empowerment ventures to reduce unemployment should be prioritized. Counties also need to establish systems of monitoring and reacting to the effects of crime incidents on existing and prospective manufacturing firms and other investments.

Finally, it is vital that counties come up with an industrial policy from the onset. To complement this industrial policy, county governments must initiate data collection for various social-economic indicators to aid in implementation of the industrial policy and research. They should also initiate economic promotion with attractive and clear incentive frameworks. Further, counties should ensure that they are a one-stop-shop for licensing and any other industrial needs in order to position the counties as the preferred investment destinations.

5.3 Areas for Further Research

It will be important for future studies to focus on institutional theoretical approach in order to determine whether business rates charged to the firms as well as share of counties budget targeting infrastructural growth impacts on firms' location. Further, focus on behavioural approach once firm level data for a sizeable number of firms preferably across all counties is available will bring forth vital information in regard to the location decisions made by firms. Lastly, other location variables that this study has not included in the regression due to lack of data may be considered in future studies.

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Appendix

Table 1: Detailed NB regression results

xi: nbreg firms insecurity agglomeration water roadsden costofland i.dummy						
Negative binomial regression				Number of obs	=	47
				LR $chi^2(7)$	=	66.23
Dispersion = mean				Prob > chi^2	=	0.0000
Log likelihood = -158.05047				Pseudo R^2	=	0.1732
firms	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
insecurity	-2.992324	1.194525	-2.51	0.012	-5.33355	-.6510984
agglomerat~n	.03418	.0158144	2.16	0.031	.0031844	.0651757
water	.0237278	.0120589	2.06	0.040	.0011855	.0484556
roadsavai	-.0024218	.0057809	4.10	0.000	.0123974	.0350583
costofland	-.7962587	.0006797	-3.56	0.000	-.003754	-.0010896
_R.dummy_2	-.7962587	1.233718	-0.65	0.519	-3.214302	1.621785
_R.dummy_3	-1.222784	1.377648	-0.89	0.375	-3.922925	1.477356
_cons	1.556468	1.41843	1.10	0.273	-1.223603	4.336539
/lnalpha	-.069191	.2499001			-.5589862	.4206041
alpha	.9331484	.2331938			.5717885	1.522881

Likelihood-ratio test of alpha=0: $chibar^2(01)$ = 405.13 Prob>=$chibar^2$ = 0.000

Table 2: Detailed interpretations for the NB regression results

listcoef, percent help, nbreg (N=47): Percentage Change in Expected Count of firms in a given county. Observed SD: 155.47327						
firms	b	z	P>|z|	%	%StdX	SDofX
insecurity	-2.99232	-2.505	0.012	-95.0	-52.5	0.2486
agglomera	0.03418	2.161	0.031	3.5	122.4	23.3874
water	0.02482	2.058	0.040	2.5	43.2	14.4706
roadsavai	0.02373	4.105	0.000	2.4	756.4	90.5104
costoflan	-0.00242	-3.563	0.000	-0.2	-88.2	882.5877
_R.dummy_2	-0.79626	-0.645	0.519	-54.9	-32.8	0.4998
_R.dummy_3	-1.22278	-0.888	0.375	-70.6	-44.8	0.4857
ln alpha	-0.06919	-0.277				

b = raw coefficient
z = z-score for test of b=0 P>|z| = p-value for z-test
% = per cent change in expected count for unit increase in X
%StdX = percent change in expected count for SD increase in X
SDofX = standard deviation of X

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