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Infrastructure, FDI and manufacturing exports in Africa: the firm level analysis

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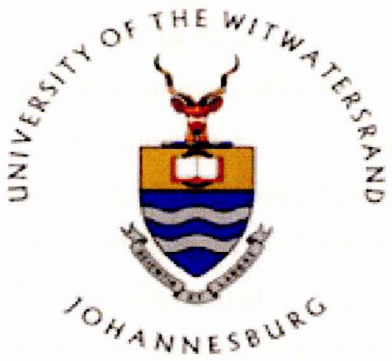

FACULTY OF COMMERCE, LAW AND MANAGEMENT

INFRASTRUCTURE, FDI AND MANUFACTURING EXPORTS IN AFRICA: A firm level analysis.

SUBMITTED TO THE SCHOOL OF ECONOMIC AND BUSINESS SCIENCES FOR THE DEGREE OF DOCTOR OF PHILISOPHY

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Abstract

The primary aim of this study is to investigate the role that is played by the quality of infrastructure on export participation and on foreign direct investment using firm level data from the World Bank and employing maximum likelihood techniques such as the Tobit and Probit models. Results show that firm size, foreign ownership, internet access, international distance, electricity, customs and generator ownership matter in influencing export participation. Thus the reason why very few firms in Africa are outward oriented is partly because of poor market access and poor electricity and customs infrastructure. In the case of foreign direct investment (FDI) results show that foreign firms are attracted to a market, bigger in size and that market access is also very important. FDI results also show that a big market in an environment characterized by acute power problems negatively affects market seeking FDI. Customs problems generally have a weak negative effect on the probability to be foreign invested particularly inward FDI, but days to export matter to outward looking foreign producers. Water problems do not seem to matter for both FDI firms and exporters in this study. In light of these findings, there is need therefore for the government in collaboration with multilateral institutions like the World Bank, United Nations and other donor agencies to mobilise resources to improve Africa's infrastructure facilities particularly customs, power and international transport facilities. This could also be done by involving the private sector through various Public Private Partnership arrangements.

Acknowledgements

I would like to thank or express my sincere gratitude and appreciation to so many people who emotionally, financially and academically assisted me in making this PhD a success. I am most grateful to my supervisor Professor Neil Rankin for his exceptional guidance, patience, encouragement and enthusiasm in reading and shaping my work. I would not have done much without his invaluable input. This thesis also benefited from very valuable comments from participants at the African Economic Research Consortium (AERC) conferences, Canadian Economics Society in Canada as well as staff who attend departmental seminars at the University of the Witwatersrand.

Many thanks also go to my family particularly my wife Patricia for putting up with many late nights and for the motivation and emotional support that you were always ready to offer. Many thanks also go my fellow comrades or colleagues in the PhD programme for their encouragements and comments on my drafts. Last but definitely not least, would also like to express my sincerely gratitude to the AERC, IDRC, SANTED and UNISA for the financial support and opportunity to present part of my work in their conferences.

The data from the World Bank's investment climate surveys is also greatly appreciated. All errors and omissions are my sole responsibility.

Dedication

To my son Mthokozisi Moyo and my late mother Margaret Moyo.

TABLE OF CONTENTS

CHAPTER ONE **1**

1. INTRODUCTION 1

1.1 Background to the study 1

1.2 Motivation of the study 4

1.3 Objectives of the study 6

1.4 Organisation of the thesis 7

CHAPTER 2 ..... **8**

2.0 INFRASTRUCTURE PROFILES OF STUDY COUNTRIES 8

2.1 Introduction 8

2.2 Transport infrastructure 9

2.3 Telecommunication infrastructure 20

2.4 Electricity Infrastructure 25

2.5 Customs Infrastructure 27

2.6 Water infrastructure 29

2.7 Infrastructure and Trade 31

2.8 Summary 33

CHAPTER 3 ..... **37**

3. INFRASTRUCTURE AND MANUFACTURED EXPORTS: A Firm level analysis 38

3.1 Introduction 38

3.2 Literature review 40

3.3 The model 55

3.4. Data and variables measurement 62

3.5 Descriptive analysis of data 66

3.6 Geographical and market diversification of exports 76

3.8 Presentation and analysis of Cross sectional results 89

3.9 Market Diversification results 106

3.10 Marginal effects 107

3.11 Conclusions 110

CHAPTER 4 115

INFRASTRUCTURE AND FOREIGN DIRECT INVESTMENT IN AFRICA (Evidence from firm level data) 115

4.1 Introduction 115

4.2 Literature review 121

4.3 The model 140

4.3.3 Estimated FDI Model 144

4.4 Descriptive analysis of firm level data 151

4.5 Econometric issues 157

4.6. Findings 159

4.7. Conclusions 170

CHAPTER 5 176

CONCLUSIONS AND POLICY RECOMMENDATIONS 176

REFERENCES 183

List of Tables

Table 2.1	Land transport infrastructure	14
Table 2.2	Port infrastructure	17
Table 2.3	Percentage of firms identifying infrastructure as an obstacle	20
Table 2.4	Telecommunications infrastructure quality indicators	22
Table 2.5	Electricity infrastructure problems	27
Table 2.6	Customs clearing times	29
Table 2.7	Water infrastructure problems	30
Table A2.1	General Infrastructure indicators	35
Table A2.2	Percentage of firms identifying infrastructure as a major problem	36
Table 3.1	Sample average firm level exports	68
Table 3.2	Correlation matrix	73
Table 3.3	Distribution of firms among sectors in each country	74
Table 3.4	Distribution of firms among sectors in each country	74
Table 3.5	Firm level variable averages by country and sector	75
Table 3.6	Market diversification (Number of equivalent markets)	80
Table 3.7	Summary of country level results	83
Table 3.8	Regressions using OLS, Probit and Tobit Models (using hours)	85
Table 3.9	Summary of endogeneity tests	86
Table 3.10	Pooled regression results using perceptions indicators	91
Table 3.11	Pooled regression results using the Tobit model (hours)	92
Table 3.12	Pooled regression results using the Probit model (hours)	93
Table 3.13	Pooled regression results using OLS and LPM (hours)	94
Table 3.14	Sectoral results using hours and days without infrastructure	103
Table 3.15	Geographical market diversification Model using OLS	106
Table 3.16	Marginal effects on selected infrastructure indicators	109
Table 3.17	South Africa marginal effects at Ugandan levels	109
Table A3.1	List of variables for chapter 3	112
Table A3.2	Alternative mean levels of infrastructure quality by country	113
Table A3.3	Infrastructure perceptions indicators means by country and sector	113
Table 4.1	FDI inward stock by host region	116
Table 4.2	FDI inflows by host region	117
Table 4.3	Distribution of firms among sectors in each country	154
Table 4.4	Firm level variable averages by country and sector	154
Table 4.5	Average infrastructure quality by country	155
Table 4.6	Foreign investment profile	156
Table 4.7	Regressions using OLS and Tobit Models	157
Table 4.8	Summary of endogeneity tests using OLS and Probit Model	158
Table 4.9	Main FDI regression results	160
Table 4.10	Export oriented FDI regression results	168
Table 4.11	Market seeking FDI regression results	169
Table A4.1	List of variables for chapter 4	172
Table A4.2	Probit Model using different levels of FDI	175

List of figures

Fig 2.1	Average percentage of paved roads	10
Fig 2.2	Map of Trans African Highways	11
Fig 2.3	Map of Africa Railways	12
Fig 2.4	Firms identifying transport as an obstacle	19
Fig 2.5	Communication tariffs at country level	23
Fig 2.6	Communication tariffs at regional level	24
Fig 2.7	Telecommunications as an obstacle	25
Fig 2.8	Electricity as an obstacle	27
Fig 2.9	Customs as an obstacle	29
Fig 2.10	Water infrastructure problems	31
Fig 2.11	Relationship between infrastructure and exporting (using hours)	33
Fig 2.12	Relationship btwn infrastructure and exporting (perception indicators)	33
Fig A2.1	FDI and infrastructure problems	36
Fig A2.2	Scatter plots (exports and infrastructure disruptions)	37
Fig 3.1	Relationship between market diversification and export intensity	80
Fig 3.2	Kernel densities	114
Fig 4.1	Infrastructure indicators	155
Fig A4.1	Kernel densities	173
Fig A4.2	FDI structure	174
Fig A4.3	Relationship between FDI and infrastructure problems in each country	174
Fig A5.1	PPP Spectrum	182

List of acronyms

ADB	African Development Bank
ASYCUDA	Automated System for Customs Data
BEC	Broad Economic Categories
CIF	Cost Insurance and Freight
CES	Constant Elasticity of Substitution
COMESA	Common Market for East and Southern Africa
DAI	Digital Access Index
EU	European Union
ECA	Economic Commission for Africa
FMA	Foreign Market Access
FDI	Foreign Direct Investment
GNP	Gross National Product
GDP	Gross Domestic Product
GMM	Generalised Methods of Moments
HS	Harmonised System
ITU	International Telecommunications Union
ITC	International Trades Centre
ICA	Infrastructure Consortium for Africa
ICAO	International Civil Aviation Organisation
ISIC	International Standards Industrial Classification
ISI	Import Substitution Industrialisation
LPM	Linear Probability Model
MENA	Middle East and North African countries
MNE	Multinational Enterprises
OECD	Organisation of Economic Cooperation and Development
OLS	Ordinary Least Squares
OLI	Owner specific, Locational and Internalisation advantages
PPP	Public – Private Partnerships
2SLS	2 Stage Least Squares
SITC	Standard International Trade Classification
SANRAL	South African National Roads Agency Ltd
SSA	Sub Saharan Africa
TANROADS	Tanzania National Roads Agency
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Energy Programme
USA /US	United States of America
UNCTAD	United Nations Conference on Trade and Development
WDI	World Development Indicators

Declaration

I, Busani Moyo, do hereby declare that the work presented in this thesis is my own, except where acknowledged and that this thesis or any part of it has not been previously submitted for the award of a degree at any university.

Signed:.....

Date: 13/05/2011

CHAPTER ONE

1. INTRODUCTION

1.1 Background to the study

A number of studies have emphasized the important role exports and Foreign Direct Investment (FDI) play in promoting growth and development (see Darrat, 1987; Balassa, 1978; Frankel and Romer, 1999; Lipsey, 2002; Alfaro et al, 2004; Aitken et al,1999 etc). The World Bank (1993) summed up the benefits of outward orientation by arguing that, export expansion generates greater capacity utilization, enables firms to take advantage of economies of scale, brings about technological progress, improves allocation of scarce resources and increases labor productivity. Advocates of export led growth strategy (Balassa, 1980; Bhagwati, 1978; Darrat, 1987; Edwards, 1998; Barro and Sala-i-Martin, 1995) pointed out that, not only are exports highly correlated with growth but the former unidirectionally causes the latter. The unprecedented rate of growth and rapid industrialization that was achieved by some Asian countries (dubbed the Asian tigers) between the 1960s and the 1990s through export promotion provided more support to the export led growth strategies (Wood et al 1997). This strong relationship between exports and growth resulted in export oriented policies being prescribed to developing countries as the appropriate development strategy.

In the same way that exporting is good for growth, foreign direct investment also has the potential to generate employment, raise productivity, transfer skills and technology, enhance exports as well as contribute to the long-term economic growth of the world's developing nations (Wheeler and Mody, 1992; Romer, 1993; Carkovic and Levine, 2004). Whilst firm level studies generally, though not uniformly show no strong evidence between FDI and growth[1], there is general consensus in the empirical macroeconomic literature that promoting foreign investment is good for growth (Borensztein et al 1998; Carkovic and Levine 2002; Hausman and Fernandez 2002 etc). Thus as much as it is important for governments to pursue export led growth strategies, there is also a similar need for countries to leverage FDI for development. Exports and FDI have the advantage of not only accelerating growth and development but also fostering

[1] See Haddard and Hanson, 1993; Aitken and Harrison, 1999; Blomstrom 1986; Villegas and Sanchez,2009.

strong economic links between industrialized nations and developing countries (UNCTAD, 2007).

Although exports and FDI are important in promoting growth and economic integration, the performance of these economic variables in Africa has been relatively poor in comparison with other developing regions. This could partly explain why the growth of the African continent has been sluggish over the years. Thus between 1960 and 2008, a meager average growth rate of 3% per annum was recorded compared to 7.1% for East Asia and Pacific and 3.9% for Latin America (WDI, 2008)[2]. These World Bank statistics also show that for the same period, per capita gross domestic product for Sub Saharan Africa also grew at an average rate of 0.7% compared to 1.9% and 5.5% for Latin America as well as East Asia and the Pacific respectively. This poor economic growth in the continent appears to be closely linked with poor export performance as well as poor inflows of foreign direct investment (FDI). In fact, according to UNCTAD (2007), the African continent's annual share of global FDI of about 3% converges to the region's shares in world exports and world output. The poor performance of exports and low foreign direct investment inflows are of concern to the continent, since these are the most important conduits through which growth, employment creation, poverty reduction as well as globalization of the international economy can be encouraged (Dollar et al, 2004).

A number of researchers amongst them Hummels (2007), Limao and Venables (2001), Buys (2006), Wheeler and Mody (1992), Srinivasan (1998), Morrisset (2000), Asiedu (2005) have debated for a long time on the factors that could explain low investment and exporting levels in Africa. Asiedu (2005); Hummels (2006); Limao and Venables (2001); Elbadawi et al (2007); Buys (2006) argued that this missing trade and investment could be a result of poor institutions, inadequate infrastructure and adverse economic geography.

[2] The growth rates between 2001 -2008 were: East Asia and Pacific 8.9%; Europe and Central Asia 5.75%; Latin America 3.6%; South Asia ,7.12% and SSA 4.9% (WDI, 2009).

Inadequate infrastructure[3] is thus a major obstacle to trade promotion in that it adversely affects the ability of local producers to compete in international markets as they are displaced by relatively efficient low cost suppliers from other regions (Wheeler and Mody, 1992). Thus infrastructural services poses costs on trade within and between countries and if the quality is poor, then a large portion of goods produced and traded will not be consumed by the national and foreign purchasers (Martin et al, 1995). By affecting the production and consumption conditions of any economy, infrastructure has an impact on exports. Khadaroo and Seenatah, (2007) also argue that the quality of developing countries' infrastructure and institutions plays a role in attracting FDI. They argue that this is mostly because multinationals are profit-oriented entities that seek to minimize the costs of doing business and if moving to a developing economy to take advantage of lower labour costs means losing patent protection to imitators, making informal payments (bribes) to get things done, incur higher transport costs due to inadequate transportation and missed supply shipments due to communication problems, then they will not choose to do business there.

In explaining the actual role that infrastructure plays in facilitating trade and FDI, Kessides (1993), argued that the quality and availability of infrastructure facilities like transport, water, telecommunication and power is important in enhancing the marginal productivity of factors of production like capital and labour. She went on to argue that infrastructure services are intermediate inputs and any reduction in their cost raises the profitability of production, thus resulting in higher levels of output, income and employment. By permitting the transition from manual to electrical machinery, reducing workers' commuting time, and improving information flows through electronic data exchanges, infrastructure services raise the productivity of factors of production like labour and capital and this improves the competitiveness of exports as well as promotes foreign investment (Kessides, 1993). Therefore, as a result of this spill over effect, infrastructure is often described as an "unpaid factor of production", since its availability and quality leads to higher returns obtainable for other factor inputs (Kessides, 1993).

[3] We define Infrastructure as the basic physical and organizational structures needed for the operation of enterprises, or the services and facilities necessary for an economy to function. This includes water and power systems, roads, telecommunication facilities, and customs systems (soft infrastructure).

Kessides (1993) also went on to argue that consumption of infrastructure services by households also contributes indirectly to productivity because many of these services, notably clean water and sanitation, are essential for health and create environmental amenities which improve the productivity of labour. Therefore the reductions in the cost and improvements in infrastructure services to households can have the beneficial effects of increasing their real income and consumption as well as reducing the cost of labour through productivity.

It is worth emphasizing that all of the above contributions of infrastructure to productivity, trade and FDI, derive not from the mere existence or creation of the physical facilities but from their operation and the value of the services generated (Asiedu, 2005; Kessides, 1993). This basically implies that reliability and accessibility of infrastructure services is more important than their physical availability. This partly explains why in this study we analyse the impact of infrastructure services by looking at quality indicators such as the number of hours or days firms go without power, water and a telephone connection.

1.2 Motivation of the study

The impact of infrastructure on export performance and foreign direct investment has been analysed largely at macro level using a variety of econometric models such as static and dynamic panel data models, spatial econometrics as well as bilateral trade flow or gravity models (see Limao and Venables, 2001; Buys, 2006; Wheeler and Mody, 1992; Elbadawi et al, 2007 Francois and Manchin, 2007 etc). The problem with these country level studies is that there are not that many countries in the world on which there is good enough macro data on social infrastructure to derive robust statistical results[4]. The other problem is that country level data assumes that the quality of infrastructure is the same across locations within a country, when in fact they may be interesting variation based on local governance (Dollar et al, 2004). A further problem with developing country level data, especially with respect to infrastructure, is that there is very little variation over time to justify panel analysis. The calculated indicators like the number of paved roads, telephone density, electricity production and consumption do not say

[4] See Levine and Renelt (1992); Rodriguez and Rodrik (2000); Dollar and Kray (2003); Blonigen (2005)

much about the quality of services derived from these infrastructure facilities. Poorly maintained and congested paved roads, telecommunication networks breakdowns as well as power outages affect service quality and are not clearly discernible from these generally used indicators. As argued by Asiedu (2005), it is not physical availability of infrastructure but reliability and accessibility that affect exporter and investor behaviour.

The other issue of concern raised by Elbadawi et al (2007) is that macro econometric modelling of the determinants of foreign direct investment and export performance in Africa is also fraught with both conceptual and econometric problems. Thus there is lack of a theoretic foundation of the relationship between these integration variables and economy wide macro indicators of geography and infrastructure[5]. There is therefore need to explicitly model the mechanisms through which they affect foreign direct investment and exporting at firm level.

Elbadawi et al (2007) went on to argue that econometric modeling of the macro level determinants of African manufactured exports also suffers from endogeneity problems with respect to infrastructure and some aspects of economic geography. This could be because measures of infrastructural quality may be subject to "halo effects", meaning that countries may have good infrastructure because they are rich (Dollar and Kray, 2002). Thus high levels of FDI and exports increase growth which may also consequently lead to an improvement in the quality of infrastructure in a country. By shifting attention to firm level analysis, we may possibly reduce this kind of bias as firms can be assumed to take infrastructural settings as given. Micro level analysis can also help in identifying the types of infrastructure that matter most to exporting and FDI firms. The identification of these effects is important in formulating infrastructure - specific trade and investment related industrial policy measures.

In short, this study is a departure from the standard approach in the literature in that, we use a number of infrastructure quality indicators measured at firm level (water, electricity, telecommunication, customs and transport). The comprehensive firm level analysis of the impact of infrastructure on trade and FDI in Africa done in this study sets it apart from other firm level

[5] Infrastructure related trade costs have an effect primarily on the behaviour of firms and it therefore makes sense to analyse these costs at firm level rather than at macro level.

studies in the literature.[6]

1.3 Objectives of the study

The main objective of this study is to offer a micro-econometric assessment of the influence of external factors like infrastructure (transport, electricity, telecommunication, water and customs) as well as geography on economic integration variables like exports and foreign direct investment using firm level data obtainable from the World Bank's investment climate surveys. The specific objectives include:

- Use of binary choice models like the Probit as well as the linear probability model (LPM) to examine the impact of infrastructure quality on export participation.

- We will also alternatively examine whether these infrastructure variables have an effect on the amount exported (export intensity) by using a censored regression model such as the Tobit as well as the two stage least squares (2SLS). Despite the shortcomings of the 2SLS and LPM, we use them here to check for the robustness of our results.[7] The use of these models is to help in identifying whether infrastructure quality has an effect on the amount exported, affect the likelihood of entering export markets or both.

- We will also supplement our analysis of infrastructure and exports with a brief examination of the impact of these supply side variables on market diversification. Thus does poor infrastructure constrain firms from diversifying their export markets and hence increase export intensity?

The use of the Tobit and Probit models in this study is important because exports can be increased by either increasing the number of firms in the export sector (export participation rate) and or helping existing exporters increase the amount of output exported (export intensity). So this study will help us identify which types of infrastructure variables are important in encouraging export participation and which ones are important for export intensity.

[6] Other related studies are by Yoshino (2008) only looked at customs and power; Clarke (2004) looked at transport whilst Elbadawi et al (2007) only concentrated on institutions. Dollar et al 2004 looked at these indicators using a non African sample composed of Bangladesh, Brazil, China, Honduras, India, Nicaragua, Pakistan, and Peru.

[7] The problem with LPM is that of non constant variance resulting in biased standard errors and incorrect hypothesis tests. It can also create predicted probabilities that are not bounded by zero and one. 2SLS give biased results when using censored data.

- We also use the Probit and Linear Probability models to determine whether the quality of infrastructure in the selected countries affect the likelihood of being foreign invested. We interrogate this theme further by differentiating between inward oriented and outward oriented foreign investment.

- We supplement our analysis of FDI by estimating models with different levels of foreign equity participation. We looked at models with 10% – 49%; 50%-100% and 100% foreign equity acquired in each firm. This will help us ascertain whether the impact of control variables on FDI is generic or it varies with the ownership structure in the firm.

1.4 Organisation of the thesis

This thesis is organized as follows. The first chapter gives an introduction and background to the whole study whilst chapter 2 provides a descriptive and comparative analysis of the quality of infrastructure in different developing regions as well as in the selected study countries of South Africa, Tanzania, Mauritius, Uganda and Zambia. Chapter 3 looks at the impact of infrastructure quality on manufactured exports whilst Chapter 4 relates the quality of infrastructure to the probability of being foreign invested in the manufacturing sector. Lastly, chapter 5 presents conclusions and policy recommendations.

CHAPTER 2

2.0 *INFRASTRUCTURE PROFILES OF SUB SAHARAN AFRICAN COUNTRIES*

2.1 Introduction

The availability and reliability of infrastructure is crucial in facilitating foreign investment, trade and development. Thus efficient transport infrastructure facilities (roads, railways, airports, seaports etc) and services provided by telecommunication networks are important in moving goods and services timeously from exporting to importing countries whilst electricity and water are essential for production. Limao and Venables (2001), also argue that remoteness and poor transport and telecommunications infrastructure isolate countries, thereby inhibiting their participation in global production. However despite the important role played by infrastructure, the current provision of infrastructural services in Africa is still far below the requirements of the African people as well as in comparison with other developing regions in Asia and Latin America (Oshikoya et al, 2001). Limao and Venables (2001); Wood and Mayer (2001) also found that poor infrastructure facilities in most of Africa account for poor trade performance. Estache et al (2005) also argued that if Africa had enjoyed Korea's quantity and quality of infrastructure it would have raised its annual growth per capita by about 1%. This argument was also supported by Esfahani and Ramirez (2003) who found that Sub Saharan Africa's poor growth is in part related to underinvestments in electricity and telecommunications infrastructure. Hulten (1996) also added that differences in the effective use of infrastructure resources explain one quarter of the growth differential between Africa and East Asia, and more than 40% of the growth differential between low and high income growth countries.

To elaborate on the above statements, this chapter provides stylised facts on the state of different types of infrastructure facilities in Sub Saharan Africa particularly in the selected study countries using both country[8] and firm level data obtainable mostly from the World Bank through its World Development Indicators, Doing Business reports and Investment climate surveys. After discussing the stylised facts, we then examine in chapter 3 and 4 whether the state of

[8] The problem with country level infrastructure data is that there are so many missing data points in a number of African countries.

infrastructure has an important role to play in influencing the probability to export or in attracting FDI in the manufacturing sector.

2.2 Transport infrastructure

Transport infrastructure is important in facilitating the movement of goods within and across national borders thus making it easy for suppliers to satisfy their customers' demands. If the quality of transport infrastructure is poor, then a large portion of goods produced and traded will not be consumed by the national and foreign purchasers (Martin et al, 1995).

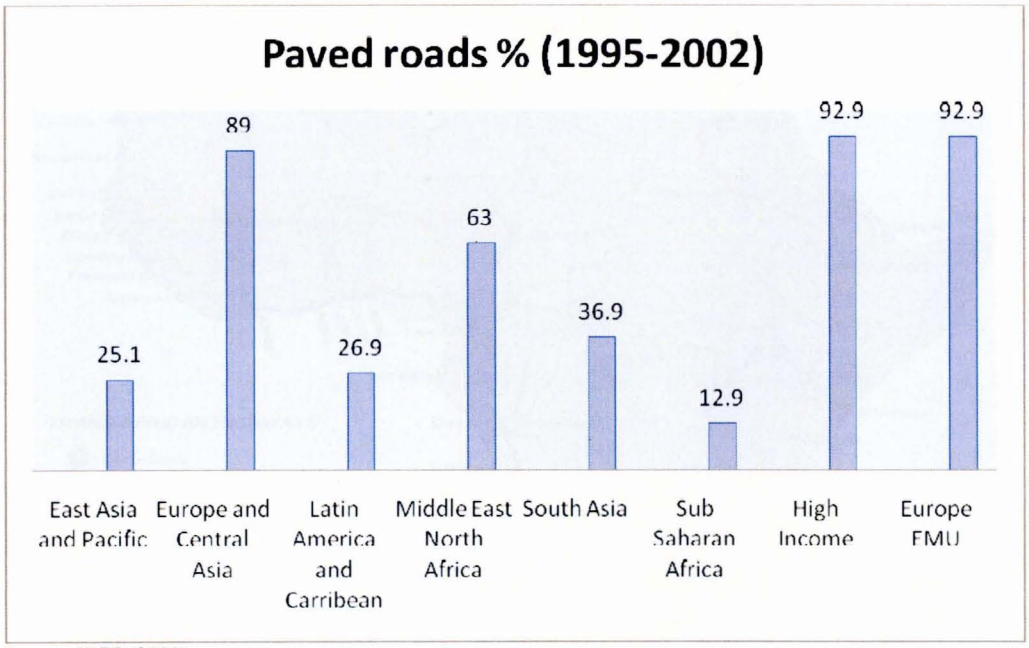
Road infrastructure in Africa is poorly developed, mostly due to the lack of investment and civil wars. Thus WDI, (2009) statistics show that the average amount invested in the transport sector including that by the private sector between 2000 and 2008 by Sub Saharan Africa was far much lower than in other developing regions. For SSA excluding Nigeria and South Africa it was US$357 million (US$1,138 million for the whole of SSA) compared to US4,445 million by Latin America and the Caribbean, US$4,702 million by East Asia and the Pacific, US$622 million by Middle East and North Africa and US$2,290 million by South Asia. These statistics suggest that a large portion of investment in the transport sector in Africa is in Nigeria and South Africa. These low levels of investment in the transport sectors happen despite the fact that road transport is the primary mode of moving goods and people in the African continent accounting for 80% of the goods traffic and 90% of the passenger traffic (UNECA, 2009). The data available for year 2005, show that the continent had approximately 353 000km of paved and unpaved roads with most of them in poor condition (WDI, 2007). The average road to population ratio for the whole continent is 26 km per 10 000 inhabitants and there is a large sub regional variation (UNECA, 2009). Thus the Commission for Africa 2009 report on transport show that Central Africa and Southern Africa have the highest road distribution with 49.5km and 56.3km respectively for every 10 000 population. These statistics also show that Poland (a country approximately the size of Zimbabwe) which is 97 times smaller in surface area than Africa as a whole has a road network that is 1.2 times larger than that of the 53 countries that form the continent[9]. WDI, (2007) statistics also show that by 2002, 19% of roads were paved in the whole of Africa, 12.9%

[9] Poland has about 423 997km of roads (2000-2005) compared to 353 000km in Africa (2005)

in SSA, and 66% in North Africa. However, by the same period 25% of the roads were paved in East Asia, 37% in South Asia and 27% in Latin America (see Fig 2.1 below).

According to the UNECA, 2009 report, most African countries face huge costs associated with transportation. The report states that, in accessing foreign markets, on average, Africa's transport and insurance costs represents 30 percent of the total value of exports which compares unfavourably with 8.6 percent for all other developing countries. These costs are excessive when it comes to landlocked countries confirming Limao and Venables (2001) finding, that being landlocked raises transport costs by 50 percent and improving infrastructure of the landlocked economy from the median to the 25th percentile reduces this disadvantage by 12 percentage points. They also argued that this benefit is even higher if transit infrastructure is improved.

Fig 2.1: Average percentage of paved roads per region

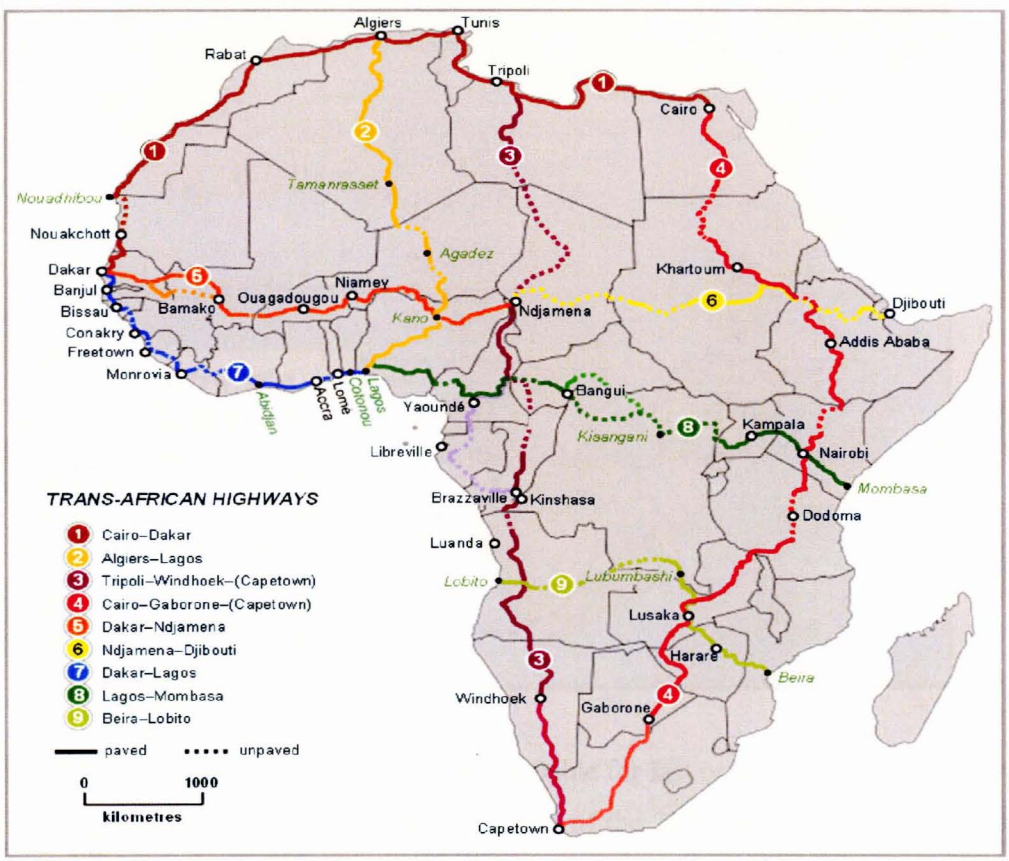


Source: WDI (2008)

In 2005, the country with the highest number of good and paved roads was Mauritius (96%) and the least connected was Chad at 0.8% (see table A2.1 appendix). Another disturbing thing about road infrastructure in Africa is that regional and national markets are not effectively linked because road density (km of roads/square km of land area) is on average 20 per square km,

compared to the world average of at least 80, 110 for South Asia and 22 for East Asia and Pacific as well as 18 for Latin America (see table 2.7 appendix). In addition to accessibility problems, many national roads in Africa are mainly concentrated in urban areas or around coastal ports and therefore do not support balanced economic development (Simuyemba, 2000). This result in some regions in a country being isolated thereby excluding or inhibiting them from benefiting and participating effectively in national economic activities. There are few regional road networks and most of them have some stretches that are not tarred and this could partly explain why intra country trade is very low, estimated to be at most 10% of Africa's total trade[10] (Simuyemba, 2000, see Fig 2.2 below).

Fig 2.2: Map of Trans-African Highways

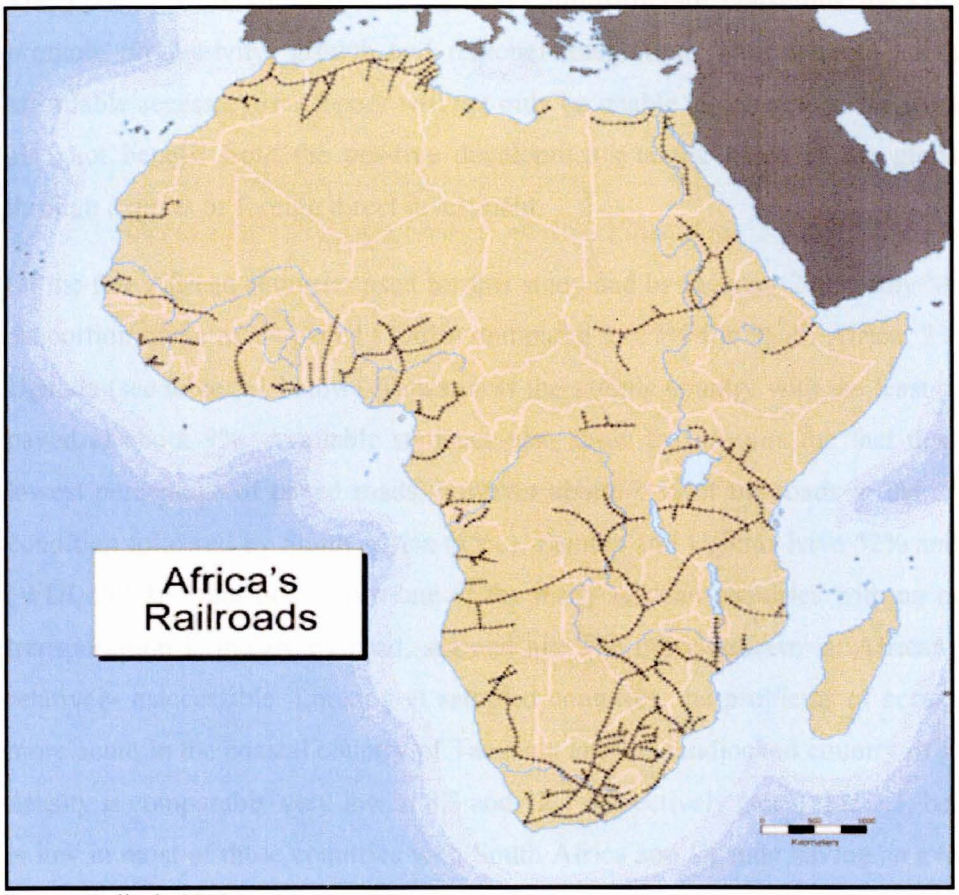


Source: http://commons.wikimedia.org/wiki/File:Map_of_Trans-African_Highways.PNG

[10] The Sub Saharan Africa Transport Policy Programme (SSATPP) is however proposing to develop a transcontinental network with four major road corridors linking major parts of Africa (Simuyemba, 2000).

Railways in Africa are no exception, they are disjointed, disconnected and are generally in a state of disrepair, often not serving their countries well (ADB, 2002, see Fig 2.3 below). The aggregate network of African railway is estimated at around 73000 route kilometres of which South Africa alone accounts for about 30% of the size (WDI, 2007). About 21% of African countries have no railway systems[11] (see fig 2.3 below).

Fig 2.3: Map of Africa's Railways



Source: Bullock, 2009

Most African lines are of light rail and unsuitable for fast or heavy traffic. All networks in Africa were built at the end of the 19th or beginning of the 20th century, often with different technical characteristics like gauges, couplings, brake systems, buffers etc (Oshikoya, 2001). The 1.067m

[11] These are Burundi, Central Africa Republic, Chad, Cape Verde, Comoros, Mauritius, Seychelles, Somalia, Gambia, Guinea Bissau, Niger, Sao Tome and Principe and Libya (WDI, 2007).

gauge predominates particularly in East and Southern Africa, the 1.00m in West Africa whilst the 1.435m gauge accounts for 76.1% of total kilometres in North Africa (Oshikoya, 2001). Upgrading and connecting existing railway lines would involve major investments in realignment, resignalling, safety systems and rolling stock. However, according to the UNECA 2009 report, railways in Africa generally have low traffic, carrying only one percent of the global railway passenger traffic and two percent of goods.

The poor network of roads and railways infrastructure constrains the continent's efforts to promote productivity, growth and regional integration. Thus without adequate mobility and affordable access, Africa's poor will not only be unable to compete in the world markets but will also not benefit from the positive developments taking place in the global economy either through exports or foreign direct investment.

Of the five African countries used for this study and by the year 2005, only Mauritius had a high proportion of its roads paved (100%) compared to 17% for South Africa, 23% for Zambia and Uganda (see table 2.1 below). Tanzania is the sample country with the least percentage of roads paved at about 9%. Available statistics also show that despite the fact that Tanzania has the lowest percentage of paved roads, however about 71% of the roads in the country are in good condition followed by South Africa (65%), Zambia and Uganda have 52% and 29% respectively (WDI, 2009). Mauritius is also one of the many African countries with no railways and where transportation is mostly by road, sea and air. The other concern is: African countries are also relatively inaccessible. Looking at sampled countries, the problems of accessibility seem to be more acute in the coastal country of Tanzania and the landlocked country of Zambia where road density is comparably very low at 8.3 and 12.1 respectively (see Table 2.1, below). Rail density is low in most of these countries with South Africa and Uganda having an average of 0.3km per square km and the least internally connected being Tanzania with 0.08.

Table 2.1: Land transport infrastructure

Country	Total surface area (000 km^2)	Total km of roads	%paved roads	Total km of rail	Rail density (000sq km)	Road density per100sq km	Railway gauge
S. Africa	1219	364 131	17	20 872	1.71	29.9	1.067mm
Mauritius	2030	202 1	100	0	0	99.6	-
Tanzania	945	78 891	9	3689	3.90	8.3	1.000mm
Zambia	753	91 440	22	2157	2.86	12.1	1.067mm
Uganda	241	70 746	23	1244	5.16	29.3	1.000mm

Source: WDI, 2007

Road transport in Uganda is by far the most dominant mode of transport in the country carrying well over 90% of passenger and freight traffic despite the fact that only 23% of the roads are paved and about 29% are in good condition (Uganda Road Fund report, 2008). The railways system is also very important for Uganda which is landlocked and far from the sea as it provides the most effective bulk haulage capacity for the country's exports of mostly coffee and imports of general goods and petroleum products. Thus according to the Uganda Road Fund report (2008), railways currently handle between 30- 40% of the total country's bulk cargo to and from the ports of Mombasa and Dar-es-Salaam. However, acute shortage of rolling stock and dilapidated infrastructure as well as closure of the northern and western lines is hampering Uganda's efforts of diverting heavy loads of cargo from the road networks thereby reducing road maintenance costs as well increasing the life span of its roads (Uganda Road Fund report, 2008).

Although the setting up of Tanzania National Road Agency (TANROADS) in 2000 has improved the quality of roads in the country, most of the paved highways are confined to the north-eastern, central-eastern and south western regions of the country. According to the TANROADS report, (2007), there are no paved roads linking the capital and the south-eastern, western, central and northern regions with most of the roads in these areas being dirt tracks with a few improved gravel sections. During rainy seasons these dirt roads are impassable and the only reliable surface connection from the east of the country towards Lake Tanganyika is by rail. Even though the percentage of paved roads is still low in South Africa, the country has a modern world class and well developed transport infrastructure. According to South African National Road Agency Ltd (SANRAL) the quality of roads have however been deteriorating in recent

years due to lack of investment on maintenance and increased road freight traffic and overloading. The OSEC (2009) report on infrastructure in South Africa, states that about 70% of South Africa's roads are in need of urgent repairs and this will cost about R65 billion.

2.2.3 Sea and airport infrastructure

Quality infrastructural investments particularly in air cargo is also a pre requisite for integrating world markets and building a sustainable and competitive high value added manufacturing sector. A country with relatively good quality airport infrastructural systems and hence low air transport costs may have a comparative advantage in time sensitive goods and those subject to uncertain demand (Hummels, 2001). According to the World Bank, (2003a), air transport is also becoming very important in developing countries, accounting for about 30% of export value. The products exported from Africa to mostly the United States by air mainly included precious stones, scientific instruments, clocks and watches (Amjadi and Yeats, 1995).

Africa is also the smallest region of air services in the world, a feature that reflects its low income and lack of air transport infrastructure (Button, 2006). All countries have at least one international airport as well as several smaller ones but few of them are capable of handling large amounts of traffic. Less than 50% of the 5304 potential air links are actually operational or being actively exploited (WDI, 2007). According to UNECA (2009) report only about 117 of Africa's airports meet international Civil Aviation Organisation (ICAO) standards and recommended practices. Most airports in Africa lack modern equipment and are characterised by deteriorating runways, obsolete traffic control equipment as well as inadequate ancillary services like baggage handling, connecting surface transportation, air cargo, customs and migration (ADB, 2007). The quality of air infrastructure varies greatly across countries but generally high income OECD countries have seven times as many airports as with paved runways (of over 3,047metres long) than low income countries (World Trade Report, 2004). Although the African continent is composed of about 28% of the total number of countries in the world, the region accounts for only 12% of the total number of airports in the world[12]. In our sample the number of quality airports (measured in terms of paved runways of over 3,047m) is higher in South Africa with

[12] There are about 53 countries in Africa out of about 195 countries in the world. The total number of airports in the world is 43 867 using 2008 World Fact book figures and of these 5304 are in Africa.

about 10 compared to Zambia with only one. The other countries have on average two airports with big run ways of size 3,042m^2 (see Table 2.2). Zambia is also one landlocked country in our sample that is located further away from the nearest sea port, implying that transit transport infrastructure services (road and air) are very important for the country.

The other notable thing is that the share of air freight cargo in world total handled by the 84 African cargo airports between 2001 and 2005 was far much lower compared to other continents. This share was 1.3% for Africa, 9.9% for Asia, 3.8% for Latin America and 19% for the European Monetary Union (WDI, 2003-2007). This shows that air transport is not widely used in Africa probably due to relatively high air freight costs which could be a result of poor airport infrastructure and poor civil aviation policies (World Trade Report, 2004). Thus in most African countries, the airline industry is monopolised by governments and so there is very little competition to encourage efficiency and lower air freight charges (Oshikoya, 2001).

2.2.3.1 Sea transport

Shipping or maritime is the predominant mode of transport in Africa, mostly because it is relatively cheaper (UNCTAD, 2006). It accounts for about 92% of Africa's external trade with a total coastline of 30 725 km and 90 major ports (UNECA, 2009). Between 2001 and 2005 sea borne trade (loaded goods as a proportion of world total) was about 6% for Africa, 29% for Asia and 13.7% for Latin America (UNCTAD, 2006). However, despite the relatively high volumes in cargo shipments (compared with air cargo), there is very little infrastructural development that has taken place in most ports. Congestion, long anchorage waiting time, high port clearing times characterise most of the continents ports (UNCTAD, 2000). Port productivity is estimated to be about a third of the international norm as a result of poor management, excessive bureaucracy and inadequate as well as unreliable equipment. The waiting time at African ports is about 10 days when importing and 4.5 days when exporting compared to 2.5 and 1.5 days respectively for high income countries (UNCTAD, 2000).

