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Foreign direct investment and food security in South Africa: a spatial analysis at the local municipal level

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Foreign Direct Investment and Food Security in South Africa: A Spatial Analysis at the Local Municipal Level.

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I. Abstract

The aim of this paper is to examine the relationship between foreign direct investment (FDI) and food security at the local municipal level in South Africa. This analysis is based on a cross sectional framework for 2016 and a panel framework over the period 2000 – 2016. Furthermore, the study utilized geospatial analysis. There is currently little to no literature deciphering the relationship between foreign direct investment and food security, in terms of the South African context. The contribution of this paper is to bridge the gap. The results show the importance of an equitable distribution of foreign direct investment, across various local municipalities in South Africa, as a means to alleviating hunger and food insecurity. More specifically, the paper has managed to highlight the fact that municipalities that receive a sufficient amount of foreign direct investment experience lower levels of hunger in comparison to the local municipalities that receive little to no foreign direct investment.

II. Introduction

South Africa is currently facing a crisis known as the paradox of plenty. Enshrined within the South African Constitution (1996), Act 108 states that all South Africans possess the right to the access of sufficient food. With regards to food accessibility and food production alone, South Africa is considered as a nation which is self-sufficient in food production and produces enough calories to adequately feed the population. On the other hand, a study done in 2014 reported that approximately 13 million South Africans were inherently plagued by their inability to acquire the food produced on South African soil (Tsegay , Rusare , Mistry, Magrath , & Willoughby, 2014). In addition, results captured from the 2005/6 Income and Expenditure Survey stated that 81 percent of households were declared incapable of having the sufficient funds to secure a basic nutritional basket of food costing an average of R262 per month in accordance with the prices listed in the year 2005 (Jacobs, 2009) .

Moreover, the South African Health and Examination Survey (SANHANES) had informed South Africans that in the year 2012, 54 percent of households were experiencing hunger or were otherwise at the risk of approaching hunger. Structural factors such as poverty, income inequality

with regards to race, and finally unemployment exacerbate the issue of food insecurity present within South African society. Whilst there has been a decline in chronic poverty since the emergence of the social grants system (1998), the unremitting presence of hunger continues to persist with in numerous households located in South Africa. According to Altman, et al. (2009), in order to reduce long-term poverty and therefore improve the status of food security with in South African households, there is a need for the implementation of meaningful long-term policies which provide work opportunities for the unemployed in order to enable the generation of income.

Studies on the relationship between FDI inflows and economic development emerged during the 1980s. Authors Mihalache-O'keef and Li (2011), analyzed the impact of sectoral FDI on food security founded on the modernization and dependency theories. Whereas, Slimane, Huchet-Bourdon, and Zitouna (2013), investigated the direct and indirect effects of FDI on food security at the sectoral level. Djokoto (2012), explored the impact of FDI within the agricultural sector pertaining to food security in Ghana alone. The three studies mentioned above sought to investigate the link between FDI and food security. The link refers to the impact of FDI on the supply of food. Although the three studies mentioned above are concerned with issues of FDI on food supply, where there is an increase in supply of food due to incoming FDI, however this does not apply to the case under which South Africa is tied to. It goes without saying that food insecurity within South Africa is an issue primarily concerned with the insufficient access to food in comparison to the lack of food supply. Taking this line of thought into consideration the demand side aspect of food security is deemed to be more prevalent as opposed to the supply side within the context of South Africa. Amartya Sen's framework on *The Entitlement Approach,* is a study focusing on the access of food rather than its supply, as the driving force contributing towards the state of hunger. Taking Sen's framework into consideration this paper seeks to investigate the impact FDI, through the transmission channel of employment, has on the forces utilized in the reduction of hunger in South Africa at the local municipal level for the period 2000 – 2016.

The main objective of this study is to analysis the effect that FDI inflows exhibit on hunger and food insecurity in South Africa at the local municipal level. The study attempts to establish if there is a relationship between FDI and hunger within the context of South Africa. A negative relationship is expected. The analysis will make use of cross-sectional and panel data. The cross-sectional data mentioned above relies on four estimation models, namely: Ordinary Least Squares

(OLS) regression, Weighted Least Squares (WLS) regression, Two Stage Least Squares (2SLS) regression, and a Spatial Autoregressive (SAR) model. The panel data relies on seven estimation models, namely: Ordinary Least Squares (OLS) regression, Weighted Least Squares (WLS) regression, Two Stage Least Squares (2SLS) regression, a Spatial Autoregressive (SAR) Panel Model, a Spatially Lagged X Variable (SLX) Panel Model, a Spatial Durbin model (SDM) and a Spatial Error Model (SEM). The data obtained for analysis within this paper is unique as it has not been utilized before within the context of South Africa. The FDI data was obtained from the Financial Times FDI Markets database. Food security related variables from the 2016 *Community Survey* along with *Night Lights* data will be employed. The analysis of the above-mentioned data will be undertaken in order to determine the direct and indirect (spatial spillovers) effects of FDI on food security in South Africa. In terms of the direct and indirect effects, Slimane, Huchet-Bourdon, and Zitouna (2013) determined the indirect effects of FDI on food security, for 63 developing countries, through agricultural production as the endogenous determinant of food availability. However, this study attempts to determine the direct and indirect effects of FDI through the utilization of local municipalities understood as geographical units for the purposes of this study.

With regards to spatial analysis there has been little to no spatial study investigating the impact of FDI on hunger and food insecurity within the South African as well as global context. This paper intends to bridge the gap through the study of the spatial impact FDI has on food security. This paper seeks to highlight the importance of an equitable distribution of FDI throughout the country towards the combating of hunger and food insecurity within South Africa

The remainder of this paper is organized as follows. Following from the introduction, this paper delves into a review of the literature pertaining to FDI and food security, as well as the theoretical framework upon which the foundation of this study rests. This study goes on to discuss the data captured along with the estimation framework utilized to contextualize the issue addressed throughout this study. In addition, the results are presented and discussed through critical analysis. Taking all into consideration, the study is finalized through the drawing of a conclusion, emphasizing the importance of the equitable distribution of FDI.

In other words, this paper highlights that municipalities who receive a sufficient amount of FDI, specifically municipalities within the Gauteng region, experience lower levels of hunger in

comparison to municipalities located within the North West/Northern Cape region who receive little to no FDI.

III. Literature Review

A. FDI and food security

Studies on the relationship between FDI inflows and economic development emerged during the 1980s. These studies were grounded on two opposing theories: the dependency theory and the modernization theory. The dependency theory argues that FDI has a negative impact on both the growth and income distribution of a country. A country's dependency on FDI results in an underutilization and misallocation of the economy's productive forces. The authors specifically focused on developing countries and ultimately concluded that the presence of stagnant economic growth results in the excessive demand in one sector of the economy ultimately generating lower demand in the remaining sectors (Mihalache-O'Keef & Li 2011). The modernization theory considers FDI as an external source of economic development that provides a country with access to international markets. Furthermore, FDI enables the diffusion of new knowledge and skills within the economy of the host country, which not only permits productivity gains, but also improves the efficiency of resource allocation (Slimane et al. 2013). Mihalache-O'Keef and Li (2011), made use of the dependency and modernization theories to explain the relationship between FDI and food security. According to Adams (2009), a country's depedency on FDI results in an underutilization of the economy's productive forces. The author specifically focused on developing countries and ultimately concluded that the presence of stagnant economic growth results in the excessive demand in one sector of the economy ultimately generating lower demand in the remaining sectors. The modernization theory focuses on both the internal and external sources of economic development within a country. FDI is considered as an external source of economic development that provides a country with access to the international markets. Furthermore, FDI enables the diffusion of new knowledge and skills within the economy of the host country. The transfer of technology not only permits producutivity gains, but improves the efficiency of resource allocation (Slimane, Huchet-Bourdon, & Zitouna, 2013).

The adoption of both theories to explain the impact of FDI on food security include Wimberley (1991), whereby the impact of transnational corporate investment and its effect on food consumption was analysed. The findings of the study suggest that FDI has a negative impact on food security. To be more precise, the author established that transnational corporation penetration exacerbates hunger as opposed to reducing it. Between the period 1967 – 1985, countries that had minimal transnational corporate penetration expeienced an increase in approximately 700 more calories and 20 grams more protein per person per day, in comparison to countries that had received maximum transnational corporate penetration. Mihalache-O'Keef and Li (2011), studied the relationship between sectoral FDI and food security. The authors concluded that primary FDI has a negative effect on food security. The authors argue that primary-sector FDI contributes poorly towards capital accumaultion. Furthermore, any benefits received from primary-sector FDI are coercively captured by the elite. The captured rents are not reinvested into public goods nor sustainable development. A final outcome of primary-sector FDI is negative environmental externalities which is transmitted through the channel of food access and food availability. Consequently, there is closure of subsistence farms which poses a threat to food security. On the contrary, the authors are of the opinion that FDI within the secondary sector can improve the securitization of food. The positive impact within the secondary sector is likely to be exhibited through the resultant increase in employment and wages, in addition to the technology and knowledge spillovers. In contrast to Mihalache-O'Keef and Li (2011), Slimane, Huchet-Bourdon, and Zitouna (2013), found that sectoral FDI has no direct effect on food security. Instead, the authors established a positive and indirect effect on food security in both the primary and secondary sectors of an economy. This can be explained though an increase in agricultural production. FDI into the tertiary sector exhibited negative indirect effects on food security. The authors suggest that the negative relationship is a result of the migration of workers as explained in the Harris-Todaro model. FDI into the tertiary sector results in the creation of jobs in the urban areas in addition to an increase in wages. As a consequence of the disparity of wages between the urban and rural areas, job seekers in the rural areas are incentivised to migrate to the urban areas in search of emloyment. The increase in the demand for food in the urban areas will ultimately result in an increase in the price of food and hence reduce the migrants access to food.

The negative effects of FDI are validated by Gerlach and Liu (2010), and Schoneveld , German , and Nutakor (2011). Furthermore, Hallam (2011) brings to attention the idea that agricultural FDI

can result in highly mechanized means of production with limited employment creation in addition to the degradation of the land.

Despite the above mentioned negative effects of FDI, FDI can play a positive role in the agricultural sector. According to Hallam (2011), there are long-term benefits which include an improvement in both technology and product quality. An improvement in product quality can allow for a country's food security status to improve. As far as Hallam (2011) is concerned, Mihalache-O'Keef and Li (2011), notes that secondary-sector FDI has a positive impact on food security through both the growth and development channel in addition to the food access and food availability channel. With respect to growth and development, secondary-sector FDI facilitates increased competition within the market and advances human capital. In terms of the food access and food availability channel, secondary-sector FDI increases employment and wages and the positive externalities within the sector are more evenly distributed. As a result, there is an improvement in the food security status of the poor.

With reference to the South African economy, there has been numerous studies analyzing the impact of FDI (Akinboade, et al., 2006; Fedderke and Romm, 2004; Gelb and Black, 2004), as well as studies pertaining to the analysis of food security (Altman, et al., 2009; Baiphethi and Jacobs, 2009; Battersby, 2012; De Cock, et al., 2013; Hendriks, 2005; Jacobs, 2009; Labadarios, et al., 2011; Rose and Charlton, 2011; Sekhampu, 2012).

Fedderke and Romm (2004), have established that the inflow of FDI into South Africa has been regarded as capital intensive, in nature. Akinboade, et al. (2006), have argued that a substantial amount of the FDI flowing into South Africa arrives from the United States as well as several European countries for reasons pertaining to the strong economic ties which these countries share with the South African economy. Moreover, in terms of the regional distribution of FDI inflows arriving in South Africa, Akinboade, et al. (2006), reported that in 2002, 78 percent of FDI inflows were located within the Gauteng region alone. Furthermore, Gelb and Black (2004), reported that during the 1990's the emergence of small to medium enterprises had emerged due to the vast inflows of FDI arriving within the South African borders. Even though small to medium enterprises received a respectable amount of funds aiding the respective enterprise through FDI, this funding has however been reported to have had little to no influence with regards to job creation and capital inflows.

B. The status of food security in South Africa

South Africa is deemed to be a food secure nation. With this in mind, South Africa does not only possess the ability to import food when food shortages arise, but exercises food self-sufficiency in almost all of its major food groups. To be more precise, within the South African context the country has the ability the satisfy its own food needs from the domestic production of food (Clapp, Food self-sufficiency: Making sense of it, and when it makes sense, 2017). Despite an adequate amount of food supplied at a national level there are still many households that are classified as food insecure (Charlton and Rose, 2012; du Toit , 2011). Ledger (2016), reports that based on the results captured from the 2010/2011 Income and Expenditure Survey, 80 percent of South African families spent an insufficient amount of money on food to adequately feed themselves in 2016.