The port and terminal handling costs are higher in African countries than in other regions. In fact it costs about 6.25 times more to clear cargo at ports by Ethiopian firms compared to firms in China (UNCTAD, 2000). Hummels (2001) calculated that the tariff equivalent of one day of

waiting for imports is 0.835% implying that it is more expensive to import and export goods when in Africa due to long waiting times. Sea freight problems in Africa are also compounded by the use of ageing fleet which by 2005 was estimated to be about 20.5 years old compared to the world average of 12.2 years (UNCTAD, 2006). The other concern is that, private sector involvement in port development is still very low and the majority of terminals in Africa are still managed by inefficient parastatal organizations. Customs procedures remain outdated and unable to cope with increased container flows. Due to port inefficiency container handling in Africa, costs the African manufacturer 300% more than his high income OECD competitor[13] (Hummels, 2001). Thus most ports are in need of modern, better managed facilities to serve traffic for which sea transport has a significant cost advantage over surface transport. Thus significant reductions in transport costs are needed to boost production, support diversification efforts and increase the competitiveness of African exports. Unless infrastructural bottlenecks are solved particularly in transport, improved market access, even on preferential terms would not solve the problem of Africa's lack of competitiveness in world trade (UNCTAD, 1999)[14].

Table 2.2: Port infrastructure

Countries	Number of airports	Paved run ways	Paved run ways over 3.047m	Number of Ports and terminals
South Africa	713	146	10	6
Tanzania	124	11	2	3
Zambia	111	10	1	Landlocked (1975km)[a]
Uganda	31	5	3	Landlocked (927km)[a]
Mauritius	5	2	1	1

Source: World Development Indicators (2003-2007), UNCTAD, 2006, AfDB statistics (2006) , CIA -World Fact Book,2007 :
a = shortest distance from nearest seaport

[13] Using Hummels (2001) tariff equivalent calculations, you can estimate the additional tariff equivalent paid by Africans compared to OECD region.

[14] High transport costs on imports inflate the consumer prices of imported goods whilst transport costs on exports undermine the country's competitiveness in foreign markets. (UNCTAD, 2000):

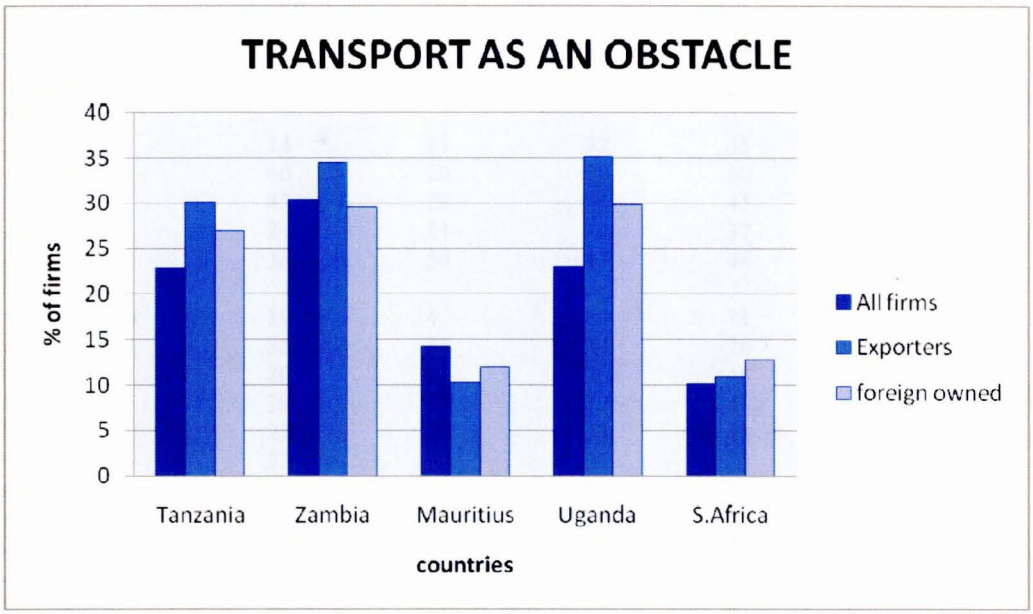
2.2.4 Firm level surveys on transport infrastructure

In addition to macro wide infrastructure indicators compiled by multilateral organisations, firm level surveys were also conducted by the World Bank in various developing and developed countries to elicit data on a number of firm specific indicators. The surveys which were initially conducted in the manufacturing sector but have now been expanded to include other industries, gather data on finance, labour and training, technology, trade, business environment as well as infrastructure variables. On infrastructure, data was elicited in two ways: First the survey questionnaire contained a question where firms in particular were asked to rank on a scale 0 to 4 (where 0 is no obstacle and 4 very severe obstacle) the degree by which selected infrastructure indicators are an obstacle to doing business in that country. Secondly, another set of questions were also asked enterprise managers to state the number of days or hours per day in the previous year, the firm had experienced power outages, insufficient water supply and unavailable mainline telephone services. The data from these two questions form the basis of our discussion of infrastructure variables at firm level.

The survey data on firms in the five study countries corroborate or confirm the infrastructure related transport inadequacies discussed using macro level data above. Transport problems seem to be a major obstacle among firms in Zambia (30.4%) and the East African countries of Tanzania (23%), Uganda (23%) (Figure 2.4 below). At city or regional level, transport is a major obstacle in KwaZulu-Natal province in South Africa (19%), Beau Bassin in Mauritius (28%), South Western region in Uganda (36%), Livingstone in Zambia (60%) and Kagera in Tanzania (53%) (see Table 2.3, below). These within country variations in infrastructure problems support Dollar et al (2004) argument that quality of infrastructure differs across locations within a country, mostly due to differences in local governance. The cross country differences in infrastructure problems could partly be explained by low levels of quality of domestic transport infrastructure like roads and airports in these respective countries. However domestic transportation does not seem to be a problem in South Africa and Mauritius, where only 10% of firms identified it to be a major obstacle. However in South Africa a high percentage of firms that complained about transport problems as an obstacle to doing business in the country were those with foreign ownership (see fig 2.4 below). Although the country has good transport networks, maybe this still does not compare favourably with the level of efficiency in developed

countries where these FDI firms originate. At sectoral level domestic transportation is less severe among exporters than non exporters (see table A2.2 appendix) This could be due to the fact that exporters are affected more by costs related to moving goods across international boundaries rather than locally and hence worry more about international transport costs. Firms in the food and agricultural sector report serious domestic transport infrastructure problems contrary to firms in the plastic paper sector. This could be due to the fact that these products (plastic paper and packaging) are time insensitive and therefore transportation delays have no adverse effects.

Fig 2.4: Percentage of firms identifying transport as at least major obstacle



Source: World Bank investment climate surveys

Table 2.3: Percentage of firms identifying infrastructure as a major obstacle in each region

	Transport	Telecoms	Customs	Electricity
SOUTH AFRICA				
Gauteng	8	3	14	9
KwaZulu Natal	19	21	21	13
Western Cape	9	12	20	5
Eastern Cape	15	6	30	15
MAURITIUS				
Port Louis	18	5	25	13
Beau Bassin	28	0	17	11
Vacoas Phoenix	0	6	11	0
Curepipe	14	0	43	14
Quatre Bornes	17	33	17	25
Other	16	7	23	13
UGANDA				
Central region	19	3	26	42
North East region	24	14	19	37
South West region	36	6	45	59
ZAMBIA				
Lusaka	24	31	32	35
Livingstone	60	20	20	60
Ndola	45	26	45	45
Kitwe	24	21	40	37
Other	36	56	17	44
TANZANIA				
Dar es Salaam	19	4	39	71
Arusha	38	34	34	76
Mwanza	20	8	20	48
Kilimanjaro	29	13	17	46
Tanga	22	17	23	48
Kagera	53	7	27	20
Morogoro	20	10	30	50
Iringa	25	75	100	75
Mbeya	0	29	43	71
Mara	40	0	25	20
Zanzibar	0	5	19	47

Source: Author's computation using Investment climate surveys data

2.3 Telecommunication infrastructure

Telecommunication plays a vital role in facilitating the flow of information between suppliers and customers who are geographically removed (Limao and Venables, 2001). Efficient internet, cellphone and telephone services reduces trading costs by reducing firms' search cost in identifying and interacting with potential overseas customers as well as collecting other types of information regarding their overseas market and investment opportunities, hence reducing market entry costs (Yoshino, 2008). This is important for both FDI and trade promotion.

Despite the importance of telecommunication[15] and with 28.5million main fixed lines in 2006, Africa has a share of only about two percent in worldwide total main fixed lines. It is estimated that there are more telephones in Brazil than in the whole of Africa (International Telecommunications Union (ITU), 2007). Most of Africa's main (fixed) telephone lines are concentrated in just six of its 53 economies. Algeria, Egypt, Morocco, Nigeria, South Africa and Tunisia account for almost 80% of all fixed lines in Africa (ITU, 2007). According to the ITU these main (fixed) telephone lines are almost exclusively located within cities and randomly in rural areas. The ITU data also show that Africa's main (fixed) telephone line penetration was 3.1 per 100 inhabitants compared to 32.4 main (fixed) lines per 100 inhabitants in Americas or 39.7 in Europe in 2005. The world average in 2006 was 19.4 main (fixed) lines per 100 inhabitants, more than six times higher than the penetration rate in Africa. It is also estimated that 92% of SSA countries have more mobile phones than mainlines per 1000 people (WDI, 2006). Available statistics show that between 1992 and 2002, the average fault rate per 100 mainlines was 72 in Africa, compared to 56 in Middle East and North Africa, 37 in Latin America and 51 in East Asia and Pacific (WDI,2007). Telephone average costs of call to the United States in US dollar are also relatively higher in Africa. Between 1997 and 2004, it costs about US$5.1 to make a 3 minute call to the US from Africa, whilst in South Asia it was US$3.5. It was also US$3.6 in East Asia and Pacific, US$2.5 in Latin America, US$3.5 in Middle East and North Africa (see table 2.4 below). Africa's telecommunications infrastructure development has also not kept pace with the rest of the world. While the world has been moving towards digital exchanges, the networks in the region are generally analogue with outmoded equipment resulting in high fault rates (ITU, 2007). The International Telecommunications Union also reports that in 2004 the African continent had the highest ratio of mobile to total telephone subscribers than any world region, and was therefore dubbed the "the least wired region of the world".

Internet accessibility is also relatively poor. Thus less than 4 out of 100 people are accessible compared to the world average internet penetration of 21.4%, 18% for Latin America, 11% for East Asia and the Pacific as well as 5% for South Asia (WDI, 2008). The International Telecommunications Union, (2007) also estimates that the African continent has fewer internet

[15] Fixed line phones are important for faxes and dial up internet connection.

users than France alone[16], a country 13 times smaller in population than SSA. The Digital Access Index (DAI) calculated by ITU and which measures the overall ability of individuals in a country to access and use information and communication technology, classifies most African countries in the low access category. Individuals in South Africa and Mauritius are the only ones with better access to communication facilities than those in other countries in the sample (see table 2.4 below).

The pattern in our country sample is also similar. Call charges are higher in Tanzania but very low in South Africa. Available statistics also show that the number of faults per 100 mainlines are however higher in Zambia and Tanzania but relatively low in Mauritius (World Development Indicators, 2007). According to WDI (2008) statistics, Mauritius has about 365 000 mainlines resulting in a fixed line teledensity of 30 per 100 persons. Mobile cellular services were launched in 1989 and teledensity in 2008 reached 80 per 100 persons. In Uganda fixed telephone density in 2008 was 16 per 100 inhabitants compared to 10% for South Africa and close to 1% for Zambia and Tanzania (ITU, 2009).

Table 2.4 Telecommunications infrastructure quality indicators

Countries and Regions	Digital Access Index	# of faults per 100 main lines (97-2002)	Call charges to the US (1997 - 2004) in US$ per minute	Delays in obtaining a telephone connection	Days without a telephone connection a month
South Africa	0.45	62	1.8	18.90	0.49
Tanzania	0.15	91	8.4	23.25	10.8
Zambia	0.17	133	2.4	17.25	3.34
Uganda	0.17	--	5	12.80	13.5
Mauritius	0.50	23	1.59	38.55	5.04
Sub Saharan Africa	--	72	5.1	32.73	-
Latin America	--	37	2.5	34.95	-
East Asia Pacific	--	51	3.6	13.39	-

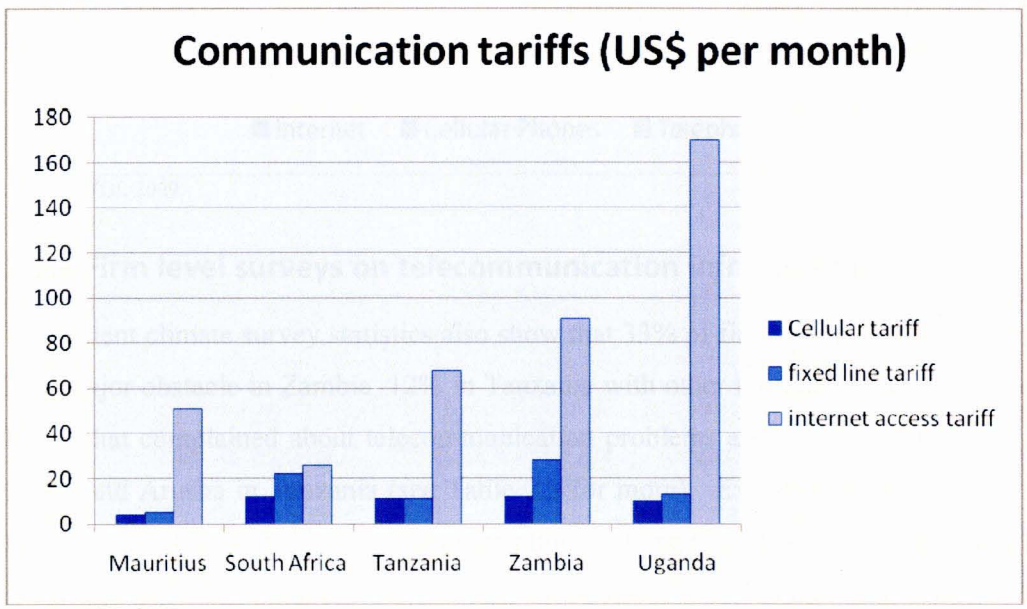
Source: World Development Indicators, 2007; International Telecommunications Union (ITU), World Bank Enterprise surveys.

Cell phone density is also relatively high in South Africa at about 87 per 100 persons compared to 22 for Zambia and 13.58 for Uganda. Internet use also follows the same pattern, high in

[16] The population of France is about 8% of the population of SSA. Using 2008 statistics SSA population is 818million and France 62million. 2002 -2005 WDI statistics show that France had 49 internet subscribers per 100 people compared to 4 for SSA.

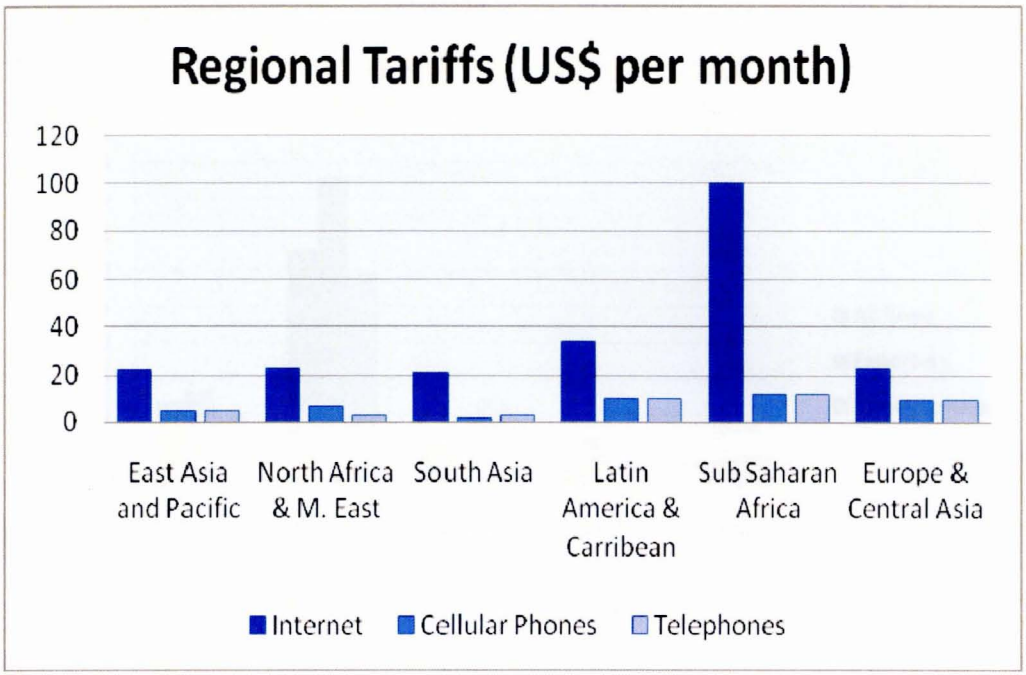
Mauritius at 25 per every 100 persons, followed by South Africa with 10 and the remaining countries Zambia, Uganda and Tanzania have less than 6 per 100 inhabitants (ITU, 2007). Generally, in all the countries the proportion of mobile subscribers per 100 people is higher than that of fixed mainlines and internet users. This could probably be due to high tariff rates for internet and fixed lines compared to cellular phones (Fig 2.5 below). This tariff pattern is partly replicated even at regional level. Internet tariffs are relatively higher in Africa compared to other developing regions. The same generally applies even when comparing cellphone and telephone rates (see fig 2.6).

Fig 2.5 Country level communications tariffs



Source: WDI, 2007

Fig 2.6 Regional communications tariffs

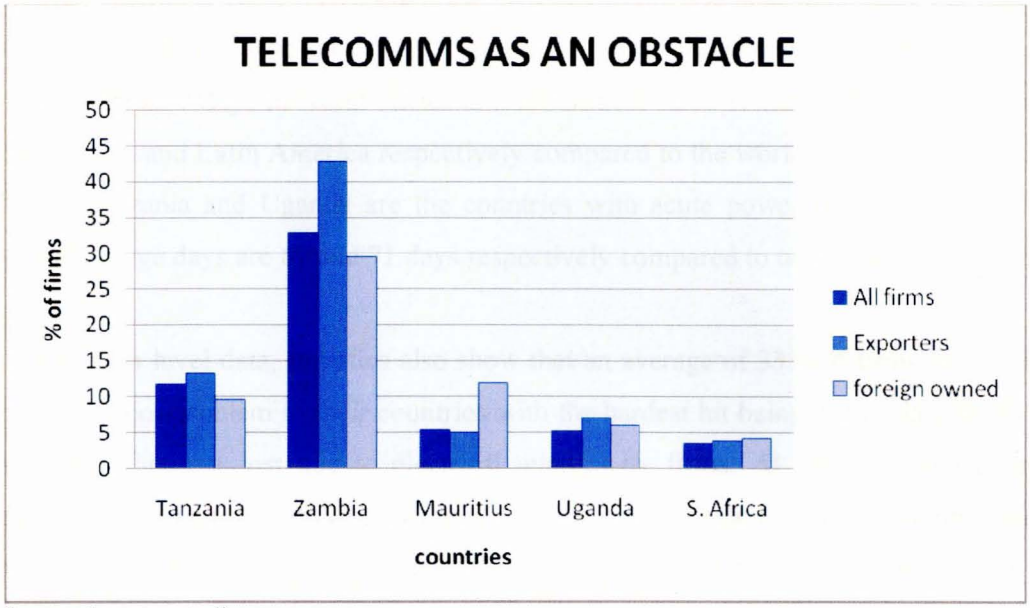


Source: WDI, 2009

2.3.1 Firm level surveys on telecommunication infrastructure

Investment climate survey statistics also show that 33% of firms identified telecommunication to be a major obstacle in Zambia, 12% in Tanzania with other three countries having less than 6%. Firms that complained about telecommunication problems are mostly in Lusaka in Zambia and Iringa and Arusha in Tanzania (see Table 2.3 for more). Exporting companies also seem to be the ones largely affected by telecommunication challenges in these respective countries except in Mauritius were complainants were mostly from firms with foreign ownership (see fig 2.7). At sectoral level telecommunication problems are less severe except in the food and wood furniture sectors. In terms of hours without telecommunication services, Zambia, Tanzania and Uganda are the worse affected, going for about eleven hours a day without telephone services. The pattern of internet usage in these countries partly reflects the above communications tariffs. Thus about 29% of firms in Zambia are connected to the internet, 46% in Uganda, 59% in Tanzania, 69% in South Africa and 91% in Mauritius. Thus high internet tariffs in Uganda and Zambia might explain why few firms are connected to the net. This pattern is repeated even when looking at exporting and foreign invested firms in these countries (see fig 2.7 below).

Fig 2.7: Percentage of firms identifying telecommunication as at least major obstacle



Source: Investment climate surveys

2.4 Electricity Infrastructure

Power supply in many African countries, is known for its unreliability and high disruption costs, and this affect production efficiency and competitiveness. Unreliable power leads to disruptions in production, loss of perishable goods, damage to sensitive equipment and loss of orders (Oshikoya et al, 2001). Despite the fact that Africa is endowed with the widest possible range of energy sources (coal, natural gas, petroleum, solar, hydro, geothermal, nuclear etc), the continent's power sector remains severely underdeveloped and energy consumption in general and electricity consumption in particular is relatively very low (Economic Commission for Africa, 2004). The problem with Africa's electricity sector is not that of scarcity but lack of infrastructure, proper financing mechanisms and regulations that are important so as to make markets work in support of energy for sustainable development (UNDP, 2004). According to UNDP (2004), most power utilities in many countries are state owned monopolies and thus low tariffs and fiscal constraints have resulted in little investment and poor maintenance of infrastructure. Power outages, power surges, brown outs, and load shedding remain common

features in most countries[17]. Available statistics show that South Asia, Sub Saharan Africa, Middle East and North Africa are the parts of the world that are mostly affected by power outages.(see table 2.5 below). Thus the average power outage days per month between 2000 and 2006 were 2.87 days in North Africa and the Middle East, 10.30 days in SSA, 42 and 3 days in South Asia and Latin America respectively compared to the world average of 9 days. At country level, Tanzania and Uganda are the countries with acute power problems in that the average power outage days are 61 and 71 days respectively compared to only 5 days in South Africa.

Using firm level data, statistics also show that an average of 33% of firms identified electricity to be a major problem in their countries with the hardest hit being Tanzania with 59% and close to 11% of output lost due to electrical outages by firms. At city or regional level, a large proportion of firms identifying electricity as a major obstacle were from South Africa's Eastern Cape province (15%) including 25% of firms in Quatre Bornes in Mauritius, 59% in South West Uganda region, 60% in Zambia's Livingstone city and 76% of firms in Arusha, Tanzania (see table 2.3 for more). Given all the firms in the study countries, power interruptions seem to be a major obstacle specifically amongst foreign owned firms and exporters. In the case of foreign owned firms this could probably be a result of the fact that most of them are into exporting and therefore timeliness in meeting orders is very important (see fig 2.8 and Table 2.5 below). The pattern is also the same when looking at the number of days or hours per day without power connection. Thus in Tanzania over a period of five days per month firms go without power for about seven hours per day compared to about four hours a day a month in South Africa. The high number of firms with alternative sources of power such as generators in Tanzania, Uganda, and Zambia also shows that power outages are a major obstacle to business in these countries. Using perception indicators at sectoral level, firms in food and agriculture sector as well as those in wood- furniture sector. ranked electricity to be an obstacle higher than firms in other sectors. Generally, electricity problems in many African countries are a result of the fact that most power utilities are state owned monopolies and thus low tariffs and fiscal constraints have resulted in little investment and poor maintenance of infrastructure.

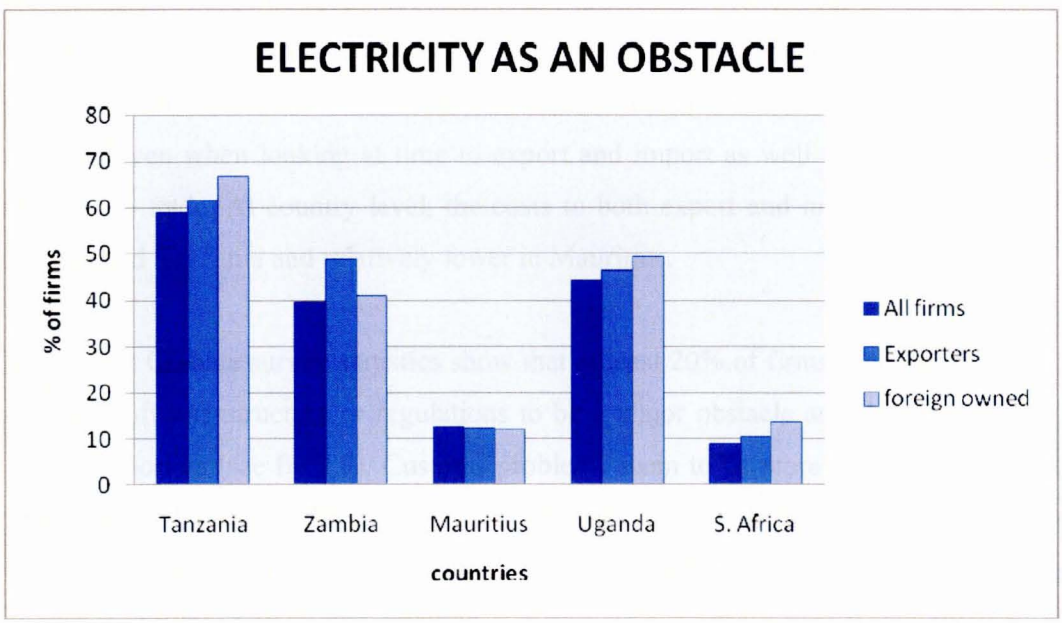
[17] Many firms in Africa have tried to avoid this problem by purchasing private generators but this alternative increases fixed costs and may contribute to loss of competitiveness.

Table 2.5: Electricity infrastructure problems (2000-2008)

Country/ region	Number of power outages Per month	Duration of outages in hours	% output lost due to power outages	Electricity from generator (if generator is used) in %	Delay in obtaining electrical connection
South Africa	2.06	4.49	1.60	10.94	15.77
Zambia	3.59	2.94	3.65	19.49	96.97
Tanzania	12.00	7.88	9.62	36.81	44.28
Uganda	11.00	10.07	10.23	30.66	33.03
Mauritius	3.22	3.22	2.23	3.38	18.65
SSA	10.30	6.70	5.84	26.74	31.94
East Asia & Pacific	5.19	3.14	2.76	12.31	21.65
Latin America	2.68	7.59	4.19	18.40	34.45
South Asia	42.21	4.56	10.81	25.94	48.42
Middle East & North Africa	2.87	3.45	4.21	16.16	49.08
World	8.48	5.56	4.86	19.77	36.68

Source: World Bank's Enterprise Surveys;

Fig 2.8: Percentage of firms identifying electricity as at least major obstacle



Source: Investment climate surveys

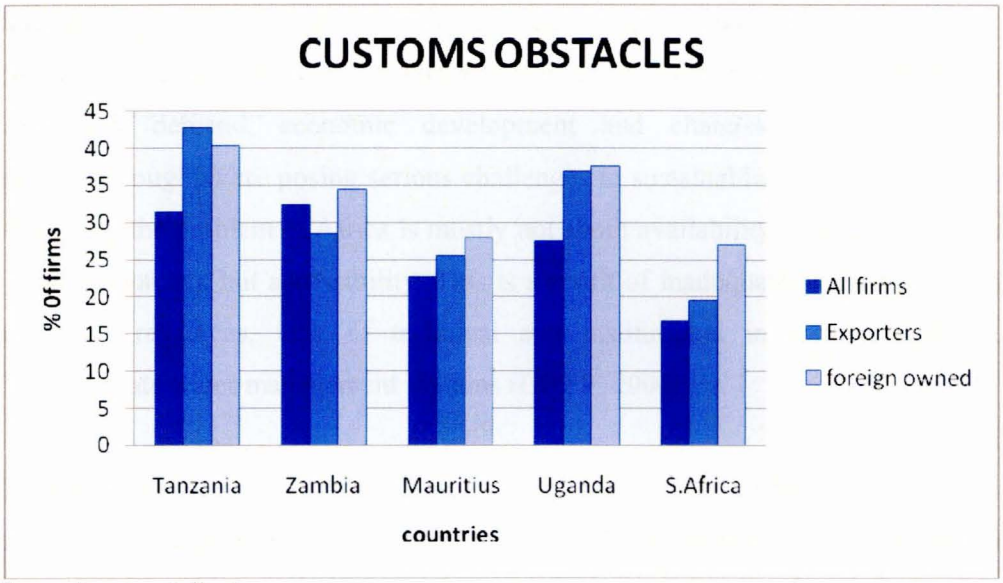
2.5 Customs Infrastructure

Transport, telecommunication and electricity are not the only infrastructural problems facing exporters in Africa. In most of these countries it takes a relatively long time for exports and

imports to clear customs procedures and in some cases additional informal payments to customs officers are needed to expedite the processing of customs documents (Clarke, 2004). In addition to long processing times, there are also so many documents that need to be completed before customs clearing is done. World Bank's Doing Business report,(2007) show that Sub Saharan Africa is second to South Asia in terms of the number of documents required to clear customs but tops the list when it comes to exports and imports customs clearing times. It takes about 9.3 and 8.6 days to clear both exports and imports respectively compared to 1.4 and 1.9 in high income OECD countries (see table 2.6 below). Hummels, (2001) also show that the cost of waiting or per day tariff equivalent in Sub Saharan Africa is 0.9%, slightly less than that of South Asia and Middle East and North Africa. This implies that it is more expensive to export goods when in Africa. Customs delays are longer in most African countries due to excessive inspection of cargoes, redundant and poorly coordinated procedures, poor communication and information management, low skills levels as well as corruption (Hummels, 2001). Doing Business reports (2009) statistics also show that costs to both import and export are relatively higher in Africa, South Asia and Latin American countries relative to East Asia and the pacific. This pattern is repeated even when looking at time to export and import as well as the number of documents required to trade. At country level, the costs to both export and import are relatively higher in Zambia and Tanzania and relatively lower in Mauritius.

Investment Climate survey statistics show that at least 20% of firms in these countries identified customs soft infrastructure or regulations to be a major obstacle and this seems to be common among exporters (see fig 2.9). Customs problems seem to be more severe among exporters and foreign owned firms in the East African countries of Uganda and Tanzania as well as among firms in the textile and garment sector. Although it takes at least five days in most of these countries to clear imports, the situation is even worse in East Africa where about 17 and 8 days are needed in Tanzania and Uganda respectively. However when exporting the pattern is a little different with South Africa topping the list followed by Tanzania (see table 2.6 below).

Fig 2.9: Percentage of firms identifying customs as at least major obstacle



Source: Investment climate surveys

Table 2.6 Customs clearing times

Country	Days to import	Documents to import	Days to export	Documents To export	Cost to export*	Cost to import*
South Africa	35	9	30	8	1531	1807
Zambia	73	9	53	6	2664	3335
Tanzania	31	7	24	5	1262	1475
Uganda	34	7	37	6	3100	3390
Mauritius	14	6	14	5	737	689
SSA	39.4	8.8	33.6	7.8	1941.8	2365.4
East Asia & pacific	24.3	7.1	23.1	6.7	909.3	952.8
South Asia	32.2	9.0	32.4	8.5	1364.1	1509.1
Middle East & North Africa	25.9	7.4	22.5	6.4	1034.8	1221.7

Source: Doing Business Report, World Bank. * Costs are in US$ per container

2.6 Water infrastructure

Just like power supply, sustainable water infrastructure is also very important in the production of manufactured goods. Most manufacturers use water either for fabricating, processing, washing, diluting, cooling as well as for sanitation needs within the manufacturing facility. Industries that use large amounts of water normally produce such commodities like food, paper,

chemicals, refined petroleum or primary metals. Many African countries are also manufacturers and exporters of these types of commodities. Adequate and sustainable provision of industrial water is therefore important for Africa to increase its supply of manufactured exports. However, increasing demand, economic development and changes in climate (variable rainfall patterns/droughts) are posing serious challenges to sustainable water provision in the continent. Generally the problem in Africa is mostly not about availability of water (there is abundant fresh water resources), but accessibility. This is a result of inadequate assessment, underdevelopment of water resources, lack of technical and institutional infrastructure as well as use of inappropriate water management systems (UNEP, 2004).

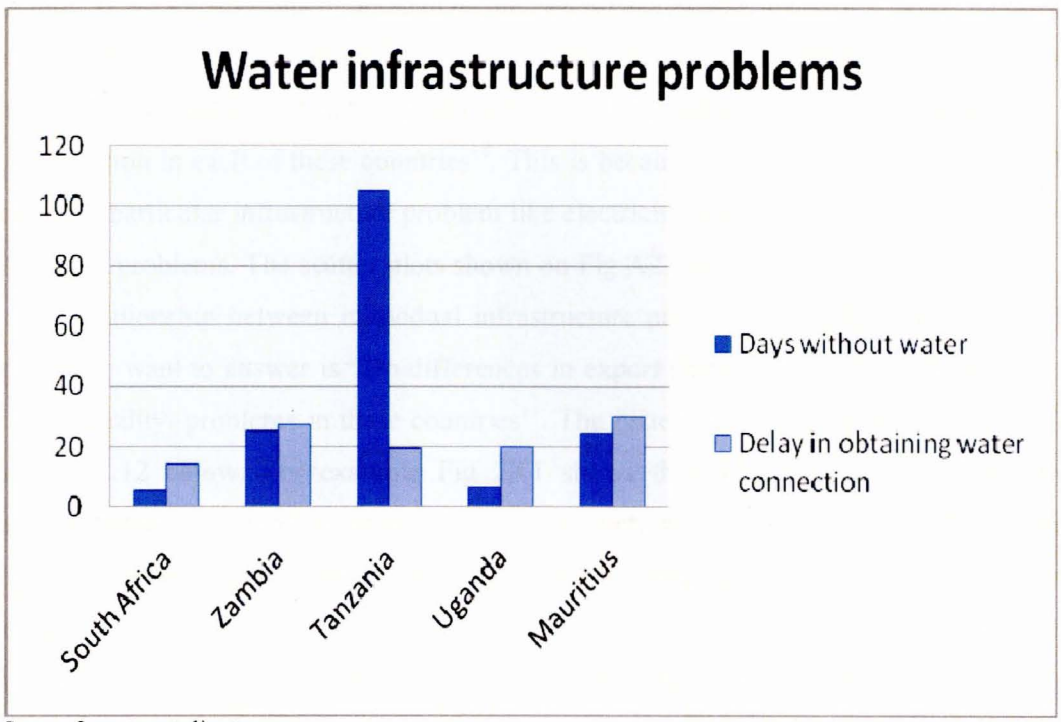
Firm level statistics also show that water problems are very common in Tanzania as firms go for about 8 days without water per month for about 13 hours a day compared with an average of 2 days for about 10 hours a day in both Zambia and Mauritius with only a day in the other two remaining countries for 3 hours in South Africa and 20 hours in Uganda (see Table 2.7 and Fig 2.10 below).

Table 2.7 Water infrastructure problems

Country	Days without water per month	Hours without water per day	Delay in obtaininga water connection
South Africa	0.42	3.42	13.90
Zambia	2.08	9.75	27.17
Tanzania	8.74	13.23	19.60
Uganda	0.51	20.82	20.13
Mautitius	2.06	11.35	30.04
Sub Saharan Africa	7.24	13.99	28.60
East Asia & Pacific	1.64	7.18	26.60
Latin America	3.97	16.02	34.11
South Asia	21.01	10.80	64.15
Middle East North Africa	6.28	10.86	62.23
World	6.43	13.06	34.94

Source:World Bank enterprise surveys

Fig 2.10: Water related infrastructure problems



Source: Investment climate surveys

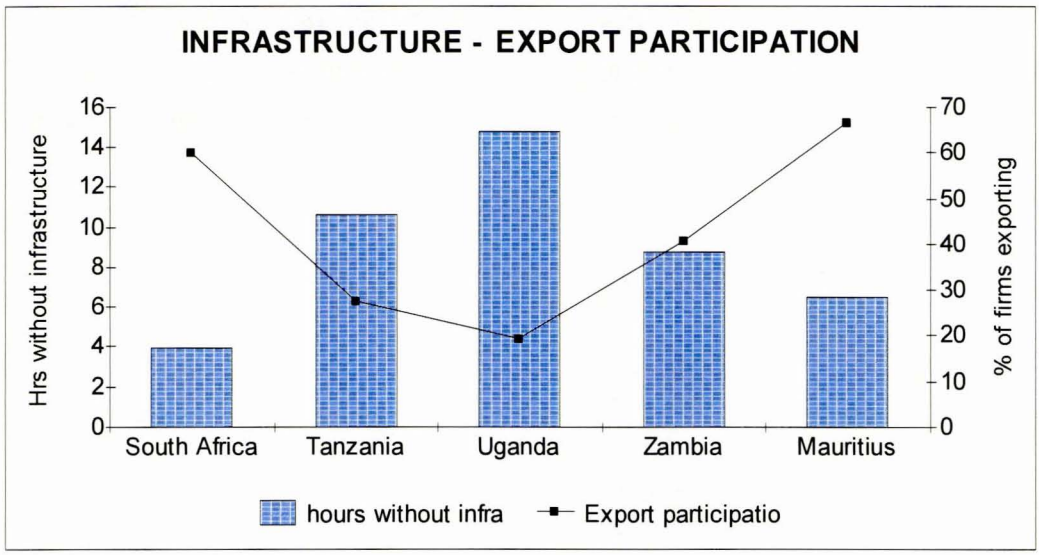
2.7 Infrastructure and Trade

We have shown that the quality of infrastructure is generally poor in Africa compared to other developing regions of East Asia and the Pacific as well as Latin America. The pattern also partly reflects or mirrors the performance of the export sector in these regions. The average export growth of the continent between 1980 and 2005 was about 4.6% compared to 14.4% for South Asia, 10% for Latin America and 17% for East Asia-Pacific (WDI, 2007). Although intra regional trade has been expanding in most of the developing world, with East Asia and Latin America recording (as a share of total trade) 50% and 30% respectively, in Africa it is surprisingly less than 10% (UNCTAD, 2004). Thus the African continent lags behind other developing regions when it comes to export performance in the same way as in infrastructure development. This pattern could imply that there is some prima facie correlation between infrastructure quality and trade performance. Using firm level data we attempted to relate infrastructure quality in our study countries to the number of firms that are exporting. To do this

we calculated in each country the average number of hours a day firms go without all infrastructure services and also calculated the average number of firms who identified infrastructure services (electricity, telecommunication, customs and transport) as a major problem. This enabled us to come up with one average infrastructure indicator that we related to export participation in each of these countries[18]. This is because exports movements may not be influenced by a particular infrastructure problem like electricity outages alone but a combination of infrastructure problems. The scatter plots shown on Fig A2.2 appendix also show that there is no clear cut relationship between individual infrastructure problems and export intensity. The question that we want to answer is "Do differences in export participation reflect differences in infrastructure quality/ problems in these countries''. The pattern of relationship is shown in Fig 2.11 and Fig 2.12 below. For example Fig 2.11 shows that there is generally a negative relationship between the number of hours firms in each country go without infrastructure services and the level of export participation. Export participation is high in South Africa and Mauritius but low in Uganda and this reflect high number of hours without infrastructure services in the latter but low hours in the former countries. This pattern is also replicated even when using alternative infrastructure indicators in the form of perceptions as is shown in Fig 2.12 below. Thus the average number of firms that complain about electricity, telecommunication, customs and transport as major obstacles to doing business also varies inversely with export participation. However the pattern is inconclusive when it comes to number of firms that have foreign equity (see Fig A2.1 appendix). This could be due to the fact that some multinationals are market oriented (horizontal FDI) whilst other seek low production cost locations (vertical FDI) and these are the ones mostly sensitive to inadequate infrastructure facilities which increase production costs.

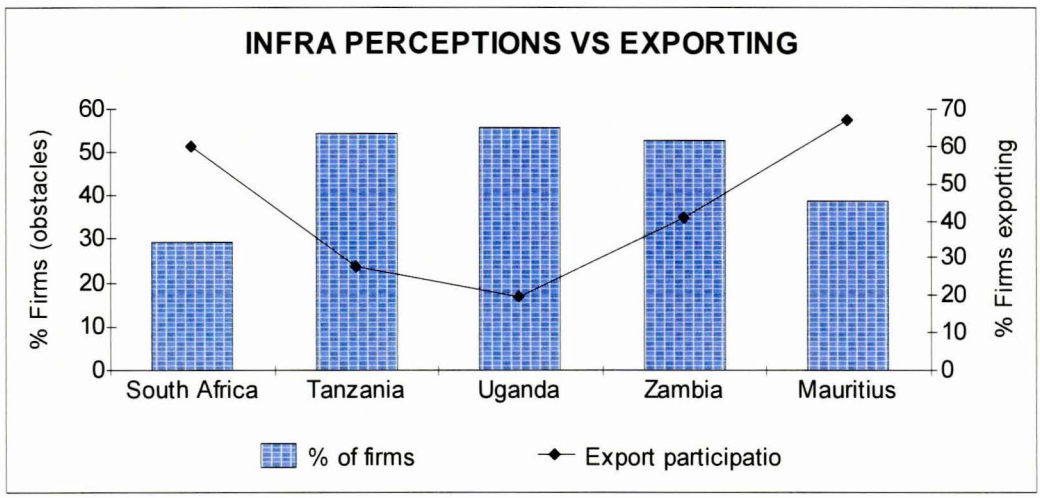
[18] The reason for doing this was because trade performance is not affected by one infrastructure indicator but by the performance of all infrastructure indicators.

Fig 2.11: Relationship between infrastructure (hrs without services) and exporting



Source: Investment climate surveys

Fig 2.12: Relationship between infrastructure perceptions and exporting



Source: Investment climate surveys

2.8 Summary

This section has given us an overview of the state of infrastructure in Africa using a number of indicators. We have shown that the quality of infrastructure is generally poor in Africa compared to other developing regions of East Asia and the Pacific as well as Latin America. There are also cases particularly in water and electricity where the African continent performs better than in

South Asia. Our qualitative analysis has also shown that there is a prima facie negative relationship between infrastructure quality and export participation. The next step now, is therefore to examine whether the correlation between the quality of infrastructure and exporting is statistically significant?

CHAPTER TWO APPENDIX

Table A2.1: Infrastructure indicators across Africa

Country	Transmission losses	Fixed lines per 100 people	Total road network km	Percentage of Roads paved	Rail km	Mobile phones per 100 people	Internet per 100 people	Road density 100sq km
Algeria	13	9	108302	70.2	447	63	7.4	5
Angola	14	1	51429	10.4	2761	14	0.5	4
Benin	-	1	19000	9.5	578	12	8	17
Botswana	15	7	24455	33.2	888	53	3.3	4
Burkina Faso	-	1	92495	4.2	622	7	0.6	34
Burundi	-	0	12322	10.4	-	2	0.7	48
Cameroon	16	1	50000	10	1016	13	2	11
Central Africa Rep	-	0	24307	-	-	2	0.3	4
Chad	-	0	33400	0.8	-	4	0.6	3
DRC	-	-	153497	1.8	3641	-	0.3	7
Congo Rep	-	-	17289	5.0	795	-	1.9	5
Cote dlvoire	-	-	80000	8.1	639	-	1.6	25
Egypt	16	15	92370	81	5150	24	8.1	9
Eritrea	-	1	4010	21.8	306	1	2.1	4
Ethiopia	10	1	37018	13.4	-	1	0.2	4
Gabon	18	3	9170	10.2	810	58	6.2	4
Gambia	-	3	3742	19.3	-	24	3.6	37
Ghana	14	2	57613	17.9	977	23	2.7	25
Guinea	-	0	44348	9.8	1115	2	0.5	18
Guinea Bissau	-	1	3455	27.9	-	6	2.2	12
Kenya	18	1	63265	14.1	1917	18	7.6	11
Lesotho	-	2	5940	18.3	-	13	2.6	20
Liberia	-		10600	6.2	490	5	-	11
Libya	13	8	83200	57.2	2757	65	3.9	5
Madagascar	-	1	49827	11.6	732	5	0.6	9
Malawi	-	1	15451	45	710	3	0.4	16
Mali	-	1	18709	18	733	13	0.6	2
Mauritania	-	1	7660	11.3	717	35	3.3	1
Mauritius	-	29	2015	100	-	62	14.5	99
Morocco	18	4	57626	61.9	1907	52	20	13
Mozambique	12	0	30400	18.7	3070	11	0.9	4
Namibia	18	7	42237	12.8	-	25	4	5
Niger	-	0	18423	20.6	-	2	0.3	1
Nigeria	24	1	193200	15	3528	22	5.5	21
Papua New Guinea	-	1	19600	3.5	-	1	1.8	4
Rwanda	-	0	140000	19	-	3	0.7	57
Senegal	30	2	13576	29.3	906	25	5.4	7
Sierra Leone	-	-	11300	8	-	-	0.2	16
Somalia	-	1	22100	11.8	-	6	1.1	4
South Africa	6	10	36413	17.3	20247	72	10.9	30
Sudan	16	2	11900	36.3	5478	12	9.3	1
Swaziland	-	4	3594	30	301	22	3.7	21
Tanzania	27	0	78891	8.6	4582	15	1.0	9
Togo	46	1	7520	31.6	568	11	5.0	14
Tunisia	12	13	19232	65.8	1909	72	12.8	12
Uganda	-	0	70746	23	259	7	2.5	36
Zambia	5	1	91440	22	1273	14	4.3	12
Zimbabwe	7	3	97267	19	-	6	9.2	25
SSA	9	1	-	11.9	-	14	3.8	7
East Asia & Pacific	7	23	-	11.4	-	35	11.1	22
Latin America	16	18	-	24.3	-	55	18.4	18
South Asia	24	3	-	56.9	-	15	4.9	110
Africa	17	17	-	70.2	-	36	13.8	7

Source: World Development Indicators (2009)

Table A2.2: Percentage of firms identifying infrastructure as at least major obstacle

	Obstacle telecommunication		Obstacle transportation		Obstacle electricity		Obstacle customs and trade regs	
	Foreign owned	exporters	Foreign owned	exporters	Foreign owned	exporters	Foreign owned	exporters
South Africa	20.51	15.56	30.77	28.33	26.50	20.74	47.01	43.33
Zambia	47.54	60.71	44.26	52.38	59.02	61.35	49.18	47.62
Tanzania	21.88	31.33	46.88	54.22	79.69	78.62	60.94	66.27
Uganda	24.64	23.73	49.28	64.41	76.81	68.33	68.12	67.80
Mauritius	29.41	19.86	47.06	29.45	41.18	29.38	61.76	50.68
Textile_Garment	23.33	16.10	46.67	35.59	50.00	40.56	60.00	50.00
Food_agric	33.00	38.24	47.00	52.35	66.00	58.73	60.00	58.82
Chemical_pharmacy	26.83	26.76	51.22	43.66	48.78	47.10	56.10	56.34
Plapackaging	12.12	20.83	21.21	27.78	54.55	42.49	39.39	52.78
Woodfurniture	30.00	32.14	40.00	42.86	70.00	59.46	60.00	28.57
Construction_metal	31.03	20.51	48.28	33.33	72.41	55.40	65.52	41.03

Source: Author's own computations based on World Bank's Investment Climate Surveys:
Note: higher mean values imply greater obstacle. (0=no obstacle; 1=minor obstacle; 2=moderate obstacle; 3=major obstacle; 4=very severe obstacle)

Fig A2.1: Hours without infrastructure services and the % firms foreign invested

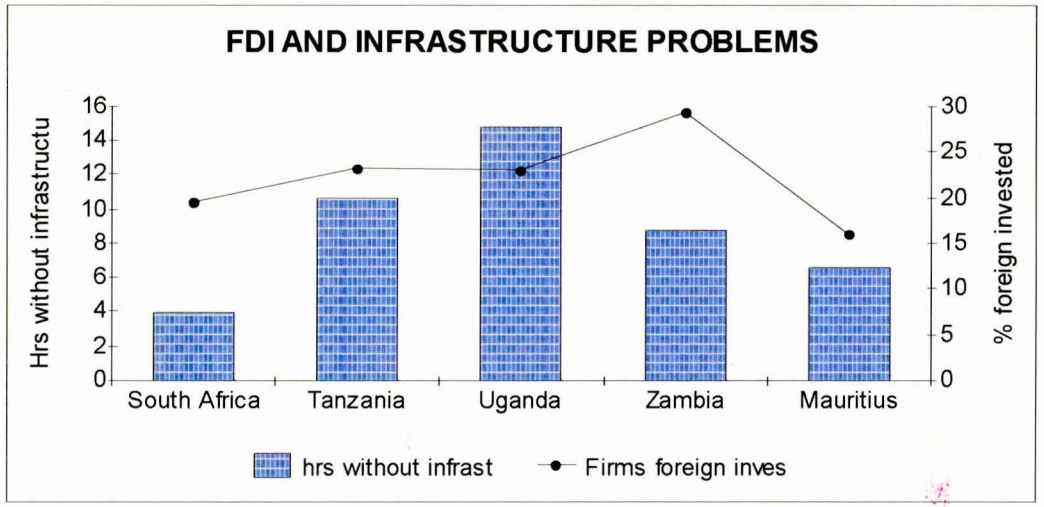
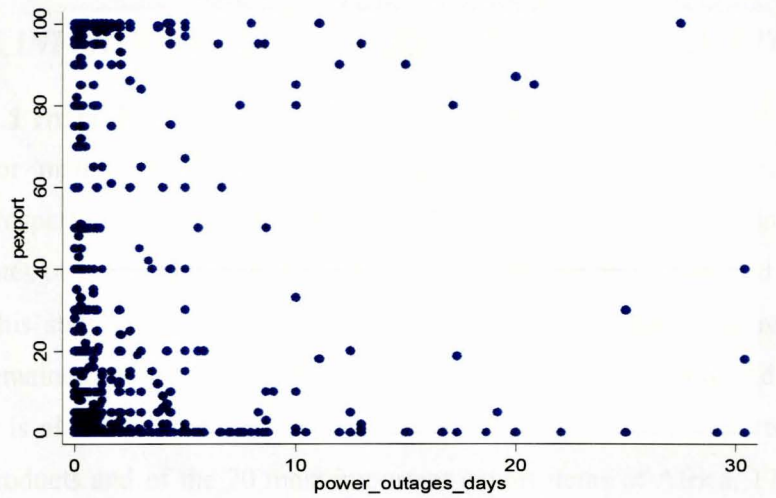
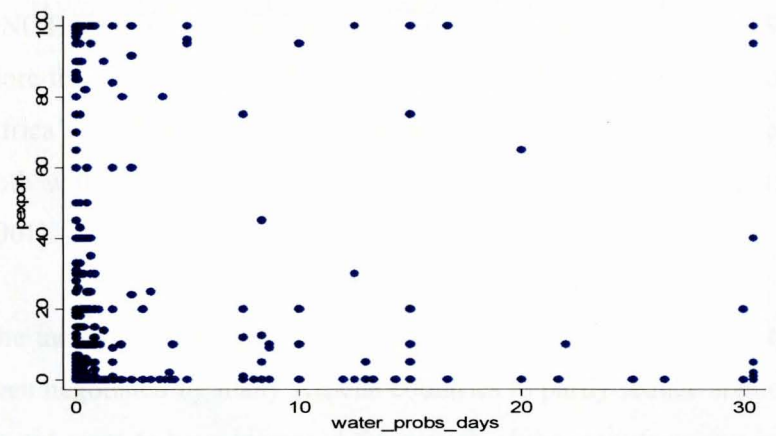
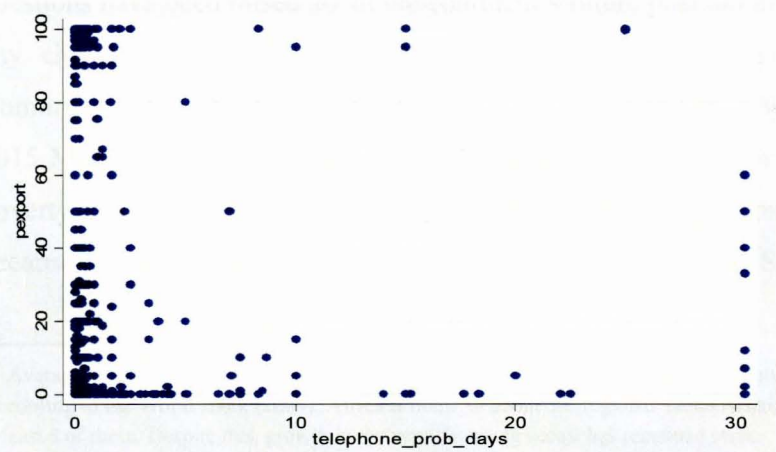


Fig A2.2: Scatter plots (exports intensity and infrastructure disruptions)







CHAPTER 3

3. INFRASTRUCTURE AND MANUFACTURED EXPORTS: A Firm level analysis

3.1 Introduction

For many poor countries, manufacturing exports expansion is often seen as the path to prosperity. This is because a handful of countries most of them in Asia, achieved unprecedented rates of growth through manufacturing exports promotion (World Bank 1993, Wood et al 1997). This strategy could help Africa given that the continent's share of manufactured exports has remained roughly constant at 0.5% from 1970 to 2003 (Yang and Gupta, 2005, Edwards, 2005). It is also estimated that only 21 percent of total African exports worldwide are manufactured products and of the 20 most important export items of Africa, 17 are primary commodities and low value resource based manufactures (UNCTAD, 2003; Yoshino, 2008). Additionally, UNCTAD, (2004) statistics, show that the 48 countries in Sub Saharan Africa maintain a little more than 1% of global trade and intra-regional trade is estimated to be at best less than 10% of Africa's total trade. This trade pattern supports the common belief that Africa trades "too little" both with itself and with the rest of the world (Alva and Behar, 2008, Limao and Venables, 2001).

The increase in the number of free trade arrangements, both bilateral and multilateral, that have been negotiated by many African countries to partly reduce applied tariffs on industrial products do not seem to have increased the growth of the manufacturing sector[19]. As a result a number of questions have been raised about the continent's future position in world trade and whether it has any chance of developing a competitive industrial structure (Elbadawi et al 2007). The Commission for Africa Report, (2005), also states that Africa will not be able to achieve the 2015 Millennium Development Goals (MDGs), nor set itself on a sustainable growth-path and poverty reduction without significantly improving its participation in global trade. This is because the continued marginalization of Sub Saharan Africa (SSA) in world trade especially in

[19] Average import tariff worldwide have also dropped from 8.6 to 3.2 percent between 1960 and 1995 (Hummels, 2007). According to the World Bank (2004), Africa is home to about 30 Regional Trade Arrangements and each country is a member to at least 4 of these. Despite this, growth in the manufacturing sector has remained static.

the market for manufactured exports is seen as the major reason for the relative lack of economic growth, high levels of unemployment and poor standards of living in the region (Commission for Africa Report, (2005).

Development policy experts have for a long time debated on the factors that could possibly constrain Africa from diversifying its exports into non traditional areas and thus move away from primary commodities. These factors include inter-alia, poor trade policies (exchange rate overvaluation and high tariffs), lack of comparative advantage (lack of appropriate technology and skilled manpower), civil conflict, etc (Elbadawi et al, 2007; Collier and Gunning, 1999; Rodrik, 1998; Sachs and Warner, 1997). However, other researchers argue that a possible explanation of this missing trade could be non tariff barriers like, poor infrastructure, inappropriate transport policies and adverse economic geography (Nordas and Piermartini (2004); Limao and Venables (2001); Simuyemba, 2000; UNCTAD, 2004). Inadequate infrastructure and poor transport networks make it difficult for manufacturers to participate in global outsourcing as they cannot guarantee timely delivery or ensure reliability and flexibility in the supply of goods (Hummels, 2007). Hummels also argued that inadequate infrastructure in many countries explain why a large majority of firms serve only domestic markets and a small portion of sales are to foreign customers. Krugman (1991) using the iceberg concept argued that poor infrastructure increases transport costs and this forces firms to be "extra" productive in order to maintain their profit margins. Differences in trade costs across countries as a result of differences in the quality of infrastructure is a source of absolute and comparative advantage which affect the volume, direction and composition of trade (World trade Report, 2004).

Sachs and Warner, (1997) argue that countries that are geographically isolated from world markets face higher costs for all international activities, and may end up with a lower division of labour and lower output per capita. This is partly supported by Hummels (2006) who also argued that distance impedes trade to a surprising extent and typical estimates suggest that doubling distance halves trade with costs substantially rising in distance even though this effect seem to diminish if transport infrastructure is good. To test the relationship that exists between distance and transport costs, Zarzoso et al (2003) estimated a transport costs function using data on maritime and overland transport for the ceramic sector in Spain and found that higher distance

and poor partner infrastructure leads to notable increases in transport costs. They also found that a 1% increase in distance increases transport costs by approximately 0.25%. As much as it is true that geography strongly affects trade and development, it is also true that geography is not destiny. The provision of good quality public infrastructure (transport and communication) can help overcome some of the adverse effects of economic geography (Henderson, 1999).

The main objective of this chapter therefore, is to offer a micro-econometric assessment of the influence of external factors like geography, infrastructure (transport, electricity, telecommunication, water and customs) on export participation in African firms controlling for firm specific variables in the analysis. This will not only fill the gap that currently exists in the literature but will also minimise the problem of omitted variable bias where infrastructure variables are excluded in empirical models on firm level exporting. Thus to set appropriate industrial policy goals and make reasonable expectations about the effects of export promotion policies you need to understand how firms become exporters. Exporting problems facing countries mostly in Africa can only be understood and remedied successfully if policy makers have a clear understanding of exporter behaviour.

3.2 Literature review

3.2.1 Theoretical literature review

The standard approach that has been followed in the theoretical literature when modelling infrastructure costs is to use the concept of iceberg trade costs. This is the same approach that was followed amongst other by Krugman and Venables (1995), Melitz (2003) and Dixit and Stiglitz (1977) when looking at the behaviour of monopolistic competitive firms in the context of international trade.

Thus Krugman and Venables (1995) demonstrated in their model how infrastructural improvements and hence low transport costs can encourage economic convergence or globalization. They argued that the decline in transport costs below a critical level result in the formation of what they called a core and periphery with nations that find themselves in the periphery suffering a decline in real incomes. In this model, high transport costs result in regions

or countries not engaging in trade and being self sufficient resulting in no specialization at the aggregate level. However if transport costs fall below a critical level the world economy will organize itself into an industrialized core and deindustrialised periphery. Thus what happens is that if transport costs continue to fall, the importance of being closer to markets or suppliers will decline but now the periphery region will offer the advantage of lower wage rate. This encourages trade and agglomeration.

Another theoretical model that relates trade costs with exporting was developed by Melitz (2003). Melitz (2003) built a dynamic industry model with heterogeneous firms producing a horizontally differentiated good with a single factor. He argued that the entry of a firm into the export market is dependent on firm-level productivity and trade costs associated with exporting. The coexistence of firms with different productivity levels in equilibrium is the result of uncertainty about productivity before an irreversible entry decision is made. Entry into the export market is also costly, but the decision to export occurs after firms observe their productivity. Firms only enter the export market if their productivity levels are high enough to absorb trade costs associated with exporting. Thus according to Melitz (2003), exposure to trade induces only the more productive firms to enter the export market whilst the least productive ones exit and the less productive produce only for the local market. Firms produce a unique horizontal variety for the domestic market if their productivity is above some threshold, and export to a foreign market if their productivity is above a higher threshold. This model basically suggests that trade is mostly beneficial to firms that are productive. The impact of trade on the distribution of firms in his model is channelled through the domestic factor market where firms compete for a common source of labour. Thus when entry into new export markets is costly, exposure to trade offers new profit opportunities to more productive firms who can afford to cover the entry costs. Thus the increased labour demand by the more productive firms and new entrants bids up real wages and forces the least productive firms to exit. In this model, import competition does not play a role in the reallocation process due to the CES specification for demand (residual demand price elasticities are exogenously fixed and unaffected by import competition). The impact of trade costs in the model is explained through its impact on the number of trading partners and productivity cut-off. Thus as trade costs fall the productivity level required of firms to enter the

export market will fall and this also generates entry of new firms who were not able to export because of higher trade costs. Firms lose their domestic market share and those into exporting make up for lost market share with increased export sales. The same result holds for a decrease in the fixed export market entry costs. In this model, exporter superiority is shown to be the equilibrium outcome of more productive firms self-selecting into the export market. This selection is driven by the existence of trade costs, which only the most productive firms can absorb while still remaining profitable.

Bernard et al. (2003) construct a static Ricardian model of heterogeneous firms, imperfect (Bertrand) competition with incomplete mark-ups, and international trade. Firms use identical bundles of inputs to produce differentiated products under monopolistic competition. Within a country without trade, only the most efficient producer actually supplies the domestic market for a given product. With international trade and variable trade costs, a firm produces for the home market if it is the most efficient domestic producer of a particular variety and if no foreign producer is a lower cost supplier net of trade costs. A domestic firm will export if it produces for the domestic market and if, net of trade costs; it is the low-cost producer for a foreign market. With positive trade costs, exporters are firms with higher than average productivity. Bernard et al. (2003) demonstrate that as trade costs fall, aggregate productivity rises because high-productivity plants are more likely to expand at the expense of low-productivity firms which fail. Declining trade costs force low-productivity plants to exit the market in both Bernard et al. (2003) and Melitz (2003), but the mechanism by which this occurs differs subtly. In Bernard et al. (2003), low-productivity plants exit because of increased import competition from foreign varieties. In Melitz (2003), countries' varieties do not overlap. As a result, an increase in imports raises the probability of death at all levels of productivity while the death of low-productivity plants is actually driven by the entry into exporting of other domestic firms. There are also two other possible reasons that plant productivity could increase in the face of lower trade costs. One is that increased competition may induce plants to improve their productive efficiency, the so-called 'kick in the pants' effect (Lawrence, 2000). Another is that the plant itself may change its product mix, i.e., intra-plant reallocation. Evidence for this type of switching by plants is found by Bernard et al. (2006a). In this case it may be that the underlying productivity of

manufacturing each good is unchanged but plant-level productivity is affected by the change in output mix.

3.2.2 Empirical literature overview

The research literature has identified a number of causes of poor manufacturing exports performance both at macro and microeconomic levels. Macro level studies have identified inter-alia poor macroeconomic policies, market constraints and supply-side factors like poor infrastructure, institutions and inappropriate transport policies (see Rodrick et al, 2002; Redding and Venables, 2004a; Fugazza, 2004). Micro level studies have tended to dwell much on efficiency, firm size, foreign ownership, market size, entry costs (sunk costs) and age (see Bernard et al, 2001; Soderbom et al, 2003; Rankin et al, 2006; Robert and Tybout, 1997; Wagner, 2005).

3.2.2.1 Macro level studies

A study by UNCTAD (2006) highlights the importance of both demand and supply side factors. This study used data from about 84 countries (17 of them from SSA) for the period 1980-2003 and employed a bilateral trade flow gravity model. They built on the theoretical and empirical model used by Redding and Venables (2004a) but used quantile regressions to account for unobserved heterogeneity across countries. Accounting for unobservable heterogeneity allows for the identification of any differences in the effect of and importance of export performance components which are linked to the degree of development of the external sector. Thus this UNCTAD, (2006) technique allows for non linearities in the relationship between exports performance and supply-demand side variables. In addition to stressing the importance of trade barriers, UNCTAD, (2006) results showed that the relative importance of demand and supply factors varies from country to country depending a great deal on the level of development of the external sector. Strong linkages to international markets, physical infrastructure, soundness of the macroeconomic framework and the quality of institutions appear to be other major determinants of export performance also identified in the study.

Other empirical studies have also examined the role played by infrastructure and institutions on export performance using bilateral trade flow models like gravity models on macroeconomic

data. Francois and Manchin (2007) using selection based gravity models and maximum likelihood techniques as well as principal components (to condense infrastructure and institutional variables) found that infrastructure and institutional quality are significant determinants not only of export levels but also of the likelihood exports will take place at all. They used the sample selection model to take account of the censoring process that leads to zero or missing bilateral trade flows as the amount of trade (a dependent variable in their model) is only observed if trade occurs[20]. In this case zero bilateral trade flows are systematically excluded from the analysis and this can bias results. Their panel study covered a large sample of 123 countries across the world (including some African countries) over the period 1988 to 2002. They found that infrastructure is quantitatively important in determining transport costs and it accounts for approximately 60% of predicted transports costs of landlocked countries due to poor internal geography. The study found that variation in infrastructure (transport and communications) explains a larger proportion of the variation in exports than do the trade barriers faced by developing countries. They also found that an increase of one standard deviation (from the mean) in the quality of communications infrastructure raises the volume of trade by roughly 11 percent, compared to a 7 % effect of transport infrastructure and 2% effect for tariffs.

Another study that also looked at the relationship between infrastructure, transport costs and trade was done by Limao and Venables (2001)[21]. Using cross sectional analysis, they studied the determinants of transport cost and found that transport costs depend on a country's geography and level of infrastructure quality. They used two different sets of data to arrive at this conclusion. Firstly, they obtained quotes for shipping a standard container from Maryland, Baltimore (United States) to selected destinations. Using linear regression they found that for coastal countries domestic infrastructure[22] explained 40 percent of the predicted transport costs,

[20] This creates a non random sample selection process which excludes zero bilateral trade flows.

[21] They used about 103 countries across the world and in their SSA sample they used about 23 countries.

[22] The index measure of infrastructure used, designed to capture the cost of travel in and through a country was constructed as an average of the density of the road network, the paved road network, rail network and the number of telephone main lines per person. In their regressions they used an inverse of this infrastructure index implying than an increase in the index suggests an increase in transport costs.

whilst for inland countries own infrastructure explain 36 percent and transit infrastructure (of bordering coastal countries) explained 24 percent. Secondly, Limao and Venables (2001) used the ratio of c.i.f. to f.o.b. data from the IMF DOTS database to calculate *ad valorem* transport costs. They used the *ad valorem* transport costs as the dependent variable in a Tobit regression. Once again infrastructure was found to be a highly significant determinant of transport costs. Improving a country's infrastructure from the median to the top 25th percentile is equivalent to it being 2358 km closer to all its trading partners.

After having identified the nature of relationship between transport costs and infrastructure, Limao and Venables (2001) went on to test the impact of infrastructure on trade using a bilateral trade flow gravity model; if infrastructure has a significant impact on transport costs, then it should also be important in determining trade flows. They found significant results: Moving from the median to the top 25th percentile in the distribution of infrastructure raised trade volumes by 68 percent. Moving from the median to the 75th percentile decreased trade volumes by 28 percent. Increasing the level of infrastructure above the median distribution therefore has significantly greater impact than falling below the median. According to Edwards and Odendaal, (2008) this could indicate the existence of some sort of threshold for the level of infrastructure, or it could simply be due to the shape of the distribution of infrastructure. Unfortunately this is an interesting finding that they did not explore further. Limao and Venables (2001) next turned their attention to intra-Africa trade. They found that a basic gravity specification could not account for Africa's poor intra-trade performance as the African dummy variable was significant and negative. However, once the infrastructure variables were included in the regression the African dummy variable switched signs indicating that given its low level of infrastructure, Africa actually trades more than expected. The severity of Africa's poor infrastructure is highlighted by the Africa Competitiveness Report (2007). One of the largest performance gaps highlighted by the report is infrastructure. In the report, Africa has the lowest regional infrastructure average out of all the other regions.

Another macro study on infrastructure was done by Nordas et al (2004) using bilateral gravity modelling incorporating bilateral tariffs on a number of countries in the developed and

developing world[23]. Nordas and Piermartini (2004) built on the work done by Limao and Venables (2001) using trade and infrastructure data from 2000. Firstly, they, argued against using direct transport costs such as the c.i.f/f.o.b[24] ratio used by Limao and Venables (2001) as these ratios are not available for Europe or Japan, nor available at the disaggregate level. They also argued that the quality of c.i.f/f.o.b data is generally poor. Secondly, Nordas and Piermartini (2004) attempted to correct for an omitted variable bias in the Limao and Venables (2001) gravity model by using a theoretical gravity model as specified by Anderson and van Wincoop (2003). This was done by including multilateral resistance variables into their model. These variables are supposed to capture the trade barriers between two trading countries relative to the average barriers of these two countries with all other trading partners (Anderson and van Wincoop, 2003). Nordas and Piermartini (2004) used the average weighted tariffs faced by the exporter and the average tariff of the importer as multilateral resistance variables. However Edwards and Odendaal (2008) argue that this is incorrect as using tariff variables will still result in an omitted variable bias since the tariff variables will not capture any of the other trade barriers faced by the trading countries. Thirdly, Nordas and Piermartini (2004) constructed separate indices for each type of infrastructure (rail, roads, telecommunications, ports, airports and time for customs clearance) in order to test individual effects of the different forms of infrastructure. They found that port efficiency has the largest impact on bilateral trade. A one percent improvement in importer (exporter) infrastructure was found to increase imports, on average, by 0.67 (0.92) percent. However, they acknowledged that this might be as a result of selection bias since only coastal countries were included in the sample.

Another way that Nordas and Piermartini (2004) expand on Limao and Venables (2001) is that they constructed a bilateral dummy variable (for the overall infrastructure index and for the separate infrastructure indices) that takes on a value of one if the combined quantity of

[23] This study also included African countries like Lesotho. Ethiopia, DRC, Chad, Niger, Zambia, Kenya, Nigeria, Gabon.

[24] cif/fob is a widely used indirect measure of international transport costs because of poor data on direct measures. This measure takes advantage of the fact that in principle exporting countries report trade flows exclusive of freight and insurance(fob) and importing countries report flows inclusive of freight and insurance. Comparing the valuation of the same flow reported by both importer and exporter yields a difference equal to international transport costs. However inconsistencies in goods classification and missing values creates problems in using this ratio.

infrastructure of the trading partners is above average and zero otherwise. This indicates whether there is a threshold of combined quantity of infrastructure (as is possibly the case in Limao and Venables, 2001). They found that country pairs that had an above average combined infrastructure traded 1.36 times more than country pairs which had a below average combined infrastructure. However, this variable in effect captures how much the maximum level of infrastructure matters in determining trade flows. The construction of the dummy variable uses the combined infrastructure of the trading partners, thus if one trading partner has sufficiently good infrastructure the country pair will have above average infrastructure. Although Nordas and Piermartini (2004) do include some interactions variables in their final set of regressions, for the most part they follow the standard procedure in the literature of including exporter and importer infrastructure variables (see also Francois et al, 2007 and Limao and Venables, 2001). According to Edwards and Odendaal, (2008), this may be a misspecification leading to an omitted variable bias since they do not capture the other factors that may enhance or detract the impact of infrastructure quality on trade.

Buys et al (2006) used a minimum quality road index[25] between trading nations in their simulation of the trade-expansion potential of an integrated road network in Africa. They argued that this provides a more accurate reflection than using an average road quality index. However, including the minimum quality road index only is also a misspecification as it ignores the infrastructure of the other trading partner (Edwards and Odendaal, 2008). This is because the infrastructure of the exporter and the importer matters, as shown in Limao and Venables (2001) as well as Nordas and Piermartini (2004). Thus it is also necessary to include a maximum road index variable in order to capture the effect of the road quality of both bilateral partners and transit countries on trade. According to Limao and Venables (2001), it is not only the quality of

[25] Their transport infrastructure quality index was calculated as follows $Q_j = P_j^{\alpha_1} G_j^{\alpha_2} C_j^{\alpha_3}$ where :

Q_j =Road quality index for country j

P_j = Percentage of roads paved in country j

G_j = GDP per capita in country j (index of capacity to maintain roads)

C_j = World Bank's country policy and institutional capacity (CPIA) index for transparency, accountability and corruption in country j (a proxy for delays and costs inflicted on truckers). The maximum index should in this case include infrastructure quality of both importer and exporter.

the infrastructure of the trading countries that matters but also that of transit countries. In their study, Buys et al (2006) used a gravity model on the data of 35 SSA countries from 2000 to 2003 to obtain estimates of the effects of road transport quality and road distances on trade.
These estimates by Buys et al (2006) were then used to calculate the current trade flows in the inter-city network and then to simulate the effect of a continental upgrading of the road network in Africa. They found that such an upgrade would expand overland trade flows by approximately $250 billion over 15 years, whilst financing the program would require about $20 billion initially and an additional $1 billion annually for maintenance.

However, Buys et al (2006) and Nordas and Piermartini (2004) fail to control for the zero trade flows between certain countries. Westerlund and Wilhelmsson (2006) argued that the OLS estimates become biased if the zero observations are simply ignored or eliminated. Ignoring or eliminating the zero trade flows would be acceptable if the cases of zero exports occurred randomly (Edwards and Odendaal, 2008). However, this is not the case as countries with high transport costs are less likely to trade. Thus using only countries that do trade constitutes a self-selected sample rather than a random sample. This non-random screening of data results in biased estimates (Coe and Hoffmaister, 2007). In order to deal with the number of zero bilateral trade flows, Francois et al (2007) used a Heckman selection model.

The results of Buys et al (2006) also suffer from an omitted variable bias as they did not include any multilateral resistance variables. Anderson and van Wincoop (2003) showed that not including the multilateral resistance variables in the gravity model means that these variables are captured by the regression residual. These omitted terms are correlated with the trade-cost term in the model, thus biasing the estimates of trade costs and all its determinants. The other thing is the clustering of variables that was done by Buys et al, (2006) makes it difficult to relate results to specific policy actions. By using both the percentage of paved roads and institutional indicators in constructing the road quality index, could mean that their results are driven specifically by poor institutions or poor maintenance not necessarily the nature of roads. The same problem also affects Limao and Venables (2001) results, in that they lumped together road quality indicator variables (percentage of paved roads) with telecommunication indicator

(number of fixed telephone line per person) in constructing their infrastructure index that they used for estimation.

Shepherd et al (2006) using gravity models found that exporting firms rely not only on the quality of infrastructure provided by home governments but also on that of neighbouring countries through which goods must transit. Due to this, the relationship between road quality and trade may not be linear as upgrades in important transit countries or resolution of regional bottlenecks could have impacts well beyond individual countries concerned. They argued that one way of controlling for these transit effects or cross country spillovers is by using the number of borders crossed.

Most of the studies that have been reviewed so far concentrated on the role of infrastructure in affecting total trade. The World Bank (2000) however argues that export diversification is one of the main elements of the development strategies that countries in Sub Saharan Africa need to follow for sustained growth and poverty reduction. Wood and Mayer (2001) departed from country level studies that use total exports by looking at factors that affect Africa's manufactured exports performance. They used a simple OLS regression to find the determinants of manufactures using a sample excluding African countries. These coefficients were then applied to the African characteristics in order to calculate an expected level of exports for each African country (given its human and natural resources). This was compared against the actual exports structure. Looking at the manufacturing sector, Wood and Mayer (2001) found that on average manufactures formed a smaller part of exports than expected. For example, eight countries had a predicted manufactures export share of 26 percent but only averaged 3 percent. Thus even after taking into account the human and natural resource endowments, which they argued give most African economies a comparative advantage in primary products rather than manufactures, Wood and Mayer (2001) could not explain the low levels of manufactures in most African countries. When investigating the causes of variation between the expected and actual levels of manufactures they found that lack of infrastructure, macroeconomic mismanagement (particularly of the exchange rate) and ineffective administration appeared to cause the shortfall between the actual and predicted values (whilst geography and sector bias of trade policies had

little to no effect). The discrepancy between actual and predicted export shares led the authors to conclude that growth in manufactured exports could make a large contribution to the growth of total exports. This in turn would boost aggregate growth (they argued that the causality can run both ways, higher aggregate growth can lead to higher export growth and vice versa). Therefore, even if Wood and Mayer (2001) are correct in arguing that Africa's comparative advantage lies in primary products (which some papers disagree with, see Bloom and Sachs, 1997 and Elbadawi, 1999) - improving infrastructure is still likely to have a significant and positive effect on the manufacturing sector (Edward and Odendaal, 2008).

3.2.3 Empirical micro level studies

At the firm level, a number of studies have been done in and outside Africa to examine the impact of various firm specific attributes on exporting using different variants of cross sectional models.

Bernard et al (2001) used a dynamic panel model of USA manufacturing plants to test for the role of plant characteristics, spillovers from neighbouring exporters, entry costs and government export promotion expenditures. They found that entry costs are significant and spillovers from the export activity from other plants negligible. State promotion expenditures have no significant effect on the probability of exporting. However, Hanson and Harrison (1997) examining the role of geographic and sectoral spillovers on exporting in Mexico find that the presence of multinational exporters in the same industry and state increases the probability of exporting.

Another firm level study by Elbadawi et al, (2006) which used cross section analysis looked at the role of institutions and geography in 18 countries in and outside Africa. They used firm level structural export equations derived from the macro model originally developed by Dixit and Stiglitz (1977) but modified by Redding and Venables (2003) to analyse market access and supplier access. In this large cross country sample of manufacturing establishments drawn from 188 cities, they found that average exports per firm are smaller in Africa than in other regions, mostly because they face adverse economic geography and operate in poorer institutional settings. In their study they argued that geography and institutions affect exports by lowering

foreign market access and supplier access.[26] Like Limao and Venables (2001), they also showed that controlling for institutions and economic geography, what in effect is a negative African dummy disappears from the firm level exports equation they estimated. Elbadawi et al (2006) also argued that African firms are located further away from wealthier or denser potential export markets (poor foreign market access) and also face steeper input prices partly because of their physical distance from cheaper foreign suppliers (poor supplier access). They also argued that supplier access problems are made worse by the fact that domestic substitutes for importable inputs are more expensive. Elbadawi et al (2006) results also show that geography and institutions influence average firm level exports more through their effect on the number of exporters than through their impact on how much each exporter sells in foreign markets.

Another micro econometric analysis of the determinates of manufactured exports in Sub Saharan Africa based on World Bank survey data is by Clarke (2005). He used eight African countries to find that firm level exports are constrained by restrictive trade and customs regulation and poor customs administration. Using an endogenous Tobit model, he also found that the quality of domestic transport infrastructure has less impact on export performance compared to international transport infrastructure. This is against the findings of Naude et al 2007 as well as Roper and Love, 2001. Naude et al, 2007 argued that domestic transport costs have a greater effect on the propensity to export and industrial location thereby influencing the spatial location of exporters within a particular country or region. Thus therefore the role of domestic transport costs on manufactured exports and location of exporting firms in Africa is highly relevant. These arguments are supported by Eaton and Kortum (2002) who state that trade diminishes dramatically with distance and that prices vary across locations and the differences are greater for places that are far apart. They also argued that average exports are larger for firms in larger national economies (large domestic markets) and where domestic transport infrastructure, rule of law is better. Even Edwards and Alves (2006) found that in South Africa, manufacturing exports are constrained by declining investment in transport infrastructure. However Clarke (2005) did

[26] Foreign market access means that a typical African firm is located further away from a denser wealthier export markets whilst supplier access means that African firms face steeper input prices because they are located far away from cheaper foreign suppliers and domestic substitutes are expensive.

not go into the details of the other types of infrastructure variables like electricity, water, and telecommunication as is intended in this research.

Another study that attempted to analyse the impact of domestic transport costs on exports and the spatial location of manufacturing exporters was done by Matthee et al (2007). They used manufactured exports from about 354 magisterial districts between 1996 and 2004 and used distance as a proxy of transport costs. They used modified Cubic Spline density functions[27] on spatially disaggregated data on exports and manufacturing firms in South Africa and showed that proximity to a port is also an important consideration in most export oriented manufacturing firms. Thus 70% of these exporters particularly in the electronics sector locate within a radius of 100km from a port or export hub.

Most of the micro level studies on African firms show that there is a strong correlation between firm sizes (measured in terms of firm employment, total assets and sales) and exporting. This variable is robust across all specifications which allow for certain forms of firm heterogeneity and dynamics (Rankin et al 2006). Söderbom et al (2003) argue that the size of the firm's domestic base is linked to its export performance implying that firms need to grow domestically to be successful internationally. In this context there is concern that government policies that restrict the growth of firms domestically may also inhibit export growth. This is because larger firms are more involved in exporting than smaller firms. Thus if size is related to the firm's participation in the export market, limited domestic demand ensures that the only way to expand is to grow into the export market.(to test this hypothesis they examined whether a change in log of employment changes the probability of a firm participating in export market in future). Rankin et al., (2006) in a panel study of five African countries discovered that the average size of a firm that is into exporting is 273 employees pointing to the importance of size as a factor explaining poor export performance. The theoretical literature also suggest that the presence of fixed costs associated with exporting may mean that export performance could improve with firm size up to

[27] Cubic spines are piecewise functions whose pieces are polynomials of degree less than or equal to three joined together to form a smooth function (Mathee et al(2006). They used these functions to overcome the problems experienced with piecewise linear regression functions which suffer from discontinuity in their derivatives. They argued that this discontinuation at the kinks of the linear regression makes analyses for shifts in elasticities and marginals difficult.

some point but thereafter remain stable or decline; that is the relationship between export performance and firm size could be non linear (Gabittas et al 2003). Teresa et al (2006) found this inverted U- shaped relationship in Philippine manufacturing firms. Schlegelmilch and Crook (1988), found a hyperbolic non linear relationship between export intensity and firm size in their studies of British and Germany manufacturing firms.

The existence of sunk costs has also been posited as an important determinant of the decision to export at the firm level (Robert and Tybout, 1997). Sunk costs in exporting are mainly those of information gathering on the new market, setting up new distribution networks, marketing and possibly repackaging of products to appeal to new consumers etc. Martina (2006) argues that if there are significant sunk costs associated with entry into the new export market, then a high level of persistence in the firm's portfolio of destination market will be seen. On the other hand, if the main sunk costs involved in exporting are captured by the initial efforts involved in becoming outward oriented, then we expect to find that firms experience less persistence in their market coverage than they do in their export status (Martina, 2006). The question of whether sunk entry costs are relevant to the decision to become an exporter was answered by Bernard and Jensen (2004). Looking at exporting activity in the US, Bernard and Jensen (2004) found that exporting in the previous period substantially increases the probability of being an exporter in the next period. A similar result was also found by Sutherland (2003) when analysing the export decisions of Irish firms. He found that significant sunk costs exist in entering the export market and these costs were experienced by most Irish firms that are exporting. Dividing exporters into those exporting only to the UK market compared to exporters to the rest of the world showed that entry costs for Irish firms to the UK market to be significantly lower than the average sunk cost to other markets. Martina (2006) using Irish firms also found that the experience of exporting to one market significantly reduces the costs associated with entering additional markets. Thus the bulk of the sunk costs involved in exporting appear to be associated with the initial movement to outward orientation of the firm.

The other feature about African firms discussed in the literature is that exporters have a high level of labour productivity and are more capital intensive and tend to be older and more likely to be foreign owned (Rankin et al, 2006). Some studies also found that firms with foreign ownership are more efficient than firms with none (see Rankin, 2002; Chung and Roberts, 2000; Mengistae and Pattilo, 2004). Recent work on export behavior of firms has emphasized the heterogeneity of firm characteristics. Thus a wide range of firm specific factors like age of firm, capital intensity and the skills of its workforce have a bearing on the threshold question of whether or not a firm participates in exporting. Aitken et al (1997), Roberts and Tybout (1997) include some plant characteristics in their work and find that plant size, plant age, and the structure of ownership are positively related to the propensity to export. However, by comparing plants at a point in time, Bernard and Jensen (1995, 1997) document large significant differences between exporters and non-exporters among U.S. manufacturing plants. They found that exporters have more workers, proportionally more white collar workers, higher wages, higher productivity, greater capital intensity, higher technology intensity, and are more likely to be part of a multi-plant firm. However, these substantial cross-section differences between exporters and non-exporters cannot tell us about the direction of causality, i.e., do good firms become exporters or do exporters become good firms (Bernard and Jensen, 2001). Thus do efficient firms select themselves into exporting or do they become efficient by exporting through the so called learning by exporting effect.

A set of theoretical models by Dixit (1989), Krugman (1989) suggest that hysteresis in exports may be due to the sunk costs in entering the export market at the firm level. This possible presence of entry costs could be tested by looking at the effect of exporting yesterday on exporting today. Thus Robert and Tybout (1997) using a dynamic model of the export decision by profit maximising firms in Columbia find that sunk costs are a significant source of export persistence and that unobserved heterogeneity across plants plays a significant role in the probability that a firm exports. Thus if sunk costs are significant we would expect to see a high level of persistence in the firm's portfolio of destination markets. Distance also plays a role in the dependence of firms on an individual market. Firms that export to only one market usually export to closer destinations (Martina, 2006).

3.2.4 Summary

The micro empirical literature has shown that a number of firm characteristics play an important role in exporting. Thus plat size, efficiency, plant age and the structure of ownership are positively related to the propensity to export. The literature has also shown that the role of infrastructure on export performance has been done largely at country level using a variety of macro econometric models. There is also consensus that distance, good transport infrastructure, telecommunications and customs facilities play an important role in facilitating trade. However there is very little that has been done at micro level to assess the influence of infrastructure quality. Most of the studies have tended to look at the impact of firm level characteristics on exporting. This has been a result of unavailability of infrastructure data measured at firm level. We attempt to fill this gap in this study by exploiting data on infrastructure variables measured at firm level gathered by the World Bank through its investment climate surveys.

3.3 The model[28]

We derive the firm level structural equation that we will estimate from a theoretical framework based on the standard new trade theory model developed by Dixit and Stiglitz (1977) and Redding and Venables (2004). This model assumes that the world consists of N countries in each of which varieties of a differentiated manufacturing product are produced under increasing returns by a continuum of monopolistically competitive producers. Each variety can be used as a consumer good or as an intermediate input entering utility or production through the constant elasticity of Substitution (CES) aggregator. Each firm also produces horizontally differentiated products using a composite factor which consists of labour and capital. This model is basically similar to the one developed by Melitz (1993) which is also based on Dixit and Stiglitz (1977) model. The only difference is that Melitz (2003) modelled productivity to enter through the output function whilst in our model this is done through the cost function. We use the model based on the work of Redding and Venables (2004) because it is simpler and easy to manipulate.

[28] Part of the development of our estimated conceptual framework borrows from the works done by Elbadawi et al (2007) and Yoshino (2008).