In terms of the 2016 Global Food Security Index, South Africa is ranked as the best country in the Sub-Saharan African region to be food secure. However, when one looks at food availability and urban absorption capacity, South Africa is ranked 22nd out of a total of 28 countries located within the Sub-Saharan region. Urban absorption capacity measures a country's capacity to absorb the stress as a consequence of urbanization, whilst still ensuring food security (The Economist Group, 2016). The substandard performance of South Africa's urban absorption capacity, allows Crush and Frayne (2010), to refer to urban food security as the 'invisible crisis'. The 'invisible crisis' is the inability of the chronically poor to access sufficient food. The sufficient access to food is undermined by the excessive costs that are associated with urban shelter, transport, health and education. Battersby (2015), argues that the poor recognition by policy makers to the crisis of urban food insecurity is a result of different households experiencing the challenge of food accessibility at different times throughout the year. As a consequence, each household implements a variety of unique and localised coping strategies. The fact that the coping strategies of each household are unique the implementation of policy aimed towards the alleviation of hunger is challenging.

According to (Shisana O, 2013), food insecurity and the risk of food insecurity in South Africa is determined by the geographical location of a household. The largest percentage of household hunger can be found in both the urban and rural infomal space. Furthermore, food insecurity and

the risk of food insecurity is too dependent on the racial profiling of population groups. African households are found to be more food insecure in comparison to households headed by the White, Indian or Coloured population (John-Langba, 2015).

Due to the idea that food security is multidimensional in nature, there is neither a specific nor an accepted measure of food security within the context of South Africa. In addition, there is no regulated means of monitoring the food security status of the population as a result of the dearth of information with reference to the dynamics of food insecurity (Altman, Hart and Jacobs, 2009; De Cock et al., 2013; du Toit , 2011; John-Langba, 2015). Consequently, various methods are utilized to assess the prevalence of food security at the household level. The two most prevalent datasets that are utilized is the General Household Survey (GHS) and the Income and Expenditure Survey (IES). The General Household Survey monitors the prevalence of hunger overtime and aims to establish where the experience of hunger remains the most problematic in South Africa. Alternatively, the Income and Expenditure Survey measures the proportion of income that is spent on food by the poor. This survey is at a household level. Additional data sources include the National Food Consumption Survey (NFCS), the Community Survey (CS), the Labour Force Survey (LFS), the National Income Dynamics Survey (NIDS), the 2012 South African National Health and Nutrition Examination Survey (SANHANES) and, the Demographic and Health Survey (DHS). The Demographic and Health Survey (DHS) of 2003 and 2008 assessed the anthropometric[1] status of children and women (John-Langba, 2015). The above-mentioned methods obtain different results due to each method probing a different dimension of food security. What is more, each method makes use of either social or economic indicators in order to quantify the intensity of food insecurity in South Africa (De Cock et al., 2013; du Toit , 2011).

According to (De Cock et al., 2013), the most important determinants of the status of food security at the household level are; human capital (education, household size and dependency ratio), household income and the district in which the household is located. The authors established that the largest percentage of food secure households are located in the Sekhukhune district, whereas the largest percentage of food insecure households reside in the Waterberg district. In addition, Rose and Charlton (2002), established that higher food poverty rates occur with a decrease in

[1] Anthropometric measurements assess the growth of an individual. In particular, it measures the, height, weight and head circumference of individuals (The Open University, 2018).

income. Food is classified as a necessity good. Taking what has been mentioned above into consideration, *Engel's Law* states that a proportionate change in income will result in a less than proportionate change in demand for a necessity good, is evident (Federal Reserve Economic Data, 2016). An increase in food poverty rates is also due to an increase in the dependency ratios of households. The outcome of an increase in the dependency ratios is an increase in the size of the household (Fukuda-Parr and Taylor, 2015).

Moreover, a study undertaken by the African Food Security Urban Network in Johannesburg found the existence of a strong link between employment, income and food insecurity. The link is established based on the level of food insecurity in Johannesburg being primarily related to household income and one's ability to access food through purchase (Crush and Frayne, 2010; Rudolph, Kroll, Ruysenaar, and Dlamini, 2012). The findings in Johannesburg reinforce the notion of food insecurity being closely linked with poverty and unemployment within a country. The lack of income, along with the decreased standard of living within the Johannesburg metropolis, due to high rates of unemployment, acts as not only contributors to food insecurity, but exacerbates the problem of social exclusion (du Toit , 2011).

The two programmes implemented by the South African government in order to address food insecurity and undernutrition include; the Zero Hunger programme of the Department of Agriculture, Forestry and Fisheries (DAFF) and the Outcome 7 programme. The Zero Hunger programme was based on the Brazilian model of addressing food insecurity. The three main policy pillars of the Brazilian model include; (i) Bolsa Família which is founded on a cash transfer programme, (ii) The Alimentação Escolar school feeding programme and, (iii) The Fortalecimento da Agricultura programme which is intended to promote small-scale farming in order to increase the income of rural households (Kilpatrick and Beghin, 2010). The intention of the Zero Hunger programme adapted in terms of the South African context was focused on food accessibility, food production and nutrition security. The programme however was immobilised in 2013. According to the Parliamentary Portfolio Committee, the alleviation of hunger and undernutrition had not been addressed since the programme's conceptualisation (Drimie, 2015). The Outcome 7 programme was launched to aid in the access to affordable and diverse food in addition to rural job creation. Further interventions of the Outcome 7 programme includes food fortification,

community gardens and individual transfer programmes which include school feeding programmes (De Cock et al., 2013; Labadarios, et al., 2011). A prominent school feeding scheme in South Africa is that of the National School Nutrition Programme (NSNP). This government sponsored programme feeds 8 million learners across primary and secondary schools. The emphasis of the programme is on the contribution towards the learning capacity of students. However, Rendall-Mkosi, et al., (2013), makes note of the fact that the energy value of the meals is inadequate. Furthermore, the meals served are of poor quality due to the meagre equipment utilized at the schools to aid in the preparation of meals.

C. Contribution of study

To date, a study has yet to be conducted focusing on the possible benefits of an amalgamation of both FDI and food security at either a national or local level. Taking this into consideration, there is currently little to no literature, particularly with reference to the South African context, available that has the ability of deciphering the relationship between FDI and food security. Therefore, the aim of this study is to offer a valuable contribution, both locally and globally, in terms of distinguishing a clear link between FDI and food security within the context of South Africa, particularly at the local municipal level. What is more, this study will be carried out using spatial model analysis.

IV. Theoretical Framework

A. Defining food security

Works concerning food security are broad and incorporate a variety of disciplines. These disciplines include agricultural and farming literature (Baiphethi and Jacobs, 2009; Nelson, et al., 2010; United Nations Environment Programme, 2013) and medical literature about nutrition (Caraher and Coveney , 2004; Mohiddin, Phelps, and Walters, 2012). The economic literature pertaining to food security is extensive and ranges from agricultural economics to trade theory as well as health economics.

Food security exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food - which meets the dietary needs and food preferences for an

active and healthy lifestyle (Food and Agricultural Organization, 2006). The definition of food security has been a subject of much debate due to the diversity associated with its concept of origin (Conway, 2012). Moreover, Hart (2009), brings to attention that the phrase "at all time" does not consider the temporal as well as intensity dimension of food security. The temporal dimension includes chronically, transitory, seasonal or cyclical. Chronic food insecurity is long-term and is associated with structural poverty and low incomes. Transitory food insecurity is short-term and occurs due to a temporary decline in the household's access to a sufficient amount of food. Seasonal or cyclical food insecurity arises as a result of a recurring pattern of inadequate access to food. This form of food security occurs prior to the harvest season. Apart from this, the intensity dimension makes reference to the magnitude of the food gap, whereby the food gap refers to the disparity between the need for food and the ability one has to receive it. Notably, the intensity dimension of food security is subdivided into 4 categories, each quantifying the status of food security. In terms of the extreme classifications, an individual is classified as food secure if they consistently consume more than 2 100 kilocalories per day. Whereas an individual is considered to be severely food insecure if they consume less than 1 500 kilocalories per day (Devereux, 2006).

The Centre for Poverty, Employment and Growth (CPEG) of the Human Sciences Research Council (HSRC) has recognized food security to consist of three dimensions, namely the availability of food, the accessibility of food and lastly, the utilization of food. In terms of food availability, it is essential for a country to have sufficient quantities of food available on a consistent basis at both the national and household level. Accessibility (also referred to as affordability) relates to the purchasing power of a household, or the ability to acquire available food on a sustainable basis. Thirdly, utilization focuses on the manner in which food is absorbed into the body. This process is affected by nutrition as well as the preparation of food (Clapp, 2015; Coleman-Jensen, P. Rabbitt, Gregory, and Singh, 2014; Tweeten L. , 1999).

Food security is often identified as being multidimensional in nature therefore accurate measurement and policy targeting is seen as a challenge (De Cock et al., 2013). Traditionally, food security has been primarily theorized as a development problem located specifically within the rural parts of a region. These areas were principally associated with issues concerning food availability. However, over the years food insecurity has been increasingly recognized as a

developmental challenge within the urban space, an issue that is currently brewing within Sub-Saharan Africa (Battersby, 2012).

Studies concerning food security have been conducted using household data with reference to specific countries and regions. These studies primarily focus on the accessibility of food for individuals (Abdu-Raheem and Worth, 2011; Coleman-Jensen, P. Rabbitt, Gregory, and Singh, 2014; Feleke, Kilmer, and Gladwin, 2004; Wilde and Nord, 2005). According to a household level study conducted by Abdu-Raheem and Worth (2011), while South Africa produces a sufficient amount of food to feed its population, it is however experiencing a rapid increase in the rate of household food insecurity. Due to empirical South African food security research being limited, challenges regarding effective policy making is a common occurrence (Hendriks, 2015).

B. Amartya Sen – The Entitlement Approach

According to Amartya Sen, hunger does not arise as a result of the reduction in the availability of food. Instead, Sen argues that hunger is a result of individuals not acquiring a sufficient amount of food to consume. The entitlement approach is a concept which emerged out of the above-mentioned statement. In other words, the state of hunger results from individuals having insufficient command over the food which they consume, as opposed to following the general consensus that hunger arises from the lack of food supplies available for consumption.

The entitlement approach is subdivided into three specific categories namely: (i) the endowment set, (ii) the entitlement set, and lastly (iii) entitlement mapping. Firstly, the endowment set comprises of a combination of resources which are legally owned by an individual. These resources include both the tangible as well as intangible assets. While tangible assets consist of land, animals and equipment, intangible assets comprise of knowledge and skill, labour power and the membership to a particular community (Osmani, 1993). Secondly, the entitlement set refers to the possible combination of goods and services which an individual legally obtains through the utilization of their resources within the endowment set. The acquisition of goods and services through the utilization of an individual's resources is set to occur within a variety of ways. For instance, a labourer will exchange their intangible asset, which is in the form of labour power, in order to achieve the commandment of food through the exchange of their wages for food. Furthermore, a farmer will utilize their labour as well as their land in order to achieve the desired

produce allocated for consumption. Lastly, entitlement mapping is the link between an individual's endowment set and their entitlement set.

Entitlement failure occurs when an individual's entitlement set does not contain a sufficient amount of food that will prevent the outcome of starvation. In order for entitlement failure to occur there needs to be either a decline or otherwise loss in the individual's endowment set, or an unfavorable shift in the individual's exchange entitlement has to occur (Dréze and Sen, 1989). According to Dréze and Sen (1989), an experience of loss within an individual's endowment set can result from the alienation of and/or the loss of labour power as a result of ill health. The emergence of an unfavourable shift in the individual's exchange entitlement results in either the loss of emplyoment, fall in wages, or a rise in food prices.

Entitlement failure within the South African context is a result of insufficient income which emerges due to the loss of employment. In other words, as argued by Altman, et al. (2009), the increase in the opportunities of employment calls for an increase in household income. This increase in household income contributes towards the alleviation of poverty and food insecurity within the context of South Africa. Ultimately, the insufficient access to food, for a substantial amount of households, is attributed to the deterioration of their exchange entitlements (Fukuda-Parr and Taylor, 2015).

Taking Sen's body of work, *The Entitlement Approach,* into consideration, this paper attempts to primarily undergo a focused analysis concerning Sen's notion around Entitlement Failure. Amartya Sen's research concerns the nature of hunger through the individual's inability to demand a sufficient amount of food due to, for example, the loss of employment, as opposed to the lack of food supply a country may face. While Amartya Sen's theory concerns parties at an individual level, this paper attempts to apply Sen's framework on Entitlement Failure at a collective level, rather than at an individual level. With regards to the collective level which this study attempts to cover, the collective level refers to the various local municipalities located within the South African borders where each municipality is classified as an individual constituent. Where employment is employed for the purposes of a transmission channel, this study seeks to investigate the degree of impact FDI has on the forces used in the effort to reduce hunger within South Africa at the local municipal level for the period 2000 – 2016.