3.3.2 Consumer behavior

The utility function of a consumer in country k is given as follows

$$U_k = \left[\sum_{j=1}^{N} \sum_{i=1}^{h} (x_{ijk})^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \qquad \sigma > 1 \tag{1}$$

where N is the number of countries and h is the number of firms in each country, x_{ijk} is the amount of product produced by the ith firm in country j and sold in country k; σ is the elasticity of substitution among the differentiated products and is assumed to be greater than one. (We also assume that in equilibrium all products produced in country j are demanded by country k in the same quantity). Following Dixit and Stiglitz (1977), the consumer utility maximisation result in consumer demand function expressed as follows[29]:

$$x_{ijk} = \frac{(p_{ijk})^{-\sigma}}{(\Omega_k)^{1-\sigma}} Y_k \tag{2}$$

where p_{ijk} is the consumer price in country k for the product produced by the ith firm in country j; Y_K is the total expenditure on domestic as well as foreign manufactured products in country k. The own price elasticity of demand in equation (2) is given by σ and the term Ω_k is the price index of manufactured goods in country k. It is expressed as follows

$$\Omega_k = \left[\sum_{j=1}^{N} \sum_{i=1}^{h} (p_{ijk})^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{3}$$

[29] The utility function is maximised subject to the following budget constraint.

$$\sum_{j=1}^{N} \sum_{i=1}^{h} p_{ijk} x_{ijk} = Y_k$$

$\Omega_k^{\sigma-1} Y_k$ in equation (2) is similar to what Redding and Venables (2002) referred to as "**market capacity**" of country k and it depends on total expenditure in k and on the number of competing firms and their prices summarised in Ω_k. It is on this term that Redding and Venables (2002) developed the concept of market access. They defined market access as a measure of market potential, measuring the export demand each country faces given its geographical position and that of its trading partners.

3.3.3 Production and firm behaviour

To produce the horizontally differentiated manufactured products, a firm uses one unit of a composite factor which consists of labour and capital to produce one unit of the product. Firms vary in production efficiency which is exogenously given and influenced by both public and private factors. Fixed production costs (F) are assumed to be identical across all firms and their presence result in firms facing increasing returns to scale (IRS) from production. These fixed costs are meant to capture entry costs (research and development) and since they are sunk, firms that cover their marginal costs survive and produce (Melitz et al, 2005).

The cost function of the ith firm in the jth country as assumed by Yoshino, (2008) is specified as follows:

$$C_{ij} = F_j + \frac{\omega_j}{\delta_{ij}} \sum_{k=1}^{N} Q_{ijk} \qquad (4)$$

where Q_{ijk} is total output of the firm sold in country k; δ_{ij} indicates firm specific production efficiency level whilst ω_j represent the composite factor price in country j. Firm level production efficiency is affected by domestic business environment like provision of quality infrastructure e.g. electricity, transport and water etc. These may have varying degrees of impact depending on location, sector and alternative sources like ownership of generator or borehole etc. Production efficiency is also affected by individual firm's characteristics like foreign ownership,

firm size[30]and even internet connection.

International trade result in firms incurring additional cost in the form of trade costs. These increase the marginal costs of production for export markets in relation to domestic markets and these extra trade costs are included in trade theories using the concept of iceberg transport costs[31].

Generally, firm level profits are obtained by maximising the difference between total revenue and total costs. Total revenue is given as follows:

Total Revenue (TR_{ij}) of a firm i from sales in country k is given as;

$$TR_{ij} = \sum_{j=1}^{N} p_{ij} x_{ijk} = \left(\frac{p_{ij}}{\Omega_k} \right)^{1-\sigma} Y_k \tag{5}$$

This is after substituting equation (2) into the left hand side of equation (5).
However profit from trade is given as the difference between total revenue and total costs. Assuming that a profit maximizing firm sets an f.o.b. price p_i such that

$$p_{ijk} = p_{ij} T_{jk} \tag{6}$$

$$TR_{ij} \equiv \sum_{j=1}^{N} p_{ijk} \, x_{ijk} \Big/ T_{jk} \,,$$

$$\Pr ofit = \sum_{j=1}^{N} \left(\frac{p_{ijk}}{\Omega_k} \right)^{1-\sigma} Y_k \Big/ T_{jk} - \left(F_j + \frac{\omega_j}{\delta_{ij}} \sum_{k=1}^{N} x_{ijk} \right) \tag{7}$$

[30] See Van Ark and Monnikhorf (1996); Van Biesebroeck (2005); Baldwin et al (2002); Leung et al (2008); Yoshino, (2008) on foreign ownership and firm size. Internet connection affects the efficiency of indirect labour which also spills over to production workers. Efficient communication with suppliers and customers is important for production efficiency

[31] See Giralt and Usategui (1997), Krugman (1991a) Samuelson (1952) and McCann (2003) for more information on iceberg transport costs.

where T_{jk} is an iceberg transport costs factor (T_{jk}>1) if it equals to one then trade is costless. Trade costs or the proportion of output lost through trading is given as T_{jk} -1. Equation (6) states that the selling price of a given variety varies between countries according to transport costs.

According to Dixit and Stiglitz (1977), the firm's profit maximization leads to a producer price with a markup rate of $\frac{\sigma}{\sigma - 1}$ over marginal cost: From the total cost equation (4) marginal costs is equal to $MC_{ij} = \frac{\omega_j}{\sigma_{ij}}$. Multiplying marginal cost by the mark up rate and equating to price p_{ij} and also using (6) we get the following

$$p_{ijk} = \frac{T_{jk}}{\sigma_{ij}} \omega_j \frac{\sigma}{\sigma - 1} \tag{8}$$

Given this, the value of total exports is equal to

$$\sum_{k \neq j}^{N} p_{ijk} \, x_{ijk} / T_{jk} = X_i \tag{9}$$

This is the same total revenue of a firm in country k. Substituting for price (p_{ijk}) and x_{ijk}, we get the following

$$= \sum_{k \neq j}^{N} \frac{p_{ijk}^{-\sigma}}{\Omega_k^{1-\sigma}} Y_k \frac{p_{ijk}}{T_{jk}}$$

$$= \sum_{k \neq j}^{N} \frac{\left[\frac{T_{jk} \omega_j}{\delta_{ij}} \sigma / \sigma - 1 \right]^{1-\sigma}}{\Omega_k^{1-\sigma}} \frac{Y_k}{T_{jk}} \tag{10}$$

This can be re- expressed as follows

$$\sum_{k \neq j}^{N} \frac{Y_k}{\Omega_k^{1-\sigma}} . T_{jk}^{-\sigma} . \delta_{ij}^{\sigma-1} . \omega_j^{1-\sigma} . \left(\frac{\sigma}{\sigma - 1} \right)^{1-\sigma} \tag{11}$$

Let

$$\left(\frac{\sigma}{\sigma - 1} \right)^{1-\sigma} = A \quad (cons \tan t) \tag{11a}$$

$$\sum_{k \neq j}^{N} \frac{Y_k}{\Omega_k^{1-\sigma}} . T_{jk}^{-\sigma} = FMA_i \tag{11b}$$

$$\eta_i = \left(\frac{\omega_i}{\delta_{ij}} \right)^{1-\sigma} \tag{11c}$$

$$X_i = FMA_j . \eta_j . A \qquad \sigma > 1 \tag{12}$$

The above equation (10b) is similar to what Redding and Venables (2001) called foreign market access. Infrastructure quality can influence exports or export participation through their effect on FMA. For example certain aspects of infrastructure quality could influence trade costs and hence T_{jk} in equation (10b). Infrastructure quality could also directly affect the determinants of production efficiency δ_{ij} or even composite factor prices ω_j. Thus poor quality infrastructure affects productivity and hence the prices of factors of production.

For this model to incorporate firm heterogeneity, we need now depart from the representative firm hypothesis and assume that η_i vary between firms and index each firm by *m*. We now replace η_i by η_{im} which still share the same determinants as η_i except that it changes from firm to firm in each country. We assume that η_{im} can be expressed as some log linear combination of firm level controls, some aspects of infrastructure quality as well as unobservable country and sector specific effects summed up in the random error term, such that:

$$\log \eta_{im} = \alpha_0 + \sum_h \alpha_{1h} \Psi_{ih} + \sum_c \alpha_{2c} \Phi_{ick} + \mu_{ik} \quad (13)$$

where Ψ represents infrastructure quality

Φ represents firm level controls

μ is a random error term and m indexes firms

Expressing (12) in logs and then substituting for (13), the **structural equation to be estimated** is therefore of the following form,

$$\log X_{ik} = \beta_0 + \sum_h \beta_{1h} \Psi_{ih} + \sum_c \beta_{2c} \Phi_{ick} + \beta_3 \log FMA_i + \mu_{ik} \quad (14)$$

3.3.4 Export participation Model

The objective of this chapter is to study the impact of infrastructure variable on the probability to export. The main question to answer is: Does the quality of infrastructure affect the likelihood of firms to participate in export markets? Therefore the above equation (14) will be estimated as a Probit model. We will compare our results with those from a related maximum likelihood Tobit model. This will help us ascertain whether infrastructure variables have a significant effect on the probability to export or the amount exported. For export participation, we will use the general Probit model which assumes the following specification:

$$y_i^* = \alpha + \sum_{j=1}^{K} \beta_j X_{ij} + u_i \quad (15)$$

Where α is the common intercept across all firms, X_{ij} is the vector of both firm and non firm specific(external) explanatory variables summarized by $\sum_{j=1}^{K} \beta X_{ij}$ excluding the error term. i = 1...N (the number of firms), j = 1 ...K (the number of explanatory variables) and y_i^* is an unobserved variable that can only be observed in a dichotomous state such that

$$y_i = \begin{cases} 1 & if \ y_i^* > 0 \\ 0 & otherwise \end{cases} \quad (16)$$

In this study the underlying variable y_i^* could be considered as the likelihood or probability of a firm exporting. The explanatory variables in equation (15) include factors that affect export paticipation like infrastructural, geography and firm specific variables.

This methodological objective helps us to depart from the traditional country level analysis and gravity models and employ binary choice models like the Probit as well as the linear probability model (LPM) to examine export participation. We however also examine the infrastructural determinants of export sales by using a censored regression model such as the Tobit as well as the two stage least squares (2SLS). Despite their shortcomings, we use the two stage least squares (2SLS) and LPM to check for the robustness of our results.[32] To summarize, our estimation procedure will be as follows:

We will start by estimating a linear probability model, but because of its shortcomings we will then use the Probit model to cross check the results. The Tobit[33] and 2SLS will be used to examine export intensity.

3.4. Data and variables measurement

The World Bank's Investment Climate Surveys (ICS) on manufacturing sectors from five Sub Saharan African countries namely, South Africa, Tanzania, Uganda, Zambia and Mauritius are the primary source of data used in this study. The surveys in these respective countries were done between the years 2002 and 2005 and the total number of manufacturing establishments covered is 1598[34]. These firms were also drawn from 6 International Standards Industrial Classification (ISIC) industries in 28 towns and cities and the selection of countries was based mainly on availability of comparable data on variables of interest.

[32] The problem with LPM is that of non constant variance resulting in biased standard errors and incorrect hypothesis tests. It can also create predicted probabilities that are not bounded by zero and one.

[33] The problem with the Tobit model is that its coefficients simultaneously measure two different effects: the impact of the corresponding regressor on the probability of entering export markets and the impact of the corresponding regressor on the amount exported (McDonald and Moffitt, 1980)

[34] The data are collected through firm surveys that include a common set of questions for all countries surveyed. The sample is selected by a simple random or stratified random sampling method controlling for size sub sector, geographic distribution based on company registration records or manufacturing census information available from government. The sample size varies ranging from about 100 for small African economies like Lesotho to more than 1000 for big countries like India, China etc.

Although the number of African countries covered by the study is rather small, however, between them, the five reflect the diversity of economies in the Sub-Saharan African region in terms of the level of economic development, export orientation and quality of infrastructure. Thus we have landlocked groups, low and middle income as well as big and small economies. South Africa and Mauritius are countries where the number of manufacturing exporters is relatively high at 60% and 67% respectively. Tanzania and Zambia are in the middle where between a quarter and two-fifths of manufactures are exporters. Uganda represents the other extreme of countries dominated by inward oriented firms where only 19% of them are into exporting (see table 3.1). In terms of transport infrastructure, Mauritius has a high percentage of paved roads (95%) with South Africa, Uganda and Zambia in the middle with an average of 21% of their roads paved. Tanzania on the other extreme has only 9% of its roads paved (WDI, 2007).

The main aim of this research is to examine primarily the role of geography (a proxy for international transport costs) and infrastructural quality in explaining differences in the likelihood to export and export levels in Africa, conditional on certain firm specific characteristics like age, firm size, foreign ownership, internet access and efficiency. Unobservable country level differences will be controlled for by using country dummies.

The residuals from a Cobb Douglas production function were used to measure efficiency thus capturing productivity differentials among firms in these countries. The production function estimated is as follows:

$$y_i = A_i k_i^{\alpha} m_i^{\beta} l_i^{\delta} \qquad (16)$$

Where y is output per unit of labour, k is capital per unit of labour, m is material inputs per unit of labour and l is indirect inputs per unit of labour. A is a firm specific parameter to measure technical efficiency. In order to convert these input values into common currency for estimation purposes, an average real effective exchange rate was used for the years in which the surveys were done in each of the study countries. The exchange rate data is from the World Bank's World Development Indicators.

The geography variable, foreign market access (FMA) is used as a proxy for international transport costs and is measured at city level to get international distance. This is because some studies have shown that there is a correlation between transport costs and distance and that a one per cent increase in distance, increases transport costs by approximately 0.25 per cent (Zarzoso et al 2003). The importance of international distance or international transport costs is also motivated by the fact that most African countries' traditional export markets are in the EU and USA which are in most cases, especially for southern and eastern Africa, in excess of 3000km. This distance is calculated from the nearest port of each city (in the study questionnaire) to the capital city of the respective African country's major trading partner using the travel distance calculator, MapCrow. This calculator estimates total air distance between any world cities and displays map coordinates for each location. Data on major trading partner is obtainable from International Trade Centre (ITC) statistics.

The reason why we prefer international distance calculated from the nearest port is to avoid problems of endogeneity associated with local city level distance[35] and to differentiate it from a closely related variable domestic transport costs which is also used for estimation. This differentiation will help us ascertain which of these two costs matter most to exporters. Therefore FMA captures the fact that African firms' sea ports are located further away from wealthier and denser potential export markets and suppliers, a factor that increases trade costs and may also negatively affect the probability to export or even the ability to diversify export markets. Another alternative indicator for FMA or international transport costs used in this study is the ratio calculated at sectoral level using cost, insurance and freight (cif) as well as free on board (fob) values for traded commodities falling in a particular sector. This data is available from UNComtrade databases. To calculate this value we compare the export and import values of the same commodity exchanged by two trading partners in a given year. We took advantage of the fact that importing countries normally record their imports using cif values whilst exporting countries report the export of the same commodity in their records using fob values. Importation and exportation values of commodities from a given sector in this database are selected and

[35] Using city level distance to proxy FMA means that the variable could be endogenous as exporting firms could be assumed to locate closer to ports or export hubs.

compared using the same identification code. Thus comparison is done using the same commodity classification code (SITC, ISIC, HS, and BEC)[36], same quantity, same net weight, same currency valuation and traded or recorded in the same year. We use the cif/fob ratio of any commodity in a given sector as a proxy for the international transport costs of transporting goods in that sector. The UNcomtrade data query allows us to easily calculate the cif/fob ratio using these specifications.

The quality of infrastructural variables like telecommunication, domestic transport, electricity and customs used in this study was proxied using firm level perception indicators obtained from the Investment Climate Surveys section on business environment constraints. In these surveys each firm was asked to judge the severity of selected infrastructure problems on a five-point scale[37]. To separate domestic transport costs from international transport costs (proxied by FMA and sectoral cif/fob), the calculation of domestic transport costs was done based on perception indicators and using firms that are not exporting. The quality of customs, telecommunication, water and electricity infrastructure was also alternatively estimated using variables like, average number of days to clear exports and imports at customs, number of hours per day or days per month without power, water and telephone connection[38]. To minimise problems of missing observations in these variable we used regional or city level averages. Thus we calculated the average number of hours or days firms go without electricity or water in a particular city. This also corrects for the endogeneity of customs transit days, as number of days it takes to clear goods may depend on the experience of the enterprise managers in dealing with custom officials. The variation of these infrastructure indicators across regions in each country may reflect differences in local governance and differences in the experience of enterprise managers in dealing with providers of infrastructure services.

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[36] Standard International Trade Classification (SITC), International Standards Industrial Classification (ISIC), Harmonized System (HS) and Broad Economic Categories (BEC). In measuring this variable we used SITC but in cases where the product was not available under the SITC code we alternatively used the ISIC coded products.

[37] The scale is: 0 = no obstacle; 1 = minor obstacle; 2 = moderate obstacle; 3 = major obstacle; 4 = very severe obstacle.

[38] These are firm level averages and so vary at establishment level.

Since a high number of firms own generators to supplement power from the public grid, the regressions include an interaction term between a dummy for generator ownership and electricity indicator variable. This interaction variable is meant to capture the fact that firms with generators may be are able to minimise the negative impact of power outages on their operations and hence on exporting. Statistics on table 3.1 below also show that firms' export participation rate and export intensity is higher among firms with generators than those without. The assumption on these variables is that quality infrastructure is important in enhancing productivity, competitiveness and hence export-participation. Thus high values of perception indicators, high number of clearing days and many hours without infrastructural services as well as high percentage of output lost due to power outages indicate poor infrastructure quality.

Dummies were also created to capture the unobserved country and sector heterogeneity. This is because some products might be more difficult to transport or may use less electricity than others whilst in some cases enterprises located in countries with good institutions and economic policies might find it easier to export than those from poorer institutional and policy settings. These dummies could also capture geographic characteristics of the countries and sectoral comparative advantage based on the countries' factor end owments differences relative to their trading partners (Yoshino. 2008). To avoid running into the dummy variable trap problem, we exclude the constant in all our estimations and where necessary, we specify the reference sector or country. The manufacturing sectors covered include textile and garment; plastic, paper and packaging; construction and metal; chemical and pharmacy; wood and furniture. The complete list of variables used in this study is presented in table A3.1 appendix.

3.5 Descriptive analysis of data

3.5.1 Firm specific controls.

Of the 1598 establishments covered in this chapter, a third of them are small with a work force of between 10 to 50 employees and another third is composed of large firms with more than a 100 workers and the rest are spread out between medium and micro sized firms. The statistics on Table 3.5 also corroborate the statistics on Table 3.1 in showing that exporters both at country and sectoral level are relatively larger in size, with a country level average of 302 permanent employees compared to 112 for inward oriented firms.

It also appears that the export participation rate (number of firms exporting) as well as export intensity (percentage of output exported) is high amongst large firms. Thus these statistics show that of the 526 large firms 70% of them export and these firms export roughly 25% of their output compared to an export participation rate and export intensity of 29% and 11% respectively among small firms. This corroborates the argument in the literature that size does matter in exporting[39]. The other feature of these manufacturing firms in these five African countries is that a large number of them are in the food and agricultural sector, textile and garments as well as plastic, paper and packaging. This pattern is replicated even at country level where Zambia and Uganda have at least 40% of their firms in the food and agriculture sector whilst South Africa and Tanzania have roughly 30% with Mauritius having the least 20%. (see Table 3.3 below). The sector with the least population of firms in all these countries (except Tanzania) is that of wood and furniture.

It is also in the food and agriculture sector as well as textile and garment that we have more firms exporting and also a relatively high percentage of output exported (see Table 3.4 for more). Statistics show that although only 16% of firms in the textile and garments sectors are involved in exporting compared to 23% in food and agriculture, the textile firms export an average of 60% of output, 1.2 times more than firms in the food and agricultural sector. Relatively high export participation rate coupled with high export intensity in the textile and garment as well as food and agriculture sectors means that policies and incentives that have a positive impact on the entrance and productivity of firms in these sectors will most likely have a large impact on exports. Food and agriculture as well textile and garment are the two sectors that are relatively larger in size than other sectors with an average employment level of more than 100 workers. This implies that these sectors are composed mostly of large sized firms. It is also in these sectors that we have high export participation and export intensity. Zambia is the only country with firms in the plastic, paper and packaging sector that do not engage in exporting at all. These statistics also show that non exporters have a high proportion of small sized firms and the sector with highest number of small size non exporting firms is wood and furniture. This sector has non exporting firms whose size is about ten times less than average size of firms that are into

[39] See Rankin et al, 2006; Soderbom and Teal, 2004.

exporting.

Table 3.1 Sample average firm level exports (all firms)

	# of firm	Exporting participation (% of firms)	Exports intensity (%)	% foreign Equity	Own Generator % firms	Own Borehole % firms	100% Foreign Owned (% firms)
Countries							
South Africa (2003)	603	60.17	13.67	15.13	9.53	0	11.37
Tanzania (2003)	276	27.72	12.30	15.77	55.35	34.70	7.00
Uganda (2003)	300	19.40	9.86	20.74	36.00	13.45	15.72
Zambia (2002)	207	40.58	16.21	24.37	38.16	59.90	14.98
Mauritius (2005)	212	66.83	38.90	8.90	39.22	13.37	5.42
Sectors							
Textile and Garments	180	16.2	61.8	11.43	25.99	21.26	6.21
Food and agric	395	23.4	47.5	20.94	51.15	42.68	12.76
Chemical_pharmacy	138	9.80	16.8	23.94	31.39	40.96	16.91
Plapackaging	193	9.90	19.4	14.12	22.40	20.21	11.40
Wood and furniture	111	3.90	23.3	6.49	20.91	18.82	3.60
Construction and metal	139	5.40	14.4	15.82	36.69	28.71	10.14
Firm characteristics							
Own generator	475	15.39	24.69	26.27	-	45.76	15.47
Foreign ownership	347	14.39	26.68	79.81	47.35	43.12	53.45
Internet	900	34.98	22.79	22.44	35.04	29.55	14.86
Firm sizes							
Micro	171	5.26	1.51	8.65	14.04	7.10	7.60
Small	546	29.85	11.41	10.87	28.09	19.94	7.27
Medium	320	53.13	17.26	15.66	29.93	37.58	10.88
Large	561	70.23	25.33	26.49	37.69	54.88	17.04

Source: Author's own calculation based on World Bank's Investment Climate Surveys
Micro if firm size<10; Small if firm size<50 &>=10; Medium if firm size<100 &>=50; Large if firm size>=100

Exporters also appear to be common destinations of foreign investment than non exporters. Table 3.4 also shows that a high percentage of firms that have foreign ownership and export are found amongst larger firms. In all the countries and sectors, the exporting industry has a higher number of firms with foreign equity participation than domestic oriented firms. Statistics on table 3.1 above show that the average amount foreign invested in these firms is high in Zambia (24%) followed by Uganda with about 21% with Mauritius having the least amount foreign invested of 9%. At sectoral level firms with the largest share of foreign ownership are found in the food and agriculture as well as chemical and pharmacy. Wood and furniture firms have the lowest share of foreign ownership. Generally large firms are more attractive to foreign investors than small

firms. This is because statistics show that 27% of equity of large firms is owned by foreign multinationals and this is about four times larger than the equity invested in small firms. Uganda and Zambia are the two countries with larger number of firms (15%) with 100% foreign ownership whilst Mauritius has the least (5%). The chemical and pharmacy, food and agriculture as well as plastic paper and packaging have between 11% to 17% of firms with 100% foreign ownership with the wood and furniture being the least at 4%.

Similarly, a large proportion of exporting firms is generally older and uses the internet to interact with customers and suppliers. The average age of exporting firms in our sample is 21 compared to 19 for non exporters. Thus the age difference between exporters and non exporters is not very large and this explains why some studies found that age does not matter in exporting (see Clarke, 2003). Statistics also show that larger firms are older than small sized firms even though there is no significant age difference between large exporters and non exporters. These statistics also show that internet access is relatively poor in Zambia with only 36% of firms connected or having a website compared to 96% in Mauritius and at least 70% in the other countries. Firms that uses internet more than others are found in the food and agriculture as well as textile and garment sectors with the wood and furniture sector having the least connected firms. Internet connections are higher among exporters and it seems a high proportion of large firms have a website or email to interact with clients or suppliers than smaller firms.

With respect to infrastructure, perception indicators show that firms that have complained about infrastructure problems as an obstacle to their operations are mostly in the exporting sector (see table A3.3 appendix). Communications infrastructure appears to be a serious problem to exporting firms in Zambia while domestic transport facilities create problems for exporters in Uganda. However electricity and customs facilities, appear to present more problems to exporting firms in Tanzania and Uganda. South Africa and Mauritius appear to have relatively better infrastructure facilities because exporting firms in these countries did not complain much about infrastructure as an obstacle. The pattern is however similar when using the number of hours per day firms go without infrastructure services. Uganda, Tanzania and Mauritius are the countries where firms go for long hours a day without power (see table A3.2 appendix). In the case of telephone and water, firms in Zambia, Tanzania and Uganda appear to be the ones

seriously affected as they also go for long hours without these services. Statistics on table A3.2 show that a typical firm in Zambia and Uganda go for about 13 hours a day without a telephone connection compared to only 4 hours in South Africa. In the case of water firms in Uganda are hard hit as they endure an average of 20 hours without water compared to 3 hours in South Africa. The percentage of output lost due to power outages also appear to be high in Tanzania and Uganda. An average of 10% is lost in Tanzania whilst 6% is lost in Uganda. The situation is a little different when looking at export and import transit days. Days to clear imports at the border are relatively higher in Tanzania, Uganda and South Africa with an average of 19, 10 and 7 days respectively. But in the case of days to export, South Africa tops the list. It takes about 13 days to clear exports in South Africa compared to 12 days in Tanzania.

The above statistics on these infrastructure indicators are corroborated by statistics on generator and borehole ownership in these countries. At country level, Tanzanian firms have most generators (55%) followed by Mauritius and Zambia at 39% and the least being South African firms (9%). The food and agriculture sector has the highest number of firms with generators (51%) followed by the construction and metals as well as chemical and pharmacy at 37% and 31% respectively. Large firms have more generators (39%) than smaller firms (28%). However it seems owning a generator helps these firms to export. The statistics show that firms with generators to alleviate power outage problems export about 25% of their output compared to firms without generators (13%).

In addition to owning generators, firms in these countries also have boreholes to minimize the problems of water shortages or disconnections. About 60% of firms in Zambia have boreholes followed by 35% in Tanzania with South Africa being the only country with no single firm owning a borehole. This shows that there are no serious water problems in South Africa to require firms to look for alternative sources of water. At sectoral level about two fifths of firms in food and agriculture as well as chemical and pharmacy own a borehole compared to about a fifth in other sectors. As is the case with generator ownership, a high number of firms owning boreholes are also large in size.

3.5.2 Tests for correlation

In order to assess the extent to which the variables we are using in this study are correlated we constructed a correlation matrix. The idea here is to test the nature of relationship between the explanatory variables particularly those that represent the quality of infrastructure. In the case of infrastructure we want to see whether there is a correlation between perception indicators and the number of days and hours without infrastructure services. A positive correlation between these variables will partly justify the use of perception indicators as alternative measures of infrastructure quality. Our results are shown in Table 3.2 below.

Though not high, there seem to be a positive correlation between variables which we use in the study as proxies for international transport costs. Thus our distance variable, FMA is positively and significantly correlated with transport costs variable measured using cif and fob values. This suggests that an increase in distance also increases transport costs though not on a one to one basis. This correlation coefficient partly corroborates the finding by Zarzosso, (2003) that a 1% increase in distance increases transport costs by about 0.25% whilst Clark et al, (2004) argued that doubling distance generates an 18% increase in transport costs.

The correlation matrix also shows that there is a positive and significant relationship between customs perception index and export and import transit days. This suggests that the formation of perceptions by enterprise managers is partly related to the time that it takes to process tradable goods at the border. The same positive pattern is replicated between electricity perception indicators and number of days and hours without power. Days without power appear to be highly correlated with the electricity perception indicator, suggesting that they may be the basis of firms' perceptions on the quality of electricity infrastructure. However in the case of telecommunications indicator and number of days or hours without a telephone connection, the relationship is positive but not significant. This is the case even when correlating internet dummy with the telecommunication index. This could be due to the fact that the telecommunication index is a composite variable whose value is not based on telephone problems alone but on the overall quality of internet, telephone and cellular phone services. Additionally, being connected to the internet as represented by the internet dummy used in this study does not suggest anything about the quality of internet services in these countries and therefore there should be no

significant correlation between the dummy and the telecommunications indicator. The positive and significant correlation between transport, customs and electricity indicators mean that it is possible to interchangeably use them in our estimation models.

Table 3.2: Correlation Matrix**

	FMA	CIF/F	INTERN	TELCO	ELECT	TRANS	CUSTIN	POW(H)	WAT(H)	TEL(H)	CUSTD	EXPD	IMPD	POW(D)	WAT(D)	TEL(D)
FMA	1.00															
CIF/F	0.42*	1.00														
INTERN	0.36*	-0.07	1.00													
TELCO	-0.25	-0.13	-0.18*	1.00												
ELCT	-0.74*	0.21*	-0.26*	0.49*	1.00											
TRANS	-0.49*	0.22*	-0.20	0.46*	0.54	1.00										
CUSTIN	-0.18	0.12	0.02	0.16	0.34*	0.23	1.00									
POW(H)	-0.34*	0.29*	-0.14	0.02	0.43*	0.17*	0.12	1.00								
WAT(H)	-0.42*	0.34*	-0.09	0.11	0.34	0.27	0.32	0.46	1.00							
TEL(H)	-0.65*	0.66*	-0.23	0.09*	0.36*	0.26*	-0.02	0.19	0.29*	1.00						
CUSTD	0.07	0.03	0.01	-0.09*	0.16	0.03*	-0.14	0.08	-0.25*	-0.25	1.00					
EXPD	0.62*	-0.10	0.17	-0.30	-0.26	-0.27	0.39*	-0.05	-0.35*	-0.45	0.69	1.00				
IMPD	-0.28	0.09	-0.09	0.04	0.36	0.19	0.47*	0.13	-0.12	-0.03	**0.90***	0.31	1.00			
POW(D)	-0.78	0.18*	-0.24	0.37	**0.81***	0.43*	0.24*	0.25*	0.16	0.24*	0.31*	-0.16	0.51	1.00		
WAT(D)	-0.22*	-0.03	-0.01	0.18	0.50*	0.08*	0.30	0.09	0.13*	-0.18	0.15*	0.01	0.18	0.63*	1.00	
TEL(D)	-0.25*	-0.01	-0.19*	0.33*	0.30	0.19*	0.07*	-0.01	0.22	0.15	-0.13	-0.29*	0.02	0.26*	0.34*	1.00

NB. * means significant at 5% **FMA = Foreign market access; CIF/F =Cost insurance and freight and free on board values; INTERN= Internet; TELCO =Telecoms index; ELCT=Electricity index; TRANS=Transport index; CUSTIN=Customs index; POW(H)=Hrs without power; WAT(H)=Hrs without water; TEL(H)=Hrs without a telephone; EXPD= days to export; IMPD=days to import; CUSTD= (EXPD + IMPD)/ 2; POW(D), WAT(D), TEL(D)= days without power, water and a telephone per month respectively.

Table 3.3 Distribution of firms among sectors in each country (Export participation rates)

	All countries (%) (1598)		South Africa (%) (603)		Zambia (%) (207)		Tanzania (%) (276)		Uganda (%) (300)		Mauritius (%) (212)	
	All firms	exporters	All firms	exporters	All firms	exporters	All firms	exporter	All firms	exporters	All firms	exporter
Textile_Garment	11.4	16.2	18.2	61.2	5.80	83.3	11.2	38.7	5.00	6.70	36.0	46.1
Food_agric	24.9	23.4	28.4	43.6	44.0	47.3	29.3	49.4	40.7	64.4	19.2	14.9
Chemical_pharmarcy	8.70	9.80	8.90	60.4	10.1	38.1	9.80	33.3	6.00	38.9	9.40	10.6
Plapackaging	12.2	9.90	23.0	46.2	6.30	000	9.10	16.0	7.70	13.0	11.3	7.80
Woodfurniture	7.00	3.90	4.00	41.7	2.90	50.0	23.6	15.4	2.30	14.3	14.4	2.80
Construction_metal	8.80	5.40	14.6	62.1	16.4	14.7	14.5	10.0	20.3	9.80	5.90	3.60

Source: Author's own computations based on World Bank's Investment Climate Surveys
Note: numbers in brackets represent the total number of firms in each country. All firms represent the percentage of firms in each country that belong to any of the sectors.

Table 3.4 Distribution of firms among sectors in each country (Export intensity)

	All countries (%) (1598)		South Africa (%) (603)		Zambia (%) (207)		Tanzania (%) (276)		Uganda (%) (300)		Mauritius (%) (212)	
	All firms	exporters	All firms	exporters	All firms	exporters	All firms	exporter	All firms	exporters	All firms	exporter
Textile_Garment	40.1	61.8	17.4	28.4	45.7	54.8	21.2	54.7	6.33	95.0	71.0	80.3
Food_agric	19.8	47.5	8.62	19.8	18.9	40.0	28.9	61.1	20.9	68.4	18.3	36.6
Chemical_pharmarcy	8.47	16.8	10.1	17.2	2.79	7.31	4.32	12.9	10.7	27.4	14.5	18.6
Plapackaging	7.12	19.4	9.01	18.0	0.00	-	4.81	24.8	0.97	4.83	14.6	30.5
Woodfurniture	5.40	23.3	4.75	11.4	32.4	64.8	2.05	18.1	1.71	12.0	15.1	34.0
Construction_metal	4.04	14.4	9.16	15.1	3.44	15.5	0.87	8.75	1.73	13.8	6.50	15.6

Source: Author's own computations based on World Bank's Investment Climate Surveys
Export intensity is the average amount exported by firms in these sectors.

Table 3.5 Firm level variables averages by country and sectors

	Owner: Male (% of firms)	Size		Foreign ownership (% of firms)		Age		TFP/ Productivity average		Internet access (% of firms)	
		Non Exporters	Exporter	Non Exporters	Exporter	Non Exporter	Exporter	Non Exporters	Exporter	Non exporter	Exporter
South Africa	90.86	159	465	11.0	26.0	20	29	-0.082	0.049	58.0	79.0
Zambia	85.40	108	397	23.0	39.0	19	20	-0.804	-0.756	21.0	36.0
Tanzania	92.27	185	219	15.0	42.0	19	17	0.712	0.639	38.0	80.0
Uganda	94.61	41	211	13.0	64.0	12	17	0.929	1.184	20.0	71.0
Mauritius	88.27	66	216	6.0	21.0	27	24	0.489	0.648	86.0	96.0
Textile_Garment	72.77	101	446	6.0	10.3	19	23	0.338	0.153	7.42	17.3
Food and agric	78.95	142	433	23.3	32.7	15	24	0.246	0.169	20.8	20.9
Chemical_pharmarcy	74.13	84	164	15.5	10.3	18	22	0.314	0.154	10.7	10.3
Plapackaging	79.87	63	185	15.5	6.73	20	21	0.152	0.498	20.8	10.8
Woodfurniture	99.60	39	314	2.59	3.14	18	19	0.289	0.327	7.72	2.90
Construction_metal	82.21	50	237	15.5	4.93	19	34	0.489	0.355	10.7	5.41
Firm sizes											
Small	90.05	22	27	11.5	21.5	16	15	0.248	0.273	41.0	65.0
Medium	90.63	69	69	18.0	21.0	21	21	-0.100	0.147	49.0	75.0
Large	91.06	373	651	21.0	39.0	27	31	-0.148	0.061	61.0	83.0

Source: Author's own computations based on World Bank's Investment Climate Surveys

3.5.3 Summary

These descriptive statistics show that exporters are larger in size, older, uses internet more, are attractive to foreign investors and are more likely to own boreholes and generators as well as complain more about infrastructure problems than non exporters. These statistics also show that most of the large firms are owned by males.

3.6 Geographical and market diversification of exports

Diversification of export markets is also one avenue through which African countries can achieve high export growth and export participation. Diversification of exports can take the form of: (i) diversifying the range of markets into which existing products are sold (geographical diversification); (ii) increasing the range of products sold in a particular market (horizontal diversification) and moving out of primary into manufactured exports so as to benefit from strong spillover effects referred to as vertical diversification (Lehmann and Herzer, 2004). Brenton et al, (2007) also argue that export diversification is a positive trade objective and important for sustaining economic growth. Diversification makes countries less vulnerable to adverse terms of trade shocks by stabilising export revenues and also encourages broader economic integration (Ghosh and Ostry, 1994).

Export diversification studies which decomposed export growth over time found that growth of the intensive as well as extensive margins have been the driving forces behind high export expansion (Brenton et al, 2007)[40]. Evenett and Venables (2002) decomposed export growth of 23 developing countries (to 92 importers) over 1970 to 1997 for around 200 product categories and found that selling existing products to new markets accounted for one third of exports growth for their smaller set of developing countries. Alberto and Martha (2008) also investigated geographic and product diversification patterns of a cross country of developing nations between 1990 and 2005. Using gravity equations they found that geographical diversification is more important than product diversification

[40] Intensive margins refers to horizontal diversification whilst extensive is geographical diversification.

especially for developing nations. They argued that reducing trade costs and trading with countries in the North have positive impacts on export diversification for developing countries. Thus good transport infrastructure (roads, rails, seaports and airports), effective telecommunication systems as well as efficient customs procedures which are important in reducing trade costs, promote market diversification and thus foster economic or regional integration.

Diversification of markets is also important to exporters in that it increases export sales and reduces a country's dependence on a small number of export markets and hence the vulnerability to shocks within destination countries. We try to capture the degree of market diversification in this section using the concept of number of equivalent markets, an approach that was developed by the International Trades Centre. This approach or formula was basically derived from the Herfindahl index[41] by Adelman (1969) when he suggested interpreting an inverted Herfindahl index as a "numbers equivalent". In order to capture the degree of market diversification, the equivalent number (NE) formula is used and it distinguishes for each country, the number of partner countries weighed according to their importance as follows:

[41] Adelman (1969) suggested interpreting an inverted Herfindahl index as a "numbers equivalent."The index approaches zero in the competitive case with a large number of small firms and equals one in the monopoly case, so its inverse approaches infinity in the competitive case and one in the monopoly. In our context, the inverse may be thought of as giving the number of equivalent sized markets that would provide a degree of competition equivalent to that actually observed in the market share data. The index captures inequality in market share by summing the square of each country's market share. For example if a country has two markets and having 50% market share in each, the Herfindahl index is $0.50^2 + 0.50^2 = 1/2$. Inverting this gives 2 (effective markets). Similarly the index for three equal sized markets in three countries is $3 \times 0.33^3 = 1/3$, so inversion gives 3 effective markets. But if there were 3 markets with the largest serving 2/3 of the country's exports and the other two each serving 1/6 of the country's exports, the Herfindahl index would be 1/2, which also translates into 2 effective markets. Thus the number of effective markets has a more intuitive interpretation than the Herfindahl index.

$$NE_i^t = \frac{1}{\sum_{j=1}^{p} \left(X_{ij\,cl}^t / X_{i\,cl}^t \right)^2} \qquad (17)$$

$X_{ij\,cl}^t$ = *country i exports of all products belonging to cluster cl to country j in year t*

$X_{i\,cl}^t$ = *country i total exports of all products belonging to the cluster cl*

$X_{ij\,cl}^t / X_{i\,cl}^t$ = *the share of market j in country i total exports of products belonging to the cluster cl*

The International Trades Centre (ITC) calculates the number of equivalent markets for a number of products exported by countries using the above formula. Since in this study our products are classified into six sectors, we then grouped all the products and the associated number of equivalent markets into these categories and then calculated an average NE value for each sector. The ITC calculates the NE value for a number of products exported by each country and what we did was to pick those products and associated NE values from the ITC database for each country and related them to the six sectors that we are working with. To calculate a specific NE value for each sector we calculated the average NE value for all the products in that particular sector. The use of these ITC values is necessitated by the fact that it is not possible to obtain this kind of information from the World Bank survey data on some of the study countries. Since this was not one of the main variables that determined the selection of study countries, we decided to fill the gap by using ITC data.

Using Table 3.6 below, the average number of equivalent markets is high in South Africa (14.9), partly reflecting its level of development, economic size as well as relatively large number of developed ports. South Africa is home to about six major commercial ports compared to three in Tanzania and only one in Mauritius with the remaining countries Zambia and Uganda being landlocked. Thus if availability of close ports is important in exporting this could explain why the number of equivalent markets is relatively high in South Arica compared to other countries. There are about 14.9 equivalent markets for each commodity sector in South Africa compared to about three (3) in landlocked

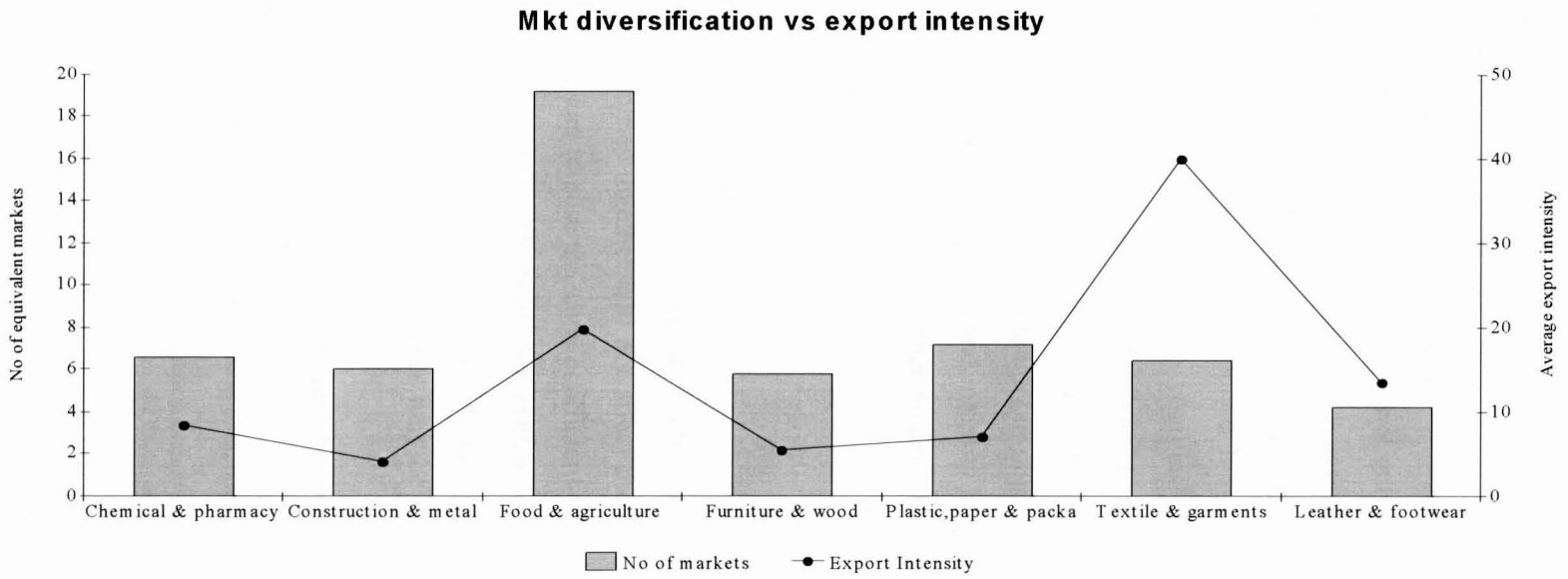
countries in our study sample (see Table 3.6 below). The geographical orientation of exports also varies among sectors as well, generally reflecting the comparative advantage of these African countries *vis a vis* the rest of the world. These African countries export food and agriculture related products to a relatively large number of markets. This is followed by the plastic, paper and packaging sector with about 7.2 equivalent markets compared to 4.2 for firms in the least diversified leather and footwear sector. However, although food and agriculture firms serve a large number of markets, the average amount exported in the sector is far much lower than in the textile and garments sector (see Fig 3.1). This means that to achieve high export revenues, we need to complement diversification gains with high export intensity.

Table 3.6 Market diversification (No of equivalent markets) by country and sector

Country	Average No of Markets Per commodity sector	Sectors	Average No of Markets
Tanzania	5.0	Wood and Furniture	5.8
South Africa	14.9	Textile and Garments	6.4
Mauritius	4.6	Leather and footwear	4.2
Uganda	3.2	Construction and metal	6.0
Zambia	3.0	Food and agriculture	19.2
		Chemical and pharmacy	6.6
		Plastic, paper and packaging	7.2

Source: International Trades Centre (ITC): Trade Competitiveness Map (Trade performance Index)

Fig 3.1 Relationship between market diversification and export intensity



3.7 Econometric issues

The dependent variable in our models is either the percentage exported or a dummy variable taking a value of one when the firm is exporting and zero otherwise. Given this measurement it is clear that we are dealing with a censored dependent variable. This is not only in the sense that percentage exported cannot be negative but a firm that is not exporting is assumed to be a corner solution to choice based on the profitability of exports[42] (Elbadawi et al, 2006). The other source of censoring in our data comes from the fact that percentage exported lies between zero and hundred whilst export participation is represented by a dummy resulting in the dependent variable being censored from both below and above. This makes Ordinary Least Squares (OLS) estimates biased and to correct this we estimate by maximum likelihood a Probit function of equation (14) as presented under the theoretical framework. Although our objective is to analyze the impact of infrastructure quality on both export participation and intensity by using the Probit and Tobit models, we will nonetheless supplement these with other models that make different estimation assumptions to check for robustness[43].

3.7.1 Country results and the pooling assumption

Since we are using country cross section analysis to estimate our coefficients, it is therefore important to test whether pooling these countries together will not affect the reliability of our estimates. Pooling basically assumes that we can impose the same coefficient on each country or industry for the same regressor, i.e that on average the effects of each explanatory variable on the dependent variable is the same across countries (Becker and Hall, 2004). However, if the size of the true effects varies considerably between countries, the estimates may be misleading in two

[42] Melitz (2003) in his new trade theoretic threshold model of exporting of this kind argued that firms that have passed the profitability threshold export on scales that increase monotonically with profitability. While the profitability can thus be inferred from the scale of exports for exporters, the dispersion of the potential profitability cannot be observed from their exporting status. So what is being censored in our data is thus not the scale of exports but rather the profitability of exporting for non exporters.

[43] In most cases when it comes to exporting, the binary models like Logit and Probit are more informative than Tobit in that they clearly distinguish the impact of independent variables on export participation. The Tobit model however does not clearly differentiates between export participation and export intensity.

ways. First, the pooled coefficients will not be the average but rather be biased towards zero or smaller value (Pesaran and Smith, 1995). Even for relatively small parameter heterogeneity the bias may be significant (Robertson and Symons, 1992). Second, the pooled coefficients will not provide a reliable estimate of the effect of a change in the explanatory variables on exports in different cross section members (Becker and Hall, 2004). Thus if the micro units underlying the aggregated data are heterogeneous, their individual characteristics can differ significantly from those of the aggregate data (Granger, 1980, Lewbel, 1992 and 1994), and policy inference based on the aggregate evidence could be misleading. Becker and Pain (2003) test the pooling assumption using principal components analysis whilst Franzese (2003) as well as Beck and Katz (2001) propose using what they refer to as "cross validated standard errors". Stanig, (2005) suggest adding interaction terms between country dummies and explanatory variables and then testing their significance[44]. However since carrying out pooling tests is not the main focus of our study, we will use a simple test. We check whether the pooled and country by country regression coefficients are significantly different (Stanig, 2005).

[44] The main shortcoming of this procedure is that the estimates of the country-specific slopes are less efficient than the pooled estimates, even if they are not biased in the case in which the coefficient is not constant across countries (Stanig, 2005).

Table 3.7: Summary of Country level results: Tobit Model (using hours and percentage exported)[aaa]

Variables	South Africa	Zambia	Uganda	Mauritius
Sector dummies	Yes	Yes	Yes	Yes
Foreign ownership	6.222	1.436	-26.529	5.654
	(3.423)*	(0.649)**	(36.845)	(1.9479)***
Internet	7.527	18.308	51.511	48.787
	(4.174)*	(11.646)	(18.475)***	(24.307)**
Efficiency	4.6733	9.7013	4.5066	5.5763
	(1.3074)***	(4.6133)**	(2.4394)*	(1.0303)***
Log age	0.095	-2.911	-1.825	-17.455
	(1.559)	(4.797)	(8.601)	(7.496)**
Log size	3.875	15.222	12.531	21.290
	(1.550)**	(4.713)***	(6.159)**	(5.614)***
Sectoral (cif/fob)	-1.559	-64.864	93.980	-41.535
	(0.501)*	(34.538)*	(38.041)**	(33.777)
Power outages(hrs)	-4.270	-13.616	-1.535	-1.614
	(1.843)**	(6.813)*	(5.228)	(0.666)**
Water probs (hrs)	2.913	-4.252	-3.360	0.521
	(1.257)**	(1.413)***	(1.608)**	(0.191)***
Telephone prob (hrs)	1.734	-0.528	-3.855	-0.963
	(1.585)	(1.665)	(2.132)*	(0.850)
Efficiency x electricity	-0.4638	-0.0352	0.0582	0.4178
	(1.9361)	(0.1403)	(0.1648)	(0.1470)
Efficiency x telephone	-0.2406	-0.1517	-0.3768	-0.9872
	(0.5129)	(0.1070)	(0.4086)	(0.3835)*
Efficiency x water	-0.7255	-0.0473	-0.9065	-0.1665
	(0.0149)	(0.2819)	(0.8484)	(0.3933)
Outages x generator	2.118	6.951	4.343	-0.746
	(1.111)*	(1.976)***	(1.695)**	(0.997)
Ave customs(days)	-2.577	-5.584	-19.981	6.783
	(0.712)**	(3.989)*	(13.954)	(2.886)**
Constant	-7.454	135.653	48.293	-175.169
	(17.089)	(100.677)	(191.164)	(50.409)
Observations	259	129	181	125

Absolute values of standard errors in parenthesis
Significant at 5% level; * significant at 1% level; * significant at 10% level
[aaa] excluded Tanzania because the sample size was very small with 83 observations.

Country level results presented on Table 3.7 above show that foreign ownership variable is significant in all the countries except Uganda. Thus the transference of skills and technologies, accessibility to overseas business networks and marketing channels as well as affordable lines of credit are very important for firms in these countries to boost exports. The insignificance of this variable in Uganda could partly explain why export participations and export intensity levels are comparatively low. Only less than 20% of firms export and the proportion of output sold in foreign markets is 9% compared to an average of 50% and 20% respectively for the other four

countries. Other firm specific variables like internet dummy, firm size and efficiency are generally significant determinants of exports in these countries. However the internet dummy is insignificant in Zambia and this is probably explained by the low internet connection rate of 21% among non exporters and 36% in outward oriented enterprises. Thus being large in size and productive is important for firms that want to grow their exports.

Results on infrastructure indicators suggest that electricity problems have a significant negative relationship on exports in South Africa, Mauritius and Zambia whilst water problems matter only in Zambia and Uganda. Having a generator enables firms to minimize the negative effects of power outages on exports in all the countries. However telephone problems have a negative and significant impact only in Uganda. The international transport costs variable estimated by using cif and fob values has a negative effect on exporting but only significant in Zambia and South Africa. Thus poor foreign market access and supplier access makes it expensive for firms to acquire inputs that they need to produce competitive exports. Efficiency-infrastructure interaction variables are all insignificant in all countries even though they carry the expected sign. This means that being efficient in a place where infrastructure quality is poor has a weak negative effect on the amount firms are able to export. Lastly, the customs variable calculated by taking the average of imports and exports transit days appear to be significant with a negative sign in South Africa and Zambia only.

These results basically show that the pattern of significance of these explanatory variables is generally the same across all the four countries and using Stanig (2005) basic rule of thumb should make it possible for us to pool the countries together.

3.7.2 Endogeneity tests

After having pooled the data, the cross sectional results using OLS, Probit and the Tobit models are shown in table 3.8. These results from these first regressions indicate that electricity, transport and international distance (FMA) variables are statistically insignificant whilst telecommunication and customs variables are statistically significant but with wrong expected signs. They also show foreign ownership, firm size and internet connection to be significant whilst age and efficiency are insignificant. It would be erroneous to draw any definitive

conclusions from these results since the estimates could be biased due to possible endogeneity of all perception based infrastructure indicators.

Table 3.8 Regressions using OLS and Probit Models (Export participation Models)

	OLS (1)	OLS (2)	Probit by maximum likelihood (3)	Probit by maximum likelihood (4)	Probit by maximum likelihood (5)
Sectoral dummies	Yes	Yes	Yes	Yes	Yes
Foreign ownership		5.0752		10.0473	
		(2.1821)**		(5.1761)*	
Log age		2.2791		-2.7622	
		(0.9535)***		(2.3087)	
Log size		5.3032		10.8382	
		(0.7651)***		(1.9207)***	
Efficiency		0.2381		1.8761	
		(1.1979)		(2.7030)	
internet		5.5495		13.7752	
		(2.0459)**		(5.0974)***	
Telecommunication		1.5543		4.5315	0.2367
		(0.9556)**		(2.2535)**	(0.0967)**
Transportation		-0.4383		0.0936	-0.0262
		(0.7988)		(1.9391)	(0.0830)
Electricity		-0.4343		-1.8890	-0.0511
		(0.8647)		(1.9119)	(0.0839)
Customs Regulation		-0.4537		0.8714	0.1460
		(0.6832)		(1.6621)	(0.0725)**
Log FMA		-44.7367		-101.2302	-2.9276
		(45.4536)		(112.8104)	(4.8518)
Electricity x generator		1.5463		8.8789	0.1677
		(0.9981)***		(2.9040)***	(0.1231)
Zambia			-0.2023	0.1496	0.1522
			(0.0890)***	(13.2344)	(0.0471)*
Tanzania	0.0189	5.5232	-0.4231	0.2843	0.3773
	(2.6535)	(5.4428)	(0.0218)***	(0.1753)	(1.5404)
South Africa	-0.6149	20.8429	0.2481	0.5449	0.0735
	(2.2905)	(23.6634)	(0.1863)	(0.1469)	(1.4727)
Uganda	-5.0484	6.9316	-0.1640	0.1470	-0.0481
	(2.4858)**	(15.1299)	(0.0210)***	(0.4299)	(2.6611)
Mauritius	20.2006	31.4322		0.7045	
	(2.8367)***	(10.9233)***		(0.2867)**	
Efficiency x electricity	-12.2412	-101823	0.8678	-0.9425	-0.3621
	(3.1806)***	(4.1567)**	(0.2635)***	(2.5765)	(0.5249)
Efficiency x telecomms	3.1921	0.4474	0.1898	0.7433	0.3921
	(2.0739)	(2.5856)	(0.1639)	(0.9505)	(0.3924)
Efficiency x transportation	16.3372	12.3551	0.4937	0.4296	0.8915
	(2.6085)***	(3.2310)**	(0.2083)**	(0.4684)	(0.4532)**

Absolute values of standard errors in parenthesis
*** Significance **at 1% level**; ** significant at 5% level; *Significant at 10% level.

Perception indicators could be endogenous in that enterprise managers with greater experience dealing with infrastructural problems might have different perceptions about these variables than

managers without the same level of experience (Clarke, 2004)[45]. Consequently, export behaviour might affect perceptions rather than the reverse. As in Table A3.3 in the appendix, exporters complain more about infrastructure problems than non exporters. This is because sometimes, firms exporting more might also be producing more and the problems of infrastructure service quality are more likely felt when firms produce more and thus need these services more compared with non exporters. The alternative variable like days to clear customs could be endogenous since it is based on the experiences of the individual firms. In this case, the more firms export, the more likely they are to experience problems in their trade related transactions such as customs clearance (Yoshino, 2008). To test the endogeneity of the four perceptions based infrastructural indicators we use the Durbin Wu Hausman test in the context of OLS and the Smith Blundell test (Smith Blundell, 1986)[46] in the context of the Tobit model. The results of these tests are shown on Table 3.9 below.

Table 3.9 Summary of endogeneity tests and first stage regression results from 2SLS

Tests and endogenous variables	All industries		F-Value	Probability Value(P>F)
	Shea's Partial R-squared	Partial R-squared		
Durbin Wu Hausman endogeneity test			3.92	0.0038
Smith Blundell exogeneity test			5.44	0.0003
Anderson- Rubin weak instrument test			3.84	0.0043
Anderson Rubin Wald test			15.87**	0.0032
Cragg- Donald weak instrument test			14.85	
Telecommunications	0.12	0.11	21.52	0.0000
Electricity	0.11	0.11	19.87	0.0000
Transport	0.11	0.11	21.19	0.0000
Customs	0.09	0.11	21.24	0.0000

** This is a Chi Square value

All these endogeneity tests reject the null hypothesis that instrumented regressors are exogenous. This rejection means that we should use a 2SLS, endogenous tobit and probit models for estimation instead of the standard models. We attempt to control for endogeneity in these infrastructure variables by substituting with the average perception index of firms involved in

[45] This experience could also affect the number of days production is interrupted by infrastructural failures. For example more experienced managers can minimise the number of days their goods take to clear at customs or to have a telephone connection because they understand the way the systems function better than inexperienced managers.

[46] The steps to follow in implementing these tests of endogeneity are explained in Wooldridge, 2002, page 531.

exporting in the same region and same sector. For domestic transport infrastructure, the sector regional average was done across firms that service the domestic market only. According to Clarke, (2004), this approach does not only correct for endogeneity but also cleans out white noise associated with the perceptions of the individual managers. Alternative infrastructural indicators were also calculated using the concept of region-sector averages.

Since weak instruments can produce biased instrumental variable (IV) estimators[47] and hypothesis tests with large size distortions (Stock and Yogo, 2004), we test the validity of our region-sector infrastructure perceptions averages using the Cragg-Donald statistic, Anderson and Rubin test as well as Shea's partial R-squared. Stock and Yogo (2004) provide two general definitions of a weak instrument set. One is based on the bias of the estimator and the other on the size distortion of the associated Wald statistic. They argue that an instrument set is weak if the ratio of bias of the IV estimates to the bias of the OLS estimates is likely to exceed some tolerable level, B. Using size distortion they argue that an instrument is strong from the perspective of the Wald test if the size of the test is close to its level for all possible configurations of the IV regression model. Stock and Yogo (2004) therefore propose tests for weak instruments based on these definitions and on the Cragg Donald statistic (Cragg and Donald, 1993). However the maximal bias approach can only be used if there is over-identification and the number of instruments is more than the number of endogenous regressors by at least two degrees of over identification.

Since our model is just identified the only Stock and Yogo (2004) definition that is applicable is the one based on maximal 5% Wald test size distortion. The null of the test that instrument set is weak is rejected if the Cragg Donald test statistic exceeds the Stock and Yogo critical values that vary with the desired maximal size distortion (r), the number of instruments (K) and the number of endogenous regressors (R). Our Cragg-Donald test statistic has a value of 14.85 (see table 3.9). Stock and Yogo (2004) provide critical values at the 5% level of significance and for various configurations of r = 0.1, 0.15, 0.20, 0.25; R=1,2 and K= 1,2,3,.....,30. Since we

[47] This argument is supported by Wooldridge, 2002 page 101, that IV methods can be ill behaved if the instruments are weak leading to inconsistent estimators and hence severe finite sample bias.

have R= 4 we do not have the exact critical value that our test statistic can be compared with. To go around this problem we will use the approach taken by Elbadawi et al (2007), where we take advantage of the fact that for given *r* and given K, the critical value strictly decreases with R. This enables us to use the critical values Stock and Yogo (2004) provide for the case of R=2 as the upper bound to the true critical value we would ideally use. For a choice of *r* =0.15, so that the maximal size distortion of the IV estimator is 15% of the maximal 5% Wald test distortion, the critical value at K=4 and R=2 is 9.93. The true critical value corresponds to R=4 and should be even lower than that. We can therefore be confident that this test would reject the null of weak instruments given our Cragg Donald statistic of 14.85. It would do so even more clearer and easily if we choose r to be higher say *r* = 0.2 or 0.25, in which case the critical values at K =4 and R=2 is 7.54 and 6.28 respectively.

Another useful IV diagnostic is that provided by Shea's partial R- squared (Shea, 1997) which basically shows the contribution of an instrument without the inclusion of the contribution of other instruments or regressors. It is a test of the individual explanatory power of the IVs. As a rule of thumb and for models with multiple endogenous regressors, if an estimated equation yields a larger value of the standard R squares and a small value of the Shea partial R squares, one may conclude that the instruments lack sufficient relevance to explain all the endogenous regressors and therefore the model maybe essentially under identified (Bo Malmberg et al (2004). The closeness of the Shea's R squared values in table 3.9 show enough separate variation in the instruments which are positive and statistically significant for each of the endogenous regressors.

Another test for robust inference in the weak instrument case is the Anderson- Rubin Wald test (Anderson and Rubin, 1949) .This test has correct size in cases where instruments are weak and when they are not and its null hypothesis is that excluded variables (instrumental variables) coefficients are equal to zero. In our model the null is rejected at 1% level suggesting that our instruments are relevant. Thus the bottom line from all these tests is that there is no evidence that our estimation results which uses these instruments suffer from potential weak instrument problem. However, the important caveat is that, these conclusions are based on diagnostic tests that can only be implemented in linear models.

The inclusion of the efficiency parameter in our models may also pose some econometric problems since it enters the estimated equations as a generated regressor in the sense of Pagan (1984). In accordance with Elbadawi et al (2007), standard estimates of the variance-covariance matrices of the OLS estimators and maximum likelihood Tobit estimators would therefore lead to standard errors that are invalid as they ignore the sampling error involved at the stage of estimating the regressors. To deal with this problem we used bootstrapping techniques to obtain consistent standard errors in the estimation of models below using 50 full sample replications where possible.

3.8 Presentation and analysis of Cross sectional results

The estimations under cross sectional analysis were done using a number of models such as the Tobit, Probit, Linear Probability Model so as to check whether our results are robust to changes in model specification. Thus if our results are able to withstand the stress (do not change markedly) after being subjected to different models built on different assumptions, then they are statistically robust. We also used different indicators of infrastructure quality and international transport costs so as to check whether our estimations are robust to changes in variable specifications as well. Our results are presented on Tables 3.10 to 3.13 below.

Country dummies: A number of studies in the literature have found that being in Africa on its own has a negative effect on trade and growth (see Elbadawi et al, 2006; Fielding 2000; Burger and du Plessis, 2006; Redding and Venables, 2004). We examine the presence of a negative African dummy by comparing the signs and the significance of our country dummies before and after controlling for infrastructure and firm specific variables. By using country dummies alone as regressors we want to examine the impact of being in any of these African countries on the probability to export. Thus does being in Zambia on its own have a positive or negative effect on export participation? After controlling for infrastructure and other firm specific variables, the idea now is to find out whether the quality of infrastructure, changes the impact of country effects on export participation. This difference will give us an idea whether changes in quality of infrastructure can account for differences in likelihood to export or amount exported by firms in these countries. Our regression results on Table 3.8, columns 1 and 3 above, where we exclude infrastructure and firm specific regressors, corroborates the fact that being in Zambia, Tanzania

and Uganda has a negative influence on exporting compared to being in South Africa. This is because these country dummies are negative and also significant. This suggests that a typical firm in these countries (Zambia, Uganda and Tanzania) is far less likely to enter export markets than a typical firm in South Africa. This is because the probability to export in South Africa is higher than in these other countries. To find out the reason that can account for this, we then control for infrastructure quality and firm specific characteristics. We find that the country dummies of Tanzania, Zambia and Uganda are no longer significant but are now positive. This could suggest that the difference between export participation rates in South Africa and these countries could be a result of poor quality infrastructure. In South Africa and Mauritius, the country dummies are positive and this is the case even after controlling for the quality of infrastructure and business characteristics. The general infrastructure facilities in South Africa and Mauritius probably provide a good environment for firms to participate or increase their exports. This argument is partly supported by infrastructure indicators on Tables A3.2 and A3.3 in the appendix. Thus infrastructure perception indicators as well as number of days and hours without infrastructure services are lower for South Africa and Mauritius compared to other study countries. Our inference however must be qualified by the fact that we also controlled for firm characteristics in columns 2 and 4 in table 3.8. It could then be that the negative dummies in Zambia, Tanzania and Uganda reflect the fact that firms in these countries are older, smaller and lack foreign participation. To check this we decided to exclude these firm specific characteristics in column 5, table 3.8. Results show that controlling for infrastructure does change the negative dummies in these countries.

Table 3.10: Pooled regression results using perception indicators

Variables	2SLS Model perceptions	Endogenous Tobit Perceptions (internet)	Endogenous Tobit Perceptions (no internet)	Endogenous Probit Perceptions	2SLS Model Perceptions Linear Prob model
Dependent variables	Pexport	Pexport	Pexport	Probexport	Probexport
Country dummies	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes
Foreign ownership	5.2124	10.9467	13.0386	0.3593	0.1061
	(2.9174)*	(6.1320)*	(6.1941)**	(0.1607)**	(0.0475)**
Log age	-2.2856	-4.8397	-4.5556	-0.0442	-0.0120
	(1.2548)*	(2.7159)*	(2.7280)*	(0.0686)	(0.0206)
Log size	5.5331	12.8190	14.5146	0.4275	0.1265
	(1.0522)***	(2.3209)***	(2.3386)***	(0.0618)***	(0.0172)***
Efficiency	-1.8201	6.5063	5.4405	0.0869	0.0291
	(3.8636)	(8.2908)	(8.3357)	(0.2243)	(0.0631)
Efficiency x electricity	6.9438	-1.4423	-2.5542	0.1127	0.0326
	(1.7264)	(5.1183)	(5.0988)	(0.1276)	(0348)
Efficiency x telecoms	-0.2750	2.1262	2.8939	0.1417	0.0320
	(2.7498)	(6.3810)	(6.3699)	(0.1615)	(0.0348)
Efficiency x transport	-1.9488	-2.2724	-0.9733	0.0327	0.0004
	(2.5622)	(5.7144)	(5.7622)	(0.1446)	(0.0418)
Efficiency x customs	0.5566	-2.0936	-1.4085	-0.0393	0.0237
	(2.1704)	(4.7729)	(4.7860)	(0.1188)	(0.0354)
Telecommunication	-1.5023	3.0742	2.3195	-0.2550	0.0808
	(3.4501)	(7.8852)	(7.9148)	(0.1899)	(0.0563)
Transportation	4.6468	7.9172	8.2332	-0.1032	-0.0180
	(2.9866)	(6.7215)	(6.7065)	(0.1695)	(0.0490)
Electricity	-7.1327	-17.5987	-18.6874	-0.4857	-0.1347
	(3.0187)**	(6.8223)**	(6.8653)***	(0.1704)**	(0.0494)***
Customs Regulation	-6.1952	-16.5023	-15.5797	-0.1989	-0.0435
	(2.8155)**	(6.3761)**	(6.3396)**	(0.1620)	(0.0459)
Log FMA	-4.4946	-7.8278	-9.7239	-0.8526	-0.6439
	(5.7461)	(13.0228	(13.0808)	(1.0999)	(0.9359)
Electricity x generator	6.9438	14.6942	15.5785	0.1979	0.0509
	(1.7264)***	(3.8957)***	(3.9418)***	(0.0968)**	(0.0281)*
Internet		19.3147		0.4499	
		(6.1208)***		(0.1511)***	
Constant	**438.1084**	663.8684	885.8808	0.8525	0.7273
	(526.6211)	(1157.477)	(1199.81)	(1.1713)	(1.0390)
Observations	**693**	**692**	**693**	**697**	**697**

Absolute values of standard errors in parenthesis: RSA and food and agric are base dummies
*Significant at 10% level; ** significant at 5% level; *** significance **at 1% level**

Table: 3.11. Pooled regressions using the Tobit Model with infrastructure variables measured in hours/ day and days/ month.

Variables	Hours (1)	Hours (2)	Hours (3)	Days (4)	Hours (5)	Marginal Effects(4)
Dependent variables	Pexport	Pexport	Pexport	Pexport	Pexport	Pexport
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes
Foreign ownership	10.9586	10.3542	9.8387	17.0286	9.8473	4.5074
	(5.3386)**	(5.3178)*	(5.1291)*	(5.3211)***	(7.2248)	(2.2195)**
Log age	-2.7786	-2.4338	-2.1450	-2.7678	0.6793	-0.9282
	(2.3083)	(2.2982)	(2.2497)	(2.3359)	(3.4796)	(0.9735)
Log size	12.8440	12.9607	13.3195	13.2853	15.6023	5.7637
	(1.9722)***	(1.9798)***	(1.8794)***	(1.9286)***	(2.9217)	(0.8133)***
Efficiency	10.8959	10.9492	13.0204	3.7249	8.3497	5.6343
	(5.2645)**	(5.2524)*	(5.0150)***	(3.7784)	(7.9834)	(2.1701)***
Efficiency x electricity	-0.7745	-1.1105	-1.2859	-1.342	-1.4799	-0.5564
	(1.1282)	(1.1025)	(0.7254)	(1.4830)	(1.0169)	(0.3869)
Efficiency x telephone	-0.0679	-0.0619	-0.0997	-2.2017	-0.0376	-0.0432
	(0.2032)	(0.2019)	(0.2007)	(1.2201)*	(0.2580)	(0.0869)
Efficiency x water	-0.1196	-0.0485	-0.0279	4.4353	0.2543	-0.0121
	(0.2883)	(0.2872)	(0.02776)	(2.234)**	(0.3347)	(0.1201)
Telephone	1.5393	1.5009	1.7978	-1.4873	0.4539	0.7779
	(0.3947)***	(0.3956)***	(0.4744)***	(1.2865)	(0.7059)	(0.2053)***
Water	1.1597	1.0178	1.0696	-2.0954	0.7723	0.4629
	(0.3599)***	(0.3792)***	(0.3497)***	(1.8341)	(0.4571)	(0.1513)***
Electricity	-1.7953		-1.1030	-5.6915	-0.6699	-0.4773
	(1.0813)*		(0.9599)	(2.3242)**	(1.0759)	(0.4154)
Average Customs Clearance	-3.3099	-1.8581	-4.4433	-1.1074	-5.2220	-1.9227
	(1.8129)*	(1.0732)	(1.6323)***	(0.8211)	(2.7139)	(0.7063)***
Export Clearance		-0.3637				
		(1.6873)				
Import Clearance		-3.3684				
		(2.1018)				
Log FMA	-6.4175	-9.2552		-3.5804	0.7073	
	(17.0646)	(17.3996)		(1.4254)**	(6.5451)	
Sec_cif_fob			-4.2182			-2.8253
			(2.1230)*			(1.2169)*
Electricity x generator	3.1354	3.1243	2.4950	6.1307	1.7549	1.0797
	(0.8041)***	(0.8023)***	(0.7254)***	(1.8287)***	(0.8951)*	(0.3139)***
Internet_telephone interaction					0.9607	
					(0.3154)*	
Borehole_water interaction					0.1057	
					(0.3500)	
Observations	582	582	572	647	586	572

Table: 3.12. Pooled regression using the Probit Model with infrastructure variables measured in hours/ day and days/ month.

Variables	Hours (1)	Hours (2)	Days (3)	Hours (4)	Hours (5)	Marginal* Effects eq(1)
Dependent variables	Probexport	Probexport	Probexport	Probexport	Probexport	Probexport
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes
Foreign ownership	0.2736	0.2641	0.4316	0.3070	0.3651	0.1084
	(0.1563)*	(0.1568)*	(0.1195)***	(0.1532)**	(0.2207)*	(0.0619)*
Log age	-0.0140	-0.0082	-0.0194	-0.0102	0.0283	-0.0055
	(0.0661)	(0.0663)	(0.0514)	(0.0651)	(0.0667)	(0.0260)
Log size	0.3870	0.3953	0.3932	0.3986	0.3524	0.1521
	(0.0598)***	(0.0603)***	(0.0431)***	(0.0573)***	(0.6612)***	(0.0235)***
Efficiency	0.3073	0.3215	0.1797	0.4299	0.3864	0.1208
	(0.1588)*	(0.1603)**	(0.0992)*	(0.1570)***	(0.1615)**	(0.0624)*
Efficiency x electricity	-0.0107	-0.0136	-0.0085	-0.0403	0.0015	-0.0042
	(0.0320)	(0.0318)	(0.0464)	(0.0255)	(0.0324)	(0.0126)
Efficiency x telephone	-0.0040	-0.0036	-0.0501	-0.0041	0.0018	-0.0016
	(0.0055)	(0.0055)	(0.0348)	(0.0056)	(0.0061)	(0.0028)
Efficiency x water	-0.007	-0.0009	-0.0641	0.0033	0.0027	-0.0003
	(0.0081)*	(0.0082)	(0.0535)	(0.0079)	(0.0083)	(0.0032)
Telephone	0.0241	0.0230	-0.0683	0.0368	0.0032	0.0094
	(0.0107)**	(0.0107)**	(0.0366)*	(0.0134)***	(0.0158)	(0.0042)**
Water	0.0197	0.0155	-0.0548	0.0142	0.0168	0.0077
	(0.0105)*	(0.0107)	(0.0620)	(0.0101)	(0.0137)	(0.0041)*
Electricity	0.0454	-0.0591	-0.0226	-0.0043	-0.0054	-0.0216
	(0.0232)**	(0.0306)*	(0.1221)	(0.0265)	(0.0321)*	(0.0123)
Average Customs Clearance	-0.1210		-0.0325	-0.1362	-0.1233	-0.0476
	(0.0533)**		(0.0187)*	(0.0477)	(0.0533)**	(0.0209)**
Export Clearance		-0.0065				
		(0.0478)				
Import Clearance		-0.1339				
		(0.0598)**				
Log FMA	0.4144	-0.8534	0.5620		0.7311	0.1629
	(4.6594)	(4.7741)	(2.8029)		(4.6821)	(1.8314)
Sec_cif_fob				-0.2445		
				(0.1468)*		
Electricity x generator	0.0454	0.0448	0.1394	0.0351	0.0402	0.0178
	(0.0232)**	(0.0232)*	(0.0473)***	(0.0212)*	(0.0235)*	(0.0091)**
Borehole_water interaction					-0.0007	
					(0.1116)	
Internet_telephone interaction					0.0259	
					(0.0080)***	
Observations	586	586	992	576	586	572

Absolute values of standard errors in parenthesis

*** Significance **at 1% level;** ** significant at 5% level; * significant at 10% level

Table: 3.13: Pooled regression using the OLS and Linear Probability Model with infrastructure variables measured in hours/ day and days/ month.

Variables	Linear Probability Model		Ordinary Least Squares Model	
	Hours	Days	Days	Hours
Dependent variables	Probexport	Probexport	Pexport	Pexport
Country dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Foreign ownership	0.0829	0.1252	7.4947	4.0609
	(0.0473)*	(0.0421)***	(2.6768)***	(2.7729)
Log age	-0.0049	-0.0008	-1.8308	-1.2618
	(0.0199)	(0.0187)	(1.1461)	(1.1875)
Log size	0.1070	0.1154	5.5359	5.2292
	(0.0163)***	(0.0141)***	(0.9111)***	(0.9397)***
Efficiency	0.0897	0.0845	2.3712	4.8432
	(0.0428)*	(0.0311)***	(1.9334)	(2.5404)*
Efficiency x electricity	-0.0014	-0.0027	-0.4495	-0.2986
Efficiency x	(0.0081)	(0.0148)	(0.6844)	(0.4457)
telephone	-0.0015	-0.0134	-1.5552	-0.0456
Efficiency x water	(0.0016)	(0.0115)	(0.5964)***	(0.0969)
Telephone	-0.0016	-0.0042	1.2346	-0.0927
	(0.0022)*	(0.0089)	(1.0112)	(0.1310)
Water	0.0042	-0.0140	-0.3790	0.6180
	(0.0029)	(0.0114)	(0.5944)	(0.2262)***
Electricity	0.0044	-0.0223	-0.6091	0.5767
	(0.0027)	(0.0125)*	(0.8384)	(0.1833)***
Average Customs Clearance	-0.0147	-0.0003	-3.2712	-0.6434
	(0.0081)*	(0.0355)	(1.0519)	(0.4611)
Export Clearance	-0.0203	0.0004		
	(0.0109)*	(0.0073)		
Import Clearance		-0.0060	0..6868	-0.0489
		(0.0035)*	(0.7663)	(0.8922)
Log FMA			0.1718	-0.1611
			(0.5362)	(0.8444)
Sec_cif_fob	-0.1498	0.0261	-20.878	
	(1.3601)	(0.0283)	(6 .4000)***	
				0.8099
				(2.5528)
Electricity x generator	0.0102	0.0281	2.5557	1.1724
	(0.0063)	(0.0125)**	(0.8314)***	(0.3539)***
Observations	586	586	582	572

Absolute values of standard errors in parenthesis
***Significant at 1% level; ** significant at 5% level; * significance **at 10% level**

Foreign ownership: It is generally argued that firms with some foreign ownership find it easier to export than domestic firms (see Rankin et al, 2005; Yoshino, 2008, Elbadawi et al, 2006; Clarke, 2005). This is because foreign ownership enables firms to have easier access to international marketing and distribution networks, particularly when the foreign owner is affiliated to a multinational corporation. This affiliation makes it easier for the firms to enter international markets (Bloomstrom and Kokko, 1998). Similarly, foreign owned firms might have easier access to finance either because they are perceived to be more efficient than other enterprises or they have access to finance in their home countries. This enables them to shoulder the fixed costs associated with entering export markets (Buch et al 2008). According to Clarke (2003), the effect of foreign ownership on export behavior might be important in developing or transitional economies, since domestic enterprises in these countries may lack the skills and resources to set up marketing, distribution and services networks. Reid (1981) argued however, that foreign owned firms may sometimes be less export oriented because they were established primarily to gain a tariff free access to host country market which may represent the only predominant market of interest outside the investor's home country. This is supported by Wolf (2007), who found that firms in the agricultural processing and plastic sector in Ghana with more foreign ownership tend to be less export oriented but rather serve the domestic market.

Table 3.10 results however show that when using perception indicators, the foreign ownership dummy carries the right expected sign and is generally significant as well as robust to changes in model specification. The same pattern is replicated even when using alternative indicators like hours and days without infrastructure services under the Tobit and Probit models in Tables 3.11 and 3.12 respectively. This variable is significant and positive even after using different measures of infrastructure quality (days or hours) as well as different proxies for international transport costs and customs efficiency. However, this variable though positive is insignificant when using OLS and probably this is because the OLS model ignores the censoring of the dependent variable which biases estimates. Marginal effects under column 7 on Table 3.11 show that having foreign ownership increases exports by about 4.5% whilst column 5, Table 3.12 shows that, there is an increase in the probability to export by about 11%. The general significance of this variable suggests that foreign ownership does not only have a modest effect

on amount exported but even on the likelihood to export. According to Yoshino (2008), there are several reasons why foreign ownership may matter for firms in low income countries such as the ones in the current sample. First, foreign direct investment brings skills and technologies from source countries that are otherwise not available domestically. Such skills and technologies help improve the productivity of firms *(productivity effect).* Secondly, another reason is that firms with foreign ownership are more likely to access established overseas business networks and marketing channels including those with parent companies which facilitates their exporting activities *(network effect).* The network effect includes not only networks for marketing and sourcing, but also for access to finance, which is very important for overseas transactions.

Firm age: The impact of firm age on exporting in the empirical literature has been studied extensively but with mixed results. Studies by Aitken at al (1997, Roberts and Tybout(1997), Fryges (2006) found a positive relationship between firm age and exporting whilst Yoshino (2008), Majochi et al (2005) on Germany and British firms; Rankin et al (2006) on Nigerian firms; Soderbom and Teal (2003) on five African countries found a negative relationship. This suggests that older firms through accumulated experience and economies of scale would be at a better advantage to participate or establish themselves in export markets. Our cross section level results show that using perception indicators as measures of infrastructure, the age variable is negative and significant under the 2SLS and the Tobit models. But however when we use other alternative measures of infrastructure, under the Tobit, Probit, OLS and Linear Probability models, this variable is consistently negative and insignificant. This suggests that there is a weak negative impact of firm age on export participation and intensity. This could be true if old firms are very inflexible to changes in technological demands than younger firms and also if these older firms were set up to promote import substitution industrialisation (ISI). In this case their goal would be to ensure local availability of imported products rather than seek external markets. However the survival of these ISI firms is only possible in countries that are still relatively closed and use protectionist policies. These results partly support the fact that, when it comes to exporting, younger firms are more likely to be less risk averse and more adventurous than conservative older firms. In this case being older will reduce the likelihood to export. Cooper and Kleinschmidt (1985) also argued that the strategy of an exporting firm varies by its age. Thus the

firms they identified as "world marketers" were significantly younger than firms guided by other strategies.

Firm size: A common finding across many African firm studies is that there is a strong correlation between firm size and exporting (van Biesebroeck, 2005; Bigstern et al, 2004; Soderbom and Teal, 2003; Rankin et al, 2006). Clarke (2004 also argued that large fixed costs associated with setting up an international distribution or service network generally makes exporting easier for large enterprises. However this interpretation is difficult to reconcile with the robust significance of the size variable when there are controls for sunk costs (Rankin et al, 2006). Additionally large firms have better access to finance than small enterprises particularly in developing countries. Our results confirm and are consistent with most of the above findings in the literature that size does matter for exporting. Using perception indicators the size variable is statistically significant at 1%. This pattern is the same even when using other alternative infrastructure indicators and different models showing that firm size is a robust determinant of export participation and intensity. The marginal effects column show that an increase in the size of the firm increases the probability to export by 15% and the amount exported by about 6%. The significance of the size variable indicates that large enterprises export more than smaller enterprises and that size is not capturing sectoral differences in technology since it remains highly significant with sectoral controls in the models. A number of studies in the literature have arrived at the same conclusions. For example Clerides et al, (1998) found consistent evidence for Columbia, Mexico and Morocco. Grenier et al, (1999) also found that Tanzania firms export more than smaller firms. Using data from several countries in Sub Saharan Africa, Bigstern et al, (2004), Elbadawi et al, (2007) and Soderbom and Teal (2003) found similar results. In fact Söderbom and Teal (2003) argue that the size of the firm's domestic base is linked to its export performance implying that firms need to grow domestically to be successful internationally. In this context there is concern that government policies (poor macroeconomic stability, high tax rates, high cost of finance etc) that restrict the growth of firms domestically may also inhibit export growth. This is because larger firms are more involved in exporting than smaller firms. Thus if size is related to the firm's participation in the export market, limited domestic demand ensures that the only way to expand is to grow into the export market. However, Gabbitas and

Gretton (2003) however argue that studies that do not explicitly control for unobserved firm specific factors (by using panel data techniques) result in them attributing to firm size a degree of influence that should rightly be attributed to other unspecified factors. The other thing about size argued by Rankin et al, (2006) that we cannot rule out in this study because of the cross sectional nature of our estimations is that the size variable may be a simple proxy for some time invariant aspects of the firm correlated with the other regressors. Rankin et al, (2006) argued that if larger firms have more skilled labour and that is the key to exporting, then size on its own is not a determinant of exporting. In this case the association between exporting and size basically reflects the importance of skilled labour that large firms are endowed with. However our cross sectional data is not able to unravel this dimension of firm size on exporting. A longer time series data is vital.

Internet access: Past studies on low and middle income countries in Europe and Asia have shown that manufacturing establishments that are connected to the internet export more than those that are not[48]. A similar relationship appears to hold for the African countries in this study. The internet dummy[49] is statistically significant and positive at 1% showing that it is associated with export participation and sales (see results on Table 3.11). A concern that has been raised in the literature about this variable is that the high cost of international communications in Africa might encourage exporters to get internet connections rather than internet connections making it easier for enterprises to export (Clarke, 2004). This means that the internet dummy may be endogenous. However, results in these models (Table 3.10) are robust to the exclusion of this variable. Due to this endogeneity and the difficulty of instrumenting for it, we decided to drop the variable from our analysis.

[48] Lal (2004) shows that Indian firms that use e-business technologies more intensively were more likely to export than other firms. Using data from manufacturing establishments in 27 low and middle income countries in Eastern Europe and Central Asia, Clarke, (2001) shows that firms that were connected to the internet exported more than other enterprises even after controlling for self selectivity bias.

[49] This dummy is equal to one if a firm has a website or an email facility and zero otherwise and is not a proxy for internet infrastructure quality.

Efficiency: A number of studies have found that exporters seem to be more efficient than non exporters (Bigstern et al,2000; Tybout and Westbrook,1995; Bernard and Jansen, 1995; Kraay, 1997). There are two alternative but not mutually exclusive hypotheses why exporters can be more productive than non exporters (Wagner, 2007). According to Wagner, the first hypothesis points to self selection of more productive firms into export markets because of additional costs of selling in foreign markets. Thus extra transport costs, distribution and marketing costs etc provide an entry barrier that less successful firms cannot overcome. Furthermore the behavior of firms might be forward looking such that the desire to export tomorrow leads a firm to improve performance today so as to be competitive in the foreign market. Thus cross sectional differences between exporters and non exporters may in part be explained by ex ante firm differences. Thus more productive firms become exporters. The second hypothesis points to the role of learning by exporting. Knowledge flows from international buyers and competitors help improve the post entry performance of export starters. Therefore firms participating in international markets are exposed to more intense competition and must improve faster than firms that sell products to domestic markets. Thus exporting makes firms more productive.

Our results obtained using perception indicators show that the efficiency variable is not important for exporting as it is consistently insignificant though positive. However when we use substitute indicators (days and hours without infrastructure services), the variable becomes positive and significant. Of the six model variations that we used under the Tobit approach in Table 3.11, the variable is significant with the right sign in four of them. This efficiency variable is also significant under the Probit, LPM and OLS models showing that it is robust to model specification. By controlling for efficiency – infrastructure interactions we want to check whether the impact of efficiency on exporting is dependent on the quality of infrastructure. The results show that these interactions terms are insignificant and negative. The negative coefficients suggest that being efficient in an environment with poor infrastructure services has a weak negative effect on export participation and export sales. Since we do not have panel data to compare to, it is difficult to know whether these firms become efficient through exporting or they need to be more efficient to penetrate export markets. These cross section results only support the argument that efficiency and exporting are positively related.

Customs Infrastructure: Hummels (2001) argued that it is more expensive to export and import goods when in Africa. Customs delays are longer in most African countries due to excessive inspection of cargos, redundant and poorly coordinated procedures, poor communication and information management systems (Hummels, 2001). The results from Table 3.10 show that customs delays have a negative and significant effect on export sales rather than export participation. This is because the customs perception index is insignificant under the Probit and LPM models. We then alternatively used the average number of days firms take to import and export goods and found that the variable is negative and significant under both the Probit and Tobit models (Tables 3.11 and 3.12). However under OLS and LPM, this variable is insignificant though consistently negative using both days and hours without infrastructure services. We also decided to check which of the customs related variable, the number of days to import as well as export clearing days is more important to exporters. Results show that days to export variable is negative and significant under the Tobit model whilst import transit days is an important determinant of the probability to export. This means that firms that are contemplating entering the export markets worry more about the number of days it takes to import whilst those that want to boost export sales are concerned more about export transit days. This could mean that firms that are deciding on whether to export or not have had an encounter with customs procedures only when importing supplies and therefore use that to gauge customs efficiency. However, traditional exporters are interested in ensuring timely delivery of export orders and so gauge customs efficiency using export clearing days.