V. Data

The level of analysis is at the local municipal level for the period 2000 – 2016. As of the 3rd August 2016, South Africa is home to a total of 257 municipalities. For purposes of this paper and based on the level of analysis, 212 local municipalities will be examined. In order for spatial analysis to occur, all relevant data had to be spatially joined with the 2016 local municipal shapefile.

A. FDI Data

The predominant source of FDI data utilized in this paper is, the Financial Times FDI Markets database. The database is principally concerned with 'greenfield' investments'. A regions attractiveness to foreign investors is indicated by the amount of greenfield FDI it receives. Moreover, this form of investment involves the startup of operational facilities in a foreign country from the ground up (Investopedia, 2018). The development of operational facilities that are associated with greenfield investment, aid in the growth of local productivity and employment generation. According to Wall (2017), Greenfield FDI serves as an appropriate proxy for total FDI. As such, this study will refer to Greenfield FDI as total FDI.

The FDI data utilized for this paper exhibits geospatial data attributes. As a result, each geographical location in South Africa that received FDI underwent verification. In other words, each destination of FDI inflows within the borders of South Africa, was thoroughly examined to ensure that the company was still in existence. If the company was still in existence the coordinates of longitude and latitude were scrutinized to establish if they have been correctly provided by Financial Times FDI Markets database. In the event that a company had no offices located in SA, it was discarded from the data set. However, multiple firms which were reported to have received FDI with coordinates which could be not be located on Google maps, were considered and searched through a process suggesting possible geographical coordinates where these firms could be located, i.e. shareholders in an alternative firm. For example, Casinos Austria received an inflow of FDI amounting to R3,8 million in 2006. The geographical coordinates provided by the FDI Markets database could not be located. It was thus established that Casinos Austria was a minor shareholder in Silver Star Casino's. Therefore, the geographical coordinates of Silver Star Casino were assigned to Casinos Austria.

What is more, the FDI data obtained, from Financial Times FDI Markets database, is classified as a dataset with no shapefile, yet still containing information for each geographical location that received FDI. With this in mind, the coordinate system of each geographical location had to be set to the degrees of longitude and latitude. This permitted spatial analysis. In addition, a merger involving the FDI dataset with the 2016 local municipal shapefile was enabled.

In terms of the 2016 local municipal shapefile, geographical features are represented by polygons which are defined by a coordinate system. Each polygon is assigned a unique ID value. For example, King Sabata Dalindyebo Local Municipality which is situated in the Eastern Cape, is assigned a unique ID value of 115. With reference to the shapefile, King Sabata Dalindyebo Local Municipality is a polygon which is defined by the numerous degrees of longitude and latitude that outline its border. Therefore, when the integration of FDI data with the 2016 local municipal shapefile occurred, each inflow of FDI was matched to a corresponding local municipality. In other words, the amalgamation of FDI with the shapefile was enabled when the geographical coordinates of FDI were positioned within the borders of a certain local municipality. As a result of the spatial join process mentioned above, each inflow of FDI was assigned a unique ID value.

B. South African Data

All relevant data for South Africa was obtained from EasyData and StatsSA due to the availability of information at the local municipal level. All variables utilized in the study are at the local municipal level. Refer to the appendix (Annexure A) for the definition of the variables utilized in this paper. Despite the fact that the 2016 Local Municipal Boundaries shapefile was obtained for the analysis, the South African data attained was based on the 2011 Local Municipal Boundaries. As a result, all relevant datasets were required to undergo geocoding in order to allow for a spatial join with the 2016 Local Municipalities shapefile. Upon completion of the spatial join, only then was it possible to conduct geospatial analysis.

The 2016 Local Municipal Boundaries came into effect on the 3rd August 2016. Hence, there was an amalgamation of a particular set of local municipalities in South Africa. The shapefile based on the 2016 Local Municipalities assigns a unique ID value to each local municipality along with the coordinates of latitude and longitude. Due to the dataset obtained being based on the 2011 Local Municipal Boundaries, the newly formed amalgamated municipalities had to be separated into

their individual constituents. Each amalgamated municipality had to be inspected to establish which local municipalities it consisted of. The individual constituents were then each assigned the unique ID value given to the amalgamated municipality to which they belonged. For example, Ray Nkonyeni Municipality situated in Kwa-Zulu Natal is an amalgamation of Ezinqoleni Local Municipality and Hibiscus Coast Local Municipality (Yes Media, 2018). The Ezinqoleni Local Municipality and Hibiscus Coast Local Municipality were therefore both assigned the unique ID value of 40. There are 18 amalgamated municipalities. Refer to the appendix (Annexure B) for the list of amalgamated municipalities and their respective constituents.

C. Night Lights Data

Night lights data emerged as a branch for the capturing of data through the United States Air Force Defense Meteorological Satellite Program (DMSP). The DMSP satellites orbit the earth 14 times per day capturing both visible as well as cloud free images of every angle on the planet. The very high spatial resolution enables researchers to spatially analyze areas of the globe ranging from continents to mere square kilometers. The observation of city lights and the collection of night lights data occurred within a serendipitous manner, a manner which was not intended for the construction of the Satellite Program. The concurrent operation of two satellites enabled the collection of low-light imagery data. The main purpose of these satellites was for the detection of moon-light data, data capturing the light that is reflected from, as well as by clouds. This is to say that in the absence of clouds, it was soon realized that one could observe city lights, lights which came to be associated with economic human activity (Addison & Stewart, 2015).

In recent years there has been an expansion of literature on the use of night lights data as a measure of economic development. The use of night lights data was first introduced into the field of economics by Chen and Nordhaus (2011) and Henderson (2012). According to these authors, the utilization of night lights data has proved to be a suitable measure with regards to income and economic growth when the availability of economic and social indicators, are indicated as weak or sparse. Mveyange (2015), suggests that night lights data can be an informative indicator when estimating regional income inequality. This finding suggests that night lights data can be considered as a proxy variablefor the level of wealth within a country. In other words, the brighter

the luminosity of a region is, the more investment into infrastructure the region is receiving (Misra, 2016). Many developing countries are sparsely illuminated in comparison to developed countries.

The night lights data presented within this paper, as satellite images, are utilized for the purposes of this paper as an instrumental variable, a variable obtained from the data repository at the National Geophysical Data Center (NGDC), National Oceanic and Atmospheric Administration (NOAA) (Version 4 DMSP-OLS Nighttime Lights Time Series, n.d.). The purpose behind this choice of instrumental variable is based solely on the notion put forth by Henderson, et al., (2012). The authors suggest that the intensity of night light within the satellite images includes the use of both outdoor as well as indoor lights. The lights observed within these satellite images is suggested to possess the ability of commenting on the consumption of goods within a given region. Taking this into consideration, the authors suggest that as income rises within a given region located on the satellite image, the intensity of the light too increases as per usage of each person, therefore suggesting an increase in both consumption and investment activities within that respective region.

The night lights data captured for the purposes of this paper is for the period 2000 – 2013. Each file obtained is identified based on the satellite number that captured the data along with the year in which the data was collected. For example, F182010 is representative of satellite number 18 having collected the data for 2010. The night lights data obtained is based on stable lights imagery which contains lights from cities, settlements and other geographic regions with persistent lighting, including gas flares (Lowe, 2014). Night lights data is classified as a raster dataset. This type of data classification consists of pixels (or cells) where each pixel is assigned a numerical value. The average brightness of the night lights pixels was computed for each local municipality. The pixels were assigned a digital number (DN) ranging from 0 (no light) to 63. Instances where there has been little to no cloud free observations, were assigned a value of 255. According to Henderson, et al. (2012), there is only a small fraction of pixels (less than 0.1%) located within areas considered as relatively wealthy as well as densely populated. These pixels are said to be censored at 63.

Due to the presence of two satellites and therefore two datasets for the period ranging from 2000 – 2007, a new raster dataset had to created. To be more precise, a new pixel value was generated from the average of the two present datasets. Refer to the appendix (Annexure C) for information on how the average night lights of two datasets was calculated.

For the providing of a more robust set of results, pixels that included the presence of gas flares were removed for the purposes of this study. The contribution of gas flares to the economic activity of a country is widely considered as non-existent (Lowe, 2014). The occurrence of gas flares in South Africa are situated in Mossel Bay due to the presence of the Mossgas Gas Field Project (Offshore Technology, 2018). Refer to the appendix (Annexure D) for material on the process as to how gas flares, located in Mossel Bay, were removed from the night lights data.

For the likelihood of an in-depth analysis, concerning the impact of food insecurity within South Africa, the converging of the above-mentioned spatial datasets, is considered as an essential amalgamation for the purposes of this paper. Moreover, the merging of the spatial datasets occurred due to the target feature of a common ID assigned to each local municipality. That is to say that the night lights data was assigned to a local municipality, based on a common ID, with specific reference to the year.

D. Data Limitations

As one might expect, the data obtained has limitations. For instance, with reference to the South African dataset, the variables related to hunger are restricted to 2016. This is due to the 2016 Community Survey being the only survey in South Africa, thus far, to ask specific questions related to the issue of food security. What is more, the night lights data obtained is limited to 2013. As a consequence, when the Two-Stage Least Squares (2SLS) model for hunger in 2016 was estimated, the instrumental variable for FDI in 2016 was the night lights data that was three periods lagged. Finally, with reference to the Gini coefficient, the final year that exhibits information at the local municipal level is 2014. Hence, in order to estimate the impact of FDI on hunger and employment a two-period lag of the Gini coefficient was employed.

VI. Estimation Methodology and Model Specification

In order to assess the prevalence of hunger in South Africa, this study will make use of two separate analyses. The first analysis will investigate the direct impact of FDI on hunger and food insecurity in South Africa. The investigation will be at the local municipal level for the year 2016. Furthermore, an OLS, WLS, 2SLS and a Cross-Sectional Autoregressive Spatial Model is utilized.

In order to analyze the impact of FDI on food security and hunger, the percentage of households that had to skip a meal or meals within the past 12 months was obtained from the 2016 Community Survey and utilized in the study. Households that did not have to skip a meal are included in the analysis as they form part of the sample of dwelling units for the survey. As mentioned previously, the demand side aspect of food security is deemed to be more prevalent as opposed to the supply side within the context of South Africa. With reference to Amartya Sen's framework on *The Entitlement Approach*, and more specifically Entitlement Failure, the second part of the analysis will investigate the impact FDI, through the transmission channel of employment, has on the forces utilized in the reduction of hunger in South Africa at the local municipal level for the period 2000 – 2016. The analysis is conducted using an OLS, WLS, 2SLS and lastly, spatial panel regression models.

Models

i. *Non-spatial Models*

Cross sectional

In order to estimate the direct impact of FDI on hunger and food insecurity in South Africa, a series of non-spatial models was explored. The models include OLS, WLS and 2SLS.

The OLS model specification is as follows,

$$y_i = \gamma + \beta' x_i + \vartheta_i, \qquad \vartheta_i \sim N(0, \sigma^2) \qquad (1)$$

where:

y_i = the percentage of households that had to skip a meal or meals within the past 12 months at time t.
t = the time period under analysis which is 2016.
γ = the intercept coefficient.
β' = incorporates all coefficients of the explanatory variables in matrix form.

x_i = a row vector that includes all the explanatory variables which comprises of FDI, the one period lagged value of FDI, the number of local firms, household grants, the Gini coefficient, grants paid to other local municipalities, household size and provincial dummy variables.
ϑ_i = error term.

As a result of heteroskedasticity present in the dataset, a weighted least squares (WLS) regression was estimated and exhibits the following model specification form,

$$y_i = \beta' x_i + \mu_i, \qquad \mu_i \sim N(0, {\sigma^2}/{\omega_i}) \qquad (2)$$

where:

y_i = the percentage of households that had to skip a meal or meals within the past 12 months at time t.
t = the time period under analysis which is 2016.
β' = incorporates all coefficients of the explanatory variables in matrix form.
x_i = a row vector that includes all the explanatory variables which comprises of FDI, the one period lagged value of FDI, the number of local firms, household grants, the Gini coefficient, grants paid to other local municipalities, household size and provincial dummy variables.
μ_i = error term whereby the heteroskedastic variances are multiplied by the reciprocal of the weights. The weights are inversely proportional to the variances, therefore observations with low variances were assigned a higher weight and observations with high variances were assigned a lower weight.

Due to the possibility of the presence of endogeneity, a 2SLS was estimated with nights lights data as the instrument of choice. The night lights data was three periods lagged.

The 2SLS model specification takes on the following form,

$$y_i = \gamma + B'_{ex} x_{ex,i} + V'_{en} x_{en,i} + \epsilon_i \qquad (3)$$

where:

y_i = the percentage of households that had to skip a meal or meals within the past 12 months at time t.

t = the time period under analysis which is 2016.

γ = the intercept coefficient.

β' = incorporates all coefficients in matrix form of the exogenous variables.

$x_{ex,i}$ = a row vector that includes all the exogenous explanatory variables which comprises of the number of local firms, household grants, the Gini coefficient, grants paid to other local municipalities, household size and provincial dummy variables.

V' = incorporates the coefficient in matrix form of the endogenous variable.

$x_{en,i}$ = a row vector that includes the endogenous explanatory variable which comprises of FDI.

Panel

In order to assess the impact of FDI on hunger and food insecurity, in South Africa, through the transmission channel of employment a series of non-spatial models along with spatial models were estimated. The non-spatial models include OLS, WLS and 2SLS. The spatial models include the Spatial Autoregressive (SAR) and Spatially Lagged X Variable (SLX) models.

The OLS model specification is as follows,

$$y_{i,t} = \gamma + \beta' x_{i,t} + \vartheta_{i,t}, \qquad \vartheta_{i,t} \sim N(0, \sigma^2) \tag{4}$$

where:

$y_{i,t}$ = the total number of citizens employed in local municipality i at time t.

γ = the intercept coefficient.

β' = incorporates all coefficients of the explanatory variables in matrix form.

x_t = a row vector that includes all the explanatory variables which comprises of FDI, the one period lagged value of FDI, the number of local firms, household grants, the Gini coefficient, grants paid to other local municipalities, household size and provincial dummy variables.

ϑ_t = error term.

As a result of heteroskedasticity present in the dataset, a weighted least squares (WLS) regression was estimated and exhibits the following model specification form,

$$y_{i,t} = \beta' x_{i,t} + \mu_{i,t}, \qquad \mu_{i,t} \sim N(0, {\sigma^2}/{\omega_{i,t}}) \tag{5}$$

where:

$y_{i,t}$ = the total number of citizens employed in local municipality i at time t.

β' = incorporates all coefficients of the explanatory variables in matrix form.

$x_{i,t}$ = a row vector that includes all the explanatory variables which comprises of FDI, the one period lagged value of FDI, the number of local firms, household grants, the Gini coefficient, grants paid to other local municipalities, household size and provincial dummy variables.

$\mu_{i,t} =$ error term whereby the heteroskedastic variances are multiplied by the reciprocal of the weights. The weights are inversely proportional to the variances, therefore observations with low variances were assigned a higher weight and observations with high variances were assigned a lower weight.

As a result of the presence of endogeneity, a 2SLS was estimated with nights lights data as the instrument of choice. All relevant tests were estimated to ensure that the nights lights variable is an adequate instrumental variable.

The 2SLS model specification takes on the following form,

$$y_{i,t} = \gamma + B'_{ex} x_{ex,i,t} + V'_{en} x_{en,i,t} + \epsilon_{i,t} \quad (6)$$

where:

$y_{i,t}$ = the total number of citizens employed in local municipality i at time t.

γ = the intercept coefficient.

β' = incorporates all coefficients in matrix form of the exogenous variables.

$x_{ex,i,t}$ = a row vector that includes all the exogenous explanatory variables which comprises of the number of local firms, household grants, the Gini coefficient, grants paid to other local municipalities, household size and provincial dummy variables.

V' = incorporates the coefficient in matrix form of the endogenous variable.

$x_{en,i,t}$ = a row vector that includes the endogenous explanatory variable which comprises of FDI.

With reference to the panel data models, grants paid to other local municipalities and the size of the household are removed from the analysis. There is no theoretical underpinning as to the manner in which the two variables impact employment. Lastly, the presence of spatial correlation, based

on the Moran I test statistic, in both the OLS and WLS models, prompted the use of spatial models which enabled geospatial analysis. With regards to the spatial models, the Gini coefficient was excluded due to the effects of endogeneity on employment.

ii. *Spatial Models*

A core feature of spatial analysis and spatial modelling is the first law of geography. This law invokes the idea that, "everything is related to everything else, but near things are more related than distant things" (Tobler, 1970). When two geographical entities are related there is either a positive or negative spatial autocorrelation. A positive spatial autocorrelation occurs when similar values appear close to one another. A negative spatial autocorrelation occurs when dissimilar values appear close to one another. Tobler's first law of geography is a quantitative technique enabling the analysis of spatial autocorrelation that is relative to distance or connectivity in relationships. In other words, geospace in terms of statistical analysis is important (Miller, 2004). In order to assess the spatial relationship in the model, a weighting matrix was constructed based on the notion of Tobler's first law of geography and the idea of distance decay. More specifically, the interaction between two geographical units decreases with an increase in distance. The distance decay matrix is expressed as the reciprocal of the distance (Murayama, 2012).

$$w_{ij} = \frac{1}{d_{ij}}$$

Where d_{ij} is the centre from spatial unit *i* to the centre of the neighboring spatial unit *j*. To compute the inverse distance matrix, the centroid of each spatial unit (local municipality) was calculated. Moreover, the distance between centroids is calculated based on Euclidean distance and the unit of measurement is in terms of kilometres. The standardization of the weighting matrix was not fulfilled. According to Anselin (1988), standardizing a weighting matrix that is constructed based on distance decay will result in the loss of any meaningful economic interpretation. Lastly, the choice of an inverse distance matrix was due to the fact that a matrix based on contiguity can be seen as a restrictive distance measure as interaction between spatial units is defined solely by the sharing of a common border (Vega & Elhorst, 2013).

Cross sectional

A spatial cross-sectional model was estimated, due to the Moran I test statistic exhibiting spatial correlation when the WLS model was estimated. Furthermore, Figure 1 clearly demonstrates the presence of spatial clustering.

The following spatial cross-sectional model was estimated,

$$y_{i,t} = \alpha i_n + \rho W y_{j,t} + \beta' x_{i,t} + W U_{i,t}, \qquad U \sim N(0, \sigma^2 I_n) \tag{7}$$

where:

$y_{i,t}$ = the percentage of households that had to skip a meal or meals within the past 12 months at time t.
t = the time period under analysis which is 2016.
α = the intercept coefficient.
i_n = n-dimensional column vector containing 1, where n is the number of local municipalities.
ρ = the spatial lag parameter which measures the degree of spatial correlation between geographical units. The lag parameter informs us of how the dependent variable is affected by the neighbouring values of the dependent variable.
W = the inverse distance weighting matrix.
$W y_{j,t}$ = the spatially lagged dependent regressor. This variable is deemed as the neighbouring (j) values of the dependent variable at time t.
β' = the coefficient of the explanatory variables.
$x_{i,t}$ = a row vector that includes all the explanatory variables which comprises of FDI, the number of local firms and household grants for local municipality i at time t.
$U_{i,t}$ = the SAR error which is serially correlated.

Panel

The following spatial panel data models were estimated,

1. Spatial Autoregressive (SAR) Model:

$$y_{i,t} = \alpha i_n + \rho W y_{j,t} + \beta' x_{i,t} + \varepsilon_i + U_{i,t}, \qquad U \sim N(0, \sigma^2 I_n) \tag{8}$$

where:

$y_{i,t}$ = the total number of citizens employed in local municipality i at time t.

α = the intercept coefficient.

i_n = n-dimensional column vector containing 1, where n is the number of local municipalities.

ρ = the spatial lag parameter which measures the degree of spatial correlation between geographical units. The lag parameter informs us of how the dependent variable is affected by the neighbouring values of the dependent variable.

W = the inverse distance weighting matrix.

$Wy_{j,t}$ = the spatially lagged dependent regressor. This variable is deemed as the neighbouring (j) values of the dependent variable at time t.

β' = the coefficient of the explanatory variables.

$x_{i,t}$ = a row vector that includes all the explanatory variables which comprises of FDI, the number of local firms and household grants for local municipality i at time t.

ε_i = the individual random effects whereby their spatial structure is irrelevant.

$U_{i,t}$ = the SAR error which is serially correlated.

Attempting to estimate an OLS regression based on the spatial autoregressive (SAR) model will yield biased results due to Wy exhibiting endogeneity.

2. <u>Spatially-Lagged X (SLX) Model:</u>

$$y_{i,t} = \alpha i_n + \beta' x_{i,t} + \theta W x_{j,t} + \varepsilon_i + U_{i,t}, \qquad U \sim N(0, \sigma^2 I_n) \tag{9}$$

where:

$y_{i,t}$ = the total number of citizens employed in local municipality i at time t.

α = the intercept coefficient.

i_n = n-dimensional column vector containing 1, where n is the number of local municipalities.

θ = the spatial lag parameter which as discussed above, measures the degree of spatial correlation between geographical units. This parameter informs us of how the dependent variable is affected by the neighbouring values of the independent variable.

W = the inverse distance weighting matrix.

$Wx_{j,t}$ = the spatially lagged dependent regressor. This variable is considered as the neighbouring values of the independent variable.

β' = the coefficient of the explanatory variables that are not spatially lagged.

$x_{i,t}$ = a row vector that includes all the explanatory variables which comprises of FDI, the number of local firms and household grants for local municipality i at time t.

ε_i = the individual random effects whereby their spatial structure is irrelevant.

$U_{i,t}$ = the SLX error which is serially correlated.

3. Spatial Durbin Model (SDM):

$$y_{i,t} = \alpha i_n + \rho W y_{j,t} + \beta' x_{i,t} + \theta W x_{j,t} + \varepsilon_i + U_{i,t}, \qquad U \sim N(0, \sigma^2 I_n) \qquad (10)$$

where:

$y_{i,t}$ = the total number of citizens employed in local municipality i at time t.

α = the intercept coefficient.

i_n = n-dimensional column vector containing 1, where n is the number of local municipalities.

ρ = the spatial lag parameter which measures the degree of spatial correlation between geographical units. The lag parameter informs us of how the dependent variable is affected by the neighbouring values of the dependent variable.

$Wy_{j,t}$ = the spatially lagged dependent regressor. This variable is deemed as the neighbouring (j) values of the dependent variable at time t.

θ = the spatial lag parameter which as discussed above, measures the degree of spatial correlation between geographical units. This parameter informs us of how the dependent variable is affected by the neighbouring values of the independent variable.

W = the inverse distance weighting matrix.

$Wx_{j,t}$ = the spatially lagged dependent regressor. This variable is considered as the neighbouring values of the independent variable.

β' = the coefficient of the explanatory variables that are not spatially lagged.

$x_{i,t}$ = a row vector that includes all the explanatory variables which comprises of FDI, the number of local firms and household grants for local municipality i at time t.

ε_i = the individual random effects whereby their spatial structure is irrelevant.

$U_{i,t}$ = the SDM error which is serially correlated.

4. Spatial Error Model (SEM):

$$y_{i,t} = \alpha i_n + \beta' x_{i,t} + U_{i,t}, \qquad U = \lambda W u + \varepsilon_i \qquad (11)$$

$y_{i,t}$ = the total number of citizens employed in local municipality i at time t.

α = the intercept coefficient.

i_n = n-dimensional column vector containing 1, where n is the number of local municipalities.

W = the inverse distance weighting matrix.

β' = the coefficient of the explanatory variables that are not spatially lagged.

$x_{i,t}$ = a row vector that includes all the explanatory variables which comprises of FDI, the number of local firms and household grants for local municipality i at time t.

ε_i = the individual random effects whereby their spatial structure is irrelevant.

$\lambda =$ the coefficient expressing the average strength of spatial correlation among the errors.

$U_{i,t}$ = the SEM error which is serially correlated.

The fact that the error terms of the spatial models are serially correlated is indicative of the presence of spatial spillovers which do not occur in OLS models. This is due to the implicit assumption which assumes that all variables are independent of each other.