Electricity Infrastructure: This variable is negative and significant as well as robust to changes in model and variable specification. Thus electricity perception indicator is negative and significant under both the Tobit and Probit models suggesting that it is an important determinant of both export participation and amount exported (see table 3.10). Using the 2SLS and LPM, the estimated parameters suggest that a unitary average increase in the perception index decreases average exports by about 7 percentage points whilst the probability of exporting falls by about 14 percent. However changing the measurement of electricity infrastructure quality by using number of days and hours without power, results are no longer robust. Under the Probit model the variable is insignificant but becomes significant when using the alternative Tobit model. This

suggests that power outages have a negative impact on amount exported than probability to export. The only consistent fact about this variable is that it has a negative impact on exporting across all models. Controlling for generator ownership consistently result in a positive and significant impact on exports. Thus marginal effects results show that the probability to export increases by 2% whilst export sales increase by 1.1% if a firm has a generator. This shows that owning a generator reverses the negative impact that poor electricity infrastructure has on exporting. Under perception indicators and using the 2SLS and LPM, owning a generator changes the probability to export by 19% and the amount exported by 14%[50].

Domestic transport Infrastructure: We included this variable in the model to differentiate the impact of domestic transport infrastructure from international transport infrastructure. The results for this variable appear to be partly consistent with Clarke, (2003) findings that domestic transport infrastructure is negative but not significant in affecting the probability to exports. However the difference with his results is that this variable shows a positive and insignificant relationship with amount exported. The insignificance could mean that firms that are into exporting are more worried about international transport costs than costs related to domestic transport infrastructure. This could explain why the geography variable foreign market access (FMA) which measures international distance or international transport costs, has a negative but weak impact on exporting and by replacing it with its alternative indicator – sectoral (cif/fob) values, it becomes negative and statistically significant. Thus in short these results suggest that international transport costs have a strong negative impact on both likelihood to export and amount exported than costs related to the quality of domestic transport infrastructure. The insignificance of the distance variable could mean that this variable is not a good proxy of international transport costs. The finding by Zarzosso (2003) that a 1% increase in distance increases transport costs by 0.25% shows that distance does not explain a large proportion of variation in international transport costs.

[50] Without a generator the probability to export is -14% and with generator it is +5%. In the case of export sales the amount exported is -7% without a generator and 7% with a generator.

Telecommunication infrastructure: Using perception indicators this variable is consistently insignificant but if we use an alternative indicator like hours without a telephone service, the variable is now significant but positive under both the Tobit and Probit models. The insignificance of the telecommunication indicator could partly be a result of its composite nature. Thus this telecommunication indicator captures the quality of telephone, internet and cellular phone infrastructure and the quality and costs of these services differ markedly in many African countries. The significance and positive effect of hours and days without a telephone service variable is counter intuitive. To explore this further, we decided to interact telephone connection problems with internet dummy to find out whether being connected to the internet minimise the effect of telephone connection problems on exports (see tables 3.11 and 3.12). Results show that this interaction variable is significant and the telephone variable is now insignificant. This could suggest that being connected to the internet not only enables firms to sell their products to a wider market but also minimises the negative effects of telephone failures. This could be true if internet services are of good quality and affordable, something possible in countries where the private sector plays a leading role in the telecommunications sector.

Water infrastructure: Just like power supply, sustainable water infrastructure is also very important in the production of manufactured goods. Industries that use large amounts of water normally produce such commodities like food, paper, chemicals, refined petroleum or primary metals. Many African countries are also manufacturers and exporters of these types of commodities. Results from this study show that the variable, number of hours or days without water is positive and significantly affects the amount exported not the likelihood to export. This is another counter intuitive result. We also explored this variable further taking into account the fact that some firms in these countries own boreholes (see tables 3.1 above) to serve as alternative sources of water. In light of this we again interacted water problems with ownership of a borehole and found that the interaction as well as water infrastructure quality variable are all insignificant (see tables 3.11 and 3.12 above). This suggests that water problems do not matter much to exporters and this is the case even if the firm owns a borehole.

3.8.1 Sectoral level results

Sectoral analysis helps us identify whether infrastructure impacts differently in each sector. This would help policy makers in coming up with sectoral specific infrastructure strategies that would promote the exports of desired manufactured goods. Similarly, this will also help encourage both horizontal and geographical diversification of exports by improving the quality and accessibility of infrastructure important in promoting non traditional exports sectors or markets.

Table 3.14 Sectoral results using alternative infrastructural indicators (hrs without infrastructure services)

Variables	Wood Furniture	Food Agric	Textile Garment	Chemical Pharmacy	Construction Metal
Dependent variable	Probexport	Probexport	Probexport	Probexport	Probexport
Country dummies	Yes	Yes	Yes	Yes	Yes
Foreign ownership	-0.337	0.024	1.178	0.613	1.021
	(0.58)	(0.08)	(2.64)**	(1.81)*	(2.85)**
Internet	-0.273	-0.247	0.772	0.796	-0.161
	(0.57)	(0.96)	(1.93)*	(2.33)*	(0.5)
Efficiency	0.01	0.165	0.073	0.273	0.174
	(0.05)	(1.03)	(0.3)	(1.44)	(0.83)
Log age	0.005	-0.366	0.15	-0.006	0.424
	(0.02)	(2.96)**	(0.8)	(0.04)	(2.54)**
Log size	0.025	0.181	0.232	0.41	0.454
	(0.13)	(1.94)*	(1.73)*	(3.36)**	(3.31)**
Sectoral (cif/fob)	-1.849	-0.435	3.378	2.565	-1.307
	(3.60)**	(2.08)*	(7.45)**	(7.42)**	(4.04)**
Power outages(hrs)	0.158	0.122	-0.257	0.029	-0.082
	(1.82)*	(2.74)	(3.90)**	(0.59)	(1.100)
Water probs (hrs)	-0.052	-0.021	0.054	-0.045	-0.003
	(1.07)	(2.10)*	(4.12)**	(3.13)**	(0.17)
Telephone prob (hrs)	0.098	0.044	-0.258	-0.161	0.018
	(5.18)**	(3.97)**	(5.76)**	(6.98)**	(1.1)
Outages x generator	-0.012	0.102	-0.015	-0.025	-0.106
	(0.17)	(2.78)**	(0.38)	(0.55)	(1.56)
Average customs(days)	0.079	-0.121	-0.02	-0.083	-0.029
	(4.28)**	(7.09)**	(0.98)	(4.04)**	(1.79)*
Efficiency x electricity	-0.4178	0.1985	0.9826	0.2842	-0.2744
	(0.1470)	(0.1145)*	(1.1681)	(0.1680)*	(0.4397)
Efficiency x telephone	-0.9872	-0.1109	-0.8036	0.3566	0.2801
	(0.3835)*	(0.773)	(0.8137)	(0.4006)	(0.4018)
Efficiency x water	0.1665	-0.2478	-0.1392	-0.6789	-0.5093
	(0.3933)	(0.1863)	(0.3141)	(0.3773)	(0.9244)
Observations	549	549	549	549	549

Absolute values of standard errors in parenthesis
*Significant at 5% level; ** significant at 1% level
Note: Estimates done using Probit Model

Results on Table 3.14 above, show that foreign ownership is positive and significant in the Textile and garment, chemical and pharmacy as well as construction and metal sectors. This could be due to the fact that these industries require an intensive use of modern technology or they need good marketing and sourcing expertise to survive in the competitive world of exports. Huge financial resources (to acquire modern technology) and aggressive marketing make foreign ownership inevitable. The significance of the size variable confirms the widely held view in the literature that big firms have the potential to export more than small firms regardless of the sector or country. The insignificance however of the efficiency variable suggest that self selectivity bias does not hold or that there is not enough evidence in our sectoral data to suggest that firms need to be efficient to export. The efficiency infrastructure variables are insignificant though negative indicating that quality infrastructure is important for productive firms to export more.

The results on infrastructure variables are mixed. International transport costs have a significant negative effect on exports in all the examined sectors excluding the textile garment and chemical and pharmacy sectors. This variable suggest that in these sectors (textile and chemicals), high transport costs encourage exports, something counter intuitive[51]. The surprising thing about this variable is that textile and garment as well chemical and pharmacy sectors are some of the few sectors with high export participation rate. Power outages are a problem in the textile and garments sectors whilst water is a negative and significant determinant of food and chemical exports. This makes sense because these two sectors, food and chemicals use a lot of water in production compared to wood and furniture and hence should be negatively affected by water shortages as expected. Having a generator is important for firms in the food and agriculture sector and this enhances the amount exported. This finding could suggest that power is so important in the food and agricultural sector that firms have to use generators to minimize outage problems. Long hours without a telephone connection have a negative impact on the amount of textile and chemical goods exported. The significance of internet access also in these two sectors

[51] This counter intuitive result may suggest that may be the transport variable measured using cif and fob values is not exactly capturing transport costs but something else. This may also imply that this kind of data is not good enough to proxy transport costs (see Hummels, 2002) for more on this.

(textile and chemical) suggests that telecommunication facilities are important to governments who want to boost textile and chemical exports. The relatively high export participation and export intensity in these sectors imply that probably communication with external clients is more important for these firms. Customs clearing days have a negative effect on the amount of textile chemical and construction goods exported and this is not surprising because firms in these sectors are more outward oriented.

3.9 Market Diversification results

In section 3.6, we calculated the degree of market diversification using the number of equivalent markets, an approach developed by the International Trade Centre. Market diversification reduces vulnerability to shocks and also promotes wide economic integration; we estimate an OLS model to find out how firm characteristics as well as infrastructure quality explain the level of market diversification. Our empirical strategy is to use the same approach that we followed at cross country level by estimating a model that checks for robustness in variable specification using different indicators of infrastructure and transport costs.

Table: 3.15. Geographical Market diversification Model using OLS

Variables	Hours (1)	Hours (2)	Hours (3)	Days (4)
Dependent variables	Market diversification	Market diversification	Market diversification	Market diversification
Country dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Foreign ownership	0.0075	0.0110	0.0144	0.0121
	(0.0337)	(0.0306)	(0.0306)	(0.0298)
Log age	-0.0037	0.0021	-0.0009	-0.0077
	(0.0141)	(0.0130)	(0.0130)	(0.0129)
Log size	0.0095	0.0231	0.0220	0.0299
	(0.0117)	(0.0106)**	(0.0107)**	(0.0104)**
Efficiency	0.0876	0.0612	0.0642	0.0049
	(0.0301)***	(0.0279)**	(0.0278)**	(0.0200)
Efficiency x electricity	-0.0083	-0.0146	-0.0159	-0.0198
	(0.0060)	(0.0049)***	(0.0049)	(0.0074)***
Efficiency x telephone	-0.0037	-0.0022	-0.0022	0.0100
	(0.0011)***	(0.0011)**	(0.0011)**	(0.0067)
Efficiency x water	-0.0001	-0.0023	-0.0027	-0.0015
	(0.0016)	(0.0014)	(0.0014)*	(0.0057)
Telephone	-0.0068	-0.0075	-0.0065	0.0241
	(0.0021)***	(0.00024)***	(0.0025)***	(0.0066)***
Water	-0.0117	0.0056	-0.0042	-0.0084
	(0.0018)***	(0.0019)***	(0.0020)**	(0.0062)
Electricity	0.0224	0.0002	-0.0011	0.0423
	(0.0057)***	(0.0050)	(0.0051)	(0.0116)***
Average Customs Clearance	-0.0103	-0.0043		
	(0.0075)	(0.0069)		
Export Clearance			-0.0198	-0.0237
			(0.0098)**	(0.0089)***
Import Clearance			0.0144	0.0206
			(0.0093)	(0.0063)***
Log FMA	0.5677			
	(0.9918)			
Sec_cif_fob		0.1099	0.1098	0.0521
		(0.0280)***	(0.0279)	(0.0221)**
Electricity x generator	0.0015	0.0011	0.0013	0.0209
	(0.0044)	(0.0039)*	(0.0039)***	(0.0081)***
Observations	586	586	736	638

Absolute values of standard errors in parenthesis
*Significant at 10% level; ** significant at 5% level; *** significance at 1% level

Results from estimations are presented in Table 3.15 above. These results are consistent in showing that firm level characteristics like size and efficiency have significant influence on market diversification. The large fixed costs associated with setting up new international distribution or service network is generally easier for large enterprises. Additionally large firms have better access to finance than small enterprises and therefore able to shoulder these fixed costs associated with entering new markets. Being productive is imperative in that it enables firms to survive competition in these new markets. The results also suggest that being efficient when there are infrastructure related problems negatively affects geographical diversification of exports. This is because it makes it difficult to ensure timely delivery of exports, production of high quality goods and constant interaction with new or prospective customers. As for foreign ownership, results suggest that market seeking multinationals diversify by acquiring stakes in local firms or by establishing foreign subsidiaries in host countries. So a foreign owned affiliate represents some form of market diversification on the part of a parent company and that could be the reason why being foreign owned is negatively or not significantly related to diversification. The age variable is also insignificant mostly because of the fact that older firms are more conservative and risk averse and inflexible to adapting to changes important in diversifying or penetrating new markets.

Infrastructural variables like telecommunication, number of hours without telephone services and water, export clearing days have a significant negative impact on market diversification. Generator ownership is also positive and significant implying that reliable power is important for market diversification because it enables firms to circumvent power outages and ensure quality competitive goods are produced. However international transport costs variable is significant but with a wrong expected sign.

3.10 Marginal effects

In the tables 3.16 and 3.17 below we report the marginal effects of exogenous infrastructural indicators (measured in hours) calculated at their overall sample means. The idea behind the marginal effects in these tables is to investigate the extent by which differences in infrastructure quality in South Africa and Uganda explain the differences in export intensity. Uganda is a good

illustrative case since its manufacturing industries are significantly less export oriented than those of countries like South Africa and has a relatively large number of firms complaining about infrastructure related problems than other countries in the sample. (see table 2.3). South Africa is one of the countries with relatively good export intensity and quality of infrastructure in this study sample.

As potential exporters, Ugandan manufacturers have a clear disadvantage over their counterparts in South Africa in terms of infrastructural quality. Thus they appear to operate in an inferior infrastructure environment compared to South African firms (see table A3.2 and table 2.3). To get a sense of the power of infrastructural quality we estimate what Uganda's average firm level exports would be if it had the quality of infrastructure of South Africa while retaining all the other characteristics of Ugandan firms. We also estimate the impact on exports of changing the quality of infrastructure in South Africa to Ugandan levels. The results are as reported in the tables 3.16 and 3.17 below (using unconditional expected values). These results show that if Ugandan firms had the infrastructure similar to her South African counterpart, the fall in average exports would be lower than the current Ugandan levels. The reverse also happens when we change infrastructural levels in South Africa to Ugandan levels. The fall in exports due to poor infrastructure quality is higher than the current levels in South Africa. Thus it appears that it is possible for the gap between export levels of South Africa and Uganda to be minimized through increases in the number of exporters and the amount exported by improving the quality of infrastructure. These results also show that the cost disadvantages in Uganda come from not only poor infrastructure but even its longer distance from major international markets which increases international transport costs given by sectoral (cif/fob) values. Thus results on table 3.16 below show that if international transport costs in Uganda were the same as those incurred by South African firms the reduction in exports will be lower. The reverse is true for South African firms. Thus a Ugandan firm is some several miles away from the nearest port than the typical manufacturing firm in South Africa and this is made worse by the landlockedness of the country.

Table 3.16 Marginal effects on selected infrastructural indicators

Ugandan marginal effects at South African Infrastructure mean levels

Infrastructure Indicators (Hrs per day)	Unconditional Expected value		Conditional on being censored		Probability uncensored		All Countries		
	Uganda Levels	Uganda at S.Africa levels	Uganda Levels	Uganda at S.Africa levels	Uganda Levels	Uganda at S.Africa levels	Unconditional Expected value	Conditional on being censored	Probability uncensored
Power Outage hours	-1.0195	-0.0735	-0.9166	-0.0317	0.0215	0.0027	-1.6070	-0.8071	0.0233
Water problem hours	-0.2755	-0.0199	-0.2477	-0.1707	0.0058	0.0007	0.1609	0.0808	-0.0023
Telephone prob hours	-0.3879	-0.0279	-0.3488	-0.2402	0.0082	0.0010	-0.4354	-0.2187	0.0063
Custom delays days	-2.1149	-0.1524	-1.9014	-1.3104	0.0446	0.0055	-0.7596	-0.3815	0.0110
Sectoral (CIF/FOB	-10.7064	-0.7717	9.6252	0.6336	-0.2257	-0.0280	7.3350	3.6838	-0.1067

Table 3.17 South African Marginal effects at Ugandan Infrastructure mean levels

Infrastructure Indicators (Hrs per day)	Unconditional Expected value		Conditional on being censored		Probability uncensored	
	South Africa Levels	S.Africa at Uganda levels	South Africa Levels	S.Africa at Uganda levels	South Africa levels	S.Africa at Uganda levels
Power Outage hours	-1.8903	-2.7066	-1.3699	-1.8958	0.0597	-0.0504
Water problem hours	1.4063	2.0136	1.0191	1.4104	-0.0444	0.0375
Telephone prob hours	0.4524	0.6477	0.3279	0.4537	-0.0143	0.0121
Custom delays days	-0.3453	-0.4944	-0.2503	-0.3463	0.0109	-0.0092
Sectoral (CIF/FOB)	-0.3901	-0.5586	-0.2827	-0.3913	-0.0123	-0.0104

3.11 Conclusions

The primary objective of this chapter is to examine the role played by the quality of infrastructure and geography on amount exported and export participation. We also wanted to test whether some theoretical predictions made in models developed inter alia by Krugman and Venables (1995), Dixit and Stiglitz (1977) and Melitz (2003) are confirmed by our results. A sectoral analysis was also carried out to ascertain whether the impact of these variables is homogenous across sectors or varies from sector to sector depending on the manufactured product.

Although descriptive statistics show that exporting firms are older, larger in size, are more attractive to foreign investors, uses internet and rate infrastructural problems more than non exporters, results from regressions are somehow mixed and the impact of these supply side constraints appear to vary from sector to sector as well as from country to country. The statistical significance of firm specific variables like size, foreign ownership and internet access confirms a number of literature findings (Clarke 2004 who looked at 8 SSA countries, Clerides et al (1998) who looked at Columbia, Mexico and Morocco, Grenier et al (1999) for Tanzania, Bigstern et al (2004), Soderborm and Teal (2003) for Sub-Saharan African; countries Bigstern et al,2000; Tybout and Westbrook,1995; Bernard and Jansen, 1995). This therefore means that governments must remove measures that restrict firm growth, create an environment attractive to foreign investors and that promotes productivity as well as design policies that improve internet accessibility.

The significance of the international distance, electricity, customs and electricity- generator ownership interaction variables means that infrastructure and distance matter in influencing export participation. Thus the reason why very few firms in Africa are outward oriented is partly because of poor market access and poor infrastructure. It is important therefore for governments to channel more resources or find alternative ways of boosting infrastructural investment in their respective countries. The significance, also of customs infrastructure suggests the need for government to improve customs facilities by setting up systems (i.e. employing skilled labor, stamping out corruption and streamlining customs procedures and use of efficient information

and communication management systems) that will improve customs efficiency and hence minimize import and export transit days.

In the case of power outages, governments need to come up with proper financing mechanisms and regulations to make markets work in support of energy generation. This can be achieved either through the commonly used private public partnership arrangements or privatization or commercialization of state run power utility monopolies. Proper regulatory mechanisms can be used to minimize abuse of monopoly power by these privatized utility companies. By so doing, resources will be generated to build and maintain electricity infrastructure. The significance of the electricity – generator interaction variable also means that firms in countries with serious electricity problems should be encouraged or assisted in acquiring alternative energy sources like generators as this appears to improve the likelihood to export as well as geographical diversification of exports.

CHAPTER 3 APPENDIX

APPENDIX SECTION: Table A3.1: List of variables

Variables	Definition
Business Characteristics	
probexport	Exporting dummy =1 if % exported is greater than zero
Logsize	Log of number of employees
Logage	Log of age of firm
anyfor	Foreign ownership dummy=1 if there is foreign ownership
Internet	Internet dummy=1 if firm ha internet or website
Pexport	% of output exported (export intensity)
Efficiency	Cobb Douglas production function residuals
Geography / Market access variable	
Foreign market access: (LogFMA)	Measured using distance from nearest port
Sector_cif_fob	Alternative international distance indicator measured using cost, insurance and freight as well as free on board values
Market diversification	Equivalent number of markets (for measurement see equation 17)
Infrastructure cost variables	
Obs_telecomms	Telecommunication perception index
Obs_electri	Electricity perception indicator
Obs_transport	Transport perception index
Obs_customs	Customs perception index
Owngenrator	Generator dummy=1 if firm has one
Alternative infrastructure variables	***Used sector –regional averages***
Water problem hours	Number of hours without water per day
Power outage hours	Number of hours without electricity per day
Generator_outage_hours_interraction	Interaction variable using hours
Telephone problem hours	Number of hours per day without telephone connection
Custom delay days	Average number of days to clear goods at customs when importing and exporting
INSTRUMENTAL VARIABLES	
Infrastructure variables	***Used sector –regional averages***
telecomIV	Average perception or number of days/ hours without telecommunications
Domestic transportIV	Average perception indicator calculated over non exporting firms
customsIV	Average perception index or number of days to export and import
electriIV	Average perception index or number of days/ hours without electricity
electri_generator_interaction	Interaction variable
Country dummies	
dumtanzania	Dummy=1 if country is Tanzania
dumuganda	Dummy=1 if country is Uganda
dumzambia	Dummy=1 if country is Zambia
dums_africa	Dummy=1 if country is South Africa
dums_mauritius	Dummy=1 if country is Mauritius
Sectoral dummies	
Textile_Garment	
Food_agriculture	
Chemical_pharmacy	
Plapackaging	Plastic, paper and packaging sectors
Wood_furniture	
Construction_metal	

Table A3.2 Alternative measures of infrastructure quality by country

	All countries (%) (1598)		South Africa (%) (603)		Zambia (%) (207)		Tanzania (%) (276)		Uganda (%) (300)		Mauritius (%) (212)	
	All firms	exporters	All firms	exporters	All firms	exporters	All firms	exporter	All firms	exporters	All firms	Exporter
Power outages days	2.35	1.82	0.49	0.51	3.10	3.01	5.60	5.26	3.22	4.68	0.65	0.64
Power outages hours	6.37	6.22	4.12	4.29	5.47	4.72	7.84	7.20	9.06	14.8	7.23	6.98
Days without telephone	1.55	1.37	0.49	0.50	3.34	4.40	4.13	4.51	1.49	0.65	0.21	0.28
Hours without telephone	14.2	11.4	3.94	3.94	13.5	11.8	10.8	12.1	13.5	16.0	5.04	6.72
Days without water	2.02	1.80	0.42	0.43	2.08	1.34	8.74	8.90	0.51	1.45	2.06	1.99
Hours without water	12.9	13.9	3.42	3.57	9.75	9.83	13.2	13.6	20.8	15.6	11.4	12.2
% output lost due to power outages.	5.30	5.26	0.90	0.72	4.53	3.65	10.8	9.78	6.25	7.64	4.00	4.49
Import clearing days	8.02	7.37	6.75	6.76	4.81	5.24	18.5	17.1	9.73	7.93	5.45	5.32
Export clearing days	10.0	9.64	12.8	13.4	2.20	2.16	11.7	10.5	3.16	2.56	4.44	4.49
Sectoral—CIF / FOB ratio	1.85	1.82	1.57	1.60	1.37	1.42	1.86	2.09	2.74	3.03	1.60	1.62
Generator ownership (% firms)	30.0	34.0	10.0	11.0	38.0	50.0	55.0	80.0	36.0	78.0	39.0	38.0

Source: Author's own computations based on World Bank's Investment Climate Surveys

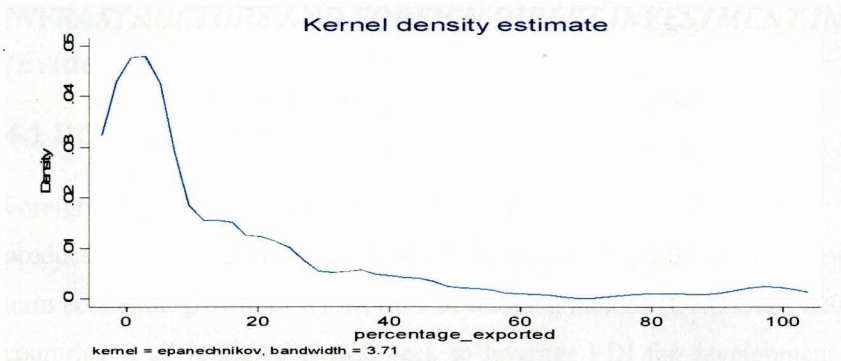
Table A3.3: Infrastructure perception indicators means by country and sectors

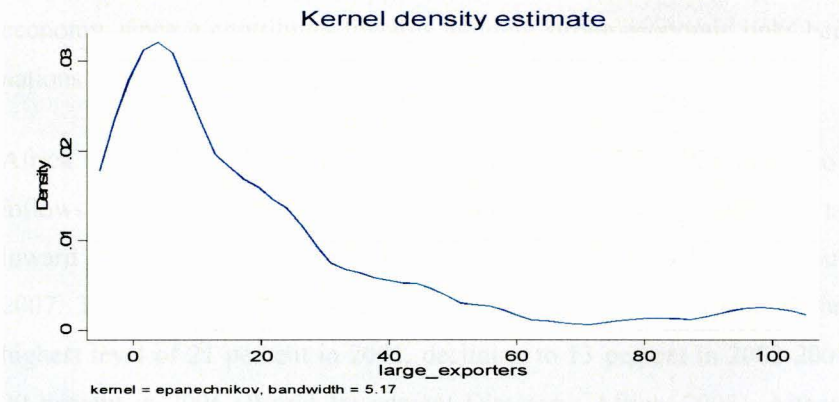
	Obstacle telecommunication		Obstacle transportation		Obstacle electricity		Obstacle customs and trade regs	
	Non exporters	exporters	Non exporters	exporters	Non exporters	exporters	Non exporters	exporters
South Africa	0.37	0.54	0.71	0.91	0.61	0.79	0.78	1.34
Zambia	1.41	1.99	1.54	1.70	1.81	2.18	1.61	1.52
Tanzania	0.99	1.08	1.34	1.74	2.55	2.73	1.44	2.17
Uganda	0.65	0.77	1.35	1.91	2.09	2.34	1.32	1.91
Mauritius	0.50	0.64	1.07	0.88	0.83	0.96	1.26	1.61
Textile_Garment	0.91	0.73	1.28	1.05	1.74	1.15	1.53	1.46
Food_agric	0.97	1.04	1.33	1.33	1.83	1.78	1.42	1.48
Chemical_pharmarcy	1.05	0.79	1.26	1.06	1.73	1.30	1.55	1.36
Plapackaging	0.84	0.65	1.20	0.94	1.52	1.05	1.42	1.26
Woodfurniture	1.06	1.02	1.28	1.19	2.08	1.69	1.40	1.33
Construction_metal	1.01	0.70	1.35	1.00	2.06	1.21	1.56	1.22

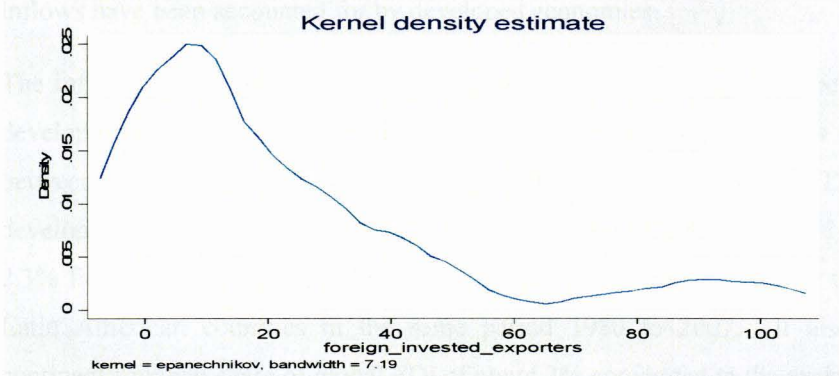
Source: Author's own computations based on World Bank's Investment Climate Surveys

Note: higher mean values imply greater obstacle. (0=no obstacle; 1=minor obstacle; 2=moderate obstacle; 3=major obstacle; 4=very severe obstacle)

Fig A3.1: Kernel densities of firms that export







CHAPTER 4

INFRASTRUCTURE AND FOREIGN DIRECT INVESTMENT IN AFRICA (Evidence from firm level data)

4.1 INTRODUCTION

Foreign direct investment (FDI)[52] has the potential to generate employment, raise productivity, transfer skills and technology, enhance exports as well as contribute to the long-term economic growth of the world's developing nations (UNCTAD, 2006). More than ever, countries at all levels of growth seek to leverage FDI for development (UNCTAD, 2007). FDI is also one of the most significant factors leading to the globalization of the international economy, since it contributes towards building strong economic links between industrialized nations and developing countries.

Africa has attracted increasing amounts of inward FDI in the past two decades, with FDI inflows rising from US$2.4 billion in 1985 to $52 billion in 2007 (see table 4.1 below) and inward FDI stock in the region rose from US$39 billion in 1980 to about US$393 billion in 2007. The ratio of FDI inflows to the region's gross fixed capital formation reached its highest level of 21 percent in 2001, declining to 13 percent in 2002-2004 and recovering to 20 percent in 2006 (World Investment Directory: Africa, 2008). Although absolute global FDI inflows have been increasing over the years since the 1980s, large shares of these inflows have been accounted for by developed economies.

The inflows of foreign direct investment into Africa have lagged far behind those of other developing countries in Asia and Latin America. According to Tables 4.1 and 4.2 below, between 1980 and 2007 the average percentage share of global FDI received by the developed world was about 73.5%, with Asian countries getting about 14.3% and a meagre 2.3% flowing to Africa. This African share is also four times less than that received by the Latin American countries in the same period 1980 to 2007. It also appears that the continent's annual share of global FDI of about 3% converged to the region's shares in world exports and world output (UNCTAD, 2007). Developed countries have also accounted for

[52] FDI is defined as the acquisition of sufficient assets or lasting interest in a foreign enterprise so as to have an effective voice in its management or to exercise managerial control (IMF, 1995:25). However acquiring 10% or more of assets of a foreign firm is the standard definition commonly used in practice.

the majority share of inward FDI stock and of flows to many African countries over various periods and some of the region's major recipient countries are Algeria, Nigeria, South Africa and Morocco (World Investment Directory, 2008). Most of the FDI stock coming to Africa originates in a few European Union countries namely United Kingdom, France, Portugal and Italy with United States representing the North American region (World Investment Report, 2008).

Table 4.1: Foreign Direct Investment Inward Stock by host region 1980-2007

	1980	1985	1990	1995	2000	2005	2006	2007
				Millions of US dollars				
World	704 256	963 352	1941 252	2914 356	5786 700	1 0180 063	12 470 085	15 210 560
Developed countries	401 680	578 373	1 410 962	2 051 355	3 987 624	7 187 182	8 766 020	10 458 610
% share in global stock	57.0	60.0	72.7	70.4	68.9	70.6	70.3	68.8
Developing countries:								
Asia	220 951	273 972	356 575	575 270	1 078 527	1613 586	2 016 072	2 706 635
% share in global stock	31.4	28.4	18.4	19.7	18.6	15.9	16.2	17.8
Latin America	40 959	68 473	110 547	185 123	502 900	829 324	945 029	1 140 007
% share in global stock	5.8	7.1	5.7	6.4	8.7	8.1	7.6	7.5
Africa	39 466	41 267	59 004	87 638	152 614	270 984	335 435	393 429
% share in global stock	5.6	4.3	3.0	3.0	2.6	2.7	2.7	2.6
South Africa	16 459	8883	9207	15 005	43 462	78 985	87 782	93 474
% share in Africa stock	41.7	21.5	15.6	17.1	28.5	29.1	26.2	23.8
Tanzania	342	386	388	620	2778	4390	5342	5942
% share in Africa stock	0.9	0.9	0.7	0.7	1.8	1.6	1.6	1.5
Zambia	364	459	1022	1553	2332	3775	4391	5375
% share in Africa stock	0.9	1.1	1.7	1.8	1.5	1.4	1.3	1.4
Uganda	11	9	6	277	807	2024	2425	2909
% share in Africa stock	0.02	0.02	0.01	0.3	0.5	0.7	0.7	0.7
Mauritius	26	43	168	253	683	805	910	1242
% share in Africa stock	0.07	0.1	0.3	0.3	0.4	0.3	0.3	0.3

Source: World Investment Report, 2008

NB: For associate and subsidiary enterprises, FDI stock is the value of the share of their capital and reserves (including retained profits) attributable to the parent enterprise (this is equal to total assets minus total liabilities), plus the net indebtedness of the associate or subsidiary to the parent firm. For branches, it is the value of fixed assets and the value of current assets and investments, excluding amounts due from the parent, less liabilities to third parties.

Table 4.2: Foreign Direct Investment Inflows by host region 1980-2007

	1980	1985	1990	1995	2000	2005	2006	2007
				Millions of US dollars				
World	54 077	55 887	207 278	341 041	1 398 183	958 697	1 411 018	1 833 324
Developed countries	46 577	41 696	172 115	220 956	1 134 564	611 319	940 880	1 247 661
% share in global flows	86.1	74.6	83.0	64.8	81.2	63.8	66.7	68.1
Developing countries:								
Asia	543	5 419	22 660	80 114	148 397	210 026	272 890	319 333
% share in global flows	1.0	9.7	10.9	23.5	10.6	21.9	19.3	17.4
Latin America	6 416	6 223	8 926	29 513	98 267	76 375	92 927	126 240
% share in global flows	11.9	11.1	4.3	8.7	7.0	7.9	6.6	6.9
Africa	400	2 443	2 805	5 655	9 671	29 459	45 754	52 982
% share in global flows	0.7	4.4	1.4	1.7	0.7	3.1	3.2	2.9
South Africa	-10	-448	-78	1 241	888	6644	-527	5692
% share in Africa flows	(2.5)	(18.3)	(2.7)	21.9	9.2	22.6	(1.2)	10.7
Tanzania	5	15	0	150	216	568	522	600
% share in Africa flows	1.3	0.6	0	2.6	2.2	1.9	1.1	1.1
Zambia	62	52	203	97	122	357	616	984
% share in Africa flows	15.5	2.1	7.2	1.7	1.3	1.2	1.3	1.9
Uganda	4	-4	-6	125	181	380	400	368
% share in Africa flows	1.0	(0.2)	(0.2)	2.2	1.9	1.3	0.9	0.7
Mauritius	1	8	41	19	277	42	105	339
% share in Africa flows	0.3	0.3	1.5	0.3	2.9	0.1	0.2	0.6

Source: World Investment Report, 2008

NB; FDI flows consist of the increase in reinvested earnings plus the net increase in funds received from the foreign direct investor. FDI flows with a negative sign (reverse flows) indicate that at least one of the components in the above definition is negative and not offset by positive amounts of the remaining components.

The industrial distribution of inward FDI stock and flows clearly shows that resource seeking FDI has traditionally played an important role in some African economies. In Botswana, the primary sector accounted for more than 60 percent of the FDI stock in 2005. In South Africa and Nigeria the major FDI recipients in terms of stock, the share of the primary sector has risen almost twofold and eight fold respectively since the mid 1990s, reflecting rising corporate profit and high commodity prices (World Investment Directory, 2008). Financial services accounted for a large share of inward FDI stock in Egypt, South Africa and Zambia while in Uganda the share increased from 18 percent in 2000 to 28 percent in 2003. In Mauritius as much as half of the FDI inflows went to the financial services sector. Only in a

few relatively small FDI recipient countries such as Madagascar, Namibia and the United Republic of Tanzania did the share of manufacturing FDI inflow increase in the 1990s although in Madagascar the share of the primary sector rose much more than that of manufacturing (World Investment Directory, 2008).

This sluggish inflow of FDI, particularly into manufacturing dampens the continent's efforts to foster economic growth and economic integration thus partly supporting the common belief that Africa will not be able to achieve the 2015 Millennium Development Goals (MDGs) [Commission for Africa report, 2005]. Thus, it would be difficult for the continent to achieve high levels of employment, reduce poverty and improve standards of living of many Africans, if growth enhancing FDI inflows continue to remain very low (Commission for Africa report, 2005).

The quest for growth in developing countries has therefore made cross-border investment by multinational firms to be the most salient feature of development strategies. Many countries in Africa have developed a variety of investment packages mostly in the form of export processing zones to attract multinational companies (UNCTAD, 2003). These packages include a number of incentives like tax holidays, export subsidies, special infrastructure facilities (warehouses and factory shells etc), tariff incentives, freedom from foreign exchange regulation and exemptions on profit repatriation restrictions as well as relaxed labour laws (Rolfe and White, 1991; Wallace 1990). This increase in the importance of cross-border investment has resulted in location choices of multinational enterprises receiving a great deal of attention from researchers across the world. Most of these studies have sought to understand the nature of firm specific as well as location specific factors that are important to multinational firms. They identified the following location determinants: market size (Head and Mayer, 2004; Coughlin *et al.*, 1991), labour cost (Wei *et al.*, 1999, Cheng and Kwan, 1999; Kinoshita and Campos. 2004 etc), infrastructure (Cheng and Kwan, 2000, Asiedu, 2002, Khadaroo and Seetanah, 2004, Wheeler and Mody, 1992, Loree and Guisinger, 1995; Morisset, 2000 etc), government policies (Head and Ries, 1996; Wu, 2000) and tariffs (Grubert and Mutti, 1991; Kogut and Chang, 1996; Bloningen, 1997) and institutions (Wei (2000a, 200b; Wheeler and Mody, 1992; Kinoshita and Campos , 2002; Kirkpatrick *et al*, 2006; Stein and Daude, 2001) Some researchers have stressed agglomeration effects, concluding that agglomeration economies are an important consideration when foreign investors make location choices (Head et al , 1995; Blonigen *et al.*, 2005; Crozet *et al.*, 2004;

Guimaraes *et al.*, 2000; He, 2002, 2003). The basic rationale is that greater numbers of foreign firms in a particular location generate positive externalities in terms of the availability of skilled workers, specialized services, intermediate products and shared knowledge (Head et al, 1995). Cheng and Kwan (2000) argue that huge market size and quality infrastructure are one of the location factors that can also lead firms to concentrate production in a particular area.

In this chapter, we also want to examine the impact of location factors (like infrastructure) and firm heterogeneity on foreign direct investment in Africa using firm level data. We however depart from the traditional approach that has been followed in the literature particularly with regard to the measurement of infrastructure variables. We propose to use infrastructure indicators measured at firm level as opposed to country wide indicators commonly used in the empirical African literature (see Schoeman *et al*, 2000; Morisset, 2000; Asiedu, 2002; Khadaroo and Seenatah, 2004). We control for infrastructure indicators by using the number of days or hours without electricity, telephone, water and customs whilst at the same time highlighting the importance of firm specific controls. Our argument is that energy consumption or generation per capita, percentage of paved roads and telephone density convey very little about infrastructure quality particularly if provision is characterised by poor maintenance of roads, intermittent power outages and poor telephone connections. It is true that a good measure of infrastructure quality should incorporate both infrastructure availability and reliability (Asiedu, 2002). The measures that we employ here however, only capture reliability. This is because infrastructure is of little use if it's not reliable and that is why we expect infrastructure reliability (how often are phone lines down) to be more important to foreign investors than availability (number of telephones lines per capita in a country).

The other problem with country level indicators is that there are not that many countries in the world on which there is good enough macro data on social infrastructure to derive robust statistical results[53] and the proxies used as explanatory variables do not provide much specific guidance about what countries need to do to improve their investment climates (Dollar et al, 2005). In addition to the fact that very few[54] FDI studies in Africa employ firm level data in

[53] See also Levine and Renelt (1992); Rodriguez and Rodrik (2000); Dollar and Kray (2003); Blonigen (2005)

[54] See Harvey and Abor, 2009 on Ghana.

their analysis, country level data assumes that the quality of infrastructure is the same across locations within a country, when in fact they may be interesting variations based on local governance (Dollar et al, 2005). Additionally, a number of studies that have examined the site determinants of FDI using firm level data have mostly looked at the characteristics of the investing firms not the characteristics of the firms that have attracted some foreign ownership (see for example Hong, 2008; Kinoshita, 1998; Chen and Moore, 2009; Dunning 1980). This study therefore provides another departure from this traditional approach. We attempt to investigate the characteristics of the invested firms that make them more attractive to foreign multinationals. Thus the question that we want to answer is: Do multinationals prefer investing in large firms, older firms or in firms with none unionized labour force? This study will not only help us understand the importance of location specific features but also the attributes of domestic firms that are attractive to multinationals who engage in mergers and acquisitions instead of Greenfield investment[55].

Furthermore, some studies have also shown that export-oriented FDI is driven by different factors than domestic market-seeking FDI (see Davis and Weinstein, 1999, 2003; Kumar, 2005; Woodward and Rolfe, 1993; Meyer 1995, Cheng and Kwan, 1999; Coughlin et al, 1991). Meyer (1995) found that market size and tariffs have a positive and significant influence on market seeking FDI whilst wages, transport costs and outward looking policy regimes are major determinants of export oriented FDI. Our aim in this chapter is also to use the available firm level infrastructure data to examine whether there are differences in the determinants of market seeking and export oriented FDI in our African sample. The identification of these effects is important in formulating infrastructure - specific industrial policies. This is because, to set appropriate industrial policy goals and make reasonable expectations about the effects of investment promotion policies, you need to understand what influences the location decisions of different multinational companies. Foreign investment problems facing countries mostly in Africa, particularly in manufacturing can only be understood and remedied successfully if policy makers have a clear understanding of the behaviour of these investors.

[55] In our data set the average amount of equity bought by a foreign multinational is about 78.3% and about 11% of foreign invested firms have 100% foreign ownership. These statistics suggest that mergers and acquisition could be the dominant form of investment by MNEs in these countries. See table 4.6 for more.

4.2 LITERATURE REVIEW

4.2.1 Theoretical literature

4.2.1.1 Mergers and Acquisitions

Foreign direct investment reflects the objective of obtaining a lasting interest by a resident entity in one economy in an entity resident in an economy other than that of the investor (Protsenko, 2003). The lasting interest implies the existence of a long-term relationship between the direct investor and a significant degree of influence on the management of the enterprise (IMF, 1993; OECD, 1996). "Significant degree of influence" and "long term relationship" are the key terms to distinguish FDI from portfolio investments, which are short term activities undertaken by institutional investors through the equity market. A "lasting interest" in foreign entity emphasises the difference to other forms of capital flows and occurs in form of know-how or management-skills transfer whilst "significant degree of influence" exist if the direct investor controls at least 10% of the equity structure of the invested firm (Michael and Elma, 2005).