The overall impact of variables in spatial models consists of both the direct and indirect effects. The direct effect represents the expected average change across all spatial units for the dependent variable in a particular region as a result of a change in one unit for a specific explanatory variable in that region (Golgher & Voss, 2015). To put it another way, in terms of the analysis for this paper the direct effect is the change in the dependent variable located in municipality *i*, as a result of a change in an explanatory variable located in municipality *i.* The indirect effect (spatial

spillovers) signifies the change in the dependent variable of a particular region as a result of a one-unit change in an explanatory variable in another region (Golgher & Voss, 2015). In other words, the indirect effect is the change in the dependent variable in municipality j¸ due to the change in the explanatory variable in municipality *i.*

VII. Empirical Analysis

A. Preliminary analysis

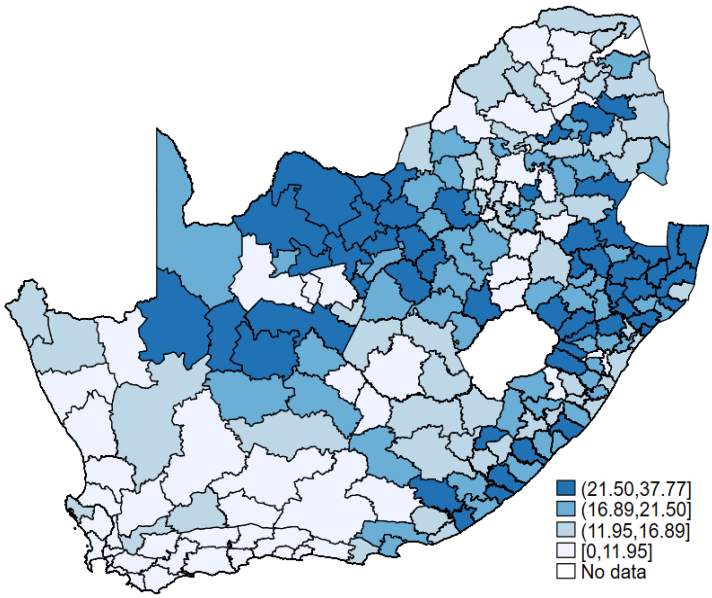


Figure 1: Percentage of households that had to skip a meal or meals in the past 12 months
Source: Data sourced from the 2016 Community Survey

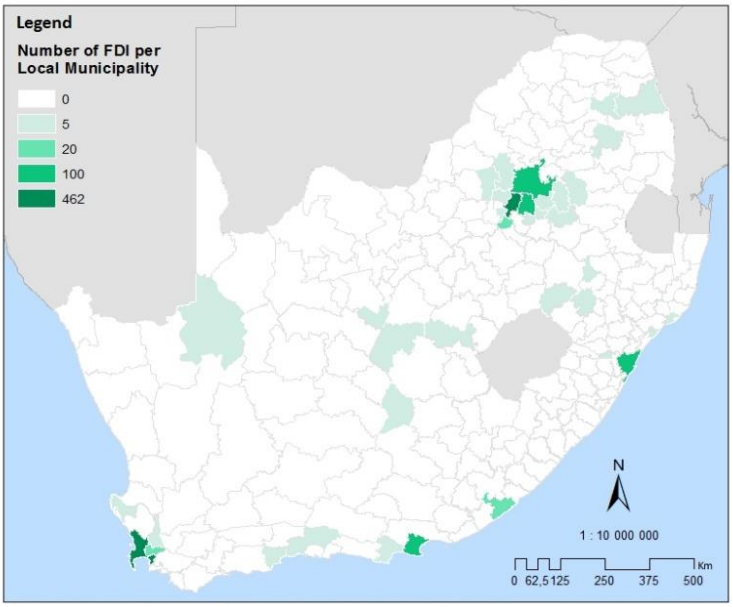


Figure 2: FDI per Local Municipality in South Africa, 2000 - 2016
Source: Data sourced from the Financial Times FDI Markets Database

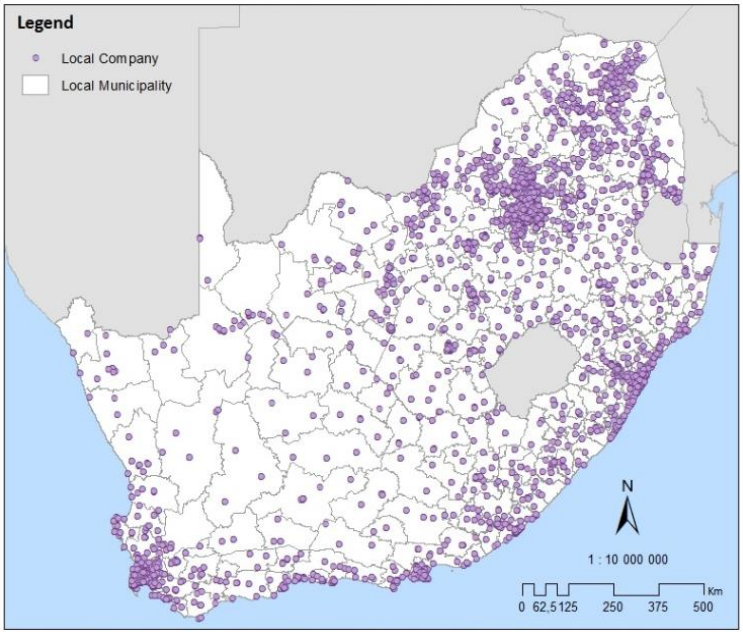


Figure 3: The Number of Local Companies in South Africa, 2016
Source: Data sourced from the Financial Times FDI Markets Database

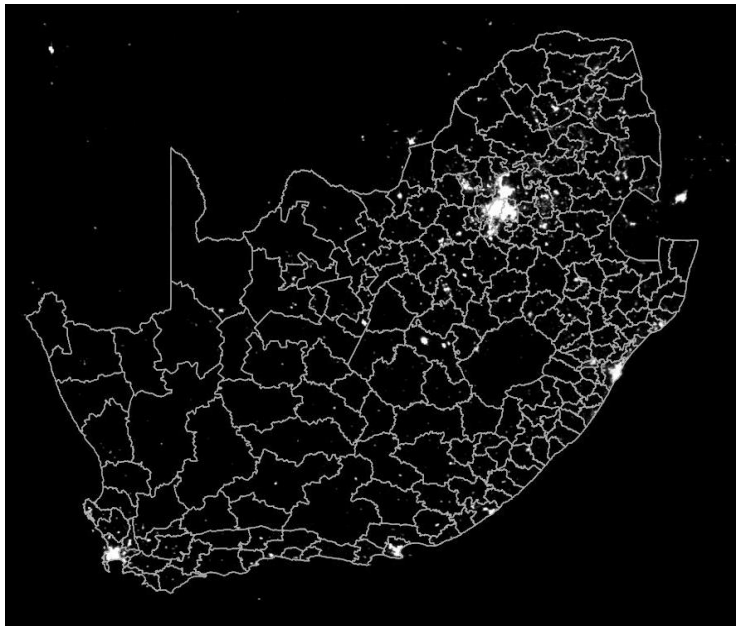


Figure 4: Night Lights Data per Local Municipality, 2013
Source: Data sourced from National Geophysical Data Center (NGDC), National Oceanic and Atmospheric Administration (NOAA).

With reference to Figure 1 it is evident that the distribution of hunger across space is non-uniform. In other words, there appears to be spatial clustering of local municipalities that experience a similar percentage of households that had to skip a meal or meals. In addition, there is a dispersion of local municipalities with a dissimilar proportion of households that had to skip a meal. As a result, a test for spatial autocorrelation was conducted using the Moran's I statistic. Annexure E confirms that the observed spatial clustering is statistically significant. Figure 2 provides a clear indication as to which local municipalities in South Africa received FDI for the period 2000 – 2016. In particular, municipalities that received more than one hundred inflows of FDI had the lowest percentage of households that had to skip a meal (Figure 1). As far as Figure 3 is concerned, there appears to be a relationship between the number of local firms situated in a local municipality and the percentage of households that had to skip a meal. Local municipalities that have the highest concentration of local firms exhibit a lower percentage in terms of the number of households that had to skip a meal. As for Figure 4, a large amount of night lights luminosity is present where a large concentration of local firms is situated. In addition, these areas that exhibit large amounts of night light luminosity received a sufficiently large amount of FDI from 2000 – 2016.

With regard to Table 1, which provides an average for the key variables utilized in the analysis, the province with the lowest average total employment for the period 2000 – 2016 is the Northern Cape. Furthermore, based on night lights data for 2013, the Northern Cape has the lowest average luminosity at 0,224. In addition, the Northern Cape has one of the highest levels of income inequality (the Gini coefficient) with reference to all nine provinces. On the contrary, Gauteng has the highest average total employment for the period 2000 – 2016 with 496 725,9 citizens working in the primary, secondary and tertiary sectors. In terms of the Gini coefficient, Gauteng is marginally better off as opposed to the Northern Cape with an average of 0,652 and 0,663 respectively. Also, Gauteng exhibits brighter luminosity in comparison to the Northern Cape, with an average of 26,313 for 2013. With reference to Figure 1 and Figure 4, the Northern Cape has the largest percentage of households that had to skip a meal whilst at the same time exhibiting a low night lights luminosity. Whereas, Gauteng experiences the least percentage of households that had to skip a meal whilst at the same time exhibiting a high night lights luminosity. As mentioned previously, night lights data is an informative indicator when measuring regional income inequality. In terms of the average number of household grants, Kwa-Zulu Natal has the least with

96,82. Despite Gauteng being the province with the highest average employment rate and average luminosity, it is also the province with the largest average number of household grants distributed at 17 195,51.

Table 1: *The average of key variables by Province for the period 2000 – 2016*

Province:	Average Number of Household Grants†:	Average Gini Coefficient†:	Average Luminosity (2013) *:	Average Total Employment†:
Northern Cape	661.5611	0.663	0.224	10558.2
Eastern Cape	1219.884	0.649	0.941	28357.69
Free State	1125.309	0.677	1.138	39967.19
Western Cape	1647.553	0.613	1.577	86918.87
North West	1158.964	0.638	2.242	48866.3
Limpopo	1324.011	0.584	2.514	40652.87
Kwa-Zulu Natal	96.82487	0.642	2.890	32799.64
Mpumalanga	1440.747	0.618	3.620	47126.53
Gauteng	17195.51	0.652	26.313	496725.9

†*Source:* Data by Quantec, EasyData
**Source:* National Geophysical Data Center (NGDC), National Oceanic and Atmospheric Administration (NOAA).

B. Regression analysis

The regression analysis is divided into three sections. The first section analyses the cross-sectional data. Whereby, the direct impact of FDI on hunger and food insecurity in South Africa will be examined. The second section examines panel data whereby the impact of FDI on hunger and food insecurity will be investigated with employment as the transmission mechanism. Lastly, spatial panel models are utilized to investigate the direct and indirect impacts of FDI on hunger and food insecurity through the transmission channel of employment.

i. Cross Sectional Data

The results for this analysis are demonstrated in Tables 2.

Table 2 displays the results for the SLM (standard linear regression model) estimated by means of OLS. In the non-spatial model, all coefficients have the anticipated sign. In particular, focusing on the relationship between FDI and hunger, higher levels of FDI inflow into a local municipality are associated with a decrease in the percentage of households having to skip a meal or meals which is indicative of a decrease in hunger. Furthermore, FDI inflows from the previous year is statistically significant and associated with a decrease in hunger, as there is a decline in the percentage of households that had to skip a meal. Household grants and the Gini coefficient are negative, as per theory suggests, and both variables exhibit strong statistical significance.

In terms of the provincial dummy variables, the Northern Cape and Kwa-Zulu Natal were omitted from the analysis as a result of multicollinearity. The Free State and the North West are the only two provinces that appear to have an increase in the percentage of households having to skip a meal as opposed to the North West being the only province with an increase in the percentage of households running out of money to buy food. The coefficient for North West is statistically significant at 1% and therefore lends itself to the idea of food security being a major problem in the province (John-Langba, 2015; Mashabela , 2017 ; Pike, 2012) . Taking the previous statement into consideration, Figure 1 illustrates that the severity of hunger in the North West province is dire. The percentage of households that experienced hunger is within a bandwidth of 21 percent to 37 percent.

Table 2: *Results for Hunger (cross-sectional study)*

Dependent Variable	(1) Hunger OLS	(2) Hunger OLS	(3) Hunger WLS	(4) Hunger 2SLS	(5) Hunger AR SPATIAL
Independent Variables					
FDI	-0.0153***	-0.0148***	-0.0332	-0.00985	-0.017040***
	(0.00342)	(0.00346)	(0.0227)	(0.0195)	(.00295)
L.FDI	-	-0.0160***	-0.0224***	-	-
		(0.00384)	(0.00560)		
Number of Local Firms	-1.50e-05	-7.31e-06	-5.98e-05***	-1.58e-05	-0.0001***
	(1.91e-05)	(1.65e-05)	(1.96e-05)	(1.86e-05)	(.0000)
Household Grants	-9.01e-06*	-9.37e-06*	-8.08e-06**	-8.94e-06*	-.00001***
	(5.16e-06)	(5.00e-06)	(3.43e-06)	(5.01e-06)	(4.02e-06)
L2.Gini coefficient (Income including social grants)	-31.43***	-31.28***	-36.85***	-31.52***	-13.38
	(5.491)	(5.521)	(6.123)	(5.249)	(10.180)
Grants paid to other Local Municipalities	0.000267***	0.000267***	-0.000443	0.000268***	0.0003***
	(1.76e-05)	(1.77e-05)	(0.000636)	(1.74e-05)	(.0000)
Household Size	4.301***	4.284***	5.009***	4.285***	3.0812***
	(0.605)	(0.607)	(1.051)	(0.582)	
Gauteng	-1.362	-1.125	4.956***	-1.358	-
	(1.739)	(1.717)	(1.842)	(1.682)	
Western Cape	-8.874***	-8.897***	-2.770	-8.849***	-
	(1.168)	(1.169)	(1.857)	(1.137)	
Eastern Cape	-1.464	-1.457	1.324	-1.440	-
	(1.433)	(1.436)	(1.810)	(1.389)	
Free State	1.014	0.997	1.075	1.042	-
	(1.582)	(1.587)	(1.956)	(1.539)	
Limpopo	-5.382***	-5.381***	-5.186***	-5.355***	-
	(1.444)	(1.448)	(1.661)	(1.406)	
Mpumalanga	-1.914	-1.671	-1.075	-1.885	-
	(1.362)	(1.389)	(1.626)	(1.335)	
North West	5.436***	5.436***	0.784	5.464***	-
	(1.550)	(1.553)	(1.847)	(1.509)	
Constant	21.67***	21.65***	21.30***	21.76***	6.02
	(2.959)	(2.974)	(1.809)	(2.792)	(6.882)
Rho spatial parameter	-	-	-	-	0.47768***
Observations	212	212	212	212	212
R-squared	0.415	0.417	0.978	0.415	0.238
Breusch-Pagan, t-statistic	6.22**	6.43**	417.47***	-	-
Ramsey Reset, F-statistic	0.57	0.53	8.17***	-	-
Jarque-Bera, test-statistic	3.e-119	1.e-116	2.e-272	-	-
Moran I, t-statistic	1.25	1.22	26.14***	-	-
Hausman, F-statistic	-	-	-	.085969	-

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Upon first examination, the OLS regression exhibits reasonable results. However, residual diagnostics indicate the necessity for a weighted least squares (WLS) regression due to the presence of heteroskedasticity. In addition, due to the observed spatial clustering in Figure 1 the Moran I's test was undertaken to establish the presence of spatial autocorrelation. The test statistic for Moran I's is statistically significant indicating a presence of spatial autocorrelation. The presence of heteroskedasticity and spatial correlation imply non-independent error terms which violates the assumption of independence. Hence, spatial units are not independent of each other. Furthermore, the OLS along with the WLS regression models exhibit non-normality. This can be explained by the uneven distribution of FDI inflows into the country. The uneven distribution of FDI results in spatial clustering. Based on Figure 4, it is evident that spatial clustering of FDI occurs predominantly in the Gauteng province and the City of Cape Town municipality.

A weighted least squares model was estimated in an attempt to account for and eliminate the presence of heteroskedasticity. The results of this model indicate a negative and statistically insignificant relationship between FDI and hunger. The one period lagged value of FDI is negative and statistically significant. One can conclude, that the one period lagged value of FDI is imperative in decreasing hunger in the current time period. The remaining variables exhibit the same sign as in the OLS regressions. Lastly, the distribution of data still exhibits non-normality despite heteroskedasticity being accounted for. As discussed previously, this is due to the spatial clustering of FDI inflows.

With reference to column 4, FDI inflows have been instrumented with night lights data for 2013. Annexure F indicates that night lights serve as a good instrument for FDI due to the F-value being 26.06 (Stock & Yugo 2005). FDI appears to have a negative yet insignificant impact on hunger in South Africa. However, the results cannot be accepted due to the null of no endogeneity not being accepted by the Hausman endogeneity test. The remaining coefficients exhibit the anticipated signs and are statistically significant except for the number of local firms in a municipality. This variable is statistically insignificant across all regressions mentioned thus far.

In terms of the province dummy variables, Gauteng and the Western Cape are the largest economically. Therefore, it is sensical to that they would receive the largest amount of FDI. As a result, two additional OLS models were estimated in order to assess whether the results differ with

the exclusion of these two provinces. Both provinces were not excluded simultaneously as this would have resulted in the erroneous error of the dummy variable trap. See Annexure F for the results.

Lastly, in order to account for spatial autocorrelation that exists between the local municipalities following the WLS regressions, a spatial autoregressive model was estimated. The spatial parameter (rho) is positive and highly significant, indicating a positive spatial correlation between spatial units in the model. The positive spatial correlation between hunger and the neighbouring values of hunger is depicted in Figure 5.

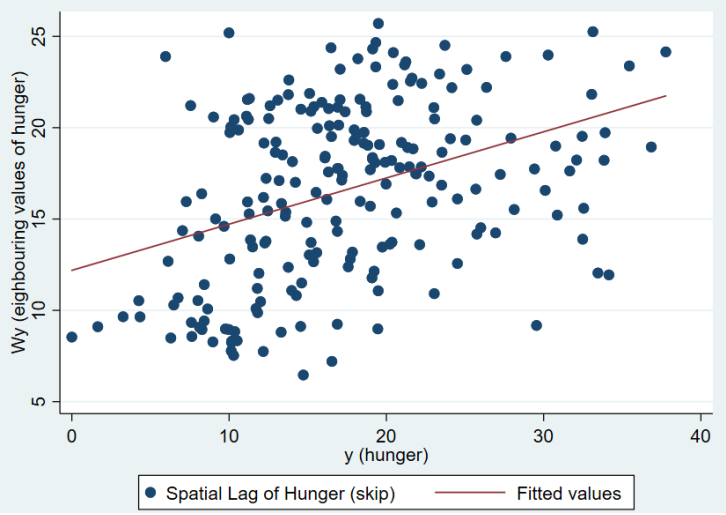


Figure 5: Moran scatterplot based on cross sectional data

To be more precise, hunger experienced in 2016 in municipality *i* was highly dependent on the prevalence of hunger experienced in the neighbouring municipalities. This is clearly demonstrated in Figure 1, whereby there was a spatial clustering of local municipalities that had the same percentage of households that experienced hunger. The remaining coefficients exhibit the expected sign and are all statistically significant except the Gini coefficient.

Table 4 displays the direct and indirect impacts on hunger in the spatial autoregressive model. The number of local firms present in a local municipality appears to have a larger direct effect in comparison to the indirect effect. In other words, an increase in the number of local firms in municipality *i,* has a greater effect in decreasing hunger in municipality *i* as opposed to decreasing hunger in municipality *j*. Based on this, hunger in a particular municipality will decline when the concentration of firms in that municipality is dense.

Moreover, there is a decline in the percentage of households having to skip a meal or meals with an increase in the inflow of FDI for both the direct and indirect effects. Both effects are statistically significant. To be more precise, an increase in FDI in municipality *i*, results in a decrease in the percentage of households having to skip a meal in municipality *i*. The same can be said for households residing in municipality *j* or the neighbouring municipalities of municipality *i*.

Table 3: *Spatial Autoregressive Model for Hunger (cross-sectional study)*

Dependent Variable	(1) Hunger	
Independent Variables	Direct Effect	Indirect Effect
FDI	-0.0171*** (0.0030)	-0.01426** (0.006)
Number of Local Firms	-0.0001*** (0.0000)	0.000051 (0.000)
Household Grants	-0.00002*** (3.91e-06)	-0.00001** (6.65e-06)
L2. Gini coefficient (Income including social grants)	-13.4194 (10.2138)	-11.1272 (9.5380)
Grants paid to other Local Municipalities	0.0003*** (0.0000)	0.00027** (0.00011)
Household Size	3.0910*** (0.5832)	2.562*** (0.9252)
Observations	212	212
Wald Test of Spatial Terms, t-statistic	26.20***	26.20***

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

When analyzing household grants, there is a negative and significant impact on hunger with reference to the direct and indirect effects. This clearly demonstrates the importance of household grants in alleviating household hunger in South Africa. Lastly, grants paid to other local municipalities and the size of the household have a positive and significant impact on hunger for both the direct and indirect effects. However, it would more sensical to only analyze the direct

effect of grants paid to other local municipalities. The direct effect is illustrating the effects of hunger in municipality *i*, when grants are paid from municipality *i*, to municipality *j*. Based on the results, when there is an outflow of funds (in this case, in the form of grants) from a local municipality there is an increase in hunger within that local municipality. If we were to analyze the indirect effects, a variable that looks at the amount of grants received from other local municipalities would need to be considered. Lastly, for the purposes of this study, one should be concerned with the direct effect of an increase in household size on hunger as the size of a household in municipality *i*, has no relevant impact on hunger in municipality *j*, unless migration is taken into account.

ii. Panel Data

In terms of the analysis for this section, employment is the mechanism through which household hunger in South Africa is affected. Ideally, an increase in employment should enable the generation of income and result in a decrease in hunger. Essentially, the economic agent has additional money and can therefore afford to demand more food.

The results for this analysis are demonstrated in Table 4.

In terms of the OLS regressions, FDI has a positive and significant impact on employment. This is indicative of the idea that, an increase in FDI decreases hunger at the local municipal level. Furthermore, the number of local firms in a municipality is highly significant across all regressions. This is clearly signifying the idea that employment through the increased presence of firms is essential to decreasing hunger in South Africa. With this is mind, the same conclusion was drawn in terms of the spatial models discussed in the previous section. Lastly, the sign for household grants and the Gini coefficient are positive, which is not expected. In terms of the provincial dummy variables, employment is increasing across all regressions for all provinces.

Upon residual analysis, the data exhibits heteroskedasticity, non-normality and spatial correlation. As mentioned previously, the non-normality of the data could be due to the fact that FDI is spatially clustered and therefore signifies an uneven distribution of FDI inflow into South Africa.

In terms of the 2SLS, the use of night lights data still signifies FDI as a variable that has a positive impact on employment. The level of significance has increased from 10% to 1% in comparison to the OLS regressions.

Table 4*: Results for Employment (panel study)*

	(1)	(2)	(3)	(4)
Dependent Variable	Employment OLS	Employment OLS	Employment 2SLS	Employment 2SLS (Spatial)
Independent Variables				
FDI	159.0*	154.7*	3,910***	3,910***
	(83.42)	(80.98)	(1,222)	(1,222)
L.FDI	-	173.5*	-	-
		(94.36)		
Number of Local Firms	16.31***	16.46***	15.69***	15.69***
	(0.501)	(0.508)	(0.537)	(0.537)
Household Grants	0.978***	0.951***	0.904***	0.904***
	(0.219)	(0.217)	(0.222)	(0.222)
L2. Gini coefficient	15,172***	16,030***	-5,291	-5,291
	(4,068)	(5,443)	(5,246)	(5,246)
Gauteng	27,983***	27,420***	14,553	14,553
	(9,683)	(9,850)	(17,981)	(17,981)
Western Cape	15,171***	15,499***	22,888***	22,888***
	(2,801)	(2,873)	(5,629)	(5,629)
Eastern Cape	2,823	2,850	1,995	1,995
	(2,128)	(2,107)	(8,110)	(8,110)
Free State	11,011***	11,326***	21,911***	21,911***
	(2,359)	(2,432)	(4,732)	(4,732)
Limpopo	12,145***	12,338***	12,198	12,198
	(1,393)	(1,520)	(10,135)	(10,135)
Mpumalanga	17,106***	17,822***	22,371***	22,371***
	(1,545)	(1,572)	(5,941)	(5,941)
North West	21,802***	22,513***	30,505***	30,505***
	(2,633)	(2,730)	(5,248)	(5,248)
Constant	3,471	1,931	3,180	3,180
	(2,378)	(3,371)	(4,424)	(4,424)
Observations	3,604	3,392	3,604	3,604
R-squared	0.929	0.932	0.401	
Breusch-Pagan, t-statistic	34038.30***	31599.60***	-	-
Ramsey Rest, F-statistic	707.96***	680.31***	-	-
Jarque-Bera, t-statistic	0	0	-	-
Moran I, t-statistic (2016)	5.07**	5.54**		
Hausman, F-statistic	-	-	145.273***	-

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The number of local firms is still positive and highly significant. The coefficient for household grants is positive but the level of significance has declined to 5%. The sign for the Gini coefficient is now negative which realistically, is to be expected. The remaining provincial dummy variables that are significant at 1% are the Western Cape, Free State, Mpumalanga and North West. The results for the spatial 2SLS is the same as that of the 2SLS in column 3.

iii. Spatial Panel Regression Models

The results for this analysis are demonstrated in Table 5.

A random-effects model was estimated over a fixed effects model for the following regressions as a result of the Hausman test statistic and Breusch-Pagan Lagrange multiplier. The results for the random effects panel model indicate that FDI and the number of local firms in a local municipality decrease hunger. Both variables are statistically significant. Furthermore, household grants appear to have a positive and statistically significant impact on employment.

Before analysis in terms of the spatial models could occur, a spatial weighting matrix had to be constructed. It is important to note that due to the construction of the inverse distance weighting matrix and the specification of Tobler's first law of geography, the magnitude of the spillovers falling on immediate neighbours will be greater than the magnitude of spillovers falling on distant neighbours.

Four spatial models were estimated, namely an autoregressive model, a spatially lagged X model, a spatial Durbin model and finally a spatial error model. The AR spatial model is model chosen for interpretation based on the information criterion. The spatial error model, despite have the lowest information criterion cannot be used for the analysis, as the model suggests that there are no spatial spillover effects. Furthermore, as per theory suggests, the use of the AR model occurs when the spillover effects are global in nature (Cook , Hays, & Franzese, 2015; Elhorst, Gross, & Tereanu, 2018). In other words, a spillover effect is transmitted across all other locations and not just to the geographical units that share a bilateral border based on the construction of the W matrix.