Direct investment undertaken by foreign firms in a host country can take the form of either greenfield investment or mergers and acquisitions (M&As), depending on whether the transaction involves mainly newly created assets coming under control of the foreign firms, or just a transfer of existing assets from local firms, respectively (Calderon et al, 2004). In the case of M&A, one can draw a further distinction between cross-border mergers, which occur when the assets and operation of firms from different countries are combined to establish a new legal identity, and cross-border acquisitions, which occur when the control of assets and operations is transferred from a local to a foreign company (with the former becoming an affiliate of the latter) (Nocke and Yeaple, 2006). In practice, world M&As have been predominantly driven by acquisitions. According to Calderon et al, (2004), world cross-border mergers represented only three percent of cross-border M&As in 1999 and over 50 percent of cross-border M&As in 1999 took the form of full (or outright) acquisitions. Minority acquisitions by foreign firms (that is, purchases of 10% to 49% participation in total capital) represented one-third of acquisitions in developing countries and less than 20 percent in developed countries (see UNCTAD, 2000). According to UNCTAD (2000), the rise in M&A foreign investment in developing economies, especially Latin American was largely driven by privatization of state-owned enterprises, particularly in the utilities and financial services industries.

In today's fast moving, rapidly changing business and technological environment, the form of market entry in new foreign markets has become a crucial decision to most MNEs (Globerman and Shapiro, 2004). Several empirical studies have identified certain determinants that may affect the choice of entry strategy. In an early entry mode study, Dubin (1976) discovered that U.S. firms tend to favour greenfield investments if the firm size was large, targeting a developing country and had previously acquired foreign experience (cited in Kogut & Singh, 1988). Hennart and Reddy (1997) found that Japanese investors in the U.S. favour the use of acquisition rather than greenfield investment if the target market is characterized by high scale economies and high concentration levels. Caves and Mehra (1986) noted that the entry mode is driven by the form of entrant's corporate organization and the characteristics of its product market. Focusing on firms entering the U.S. market, they disconfirmed the hypothesis that previous investments in a country have an impact on a firm's choice to enter by greenfield over acquisition into the U.S. market. In addition, they indicated that acquired experience in these fields, e.g. knowledge of routinized processes in internationalization, will encourage a firm to choose acquisition rather than greenfield investment. In a similar fashion, Andersson and Svensson (1996) differentiate between technological and organizational skills of a firm and analyzed empirically their impact on entry mode choice. They come to the conclusion, that firms with strong organizational skills prefer takeovers, while firms with strong technological skills favour greenfield operations. Zejan (1990) also found that experience is insignificant and that takeovers become more common because of growing instability and uncertainty in host countries.

Dunning (2001) identifies the importance of cross-border M&As in the FDI process and offers a broad conceptual distinction among different modes of FDI. Specifically, he suggests that the location requirements of strategic asset-seeking FDI are different from those of natural resource, market or efficiency-seeking FDI. In particular, the presence of high quality physical and human infrastructure and a favourable political and commercial ethos towards M&As and cooperative alliances are especially important for strategic asset-seeking FDI. Other studies also suggest a variety of possible factors that conceptually make M&A activity a more likely mode of FDI in some countries than in others. For example, Pugel (1985) hypothesizes that the depressed U.S. stock market made entry by acquisition more attractive and more prevalent in the United States in the 1970s. Feliciano and Lipsey (2002) examined inward FDI in the United States for 50 industries over the period 1980-1990. They estimate

equations for the share of U.S. corporate assets acquired by foreign entities and the share of U.S. corporate assets accounted for by new foreign establishments. Several differences are identified. In particular, a higher price for the U.S. dollar discourages inward takeovers, whereas the exchange rate is not significantly related to foreign investment in new establishments. Higher U.S. stock prices are a stronger positive influence on foreign investment in new establishments than on foreign acquisitions. However, acquisitions and establishments of new firms both tend to occur in periods of high U.S. growth.

4.2.1.2 Export oriented and market seeking FDI

There are two main reasons for firms to engage in FDI and these include serving a foreign market and taking advantage of lower cost inputs. This distinction is used to differentiate between two main types of FDI: horizontal and vertical. Horizontal FDI refers to the foreign manufacturing of products and services roughly similar to those the firm produces in its home market (Aizenman and Marion, 2001). This type of FDI is called "horizontal" because the multinational duplicates the same activities in different countries. Horizontal FDI arises because it is too costly to serve the foreign market by exports due to transportation costs or trade barriers and is therefore a substitute of international trade (Fukao and Wei, 2008).

The first presentation of the horizontal model was by Markusen (1984). In its original version, the two countries are identical and Markusen compares equilibrium with one multinational enterprise (MNE) to that with two national firms. In the horizontal model, a MNE firm has two advantages over a national firm. The first advantage arises because headquartering is a joint input, that is, it can be used in multiple production locations, including those in other countries, without additional cost. Thus, if two national firms were producing the same amount as the single horizontal MNE, their average headquartering costs would be twice as great. The second advantage of the MNE is that by servicing a market through local production, it avoids trade costs. In determining the relationship between the skills difference and horizontal FDI, the key is to recall that the skill-intensive production of the MNE's good takes place in both countries. As one country becomes skill abundant relative to the other, it gains a comparative advantage in both headquartering and the production of the MNE's good. Thus, the MNE has an incentive to shift production and citizenship towards the skill abundant country. Therefore, as the skill differences rises, FDI goes down since the MNE produces less in the host. Two factors are important for the appearance of horizontal FDI: presence of positive trade costs and firm-level scale

economies. The main motivation for horizontal FDI is to avoid transportation costs or to get access to a foreign market which can only be served locally. Theoretical models of horizontal FDI are based on the trade-off between additional fixed costs from setting up a new plant and the saving of variable costs from avoiding tariffs and transportation.

The model predicts two situations when horizontal FDI will dominate over exports or crowd them out completely. The first is when the transportation costs are large in comparison to the plant fixed costs, while the second occurs when firm-level scale effects are larger than plant level scale effects. This means that the incentive for horizontal multinationals increases the greater are transport costs relative to fixed plant costs and the greater are increasing returns at the firm level relative to the plant level. The findings from the models of horizontal FDI can explain a variety of features of FDI flows. First, horizontal FDI reduces trade flows, since the market is served through local production instead of exports. Second, horizontal FDI takes place if the costs of importing are high relative to costs of investing. Third, horizontal FDI is more likely to occur in large foreign markets, which allows spreading fixed costs for the new plant over a large volume of production.

Vertical FDI takes place if the MNE geographically fragments its production by stages. The fragmentation of production occurs in order to exploit differences in relative factor costs. It is called vertical since the production stages in different countries are conducted one after another. The modelling of this type of FDI is based on the idea, that different parts of the production process have different input requirements. Since the input prices vary across countries it becomes profitable to split production, conducting for example labour intensive production stages in countries with low labour costs

The vertical model finds its genesis in Helpman (1984). In its original form, the model is described by a standard Hecksher-Ohlin model with the exception that the factors used in the production of the MNE's good can be combined across borders. This again shows that the skilled labour used in the headquartering activity can be geographically separated from the production activity. Here, there are no trade costs. As is typical in the Hecksher-Ohlin model, when the factor endowments of the two countries lie within the factor price equalization (FPE) set, the integrated world equilibrium can be achieved through trade in goods. In this case, there is no need for an MNE since there is no advantage to this structure relative to a national firm structure. Vertical FDI only exists when factor endowments lie outside the FPE

set, i.e. only when the skill difference between the parent and host countries is sufficiently greater than zero. If otherwise the difference in relative endowments of countries is not sufficiently large, trade in goods will lead to the equalisation of factor prices between countries. Then, there will be no incentive for the firm to separate headquarter and production activities and FDI will not occur. If, however, the difference in relative factor endowments is large, one country for example has a much higher endowment of labour relative to capital, then trade does not equalize factor prices. Here it is profitable for the firm to split activities, locating the labour-intensive part of production (e.g. assembling) in the labour-abundant country. Zhang and Markusen (1999) argue that the size of the host market has a negative impact on vertical FDI because the fixed costs for the new plant can be sooner covered in a larger market.

Another term related to vertical multinational activities is "export platform FDI", which has gained attention in recent studies. It is defined as production in a host country, with the output sold to a third market and not in the parent or local market. Thus, such a definition incorporates the features of vertical and of horizontal FDI as well. Here the foreign affiliate serves a large integrated market as a horizontal investment. But at the same time the location within the region is chosen on the basis of cost considerations, which is typical for vertical FDI (Ekholm et. al., 2003). However, empirical findings by Hanson et al., (2001) suggest a closer relationship to vertical FDI, since this type of investment is strongly cost driven and depends negatively on the size of the foreign market.

According to Pradham and Abraham (2001) export oriented FDI can be expected to generate strong links with local economy compared to market seeking- horizontal FDI in the host country because it is motivated to exploit the locational advantages offered by the host county like low-cost labour, raw materials, components parts etc. They argue that because of this, the scope for 'knowledge spillovers' from the entry of export FDI is much larger than from horizontal FDI. The presence of vertical FDI may also induce purely domestic firms to diversify into export market when information on foreign markets brought in by foreign firms spill over to them. Another important aspect in which vertical FDI is relatively beneficial vis-à-vis market seeking FDI is the possibility 'crowding-out' effect. Market seeking FDI being motivated to serve the domestic market can erode the market share of domestic firms because of their superior assets bundles. Vertical FDI on the contrary can stimulate domestic investment by generating demands for intermediate goods and besides being primarily

oriented to markets which are external to the country of location, are less likely to adversely affect domestic firms.

Recent work by Markusen, Venables, Konan,and Zhang (MVKZ, 1996) and Markusen (1997) has combined these two motivations for FDI into a unified approach called the Knowledge Capital (KK) model. According to Markusen and Maskus (1999) among others, one of the key methods for distinguishing between the horizontal and vertical motivations for FDI is to analyze the relationship between countries' relative factor endowments and FDI. In particular, the literature has focused on countries' relative supplies of skilled labor. According to the theory, horizontal FDI is greatest when countries have similar endowments since this supports production of the MNE's good in both countries Vertical investment, however, is greatest when countries have very different endowments since that creates large differences in factor prices

Horizontal FDI takes place between large, similar countries, whereas vertical FDI arises between a high-cost country and a low-cost country. Trade costs make horizontal FDI more attractive while they are discouraging vertical FDI. Both types of FDI have a positive impact on welfare by avoiding the duplication of headquarter activities and by making the global production more efficient. They differ, however, in the impact on wages. Vertical FDI reduces the absolute wage differences between countries and increase the relative wages within countries.

Further differences between vertical and horizontal FDI exists with respect to the mode of market entry. Potsenko (2004) found that in the Czech Republic, horizontal FDI takes place in almost 50 percent of all cases by acquiring local firms. One possible explanation for this was that, buying an existing firm gives the investor a quick access to a large market share. In addition, a well established local brand makes it easier to serve the new market. In contrast, 68.1 percent of export oriented vertical FDI choose greenfield investment as the form of market entry. These multinationals seem less interested in local brands, and a modernisation of existing old production lines could be more expensive than a completely new production site.

4.2.1.3 General theoretical determinants of FDI

Shatz and Venables (2000) distinguished between two main reasons why foreign direct investors would like to locate in a foreign country. The first one is to better serve the local

market and is called 'horizontal' or 'market seeking' since it results in a duplication of production plants. The main motivation behind horizontal FDI is to economize on tariffs[56], transport costs and to tap a new market. This type of FDI is a substitute for international trade and is mainly driven by market size and trade barriers. The second reason for locating in a foreign country is to have access to lower-cost inputs and also to overcome distribution problems and this FDI is called 'vertical' or 'production cost minimizing' since there is fragmentation. The motivation here is to economize on production inputs so as to maximise profits on each good produced.

However, the earliest theories of foreign direct investment were based on the theory of portfolio investment which assumes that international capital moves across borders in search of higher returns (Mcdougall, 1960). In this framework, international capital should flow from developed countries where there are lower returns at the margin, to developing countries where there are significantly higher returns caused by scarcity of capital. These theories were inadequate in explaining the behaviour of capital flows to developing countries which despite their low capital-labour ratios, continue to receive the least FDI relative to other parts of the world (Razin,et al 2004).

Due to the inadequacy of the portfolio theories of investment, economists began to explore alternative theories to explain FDI movement. The main questions were no longer related to factor movement; rather they were related to why companies wanted to extend their production activities across international borders and why they sought to control foreign production. Hymer (1960) provided the earliest attempt to answer these questions. Hymer's explanations were based on the industrial organization theory. Firms operating in a foreign country are seen as being at a disadvantage compared to domestic firms. The disadvantage arises because unlike domestic firms, foreign firms are not familiar with local conditions such as legislation, business culture, language, etc. Foreign firms must therefore have off-setting firm-specific advantages allowing them to compete with domestic firms. The firm-specific advantages include superior technology, scale economies and intangible assets such as managerial skills and brand names. These firm-specific advantages should be transferable across national boundaries at low costs, thereby providing a potential source of economies of scale. Hymer's theory predicted that a multinational enterprise arises in order to exploit its

[56] Also referred to as tariff jumping FDI.

firm-specific advantages in a foreign location. After Hymer (1960), later developments within the industrial organization approach placed emphasis on the special characteristics that make foreign firms competitive and the nature of market imperfections surrounding FDI.

Although the industrial organisation theories were able to explain why MNEs emerge, there was no explanation of how the MNEs made decisions on where to locate their international operations and in what form. This takes us to yet another important contribution in the development of FDI theory called the internalisation theory which is based on Coarse (1937) transaction costs theorem. Buckley and Casson (1976) gave the first explicit presentation of the internalisation theorem. The internalisation theory observes that different business activities are linked by flows of intermediate products, including not only ordinary semi-processed materials, but also knowledge in the form of technological know-how and skills embodied in goods and human capital. These links can be based on external market transactions. The theory further postulates that external markets are often inefficient particularly with regards to transactions in intermediate products that embody firm-specific intangible assets. This is because the specification and pricing of these products is particularly difficult. Moreover, external markets in knowledge-intensive products are difficult to organise, giving rise to high transaction costs. Buckley and Casson (1976) argued that a firm can overcome market imperfections by creating its own market or internalising hence investing abroad through FDI.

Dunning (1980) recognised that although the industrial organisation and the internalisation theories provided useful insights, both theories did not individually offer a comprehensive explanation of FDI. He then proposed an eclectic approach which combined the industrial organisation approach; the transaction costs economics, and the trade and location theory. In Dunning's original eclectic framework, the structure and intensity of MNE's foreign direct investment decisions are influenced by three factors: ownership-specific (O) advantages, internalization (I) advantages and location-specific (L) advantages.

In its original form, the eclectic paradigm stated that the extent, form, and pattern of international production is determined by the configuration of three sets of advantages as perceived by enterprises. First, in order for firms of one nationality to compete with those of another by producing in the latter's own countries, they must possess certain advantages specific to the nature and/or nationality of their ownership. These advantages sometimes

called competitive or monopolistic advantages must be sufficient to compensate for the costs of setting up and operating a foreign value-adding operation, in addition to the costs faced by indigenous producers or potential producers. Therefore ownership advantages are the MNE's possession of firm-specific competitive advantages over domestic firms in serving particular markets. These ownership advantages such as patents, know-how, trademarks, specialised management capabilities, scale advantages, organisational and marketing systems and innovatory capabilities are exclusive only to the firm that owns them and not accessible to any other firm, thus providing a potential source of economies of scale.

Internalization advantages refer to the benefits that accrue to the MNEs by choosing to enter the foreign market through direct investment rather than relying on international arms-length markets. This second condition for international production is that it must be in the best interests of enterprises that possess ownership-specific advantages to transfer them across national boundaries within their own organizations rather than sell them, or their right of use to foreign-based enterprises (Dunning, 1987). This immediately suggests that MNEs perceive that the international market place is not the best modality for transacting intermediate goods or services. The reasons for the internalization of markets includes the following kinds of market failure: (i) those that arise from risk and uncertainty (ii) those that stem from the ability of firms to exploit the economies of large-scale production and (iii) those that occur where the transaction of a particular good or service yields costs and benefits external to that transaction, but that are not reflected in the terms agreed to by the transacting parties (Dunning, 1987). These transaction market failures are normally expressed in the form of safeguarding supplies of essential inputs, ensuring the quality of end products, guaranteeing markets, protecting property rights and spreading the costs of shared overheads etc. The greater the perceived costs of transactional market failure, the more MNEs are likely to exploit their competitive advantages through international production rather than by contractual agreements with foreign firms.

Location-specific advantages refer to specific locational characteristics of alternative host countries that provide an MNE with the incentive to locate at least some part of their production activities in another country rather than in its home country. This strand of the eclectic paradigm is concerned with the "where" of production. Enterprises will engage in foreign production whenever they perceive it is in their best interests to combine spatially transferable intermediate products produced in the home country, with at least some

immobile factor endowments or other intermediate products in another country. Dunning (1987) argued that the choice of location is prompted by spatial market failure and that trade barriers have led to a lot of foreign manufacturing investment by MNEs. At the same time a reduction in transport costs, natural resources availability, cultural and political environment, factor prices, government policies regarding trade and local content requirements as well as the formation of customs unions or regional trading blocs have prompted greater regional specialization of production by MNEs (Dunning 1987b). While the O-advantage depends strictly on the characteristics of the firm and its business, the host country conditions and policies can influence the L and I advantages.

Whilst Dunning's original eclectic theory emphasized on locational advantages, he did not explicitly emphasis the role that infrastructure in the host country could play to influence industrial location. It was only after the early 1990s when there was growing emphasis on the role of infrastructure in economic growth that FDI theorists began to incorporate the role of these supply side variables in explaining FDI. In particular, recent extensions to the ownership location and internalisation (OLI) framework have placed a vital role on infrastructural factors as determinants of FDI in developing countries. Thus Dunning and Lundan (2006) contributed towards fusing the traditional OLI framework with infrastructural factors. They argued that good infrastructure create location advantages that foreign firms seek before operating and investing in the host country.

The earliest attempt at modeling the role of infrastructure particularly transport infrastructure was done indirectly by Krugman (1991) when he introduced the concept of economic geography in explaining industrial location. His model sought to answer why and when does manufacturing become concentrated in a few regions, leaving others relatively undeveloped with the remaining regions playing the "peripheral" role of agricultural suppliers to the manufacturing "core"? Using a two regions, two goods and two factors of production model and borrowing from the monopolistically competitive model initially developed by Dixit and Stiglitz (1977), as well as assuming iceberg transport costs, Krugman used his model to show that transport costs can encourage firms to concentrate or fragment production. One important message from his model is that if the size of the market for a good produced by a firm is huge in a certain region, then firms will concentrate production there. He called this, the "home market effect" suggesting that it is better to produce in that market than to export particularly if trade costs are high. On the other hand, if transport costs of moving goods from

one region to another are zero location is irrelevant but if they increase firms will move from the core to the periphery. He also argued that there is a threshold level of transport costs beyond which increases trigger manufacturing divergence. In short Krugman's model highlighted the importance of market size in industrial agglomeration and also the fact that high transport costs can lead to defensive investment.

Martin and Rogers (1995) went a step further and modelled the role of different types of infrastructure (domestic and international) in influencing industrial location. They proposed a new way of modelling public infrastructure which makes it possible to analyse its effect on trade patterns and industrial location[57]. His model differs from that of Krugman (1991) in that poor infrastructure impose costs on trade within and between countries rather than only on international trade *a la* Krugman. Using iceberg transport costs as in Krugman (1991), they also differentiate between infrastructure that facilitates domestic production (domestic infrastructure) and infrastructure that facilitates international trade (international infrastructure). Thus the iceberg costs are modelled to affect the transportation of goods from foreign markets as well as transportation to final destination at home. In this case infrastructure costs are lower when the good is produced at home than when it is produced abroad because it has to incur both domestic and international trade costs. Their model which is a variant of Helpman and Krugman (1985) and Krugman (1991), assumes two countries (home and foreign), two factors of production (capital and labour) which are used to produce a variety of differentiated goods, fixed by the endowment of capital in each country. This model shows that when trade is integrated, firms will locate in countries with good domestic infrastructure. Thus poor domestic infrastructure will increase the price of home differentiated goods for domestic consumers and will therefore decrease the demand for these goods and increase the demand for foreign goods. To take advantage of the high demand in the country with better domestic infrastructure and therefore returns to scale, firms will locate in this country. In this model, differences in international infrastructure do not induce industrial location but good international infrastructure increases the sensitivity of industrial location to differentials in domestic infrastructure. Agglomeration of firms will occur if the difference in domestic infrastructure is important and if international infrastructures are strong. This result mirrors Krugman's (1991) finding that if transport costs are low and

[57] They interpreted public infrastructure to include any facility or institution provided by the state which facilitates production and consumption. This interpretation incorporates not only transport and telecommunications but even law and order.

economies of scale are strong, manufacturing will concentrate in one country. They also arrive at the same conclusion as Krugman (1991) in showing that differences in market size will result in firms locating in country with largest market.

Martin and Rogers (1995) model does not distinguish between export infrastructure and import infrastructure on the argument that it is difficult to think of many infrastructures that would facilitate exports but not imports and vice versa. This model assumed that improvement in the quality of infrastructure implies symmetric reduction in transactions costs for both exports and imports. This assumption is justified in their model on the grounds of simplicity. However, Kikuchi and Iwasa (2009) argue that infrastructure improvements often cause asymmetric reductions in transaction costs. For example, an improvement in the quality of a region's local transport networks affects the region's imports more than its exports. Kikuchi and Iwasa (2009) illustrated their argument using a simple two region two good and two factor model. By using iceberg costs they show that an improvement in the quality of import infrastructure in one region sets into motion two effects. The first one is that it lowers trade costs and increases the effective number of imported varieties resulting in a fall in local demand for locally produced varieties. Secondly easier access to a region with high quality import infrastructure increases the advantage of locating in the other region with poor import infrastructure. These two effects reinforce each other and induce firms to move away from the region with good import infrastructure. According to this model, although better import infrastructure reduces import transaction costs, it also induces industrial diversion and raises the transaction costs of receiving products from those industries that relocate elsewhere. In this model, the possibility that industries will be diverted provides some theoretical grounds for the coordination of infrastructure investments among regional economies.

4.2.1.4 Summary

These models that relate industrial location to infrastructure agree that the presence of quality infrastructure is seen as reducing any type of costs that affects the amount of output that reaches the consumer commonly referred to as iceberg costs (Krugman, 1991, 1993; Martin and Rogers, 1995; Kikuchi and Iwasa (2008). This characterization does not only capture the key role played by transport infrastructure but also by other types of infrastructure that may have an effect on output such as telecommunication or electricity. Assuming that infrastructure is supplied mostly by the government, the presence of quality infrastructure affects the location decisions of foreign firms in many ways. First the presence of good

infrastructure significantly reduces firm's output costs providing a positive incentive for vertical foreign direct investment in cases where MNEs base their location decisions purely on a cost basis (Markusen, 1984). Secondly improved public infrastructure also provide a negative incentive for the location of horizontal FDI or investment motivated by the avoidance of transport and other input costs (Castro et al, 2007). In this case, foreign companies may choose to supply the country from a subsidiary located in another country instead of locating a plant there, thereby reducing FDI inflows into the host country.

Martin and Rogers (1995) argue that in the presence of economies of scale public expenditure in domestic infrastructure may have different impacts on the geographical distribution of FDI inflows than expenditure in regional infrastructure or public infrastructure aimed at enhancing market access to neighbouring countries. In such settings foreign firm will tend to locate in countries with the best domestic infrastructure in order to take advantage of economies of scale. In contrast, regional infrastructure may influence the sensitivity of foreign firms' investment location decisions to infrastructure differentials and hence actually reduce FDI in the countries with poor domestic infrastructure. The overall effect of regional infrastructure is therefore ambiguous a priori as it depends on the existing stock of domestic infrastructure in each host country (Castro et al, 2007). Third public infrastructure could also enhance access to intermediate goods suppliers in neighbouring countries providing a positive incentive for complex FDI location strategies, where MNEs locate different production activities in separate geographic regions. Thus theory does not suggest an unambiguous and unique effect of a reduction in transport or other input costs caused by improvements in public infrastructure on the spatial location of FDI. The multiplicity of these theoretical channels implies that disentangling the true effects of infrastructure quality on FDI location primarily remains an empirical issue (Castro et al, 2007).

The above discussion also highlighted the fact that mergers and acquisitions have been the dominant mode of entry by multinationals in many countries. The factors that played a role in attracting this kind of investments in host countries include inter-alia, privatisation programmes, instability and uncertainty, level of respect for private property rights, stock market performance etc. These surveys also found that accumulated international business experience of a company is an important determinant of the company's choice between M&A and joint ventures as an FDI mode. Firms with more international business experience are more likely to choose the M&A mode and this suggest that countries home to "experienced"

MNEs will have higher shares of outward FDI taking the form of M&A than will countries home to relatively inexperienced MNEs. This section also discussed the difference between horizontal and vertical multinationals and argued that the former is motivated by market size and trade costs whilst the latter is a result of differences in factor prices between countries. Vertical multinationals are also seen to be trade creating or complementing whilst horizontal FDI is a substitute for international trade.

4.2.2 Empirical Literature review

Root and Ahmed (1979) were among the first scholars to establish a positive role of general infrastructure on FDI. They used a data set of about 70 developing countries over the period 1966 to 1970 and employed a multiple discriminant analysis technique since they were dealing with categoric rather than continuous data. They measured infrastructure variables using transport expenditures as a proportion of GDP, communication expenditure as a percentage of GDP and electricity production per 1000 people. Their results show that developing countries that have attracted the most nonextractive direct foreign investment on a per capita basis are those that have substantial urbanization, a relatively advanced infrastructure, comparatively high growth rates and per capita GDP, and political stability. Similar results were also obtained by Wheeler and Mody (1992) using a panel data model of 42 countries from 1982 to 1988. They found that infrastructure quality (transport, communication and energy) is an important variable for developing countries seeking to attract FDI from the United States, but less important for developed countries that already have high quality infrastructure.

In an attempt to study inter-temporal linkages and regional distribution of FDI, Cheng and Kwan (2000) estimated the effects of the determinants of foreign direct investment in 29 Chinese regions from 1985 to 1995 using Chow's (1997) partial adjustment model. Their study is different from the conventional empirical studies in that it recognized that investment flows depends on the actual stock of capital and this takes time to adjust towards the target stock of FDI which changes with the environment. They postulated that the desired stock of FDI in region one in period t is a function of the region's infrastructure, labour quality, wage rate, regional income. In measuring infrastructure, they used total lengths of roads per unit of land mass, the total lengths of high grade paved roads per unit of land mass and the total lengths of railway per unit land mass. On quality of labour they experimented with the percentage of the population with at least primary school education, junior secondary school

education and senior secondary school education. In their results they found that good infrastructure (roads) contributed to FDI but high grade paved roads did not perform any better than all roads. They also found that wages had a negative effect on FDI in contrast with Chen (1996) finding that wages did not affect FDI as well as Head and Ries (1996) that the effect of wages was negligible. None of the education variables used had a significant impact on FDI. They also found that the region's market as approximated by regional income has a positive effect on industrial location. They also found a self reinforcing effect of FDI on itself something consistent with the agglomeration effect identified by Head and Ries (1996), where they argued that FDI attracts further FDI. The problem however with their self reinforcing effect is that they assumed it to be the same for all regions implying that the "Gompertz growth curves" for all regions FDI stocks share the same slope. To improve the model, it may be desirable to have measures of region specific self reinforcing effects which takes into account the differences in the accumulation of FDI stocks.

Kumar (2001) departed from using individual indicators of infrastructure and constructed a composite index for infrastructure availability which captured availability of transport, telecommunication, information and energy. He used data from 66 developed and developing countries across the world over a period 1982 to 1994 and employed principal component analysis. Using overseas affiliates of US and Japanese firms, he found that infrastructure availability is important for outward oriented FDI. He constructed an infrastructure index for the study countries for the periods 1982, 1989 and 1994. The aspects of transport infrastructure that they used to construct availability and quality is roads length per square kilometre of area and commercial vehicles per 100 inhabitants. On telecommunication they used telephone density measured using telephones per 1000 people whilst for information they used intensity of electronic and print media measured as newspapers and television per 1000. Energy availability was measured using energy use per inhabitant. In differentiating between exports oriented FDI and domestic oriented FDI, he argued that domestic oriented FDI is governed by different factors than is domestic market seeking FDI. Thus by being efficiency seeking export oriented FDI could be more sensitive to availability of quality infrastructure than overall FDI. He also argued that there are two distinct types of export oriented FDI, the one serving primarily the MNEs home market and those serving third countries. He found that the quality of infrastructure has a positive and significant coefficient while explaining third country orientation of exports of both US and Japan. The infrastructure

index they created had a positive and significant effect when explaining home market orientation of US affiliates but insignificant for Japan.

Employing a different econometric technique, Castro et al (2007) looked at the impact of infrastructure on the location of FDI in Argentinean provinces using spatial econometric techniques. They estimate their spatial models using maximum likelihood techniques and the Generalized Spatial two stage least squares model. They used FDI determinants like infrastructure, market size factor endowments, and public expenditure. On infrastructure, they used two proxies for road networks; total roads length and paved roads whilst for electricity they used installed power capacity and gross electricity generation. Host market size was proxied using gross provincial product. They proxied skilled and unskilled labour using per capita primary and secondary school enrolment respectively. Their results show that paved roads matter for FDI but other proxies of infrastructure do not seem important. More precisely they found that increasing the kilometres of paved roads by 10% increases FDI in the host province by between 17% and 33%. The results also show a robust home market or domestic market size effect but the electricity variable shows a negative significant sign.

However, Woodward and Rolfe (2002) analyzed the location of export-oriented manufacturing investment in the Caribbean Basin, using micro data for all reported manufacturing plant openings from 1984-87. They test a broad range of influences on country selection and compared the results with the existing literature on foreign direct investment in less developed countries. The probability of country selection was estimated with a conditional logit model. The estimates were then used to predict the location of Caribbean Basin investments made in 1988 and 1989. They argued that since a nation's infrastructure incorporates many facets of the economy, a proxy measuring one aspect of infrastructure, such as communications, may not reflect the quality of infrastructure in other respects, such as transportation. To them, per capita GNP provides information about the general quality of infrastructure in the country. Their arguments are based on Coleman and Nixson (1986) finding that economic and social indicators are highly correlated with the level of GNP per capita. Their results show that per capita GNP has a positive effect on foreign investment whilst transport costs have a negative significant impact.

Hong (2008) also departed from using country level data and employed firm level analysis. He developed a model which indicates that foreign firms' location choices are determined

jointly by site attributes and firm heterogeneity. The model is estimated using data on 2565 foreign manufacturing investments in China's 21 provinces gathered by the government between 2004 and 2005. The conditional logit estimates and simulation results provide supportive evidence. An increase in a firm's labour intensity magnifies the impact of labour cost, while a location's communications infrastructure has a stronger influence on foreign firms that have adopted modern information technology. To control for transport infrastructure he used the proportion of road length over land area and for communication infrastructure he used the proportion of internet users in the population of the province. Results show that better infrastructure appears to reduce relevant costs and facilitate business operations. Road density and percentage of internet users included in the model are found to be important considerations when foreign investors choose locations. In order to examine whether the importance of infrastructure varies with firm-specific characteristics, he included interaction terms between local communications infrastructure and firms' adoption of modern information technology. The coefficient estimate is positive and significant, suggesting that firms adopting modern information technology put more emphasis on local communications infrastructure when they make location decisions.

In the African context, a study by Asiedu (2002) where she analyzed 34 countries over a period 1980 to 2000 and used infrastructure indicators like the number of telephones per 1000 people and also controlling for classical FDI determinants (like market size, cost of labour and skills) concluded that countries that improved their infrastructure were rewarded with more investments. Using OLS, she found that a unitary increase in telephone density leads to 1.12 percentage increase in FDI/GDP.

Another study that used African data was done by Khadaroo and Seetanah (2004). They applied static and dynamic panel data models like Generalised Methods of Moments (GMM) to study the role of transport infrastructure on FDI in 33 Sub Saharan African countries for the period 1984 to 2002. They measured transport infrastructure using the length of paved roads per square kilometre of area. They proxied communication infrastructure by the number of telephones available per 1000 people arguing that availability of telephones is important to facilitate communication between the home and host countries. This is the same variable that was also used by Loree and Guisinger (1995); Asiedu (2002) Alam and Quazi (2003). They also controlled for non infrastructure variables like market size measured using per capita GDP and labour quality proxied using general secondary education enrolment.

Their results show that transport and communication infrastructure are important in attracting FDI and the same is true for market size as well as quality of labour.

Sekkat and Veganzones Varoudakis (2004) estimated a correlation for infrastructure of 0.45 for the case of Middle East and North African countries (MENA) in the 1990s and a lower correlation coefficient of 0.21 for the manufacturing sector. Using panel data econometric techniques and a sample of 26 countries and data from 1990 to 1999, they reported that if the MENA countries had increased their infrastructure to the level of the East Asian economies, FDI flows could have reached 2.5% of GDP compared to 1.2%. The only measure of infrastructure that they used was number of telephone lines per capita. They found that infrastructure effects are higher for FDI in the manufacturing sector than total FDI.

Although many studies found a positive relationship between FDI and infrastructure measures, some studies however failed to confirm the positive relationship. In a cross country study, Shepotlylo (2006) was not able to find any correlation between a measure of infrastructure stock and the pattern of geographical location of FDI in 24 transitional countries. Bronzini (2004) using a maximum likelihood tobit model, did not find any significant impact of public infrastructure on the spatial distribution of FDI inflows across Italian regions. He used an infrastructure index standardized by province size which incorporated roads railways ports, airports and telecommunication. The insignificance of the infrastructure variable however, could be due to the fact that the variable is highly correlated with another variable that was used and referred to as regional density. The correlation matrix between these variable shows that a denser area is more endowed with infrastructure and their inclusion in the same model could have biased results. Quazi (2005) could also not establish a positive and significant relationship between infrastructure measured as the number of telephones per 1000 people and FDI using a panel data from 1995 to 2000 from a sample of East Asian countries. Fung et al (2005) examined whether hard infrastructure, in the form of more highways and railroads or soft infrastructure in the form of more transparent institutions leads to more FDI. By controlling for other FDI determinants like market size and human capital and using data from USA, Japan, Korea, Taiwan, Hong Kong and China, they also found that soft infrastructure is a more important determinant of FDI than hard infrastructure.

4.2.2.1 Horizontal and vertical empirical studies

One of the main difficulties in estimating the theories of vertical and horizontal FDI is the lack of empirical data. Official FDI statistics do not distinguish between vertical and horizontal FDI, thus making empirical studies only possible with firm level data

Pradham and Abraham (2005) estimated a Tobit model using Indian manufacturing firms to examine the impact of firm and location specific factors on export oriented FDI. They used variables like firm age, firm size, labour productivity etc. They calculated a composite index of six different aspects of infrastructure such as road length per square kilometre of area, commercial vehicles per 100 inhabitants, telephones per 100 inhabitants, televisions per 100 inhabitants, newspapers per 1000 inhabitants, and energy use per inhabitant. Using different equity ranges from 10-25 up to 85-100 they found that low level of general skills, infrastructure bottlenecks, and failures to use bilateral investment treaties as tools for attracting export oriented FDI are main factors lowering the attractiveness of India as compared to others.

Fukao and Wei (2008) also looked at the differences in the locational determinants of vertical and horizontal FDI using firm level manufacturing data from Japan for the periods 1992 – 2002. Using a conditional logit model and controlling for variables like wages, skills, electricity infrastructure (proxied using electricity generation per capita), market size, tariffs and distance, they found that market size is positive and significant for horizontal FDI whilst negative and significant for vertical FDI. The labour cost (wages) and skills variables are all negative and significant for vertical FDI as suggested by theory. This suggests that vertical firms that are aiming at cheap production factors are more interested in low-skilled low-wage labour. They also found electricity infrastructure to have a positive impact on vertical FDI and negative on horizontal FDI. This suggests that good infrastructure is more important for vertical FDI than horizontal in that it helps in reducing production costs. Production for export may be more sensitive to production costs in host countries because the firm can choose an alternative location to serve a broader market.

Aizenman and Marion (2001) using cross sectional analysis of 103 countries over the period 1980 to 1999 looked at the impact of uncertainty measured using output and exchange rate volatility on both vertical and horizontal FDI. Their results suggest that volatility increases horizontal FDI but discourages vertical FDI. Assuming that emerging markets attract

relatively more vertical FDI than do mature markets, results show that output volatility appears to have no noticeable effect on FDI inflows, real effective exchange-rate volatility has significant and differential effects on FDI into mature and emerging markets. The correlation between exchange-rate volatility and FDI inflows is positive and significant for relatively high-income countries. For lower-income countries, the correlation is not negative, but it is insignificantly different from zero. According to Aizenman and Marion (2001), this finding is consistent with the view that greater uncertainty discourages vertical FDI and emerging markets attract a relatively greater share of vertical FDI.

4.2.2.2 Summary

The empirical studies on the relationship between infrastructure and FDI have partly confirmed the ambiguous relationship between these two variables and also shown that these studies including micro level studies have tended to proxy infrastructure variables using country wide indicators. However there are few if not none studies that have attempted to differentiate between domestic and international infrastructure or between export and import infrastructure in their analysis. The empirical literature has also shown that there is very little that has been done to analyse infrastructure particularly in Africa using firm level data. This is the gap that this chapter attempts to fill.

4.3 The model

Most of the models that we discussed under the theoretical literature right from Krugman (1991), Martin and Rogers (1995), Kikuchi and Iwasa (2008) as is the case with all other industrial location models converge in pointing out that profit maximization is very important in influencing industrial location. All these models however analyzed the role of infrastructure mostly from the consumption side and not from the production side. This approach enabled Martin and Rogers (1995) to capture how infrastructure facilitates trade between and within countries and Krugman (1991) to show how differences in transport costs between regions result in firms locating production in the region with high transport costs so as to avoid these costs. The inability of these models to show how production costs are affected by infrastructure quality makes it difficult to relate firm behaviour to industrial location. A model that attempted to fill this gap was developed by Head and Mayer (2002).

Our theoretical model below (which forms the basis of the empirical estimations) draws largely from the work of Head and Mayer (2002). It is also supplemented by the works done

by Dixit and Stiglitz (1977) as well as Krugman (1991). This model assumes that the locations available to a multinational enterprise are made up of N heterogeneous countries ($j = 1, \ldots\ldots\ldots\ldots, N$) and country heterogeneity is defined by both economic (e.g market size, labour costs, infrastructural costs) and spatial (market access) characteristics (Head and Mayer, 2002). In this model foreign investments are supposed to arise only once positive profit opportunities are available in some locations.

4.3.1 Consumer behaviour

The utility of a representative consumer in each country i is a CES function which depends on the quantity of each variety $h = 1, \ldots\ldots\ldots\ldots, n_j$ consumed of a differentiated good produced in country j and is given as follows:

$$U_i = \left[\sum_{j=1}^{N} \sum_{h=1}^{nj} \left(q_{ijh} \right)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \qquad \sigma > 1 \qquad (18)$$

where q_{ijh} is the quantity of the h variety produced in country j and consumed both in country i and j; σ is the elasticity of substitution among the differentiated products and is assumed to be greater than one. Maximizing this utility function subject to the budget constraint given by the expenditure of country i on all varieties produced in all other countries,(i.e $k = \sum_j n_j$) and if we let M_i to represents this budget constraint, the associated demand function is as follows:

$$q_{ijh} = \frac{\left(p_{ijh} \right)^{-\sigma}}{\sum_k n_k p_{ij}^{1-\sigma}} M_i \qquad (19)$$

where p_{ijh} is the delivered price or import price (c.i.f) faced by consumers in country i for products from country j. This delivered price is a product of the producer price p_j and the trade costs factor τ_{ij}. Trade costs include all transaction costs associated with moving goods across space and national borders. The quality of transport, telecommunications as well as customs infrastructure plays an important role in determining these trade costs.

4.3.2 The Profit Equation for Foreign Affiliates

The model also assumes that each firm sets its producer price to maximize profits and following Dixit and Stiglitz (1977), firms treat the elasticity of substitution as if it were the price elasticity of demand (this may be interpreted as the assumption that each firm has infinitesimal market share). The producer prices are simply mark ups over marginal costs denoted c_r : $p_r = c_r(\sigma/(\sigma-1)$. Substituting into the above demand function, equation (19), we obtain the quantity that each firm producing in country j would deliver to each destination country i :

$$q_j = \frac{(\sigma - 1)}{\sigma} \frac{(c_j \tau_{ij})^{-\sigma}}{G_j} M_i \tag{20}$$

where $G_j \equiv \sum_k n_k (c_k \tau_{ik})^{1-\sigma}$. The gross profit earned in each destination country i including home for a firm producing in country j is

$$\pi_j = (p_j - c_j)\tau_{ij} q_j = \frac{(c_j \tau_{ij})^{1-\sigma}}{\sigma G_j} M_i \tag{21}$$

This gross profit function can also be expressed as follows:

$$\pi_j = \frac{c_j^{1-\sigma}}{\sigma} \sum_{i=1}^{N} \frac{1}{\sum_k n_k (c_k \tau_{ik})^{1-\sigma}} \tau_{ij}^{1-\sigma} M_i \tag{22}$$

These profits are a decreasing function ($\sigma > 1$) of local production costs c_j in the same country j, a decreasing function of the intensity of competition with rivals [$\sum_k n_k (c_i \tau_{ij})^{1-\sigma}$], itself increasing with the number of rivals n_k and decreasing with the production costs they face. The profits are also an increasing function of the market potential ($\sum_{i=1}^{N} \tau_{ij}^{1-\sigma} M_i$ of country j, i.e. the total demand that is accessible from a plant located in country j.

Summing the aggregate gross profits earned in each market and subtracting the fixed costs F_r necessary to establish a plant in country or region r, we obtain the aggregate net profits to be earned in each location r

$$\Pi_r = \frac{C_r^{1-\sigma}}{\sigma} \sum_{i=1}^{R} \frac{1}{\sum_k n_k (c_k \tau_k)^{1-\sigma}} \tau_{ri}^{1-\sigma} M_i \quad - F_r \tag{23}$$

This expression can be re arranged as follows, assuming that invariant fixed costs do not affect profit ordering of countries and therefore can be omitted.

$$\Pi_r = \sum_{i=1}^{R} \frac{1}{\Theta_r} \Gamma_r \Psi_r \tag{24}$$

With $\Gamma_r = \sum_{i=1}^{R} \left[1 \Big/ \sum_k n_k (c_k \tau_k)^{1-\sigma} \right]$ a measure of the comparative advantages of country j with respect to the other countries, we assume that this comparative advantage is determined partly by the availability and efficiency of infrastructural services. This is because differences in trade costs across countries and between different types of infrastructure is a source of absolute and comparative advantage which affect the volume, direction and composition of foreign direct investment. (World Trade Report, 2004). $\Theta_r = \frac{\sigma}{c_j^{1-\sigma}}$ represents the total production costs of a firm located in country r . We assume here that firm size, unionization and labour quality are variables that can influence these costs. Financial economies, efficiency from large scale production, restrictive labour contracts and productive skilled labour affect the costs of producing goods in any firm and $\Psi_r = \sum_{i=1}^{N} \tau_{ij}^{1-\sigma} M_i$ measuring the market potential of location r. This is also similar to Krugman (1991) market access variable.

Thus according to the above profit equation, a given country might be characterized by higher profits than a rival location when the country is characterized by a large increase in the market potential and if the quality of infrastructure is good and costs of transporting goods across borders as well as factor inputs are relatively cheaper.