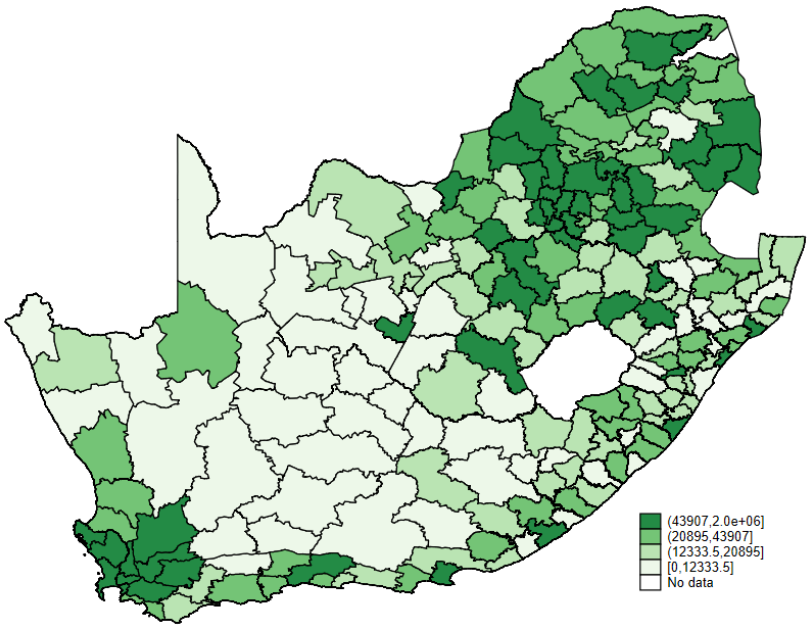


Figure 6: The total number of citizens employed per local municipality in 2016.

As per Figure 6 suggests, the employment spillovers in certain regions of South Africa appear to be global instead of local in nature. As can be seen, the spillover effects of employment are not contained to the immediate neighbours of each local municipality.

Based on the results of the AR model, the spatial autocorrelation parameter is large and significant. In addition, the number of local firms in a municipality have a positive and highly significant direct effect on employment. In other words, an increase in the concentration of firms in municipality *i*, results in an increase in employment and hence decreases hunger in municipality *i*. To be more precise, the formulation of a spatial spillover is dependent on the number of local firms in neighbouring municipalities. In other words, it is more likely for there to be large spatial spillovers if municipality *i* is surrounded by municipalities whereby they themselves have a large concentration of firms.

The direct impact of FDI on employment in a local municipality is positive and statistically significant. This indicates the importance of increasing the attractiveness of local municipalities to foreign investors. The spillover effect of FDI still has a positive impact on employment generation in neighbouring municipalities.

Lastly, household grants appear to have a positive and statistically significant impact on employment for both the direct and indirect effects.

Based on the above analysis, it is evident that FDI and the concentration of firms in a local municipality has a significant impact on decreasing hunger. More specifically, there are significant spillover effects in terms of both FDI and the concentration of local firms. As theory suggests, household grants play an important role in alleviating the harsh reality of hunger in South Africa.

Table 5: *Result for Spatial Models with Employment as the Dependent Variable (panel study)*

		(1)	(2)	(3)	(4)	(5)
Dependent Variable		RE Model	Spatial AR Model, RE	Spatially Lagged X, RE	Spatial Durbin Model, RE	Spatial Error Model, RE
Independent Variables						
	FDI	24.1891**	21.96**	23.30**	19.53*	19.40**
		(11.1591)	(10.32)	(10.72)	(10.14)	(10.04)
	Number of Local Firms	18.6052***	19.39***	19.36***	14.48***	19.50***
		(0.1619)	(0.197)	(0.200)	(0.191)	(10.038)
	Household Grants	0.3947***	0.329***	0.384***	0.316***	0.276***
		(0.0257)	(0.0240)	(0.0247)	(0.023)	(0.023)
Direct Effects	FDI	-	22.1085** (10.3882)	23.3018** (10.7226)	21.0599** (10.4732)	19.40** (10.038)
	Number of Local Firms	-	19.5217*** (0.2001)	19.3625*** (0.2001)	19.4852*** (0.1960)	19.50*** (0.187)
	Household Grants	-	0.3312*** (0.2408)	0.3840*** (0.0247)	0.3230*** (0.0284)	0.276*** (0.023)
Indirect Effects	FDI	-	32.6066** (16.0798)	355.5446*** (76.8688)	293.822 (387.335)	-
	Number of Local Firms	-	28.7905*** (4.5717)	1.9575 (1.3424)	0.4067 (6.9261)	-
	Household Grants	-	0.4885***	-	1.2725***	-
			(0.0803)		(0.2904)	
	Constant	16892.73***	-21,755***	9,174*	3188.239	15119.86***
		(2556.12)	(4,610)	(5,124)	(5194.064)	(4059.435)
	Rho spatial parameter	-	0.622***	-	0.818***	1.304***
	Theta spatial parameter (FDI)	-	-	384.1***	43.77	-
	Theta spatial parameter (Firms)	-	-	2.115	-15.85***	-
	Observations	3,604	3,604	3,604	3,604	3,604
	Number of groups	212	212	212	212	212
	Hausman, t-statistic	4.48	-	-	-	-
	Breusch-Pagan LM, t-statistic	14025.78	-	-	-	-
	AIC	-	83285.07	83506.27	83188.79	83149.18

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

VIII. Conclusion

For the purposes of this paper, this paper concerns two different forms of data, in order to assess the impact that FDI inflows have on hunger and food insecurity within South Africa. The first analysis looked at cross-sectional data for 212 local municipalities within the year 2016. The cross-sectional model estimated the direct impact FDI has on hunger and food security in South Africa. Whereas, the second type of analysis, focusing on panel data, estimated the impact of FDI on hunger and food insecurity through the means of employment, a transmission mechanism. Taking the previous point into consideration, employment as a transmission mechanism was founded within Sen's framework, titled *The Entitlement Approach*. This paper attempts to apply Sen's framework on Entitlement Failure, located at a collective level, as opposed to an individual level as utilized by Sen. The collective level refers to the various local municipalities located within the South African borders. Within the collective level, each municipality is classified as an individual constituent. The purpose behind the application of Sen's framework within the South African context, revolves around the issue of the rising levels of food insecurity, as a result of the inability of various South Africans' to access food, rather than the lack of food availability itself. As a nation, South Africa is food secure where there exists no shortage in food production, however at a household level, many South Africans currently face the harsh reality of hunger and food insecurity.

The results indicate that the direct impact FDI has on hunger, is both negative and significant when hunger is denoted as the percentage of households that had to skip a meal or meals. In terms of WLS and 2SLS models specifically, FDI inflows have a negative and insignificant effect on hunger. A spatial autoregressive model was estimated. The results from the model, based on the percentage of households that had to skip a meal or meals, indicate that FDI has a negative and significant impact on hunger in addition to a negative and significant spatial spillover.

With reference to Sen's framework and the use of employment as the transmission mechanism, FDI has a positive and significant effect on employment across all non-spatial models. Moreover, the presence of spatial correlation between local municipalities prompted the use of spatial models. The results indicate that FDI has a positive and highly significant impact on employment within both a single municipality as well as its neighbouring municipalities.

The cross-sectional results clearly indicate a negative relationship between hunger and the inflows of FDI arriving within a local municipality. Furthermore, the panel data results support the notion of Sen's *Entitlement Approach*. The demand for food in South Africa arises through the generation of income via the creation of employment. However, it is the results estimated from the panel spatial models which hold much significance for the purposes of this paper. It is important to note that the spatial parameter for FDI is 384.1, as well as being highly statistically significant with regards to indicating that employment within municipality *i* is significantly influenced by the amount of FDI received by the neighbouring municipalities, *j*. Due to the inflows of FDI being spatially clustered in the Gauteng and Cape Town region, the local municipalities having indicated the largest percentage of households experiencing hunger, are located within the North West, Northern Cape, Kwa-Zulu Natal and Eastern Cape provinces. Taking all the regressions estimated into consideration, the results indicated that household grants are imperative with regards to combating hunger and food insecurity within a local municipality.

To conclude, this paper highlights the importance of an equitable distribution of FDI across various South African municipalities as a means to alleviating hunger and food insecurity at the local municipal level. In other words, this paper has managed to highlight the fact that municipalities who receive a sufficient amount of FDI, specifically municipalities within the Gauteng region, experience lower levels of hunger in comparison to municipalities located within the North West/Northern Cape region who receive little to no FDI. Based on the above statement, it is therefore vital for local municipalities receiving little to no FDI to attract FDI inflows from multiple foreign investors. This paper sought to recognize the issue multiple local municipalities are facing with regards to an insufficient amount of FDI brought into South Africa from foreign investors, thus contributing towards the rise in levels of hunger. It is important to emphasize that this study has not addressed the means to which local municipalities can bolster their attractiveness to foreign investors, however this question secures a route through which research has the ability to address.

IX. Appendix

Annexure A: *Definition of variables*

Variable	Definition
Hunger	The percentage of households that had to skip a meal or meals within the past 12 months in a local municipality.
Employment	The total number of citizens employed per local municipality.
Foreign Direct Investment (FDI)	The value of FDI in Rands.
Number of Local Firms	The total number of firms situated in a local municipality for the period 2000 – 2016.
Household Grants	The number of grants paid to households or individuals residing in a particular municipality.
L2. Gini coefficient (Income including Social Grants)	Two period lagged value of the Gini coefficient. This consists of income inclusive of pension fund, disability grant and child support grant. Interpolation of national level data was conducted by Quantec Research (Pty) Ltd in order to obtain the data at the local municipal level.
Grants paid to other Local Municipalities	The payment of a grant from local municipality *i* to local municipality *j*.
Household Size	The average number of household residents per local municipality.

Annexure B: *List of Amalgamated Municipalities and its Constituents*

Amalgamated Municipality	Constituents
1. Alfred Duma Local Municipality	P5D03M01: Emnambithi/Ladysmith (KZN232) P5D03M02: Indaka (KZN233)
2. Ray Nkonyeni Local Municipality	P5D01M05: Ezingoleni (KZN215) P5D01M06: Hibiscus Coast (KZN216)
3. Dawid Kruiper Local Municipality	P3D04M01: Mier (NC081) P3D04M03: //Khara Hais (NC083)
4. City of Mbombela Local Municipality	P8D03M02: Mbombela (MP322) P8D03M03: Umjindi (MP323)
5. The Big 5 Hlabisa Local Municipality	P5D07M03: The Big 5 False Bay (KZN273) P5D07M04: Hlabisa (KZN274)
6. Walter Sisulu Local Municipality	P2D04M03: Maletswai (EC143) P2D04M04: Gariep (EC144)
7. City of uMhlathuze Local Municipality	P5D08M01: uMfolozi (KZN281) P5D08M05: Mthonjaneni (KZN285)
8. Fetakgomo Greater Tubatse Local Municipality	P9D05M02: Fetakgomo (LIM474) P9D05M05: Greater Tubatse (LIM475)
9. Modimolle-Mookgopong Local Municipality	P9D04M03: Mookgopong (LIM364) P9D04M04: Modimolle (LIM365)
10. Rand West Local Municipality	P7D03M02: Randfontein (GT482) P7D03M03: Westonaria (GT483)
11. JB Marks Local Municipality	P6D04M01: Ventersdorp (NW401) P6D04M02: Tlokwe City Council (NW402)
12. Enoch Mgijima Local Municipality	P2D03M02: Tsolwana (EC132) P2D03M03: Inkwanca (EC133) P2D03M04: Lukanji (EC134)
13. Raymond Mhlaba Local Municipality	P2D02M07: Nkonkobe (EC127) P2D02M08: Nxuba (EC128)
14. Dr Beyers Naude Local Municiplaity	P2D01M01: Camdeboo (EC101)

	P2D01M03: Ikwezi (EC103) P2D01M07: Baviaans (EC107)
15. Dr Nkosazana Dlamini-Zuma Local Municipality	P5D10M01: Ingwe (KZN431) P5D10M02: Kwa Sani (KZN432)
16. Inkosi Langalibalele	P5D03M03: Umtshezi (KZN234) P5D03M05: Imbabazane (KZN236)
17. Vulamehlo Local Municipality (located South of the eThekwini Municipality)	P5D11M01: eThekwini (ETH)
18. Mutale Local Municipality	P9D02M01: Musina (LIM341) P9D02M02: Mutale (LIM342)

Annexure C: *Averaging of night lights data*

Based on (Lowe, 2014), the average pixel value of two years was created using ArcGIS. The two datasets, were loaded into ArcGIS as layers and a new raster dataset was calculated. For example, once F142000 and F152000 were loaded into ArcGIS, a new raster dataset was calculated upon the selection of Spatial Analyst Tools and then Raster Calculator. Using the command: (Float(raster1) + Float(raster2))/2, produced a new raster dataset consisting of the average luminosity for 2000. Raster 1 would be the geographical layer labelled F142000 and Raster 2 would be the geographical layer labelled F152000. This process was repeated for years 2001 – 2007.

Annexure D: *Removal of gas flares from night lights data*

Based on (Lowe, 2014), the removal of gas flares was executed through ArcGIS. A shapefile with the gas flares situated in South Africa was download from National Geophysical Data Center (NGDC), National Oceanic and Atmospheric Administration (NOAA). The gas flare shapefile was loaded and superimposed on the night lights data and shapefile of the local municipal boundaries of South Africa.

The gas flare shapefile along with the night lights shapefile in South Africa were spatially joined and was executed through Analysis Tools → Overlay → Union. This process created an output shapefile with the presence of gas flares. The input feature was the gas flare polygon shapefile.

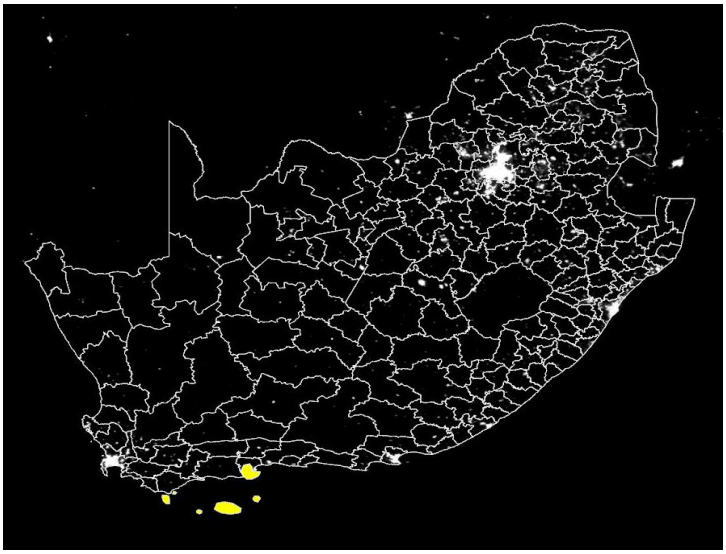


Figure 7: Gas Flares in Mossel Bay

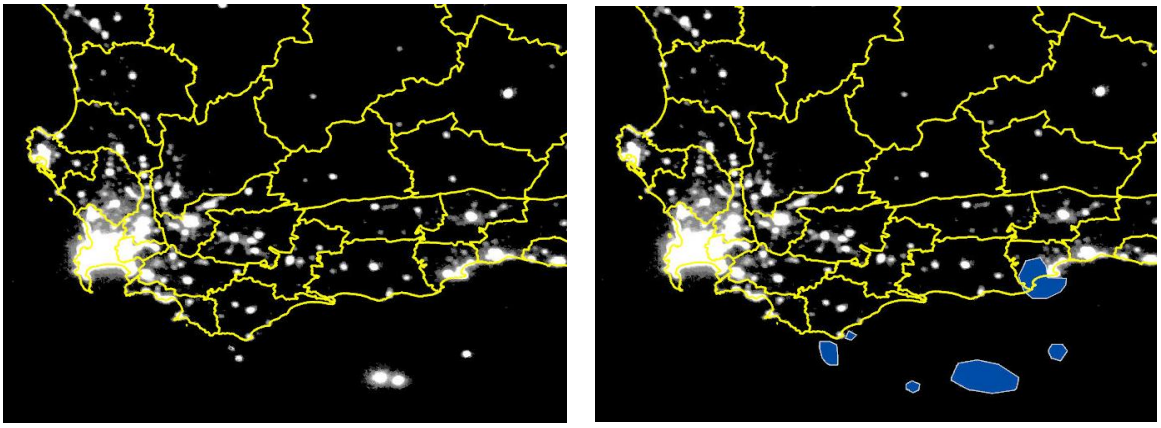


Figure 8: Gas Flares in South Africa
Source: National Geophysical Data Center (NGDC), National Oceanic and Atmospheric Administration (NOAA).

Upon the union of all three files, the gas flares could now be detached from the South African local municipal night lights shapefile. This process was accomplished through Analysis Tools → Overlay → Erase. The input feature was the shapefile consisting of union of the South African local municipal night lights and gas flares. The erase feature was the gas flare shapefile. The resulting map was that of South Africa without the presence of gas flares.



Figure 9: Gas Flares in Mossel Bay extracted

Annexure E: *OLS regression and Moran I statistic*

	(1)
Variable of interest	Hunger
Constant	17.41***
	(0.508)
Observations	212
R-squared	0.000
Moran I, t-statistic	119.22***

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annexure F: *OLS Regression of FDI and Night Lights Data for 2016*

	(1)
Dependent variable	FDI
Night Lights (average)	1.236***
	(0.242)
Constant	-1.976
	(1.955)
Observations	212
R-squared	0.110
F value	26.06***

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annexure G: *OLS regression with exclusion of Gauteng and Western Cape dummy variables*

Dependent Variable	(1) Hunger	(2) Hunger	(3) Hunger	(4) Hunger
FDI	-0.00860*	-0.00816*	-0.0163***	-0.0158***
	(0.00453)	(0.00458)	(0.00360)	(0.00362)
L.FDI		-0.0132***		-0.0179***
		(0.00402)		(0.00450)
Number of Local Firms	-3.44e-05	-2.82e-05	-3.29e-05	-2.25e-05
	(2.13e-05)	(1.86e-05)	(2.05e-05)	(1.68e-05)
Household Grants	-9.22e-06*	-9.52e-06*	-1.31e-05***	-1.30e-05***
	(5.18e-06)	(5.14e-06)	(4.49e-06)	(4.37e-06)
L2.Gini coefficient (Income including social grants)	-37.27***	-37.15***	-30.10***	-29.74***
	(7.348)	(7.386)	(5.799)	(5.841)
Grants paid to other local municipalities	0.000275***	0.000275***	0.000281***	0.000281***
	(2.66e-05)	(2.67e-05)	(2.80e-05)	(2.81e-05)
Household Size	5.646***	5.633***	4.167***	4.120***
	(0.696)	(0.697)	(0.593)	(0.596)
Gauteng	3.418**	3.622**	-	-
	(1.703)	(1.709)		
Western Cape	-	-	-9.203***	-9.287***
			(1.256)	(1.256)
Eastern Cape	1.735	1.745	-1.779	-1.818
	(1.512)	(1.516)	(1.487)	(1.489)
Free State	5.002***	4.992***	0.576	0.491
	(1.637)	(1.641)	(1.691)	(1.699)
Kwa-Zulu Natal	-	-	-	-
Limpopo	-2.328	-2.323	-5.660***	-5.700***
	(1.468)	(1.473)	(1.511)	(1.517)
Mpumalanga	1.332	1.538	-2.222	-1.999
	(1.376)	(1.410)	(1.433)	(1.444)
North West	9.048***	9.053***	5.056***	5.000***
	(1.540)	(1.543)	(1.641)	(1.648)
Northern Cape	2.883	2.881	-1.301	-1.371
	(1.755)	(1.760)	(1.818)	(1.825)
Constant	16.80***	16.77***	21.74***	21.74***
	(4.279)	(4.303)	(3.187)	(3.207)
Observations	212	212	212	212
R-squared	0.308	0.309	0.416	0.418
Breusch-Pagan, t-statistic	0.59	0.64	5.76***	6.07***
Ramsey Reset, F-statistic	0.81	0.75	0.47	0.39
Jarque-Bera, test-statistic	6.e-238	1.e-235	2.e-107	4.e-103
Moran I, t-statistic	27.66***	27.97***	1.52	1.47

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Annexure H: *Pairwise Correlation Coefficients for Table 2.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Hunger	1.00														
(2) FDI	-0.00	1.00													
(3) L.FDI	-0.01	0.01	1.00												
(4) Number of Local Firms	-0.01	0.06	0.07	1.00											
(5) Household Grants	0.03	0.02	0.03	0.20	1.00										
(6) L2. Gini coefficient	0.06	0.03	0.02	0.00	0.03	1.00									
(7) Grants paid to local municipalities	0.07	0.02	0.00	0.06	-0.00	0.01	1.00								
(8) Household Size	0.01	-0.02	-0.02	-0.14	-0.07	0.01	-0.04	1.00							
(9) Gauteng	-0.01	0.05	0.05	0.48	0.19	0.02	0.02	-0.23	1.00						
(10) Western Cape	-0.04	-0.01	-0.01	0.04	-0.00	-0.03	0.02	-0.13	-0.08	1.00					
(11) Eastern Cape	0.00	0.01	0.01	-0.06	-0.01	-0.01	-0.00	0.02	-0.09	-0.16	1.00				
(12) Free State	-0.00	-0.02	-0.02	-0.04	-0.01	0.06	-0.00	-0.15	-0.07	-0.11	-0.13	1.00			
(13) Limpopo	-0.01	0.00	0.00	-0.04	-0.01	-0.07	-0.01	0.01	-0.07	-0.12	-0.14	-0.10	1.00		
(14) Mpumalanga	-0.00	-0.01	-0.01	-0.03	-0.00	-0.02	-0.01	0.01	-0.06	-0.10	-0.12	-0.09	-0.09	1.00	
(15) North West	0.02	-0.02	-0.02	-0.04	-0.01	0.00	-0.01	-0.07	-0.06	-0.11	-0.13	-0.10	-0.10	-0.09	1.00

Annexure I: *Pairwise correlation coefficients for Table 4.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Total Employment	1.00												
(2) FDI	0.09	1.00											
(3) L.FDI	0.10	0.01	1.00										
(4) Number of Local Firms	0.96	0.06	0.07	1.00									
(5) Household Grants	0.28	0.02	0.03	0.20	1.00								
(6) L2. Gini coefficient	0.02	0.03	0.02	0.00	0.03	1.00							
(7) Gauteng	0.48	0.05	0.05	0.48	0.19	0.02	1.00						
(8) Western Cape	0.05	-0.01	-0.01	0.04	-0.00	-0.03	-0.08	1.00					
(9) Eastern Cape	-0.07	0.01	0.01	-0.06	-0.01	-0.01	-0.09	-0.16	1.00				
(10) Free Stata	-0.03	-0.02	-0.02	-0.04	-0.01	0.06	-0.07	-0.11	-0.13	1.00			
(11) Limpopo	-0.03	0.00	0.00	-0.04	-0.01	-0.07	-0.07	-0.12	-0.14	-0.10	1.00		
(12) Mpumalanga	-0.02	-0.01	-0.01	-0.03	-0.00	-0.02	-0.06	-0.10	-0.12	-0.09	-0.09	1.00	
(13) North West	-0.02	-0.02	-0.02	-0.04	-0.01	0.00	-0.06	-0.11	-0.13	-0.10	-0.10	-0.09	1.00

Annexure J: *Variance Inflation Factor (VIF)*

Table 2 (OLS):

Variables	**VIF**	**1/VIF**
FDI	1.02	0.976595
L. FDI	1.17	0.852575
Number of Local Firms	1.44	0.693488
Household Grants	1.16	0.862100
L2. Gini coefficient	1.29	0.775540
Grants paid to other Local Municipalities	1.01	0.988051
Household Size	1.28	0.783815
Gauteng	1.75	0.572857
Western Cape	1.27	0.785997
Eastern Cape	1.29	0.775315
Free State	1.32	0.755318
Limpopo	1.28	0.781139
Mpumalanga	1.21	0.829187
North West	1.21	0.829535
Mean VIF	1.26	

Table 4 (OLS):

Variables	**VIF**	**1/VIF**
FDI	1.01	0.993395
L. FDI	1.01	0.993342
Number of Local Firms	1.34	0.748138
Household Grants	1.06	0.946118
L2. Gini coefficient	1.01	0.986732
Grants paid to other Local Municipalities	1.01	0.994261
Household Size	1.17	0.851177
Gauteng	1.51	0.663750
Western Cape	1.27	0.784773
Eastern Cape	1.26	0.795203
Free State	1.23	0.811631
Limpopo	1.19	0.841244
Mpumalanga	1.15	0.871307
North West	1.18	0.844384
Mean VIF	1.17	

Table 2 (WLS):

Variables	**VIF**	**1/VIF**
FDI	1.17	0.853175
L. FDI	1.91	0.522724
Number of Local Firms	1.85	0.540762
Household Grants	2.64	0.379292
L2. Gini coefficient	954.31	0.001048
Grants paid to other Local Municipalities	1.01	0.986839
Household Size	596.96	0.001675
Gauteng	8.38	0.119302
Western Cape	48.98	0.020418
Eastern Cape	161.89	0.006177
Free State	3.49	0.286753
Limpopo	1.21	0.828103
Mpumalanga	1.63	0.615322
North West	34.81	0.028726
Mean VIF	130.02	

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