By taking logs these potential profits made by a foreign firm located in region r can be represented as follows:

$$\pi_r = \sum_{j=1}^{R} \gamma_r + \sum_{j=1}^{R} \psi_r - \upsilon \ , \qquad (25)$$

where γ_r refers to the (log) comparative advantages of country r with respect to the other locations. We assume that this comparative advantage is influenced among other things by the quality of infrastructure in country r. The term ψ_r captures the rth country's (log) market access and the last term captures production costs which are an increasing function of factor inputs, unionization and a decreasing function of firm size, labour quality etc. Thus if we assume like in Head and Mayer (2002) that the variable cost function $\Theta_r = \frac{\sigma}{c_j^{1-\sigma}}$ is assumed to be a Cobb Douglas then these costs will be a function of factor inputs and total factor productivity. This total factor productivity could be assumed to vary with firm size, unionization and quality of labour.

Thus when an MNE firm chooses its location, the only relevant information is the ordering of the profits. Thus if a location is chosen as the destination of FDI, then from an investor's point of view, it must be more profitable to produce in that location than in others, given the location choice of other investors. If the goods are produced for exports as in the case for outward oriented FDI the cost of producing the goods and the costs of transporting them to the world markets as well as the size of the firm could be crucial. But if the goods are produced for the local market as in the case of market seeking FDI, then local demand factors and even the age of the firm would matter. Therefore profitability for a firm of locating in a certain country is a very simple function that is decreasing in production and trade costs and increasing in the market potential. Production and trade costs are influenced by the cost of inputs like labour and capital as well as quality of infrastructure services as well as specific features of foreign owned firms.

This theoretical model forms the basis of the binary choice model we will estimate. Thus the parameters that indicate the characteristics of firms that are foreign invested and the features of potential host countries are estimated using maximum likelihood Probit model.

4.3.3 Estimated FDI Model

The general Probit model assumes the following specification

$$y_i^* = \alpha + \sum_{j=1}^{K} \beta_j X_{ij} + u_i \quad (26)$$

Where α is the common intercept across all firms, X_{ij} is the vector of both firm and non firm specific(external) explanatory variables summarized by $\sum_{j=1}^{K} \beta X_{ij}$ excluding the error term. *i* = 1...N (the number of firms), j = 1 ...K (the number of explanatory variables) and y_i^* is an unobserved variable that can only be observed in a dichotomous state such that

$$y^*_i = \begin{cases} 1 & if\ y_i > 0 \\ 0 & otherwise \end{cases} \quad (27)$$

This can be expressed as a structural equation in full as follows:

$$y_i^* = \beta_0 + \sum_h \beta_{1h} \Psi_{ih} + \sum_c \beta_{2c} \Phi_{ick} + \beta_3 \log FMA_i + \mu_{ik} \quad (28)$$

Where; Ψ represents infrastructure quality

Φ represents firm level controls

μ is a random error term and *m* indexes firms

FMA measures international transport costs

In this study the underlying variable y_i^* could be considered as the probability or likelihood of a firm to have some foreign ownership. This variable will also be used to capture the probability of attracting inward or outward FDI. The explanatory variables in equation (28) should include items that affect the likelihood of being foreign invested including infrastructural and geography variables and as well as firm specific factors of invested enterprises.

4.3.4 Hypothesis

Formally we want to test the hypothesis:

HO: *A location with good infrastructure is more attractive to foreign investors than one without.*

4.3.5 Variables used and their measurement

Even though the theoretical literature argues that the relationship between infrastructure and industrial location is ambiguous[58], a number of empirical studies have found that good quality infrastructure plays an important role in attracting foreign investment (see Rolfe and White, 1991; Woodward and Rolfe, 200; Asiedu, 2002; Castro et al, 2007 etc). In fact, Rolfe and White (1991) argued that infrastructure quality is very important in the attractiveness of a country for offshore manufacturing investment in that it subsidises their total cost of investment raising the rate of return. Khadaroo and Seetanah (2004) also added that multinationals are profit seeking entities that seek to minimise the cost of doing business and if moving to a developing country to take advantage of lower labour costs means losing patent protection to imitators, making informal payments to get things done, incurring high transport costs due to inadequate transportation and missed supply shipments due to communication problems, then multinationals will not choose to do business there.

Our dependent variable is a dummy which takes the value of one if the firm has foreign equity participation that is greater or equal to 10% and zero otherwise. 10% is the general level of participation at which the direct investor is normally regarded as having an effective say in the management of the enterprise involved (UNCTAD, 2009). In differentiating between export and domestic oriented FDI, we also defined the former by using a dummy that takes the value one if the firm has foreign equity participation greater or equal to 10% and is also involved in exporting, zero otherwise. Market seeking FDI is also a dummy defined for foreign invested firms that are not into exporting (export intensity is zero).

We use telecommunication, electricity, water and customs variables to control for infrastructure in our FDI models. The number of days it takes to import and export is used here as an indirect measure of the quality of customs infrastructure at the border. According to Hummels (2007) customs delays are longer in many African countries due partly to poor communication and information management systems. The quality of telecommunication, water and electricity infrastructure is estimated using the average number of hours or days without a telephone connection, water and power per day and month respectively as well as percentage of output lost due to power outages[59]. We however prefer to use hours rather than

58 See Krugman (1991); Martin and Rogers (1995).

[59] These are firm level averages and so vary at establishment level.

days without infrastructure services as a better indicator of infrastructure quality. This is because infrastructure problems are more severe in a country where residents go for longer hours a day for a certain number of days per month without services than in a country where firms are only affected for relatively fewer hours a day for the same number of days a month. The data on these variables was however characterised in some cases by non responses and we tried to minimise the negative impact of this on the size of the sample and quality of results by measuring them at regional level using city level averages. This approach also minimises endogeneity problems for the customs variable used, since time to export might be affected by the experience of the enterprise manager in dealing with customs officials. We also alternatively measure some of these infrastructure variables excluding water using perception indicators also obtainable from the Investment Climate Surveys and where each firm was asked to judge the severity of selected infrastructure problems on a five-point scale[60]. The assumption on these variables is that quality infrastructure is important in enhancing productivity, competitiveness and hence creates an environment attractive to foreign investors. Thus high values of perception indicators for infrastructural variables i.e. high number of clearing days and many hours without infrastructural services as well as high percentage of output lost due to power outages indicate poor infrastructure quality and hence should negatively affect FDI inflows.

The empirical literature also suggests that the size of the firm does matter in foreign direct investment (see Horst, 1972; Kravis and Lipsey, 1982; Lall, 1986; Blomstrom and Lipsey, 1986, Kinoshita, 1998). Although evidence support the fact that large firms are more likely to invest abroad than small firms, descriptive statistics on the firms in this study sample also show that most of the firms that have some foreign investment are larger in size than domestically owned. Thus the average size of a firm with some foreign ownership is 368 employees compared to 130 for domestic owned firms (see Tables 4.4 below). This may indicate that foreign investors also target large firms when making investment decisions. This may be because large firms have better access to local credit facilities and that large scale production implies that the firm is likely to produce goods more efficiently through learning by doing and may also have more market power (Kinoshita, 1998). We decided to include the

[60] The scale is: 0 = no obstacle; 1 = minor obstacle; 2 = moderate obstacle; 3 = major obstacle; 4 = very severe obstacle.

size variable in this study to capture this and the variable is approximated by the number of permanent employees in the firm.

Another variable that has been identified in the literature as an important determinant of FDI is the size of the host country's market (see Head and Mayer, 2004; Coughlin *et al.*, 1991 etc). The size of the market represents the level of demand available for goods and services produced by the foreign investors and this variable is particularly important for horizontal multinationals also referred to as market seekers. Thus plants producing for an external market can be located with little or no regard for domestic demand potential (Woodward and Rolfe, 1992). The argument is a larger market increases *ceterisparibus* the amount of potential buyers, and thereby raises expected profits. Higher potential profits in large markets are also amplified by the fact that larger markets facilitate potential economies of large scale production. In addition, a larger market also provides more opportunities to place a new product (Lankes and Venables, 1996). However according to Resmini (1999), the scale of new market opportunities does not, depend solely on the total market size but also on the dynamics of the market. Therefore, investors prefer markets with high sustainable growth rates (Neuhaus, 2006). Khadaroo and Seetanah (2004) also argue that FDI responds positively to market size once it reaches a threshold level that is large enough to allow economies of scale and efficient utilisation of resources. The importance of market size has been confirmed in many previous studies [see Kravis and Lipsey, 1982; Schneider and Frey, 1985; Wheeler and Mody, 1992; Loree and Guisinger, 1995; Lipsey , 1999; Wei 2000; Coughlin and Segev, 2000; Fung *et al.*, 2002; Head and Mayer, 2004; Woodward, 1992; Zhang, 2001 etc]

In this study we measure the size of the market at city level by weighting country GDP by the proportion of the population in each city. This is because it is difficult to get city level GDP which is an ideal measure of market size at city level. Head and Mayer (2004) and Hong (2008) use a market size variable measured using GDP weighted by distance to proxy market accessibility. We also attempt to capture the same thing by interacting the market size variable with a measure of domestic transport costs to determine how accessible the market is from the city where the firm is located. This is because high transport costs make distant markets more difficult and costly to serve. Thus the location potential of a place should include the influence of the transportation costs that are required to access it in addition to the size of the market.

Another variable that we have also decided to include in the study is firm age. Our argument is that foreign investors might also be attracted to old firms because they may have a deeper and broader understanding of the local market conditions. The number of years they have been in existence enables them to have a better knowledge of the dynamics of local market conditions and survival strategies than younger firms. Even though it may be true that firms gain knowledge and resources with the passage of years, younger firms can get required resources and capabilities via using short cut mechanisms like hiring highly experienced and competent managers (Reuber and Fischer, 1997). Harvey and Abor (2009), however, found that firm age negatively affects FDI inflow in the Ghanaian manufacturing sector. In the case of export oriented FDI, Pradham and Abraham (2005) found that the estimated relationship between firm age and export behaviour over the whole range of equity participation resembles an inverted S-shape. As age increases, it tends to induce foreign affiliates to export more over the equity range 10-25 percent then reduce their export intensity over equity range 55-75 percent and again turn to increase it over the equity range 85-100 percent. This would indicate that foreign affiliates when they grow older they tend to have significant higher export performance only when they have minority foreign equity participation (10-25 percent) or largely majority owned (85-100 percent). We proxy firm age here by using the difference between the year the firm started operating and the year when this firm level survey was done.

The quality of labour in the host country is another variable that has been identified in the literature as a major FDI determinant. (see Merlevede and Schoors (2005); Neuhaus, 2006; Borensztein et al, 1998). High labour quality not only raises output but enables firms to use advanced production techniques. This is particularly true for FDI from US, Japan and Western Europe which is capital intensive and skilled labour oriented (Zhang and Markusen, 1999). Merlevede and Schoors (2005) also argue that although unit labour costs may describe the quality of the current labour force, they do not necessarily reflect the capability of the labour force to adapt to new technologies. Therefore, an investor should additionally look at the current level of human capital in the economy in addition to being concerned about the level of wages. Glickman and Woodward (1987) found that an indicator of labour force quality is a significant determinant of foreign investment location in the US. Coughlin and Segev (2000), Cheng and Kwan (2000), Hong, (2008) also found labour quality to be important to foreign investors. We measure labour quality in this chapter at city level by

using the percentage of the labour force with tertiary and secondary education weighted by the proportion of city population in country population[61].

Another closely related variable that we use in this chapter is unionization of labour, Coughlin and Segev (2000) argue that the extent of unionized labour is a characteristic of labour market widely publicized by promoters of economic development in countries with low unionization rates. The argument is, in less unionized countries firms have the managerial freedom to pursue profit maximization unencumbered by union contract restrictions. This is advantageous to foreign firms who want to introduce new managerial practices. Empirical findings on this variable are however inconclusive. The coefficient of this variable may be negative if unions insist on labour practices that lower productivity (Bartik, 1985; Head et al. 1999). Thus using a conditional logit model, Bartik (1985) found that high unionization is a strong repellent to U.S. domestic branch plant location, even when controlling for labour costs. However Friedman et al, (1992) found unionization to be a positive and statistically significant determinant of plant location whilst Woodward and Rolfe (1992) found it to be negative but insignificant for countries in the Caribbean Basin. We measure unionization in this study by using a firm level dummy that indicates whether employees in the firm belong to a union or not. Our fundamental assumption in this study is that before being foreign invested some of these local manufacturing firms were relatively larger in size, older and had unionized labour force than others.

Dummies were also created to capture the sector heterogeneity. This is because some products might be more difficult to transport or may use less electricity than others during production. These dummies could also capture sectoral comparative advantage based on the countries' factor endowments differences relative to other competing countries (Yoshino. 2008). Just like Wheeler and Mody (1991), in some cases our models excluded country specific dummies because much of the interesting variation in the data is across countries, reflecting conditions which change slowly. The use of country specific dummies would have the effect of removing this variation, leaving only short run within country changes as the basis for parameter estimation. The results would therefore tell us much less about how firms choose among countries when making investment decisions (Wheeler and Mody 1992). So that we do not completely suppress within country variation we try to capture it by using

[61] Data on this variable is obtained from the World Development Indicators (2009).

sectoral dummies. To avoid running into a dummy variable trap, we estimated our models by excluding the intercept and where necessary, we used one sector or country as a comparator or base variable. The manufacturing sectors covered include textile and garment; plastic, paper and packaging; construction and metal; chemical and pharmacy; wood and furniture. The complete list of variables used in this study is presented in the appendix, Table A4.1.

4.4 Descriptive analysis of firm level data

4.4.1 Firm specific controls

Of the 1598 establishments in this study, about 22% of them have at least part of their equity foreign owned. Of these foreign owned firms 97% of them have more than 10% of their equity sold to foreign investors whilst about 79% have foreign equity participation that is greater than 50%[62]. Additionally 16% of foreign invested firms have less than 50% of their equity in the hands of foreign investors whilst 5% of these firms have the share ownership structure equally balanced between domestic and foreign ownership (50%). The minimum level of foreign equity participation is 0.12% whilst about 11% of foreign invested firms have 100% foreign ownership.

The statistics on tables 4.4 and 4.6 show that firms with some foreign ownership both at country and sectoral level are relatively larger in size, with a country level average of 367 permanent employees compared to 130 for those without foreign investment. Foreign invested firms also appear to be less export oriented than wholly owned domestic firms. In all the countries and sectors (excluding plastic paper and packaging as well as construction and metal), at least 50% of exporting firms are not foreign invested. However, of the foreign invested firms about 67% of them export an average amount of about 27%. This basically means that most of the FDI firms are outward oriented rather than market seeking. A large proportion of foreign invested firms in these countries and various sectors use the internet and this may imply that maybe most of the manufacturing FDI firms (since very few are into exporting) are importers and therefore need to interact with international suppliers for inputs or it is relatively cheaper to communicate with clients through internet than using other means of communication like cellular phones and telephones.

[62] These are firms that are operationally controlled by foreign investors.

The sector with the highest number of firms that are foreign invested is the chemical and pharmacy with about 30% and the least being the wood and furniture (9%). The same pattern is replicated when looking at the average amount foreign invested in each firm[63]. It is high in the chemical and pharmacy sector (24%) and lowest in the furniture sector (6%). The situation however changes when we look at the percentage amount exported (export intensity) by each foreign invested firm in each sector. Statistics on table 4.6 show that percentage amount exported is high in the textile and garment sector (48%) as well as food and agriculture (36%) and lowest in the construction and metal sector (4%). These statistics also show that the number of firms that are foreign invested and the average amount foreign invested in each firm as well as export intensity is higher amongst firms with generators than those without. It also appears that foreign investors are interested in large firms than small firms given the fact that 34% of large firms are foreign invested compared to 14% of small firms. Furthermore, on average 26% of the equity stakes of the large firms are owned by foreign investors whilst only an average of 10% is invested in small firms. Export intensity of these foreign invested firms also seem to be high among the large firms compared to other firms and this partly suggests that firm size is important for those firms that have some foreign ownership and also export. There also seem to be very little age difference between firm that are domestic owned and the ones that have some foreign investment. The average age of FDI firms is 22 years compared to 20 years for those without any amount invested in them by foreign companies.

With regard to infrastructure (see table 4.5 below), power outage problems (in terms of hours) are more severe in Uganda, Tanzania and Mauritius. Thus the average number of hours per day firms go without electricity is at least 7 hours compared to 4 hours in South Africa and 5 hours in Zambia. Power outages create a lot of problems for firms in Tanzania and Uganda in that the percentage of output lost by firms in these countries is also relatively large. Thus about 11% of output is lost by firms in Tanzania whilst about 6% of output is lost by firms in Uganda. Telecommunication is generally a problem in these countries with an overall average of 14 hours a day. Telephone problems seem to be severe in Zambia, Tanzania and Uganda. In these countries, firms go for an average of 11 hours a day without a telephone connection compared to an average of 4.5 days in South Africa and Mauritius. A similar pattern is replicated when looking at water problems. Thus Uganda is hard hit by

[63] This is calculated using all the firms in the sector.

water problems as firms go for about 20 hours a day without water. Mauritius and Tanzania also go for relatively longer hours without water supply. These statistics show that firms in these two countries go for about 12 hours without water a day and this could have a large impact on firms that use a lot of water for production purposes. Import clearing problems seem to be common in Tanzania, Uganda and South Africa. It takes about 18, 10 and 7 days to clear imports at the borders of Tanzania, Uganda and South Africa respectively compared to only 4 days in Zambia. However, when it comes to exporting it seems South Africa tops the list followed by Tanzania. Ugandan customs facilities appear to be relatively efficient in that it takes only 3 days to clear exports in the country. This could also partly explain why we have relatively more firms that have foreign equity being into exporting in Uganda (64%) compared to 26% in South Africa. However, it also appears that export transit days are not a good indicator of FDI exporting because, in Mauritius it takes only 4 days to clear exports but only 17% of FDI firms are into exporting less than in South Africa (26%).

Table 4.3 Distribution of firms among sectors in each country

	All countries (%) (1598)		South Africa (%) (603)		Zambia (%) (207)		Tanzania (%) (276)		Uganda (%) (300)		Mauritius (%) (212)	
	All firms	Foreign invested	All firms	Foreign invested	All firms	Foreign Invested	All firms	Foreign Invested	All firms	Foreign Invested	All firms	Foreign Invested
Textile_Garment	11.4	16.7	8.2	14.3	5.8	16.7	11.2	25.8	5.0	20.0	36.0	13.7
Food_agric	24.9	25.3	10.4	19.4	44.0	28.6	0	29.6	0	25.4	19.2	17.9
Chemical_pharmarcy	8.7	29.7	8.9	26.4	10.1	33.3	9.8	33.3	6.0	50.0	9.4	10.5
Plapackaging	12.2	17.1	13.0	13.7	6.3	30.8	9.1	21.9	7.7	30.0	11.3	0
Woodfurniture	7.0	9.0	4.0	12.5	2.9	16.7	23.6	7.7	2.3	14.3	4.4	0
Construction_metal	8.8	20.9	14.6	15.8	16.4	22.2	14.5	27.5	20.3	22.5	5.9	8.3

Source: Author's own computations based on World Bank's Investment Climate Surveys

Note: numbers in brackets represent the total number of firms in each country. All firms represent the percentage of firms in each country that belong to any of the sectors

Table 4.4 Firm level variables means by country and sectors

	Size		Age		Internet access (% of firms)		Exporters (% of firms)		Owner: Male (% of firms)	
	Not Invested	Foreign Invested	Not Invested	Foreign Invested	Not Invested	Foreign Invested	Not Invested	Foreign Invested	Not Invested	Foreign Invested
South Africa	264	674	23	32	67.4	85.5	74.4	25.6	91.59	80.00
Zambia	145	433	21	14	21.4	40.9	61.7	39.3	85.84	83.33
Tanzania	70	183	18	18	40.9	82.5	57.8	42.2	92.59	90.63
Uganda	25	242	12	17	17.3	72.5	35.6	64.4	94.87	93.48
Mauritius	148	306	25	22	92.0	96.0	82.8	17.2	88.08	90.91
Textile_Garment	308	424	22	20	65.8	79.3	80.5	19.5	81.82	86.67
Food and agric	171	556	19	19	39.1	71.7	57.1	42.9	91.70	90.70
Chemical_pharmarcy	116	144	20	21	64.9	76.9	67.6	32.4	86.67	92.31
Plapackaging	94	183	21	15	67.3	69.7	79.2	20.8	95.00	94.12
Woodfurniture	77	395	17	26	33.0	90.0	75.0	25.0	97.40	100.00
Construction_metal	83	176	22	27	39.1	79.3	71.8	28.2	90.24	100.00

Source: Author's own computations based on World Bank's Investment Climate Surveys

represents percentage of firms that are exporters and are also foreign invested or not

Table 4.5 Average infrastructure quality by country

	All countries (%) (1598) All firms	South Africa (%) (603) All firms	Zambia (%) (207) All firms	Tanzania (%) (276) All firms	Uganda (%) (300) All firms	Mauritius (%) (212) All firms
Power outages days	2.35	0.49	3.10	5.60	3.22	0.65
Power outages hours	6.37	4.12	5.47	7.84	9.06	7.23
Days without telephone	1.55	0.49	3.34	4.13	1.49	0.21
Hours without telephone	14.21	3.94	13.48	10.81	13.45	5.04
Days without water	2.02	0.42	2.08	8.74	0.51	2.06
Hours without water	12.96	3.42	9.75	13.23	20.82	11.35
% output lost due to power outages.	5.30	0.9	4.53	10.83	6.25	4.00
Import clearing days	8.02	6.75	4.81	18.47	9.73	5.45
Export clearing days	10.01	12.78	2.20	11.67	3.16	4.44

Source: Author's own computations based on World Bank's Investment Climate Surveys

Fig 4.1 Infrastructure indicators by country (Hours per day without infrastructure services)

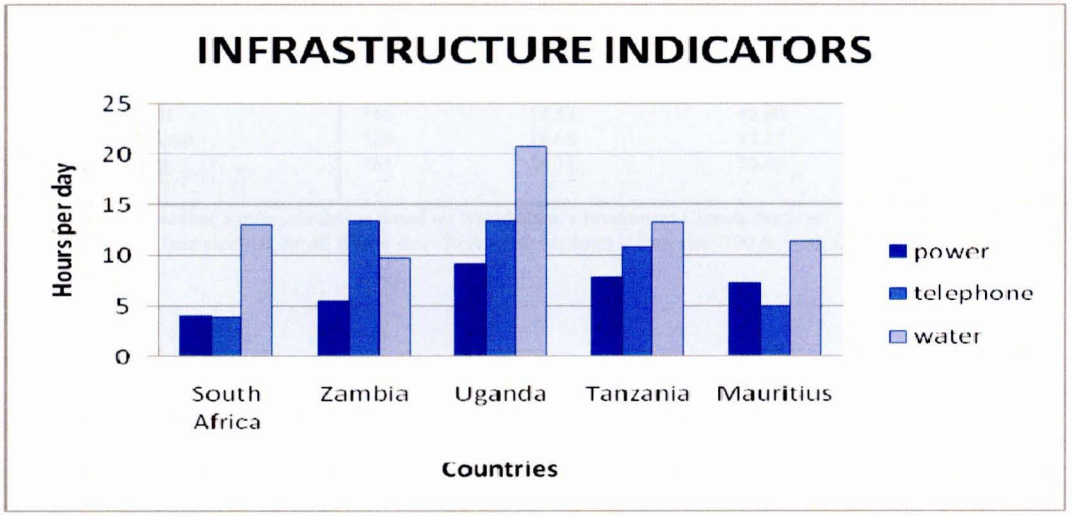


Table 4.6: Foreign investment profile

	Number of establishments	(% of firms) foreign invested	Average % **** foreign invested firms (all firms)	export intensity of foreign invested(%)	% of firms 100% foreign invested among FDI firms	Average % Equity bought in each FDI firm
All countries	**1598**	**21.71**	**16.78**	**26.68**	**11.24**	**79.80**
South Africa	603	19.57	15.13	20.35	11.37	77.33
Zambia	276	29.47	24.37	22.54	7.00	82.68
Tanzania	300	23.19	15.77	25.92	15.72	72.44
Uganda	207	23.00	20.74	26.00	14.98	91.21
Mauritius	212	16.11	8.91	62.58	5.42	68.32
Textile and Garments	180	16.67	11.42	48.42	6.21	74.93
Food and agric	395	25.32	20.24	36.44	12.76	81.81
Chemical_pharmacy	138	29.71	23.94	13.46	16.91	83.47
Plapackaging	193	17.10	14.12	12.28	11.40	82.58
Wood and furniture	111	9.01	6.50	13.00	3.60	72.10
Construction and metal	139	20.86	15.82	3.83	10.14	77.98
Firm characteristics						
Own generator	475	33.89	26.27	32.75	15.47	78.47
Internet	900	28.33	22.44	29.76	53.45	80.32
No generator	1111	16.11	12.81	21.24	14.86	81.01
Firm sizes						
Micro	171	10.19	9.44	11.81	7.60	92.5
Small	546	14.53	10.80	21.98	7.27	77.94
Medium	320	19.68	15.23	21.57	10.88	76.93
Large	561	34.31	26.49	32.20	17.04	80.50

Source: Author's own calculation based on World Bank's Investment Climate Surveys

Micro if firm size<10; Small if firm size<50 &>=10; Medium if firm size<100 &>=50; Large if firm size>=100; **** amount foreign invested per firm

4.5 Econometric issues

Since our dependent variable is a foreign ownership dummy, it is not advisable to use OLS as that will lead to incorrect standard errors and that OLS assumes that the predicted probability of being foreign invested is linearly related to the explanatory variables[64]. To avoid this we estimate by maximum likelihood a probit function of equation (1) as presented in section 4.3 above. Although a probit function is the methodology central to the study, we will however use linear probability model mostly to check for the robustness of our results. Moreover, because of the smallness in the number of foreign owned firms in countries like Tanzania, Uganda and Mauritius, it is not possible to carry out country level estimations so as to test our pooling assumption. Thus statistics show that the majority (60%) of foreign invested firms are found in South Africa and the rest are spread amongst the four other countries. We therefore assumed that pooling is possible and then proceeded to pool our countries data and the first stage regression results are presented below in table 4.7:

Table 4.7 Regressions using OLS and Probit Models

	OLS (1)	Probit by Maximum likelihood (2)
Dependent variable	Anyfor	Anyfor**
Country dummies	Yes	Yes
Sectoral dummies	Yes	Yes
Firm age	-0.0372	-0.3173
	(0.0111)***	(0.1067)***
Firm size	0.0899	0.2599
	(0.0094)***	(0.1147)**
Market size	0.0588	2.2407
	(0.0366)	(7.3864)
unionization	0.0041	0.3317
	(0.0286)	(0.2724)
labour quality	-0.0061	0.2865
	(0.0.0085)	(1.1475)
Telecommunication	-0.0035	0.0557
	(0.0120)	(0.1005)
Transportation	-0.0029	-0.0246
	(0.0099)	(0.0930)
Electricity	0.0081	-0.0135
	(0.0099)	(0.0992)
Customs Regulation	-0.0139	0.0034
	(0.0086)	(0.0775)
Observations	782	786

** Anyfor = foreign ownership dummy: Absolute values of standard errors in parenthesis; ***Significant at 1% level; **significant at 5% level; *significant at 10% level

[64] See Pradham and Abraham (2005) who found a non linear relationship between FDI and firm age

Results from first regressions using Probit model and shown above on table 4.7 indicate that electricity, customs, transport and telecommunication variables are statistically insignificant whilst firm age and firm size are the only variables statistically significant. The market size variable also has a probability value greater than one under the probit specification. It would be erroneous to draw any definitive conclusions from these results since the estimates could be biased due to possible endogeneity of all perception based institutional indicators. Perception indicators could be endogenous in that enterprise managers with greater experience dealing with infrastructure problems might have different perceptions about these variables than managers without the same level of experience (Clarke, 2004). To test the endogeneity of these two perceptions based institutional indicators we use the Durbin Wu Hausman test estimated after running the 2SLS linear probability model and the Smith Blundell test (Smith and Blundell, 1986)[65] in the context of the probit model. All these endogeneity tests reject the null hypothesis that instrumented regressors are exogenous. This rejection means that we should use instrumental variables models like 2SLS, endogenous Tobit and endogenous probit models for estimation instead of the standard approaches. The results of these tests are shown on Table 4.8 below. We attempt to control for endogeneity in these institutional variables by substituting with the average perception index of firms involved in exporting in the same region and same sector. According to Clarke, (2004), this approach does not only correct for endogeneity but also cleans out white noise associated with the perceptions of the individual managers. This approach is also followed when using perception based infrastructural indicators.

Table 4.8 Summary of endogeneity tests using OLS and Probit models

Tests and endogenous variables	All industries			
	Shea's Partial R-squared	Partial R-squared	F-Value	Probability Value (P>F)
Durbin Wu Hausman endogeneity test**			4.7512	0.0929
Smith Blundell exogeneity test			19.56	0.0000
Cragg- Donald weak instrument test			27.409	
Electricity	0.116	0.089	32.745	0.0000
Telecommunications	0.127	0.146	57.559	0.0000
Customs Regulations	0.108	0.135	33.475	0.0000
Domestic transport	0.123	0.105	44.673	0.0000

** HO: regressors are exogenous

[65] The steps to follow in implementing these tests of endogeneity are explained in Wooldridge, 2002, page 531.

4.6. Findings

After testing for endogeneity and correcting for it by creating infrastructure instruments calculated at city and sectoral level, we went on to estimate results using two approaches. Thus our results were obtained using different variants of a probit model where infrastructural indicators are controlled for using perception indicators as well as number of hours without infrastructural services. Our aim is to examine the role played by infrastructure quality as well as firm characteristics in enhancing the probability of attracting foreign ownership. Our dependent variable is therefore a foreign ownership dummy that is equal to one when a firm has some foreign equity and zero otherwise. Some studies in the empirical literature use the conditional logit model to examine how site and firm attributes affect the probability of investing in a given country.[66] However, this fixed effects model can only be implemented on cross sectional time series data and therefore not suitable for the type of data (simple cross sectional) we have. We compare and contrast our results on the Probit model with those obtained using the 2SLS linear probability model. This is done purely for robustness[67] purposes and with the full knowledge of the associated shortcomings of using such models on our data. These results are shown on table 4.9 below and summarized as follows: We also supplemented these results by examining whether the impact of these variables could be affected by the level of equity invested by foreign multinationals in each firm. To do so, we disaggregated foreign equity into three ranges i.e. 10% – 40%; 50% - 100% and 100% (results are presented on table A4.2 appendix).

Market size: A number of studies have argued that the size of the domestic market is very important in attracting FDI (see Kravis and Lipsey, 1982; Schneider and Frey, 1985; Wheeler and Mody, 1992; Coughlin and Segev, 2000; Fung *et al.*, 2002; Head and Mayer, 2002 etc). In this study we estimated this variable at city level by weighting national GDP by the proportion of country population in each city[68]. This is because it is difficult to find values for city level GDP and the beauty of this variable is that it proxies the purchasing power of the size of the population and hence better than just using population size. Results show that this variable is significant and carries the expected positive sign. It is also robust to changes in model and variable specification. We also use another version of the market size variable

[66] See Head and Mayer (2002); Hong (2008); Woodward and Rolfe (2002).

[67] This is done to check whether our results do not change if a different model with different assumptions is used.

[68] City level population data was obtained from the World Gazetteer. http://world-gazetteer.com

Table 4.9: Main FDI Regression results****

Variables	Endogenous Probit (1)	Endogenous Probit (2)	Endogenous Probit (3)	2SLS Linear Prob model (4)	Probit Hours (5)	Probit Hours (6)	Probit Days (7)	Probit Days (8)	Marginal Effects Using (6)
unionization	-0.0605	-0.0643	-0.1874	-0.0198	-0.0381	-0.0443	-0.0917	-0.0328	-0.0041
	(0.1129)	(0.0548)	(0.1683)	(0.0297)	(0.1372)	(0.1371)	(0.1298)	(0.1328)	(0.0389)
Firm size	0.2890	0.1249	0.3954	0.0815	0.3441	0.3472	0.3468	0.3566	0.0991
	(0.0421)***	(0.0308)***	(0.0764)***	(0.1101)***	(0.0455)***	(0.0456)***	(0.0440)***	(0.0445)	(0.0125)***
Market size	0.0911	0.7432		0.0229	0.1310	0.1280	0.1580	0.0423	0.2029
	(0.0408)**	(0.6891		(0.0102)**	(0.0562)**	(0.0566)**	(0.0415)***	(0.0626)	(0.0665)**
Labor quality	-0.0193	-0.0092		-0.0070	-0.0544	-0.0351	-0.0288	-0.0005	-0.0067
	(0.0179)	(0.0074)		(0.0047)	(0.0198)	(0.0233)	(0.0192)	(0.0225)	(0.0143)
Power outages					-0.0337	-0.0308	0.0034	-0.9609	-0.1391
					(0.0193)*	(0.0194)**	(0.0387)	(0.4033)**	(0.0461)**
Water problems					0.0058	0.0056	-0.0079	0.0031	0.0010
					(0.0066)	(0.0067)	(0.0196)	(0.0198)	(0.0024)
Telephone probs					0.0023	0.0036	0.0709	0.0956	-0.0080
					(0.0056)	(0.0057)	(0.0494)	(0.0507)*	(0.0023)
Firm age	-0.1581	-0.0264	-0.1142	-0.0412	-0.1657	-0.1629	-0.1610	-0.1678	-0.0418
	(0.0472)***	(0.0219)	(0.0677)*	(0.0127)***	(0.0532)***	(0.0533)***	(0.0525)***	(0.0527)***	(0.0149)***
Import clearing days						0.0183	0.0141	0.0152	0.0165
						(0.0177)	(0.0136)	(0.0136)	(0.0043)
Export clearing days						-0.0201	-0.0330	-0.0282	0.0095
						(0.0132)	(0.0116)***	(0.0116)**	(0.0054)
Average customs clearing days					-0.0111				
Internet connection					(0.0187)				
Electricity index	0.2077	**0.0485**	0.3050	0.0514				0.3420	
	(0.1063)*	**0.0406)**	(0.1034)***	(0.0273)*				(0.0543)**	
Telecommunication index	**0.0255**	**0.0052**	-0.0371	0.0079					
	(0.1226)	**(0.0472)**	(0.1436)	(0.0313)					
Domestic Transport index	**0.0065**	**-0.4244**	-1.1633	-0.0032					
	(0.1235)	**(0.2393)***	(0.6087)*	(0.0311)					
Customs Reg Index	**-0.0506**	**-0.0057**	-0.0275	-0.0139					
	(0.1053)	**(0.0426)**	(0.1391)	(0.0271)					
Mket size_domestic transport		0.0294	0.0822						
		(0.0157)*	(0.0396)**						
Mkt size_power outages								0.0684	
								(0.0284)**	
Observations	**1049**	**1049**	**1049**	**1049**	**767**	**767**	**822**	**822**	**767**

Absolute values of standard errors in parenthesis; **Significant at 5% level; ** *significant at 1% level; * significant at 10% level; ***Country and sectoral dummies included except in columns 2,6 and 8

measured by interacting market size with domestic transport costs. This domestic market access variable is also significant even when using the 2SLS linear probability model. However, including the market size and the interaction of market size and transport costs in the same model result in the former variable (market size) being statistically insignificant (see column 2 table 4.9 above). This implies that it is not the big market per se that is attractive but its accessibility by foreign firms matters most. As much as domestic transport costs are important for market accessibility, electricity is also very important for producing goods to serve the respective domestic market. Acute power problems may interrupt production and affect the ability of firms to meet the demands of the huge local market that they were attracted to. To capture this, we interacted market size with power outages (hrs) and found that the variable is positive and significant. This could probably mean that the size of the market is more important to investors than power related infrastructure problems. Generally, the significance of the market size variable indicates that big cities with big population stand a very good chance of attracting investors than small urban centres. This also explains why agglomeration of firms is more pronounced in big urban centres than in small towns.

Firm size: The inclusion of firm size in the model was a result of the fact that most of the foreign invested firms in our sample are larger in size than the domestic owned. This suggested that there could be a relationship between FDI and firm size and that foreign investors probably target large firms when making investment decisions. This may be because large scale production implies that the firm is likely to produce goods more efficiently through learning by doing and may also have more market power (Kinoshita, 1998). The results from the estimations support the existence of a strong relationship between these two variables. Like market size, firm size does matter in enhancing the probability of attracting foreign investment and is significant at 1%. The significance of this variable is independent of the proportion of equity foreign invested in each company. The results are the same whether less than or more than 50% is foreign invested in each firm (see table A4.2 for more). Thus marketing and financial economies associated with large firms could also partly explain why they are attractive to foreign investors. The other reason could be that fixed costs of FDI make it profitable to invest in larger firms. Thus the ability to access cheap credit facilities and market power make it easier for a foreign investor to realize good returns from their investment and also recoup fixed production costs in large firms within a short period of time.

Firm age: This variable was meant to capture or to examine whether the number of years a firm has been in existence could proxy in-depth knowledge of local market conditions a feature that may be attractive to mergers and acquisition foreign investors. Results show that firm age has a negative and significant impact in enhancing the probability of attracting foreign investment. This result suggests that being old is not attractive to these multinationals and probably knowledge of local market conditions is not directly related to firm age. As argued by Reuber and Fischer, (1997) younger firms can get required resources and capabilities via using short cut mechanisms like hiring highly experienced and competent managers. Younger firms are more likely to be less risk averse and more adventurous than conservative older firms and are also flexible to changes in technological demands and this could be the feature attractive to foreign producers. These findings are also supported by the fact that this variable is also negative and significant when the level of equity foreign invested in each firm is greater or equal to 50% (see table A4.2 appendix for more).

Unionisation: This variable was meant to capture whether firms that have organised labour force in form of unions are less attractive to foreign investors than ones without. The argument is, restrictive contracts may make it difficult for multinationals managers to introduce new managerial practises so as to pursue the goal of profit maximisation. Results in this study show that unionisation has a negative but insignificant effect on attracting foreign investment. This insignificance could mean that organised labour forces in form of trade unions are a common feature in many countries, not easily avoidable and therefore should not be important in influencing industrial location. We also examined whether the significance of this variable varies with the level of foreign investment in each firm (see table A4.2 appendix). Results show that at lower levels of foreign equity (less than 50%), unionisation has a negative and significant effect on FDI but has a positive but insignificant impact at higher FDI levels. The fact that companies whose management is overally controlled by foreign investors (greater than 50% equity) are not worried about unionisation compared to those controlled by domestic individuals partly supports the finding that unionisation is not important to foreign investors. However it is possible that this variable could be endogenous particularly if we assume that unionisation in a firm could be introduced by foreign investors from countries with organised labour so as to effectively deal with employee related

matters[69].

Quality of Labour: This variable has been found to be very important to multinationals because it enables them to easily transfer technology and expertise necessary for efficient production. This variable was proxied in this chapter by weighting the percentage of the total labour force with secondary and tertiary education by the proportion of country population in each city. This is the standard approach in the literature (see Coughlin and Segev, 2000; Cheng and Kwan, 2000; Hong, 2008). Results show that the human capital variable is consistently negative and insignificant but the pattern of significance is mixed when looking at different levels of investment. This general counter intuitive result could mean that the production technologies used by multinationals in these countries do not require secondary and tertiary education or that highly skilled labour is usually expensive for FDI firms trying to cut production costs. Cheng and Kwan (2000) found to some extent similar results in China. Thus the proportions of the population with primary, junior and senior secondary education were found to be insignificant in attracting FDI.

Customs Infrastructure: Some researchers have argued that it is more expensive to export and import goods when in Africa, something that may work against efforts to promote particularly outward oriented FDI (see Bloningen, 2005; Hummels, 2001). Customs delays are longer in most African countries due to excessive inspection of cargoes, redundant and poorly coordinated procedures, poor communication and information management systems (Hummels, 2001). The results from this study are partly consistent with these arguments since the coefficient of the customs variable is negative and statistically insignificant when using perception indicators. However using alternative indicators like the average time to export, this variable is negative and significant but negative and insignificant when using the average number of days to both import and export. This pattern is replicated even when looking at different levels of foreign equity participation. However when using the average number of days to import, results are positive but insignificant. This could also suggest that multinationals in this study sample are mostly outward oriented and therefore affected by export transit times. Results on table 4.10 below support this argument as export clearing days are negative and significant for export oriented firms.

[69] Due to difficulties in coming up with instruments to correct for this, we did not correct for possible endogeneity on this variable.

Electricity Infrastructure: This variable is negative and significant when using the number of hours without power but positive and significant when using perception indicators. The positive counter intuitive sign of perceptions could imply that the indicators are capturing something else other than quality of infrastructure or that this result supports the belief that poor infrastructure could act as a barrier to entry and a source of monopolistic profits. However the negative and significant effect of number of hours without power suggest that power is important for production and power problems negatively affect the industrial location decisions of multinationals. Using different levels of FDI, this variable is generally negative though insignificant at all levels. The estimated marginal effects suggest that a unitary average increase in the number of hours without power decreases the probability of being foreign invested by 13 percentage points (see column 9, table 4.9 above). There is therefore need for governments that are interested in attracting FDI to improve the quality of electricity infrastructure so as to improve the productivity and competitiveness of foreign investors. This will not only attract more FDI but will also ensure that the current foreign investors are retained or do not relocate to better locations.

Domestic transport Infrastructure: The results for this variable show that domestic transport problems proxied by perception indicators have a negative effect on FDI. This is true even after controlling for market access (market size-domestic transport problems interaction). This could mean that in addition to facilitating market access, good domestic transport infrastructure is important for things like accessing inputs and for also reducing transport costs that are a result of using poor road networks. This variable is however expected to matter most to firms that are market seeking than vertical multinationals. Results on table 4.11 show however a weak negative effect on inward oriented FDI. After disaggregating FDI levels and using the international transport indicator: distance represented by FMA, we found that this variable is positive but insignificant. This illustrate that international transport costs have a weakly positive effect on industrial location. This is true for horizontal FDI which is a substitute for international trade.

Telecommunication infrastructure: Results show that the telecommunication infrastructure variable is positive and insignificant when using perception indicators and this is the case even when using the number hours without a telephone connection. The variable, hours without a telephone connection is however consistently negative but insignificant at different levels of foreign investment. Due to the fact that it appears that most foreign invested firms

have an internet connection (see table 4.6 above), we decided to control for internet connection (see column 8 table 4.9 above). The variable is significant at 5%. The significance of the internet connection variable coupled with the insignificance of hours without telephone variable may imply that internet services is a facility mostly used by FDI firms. Therefore good internet infrastructure is important to ensure quality internet services and this might also be a pull factor for FDI.

Water infrastructure: Although water plays a very important role in the production of various manufactured goods, results from this study however show that this variable is positive but statistically insignificant. This is also the case even when examining different levels of FDI. This result is robust to model specification and therefore mean that the quality of water infrastructure is a weak determinant of the probability to be foreign invested. This may mean that water is not a major productive input and thus not important in attracting FDI. The other thing is FDI firms could be aware that they can minimise water related production problems by using borehole water. Descriptive statistics show that about 33% of foreign owned firms have a borehole.

4.6.1 Market seeking and outward looking FDI results

In this section we distinguish between horizontal FDI and vertical multinationals and then analyse whether site attributes and firm specific attributes have differential impacts on these types of foreign investments. To measure horizontal FDI we looked at those foreign invested firms that are not exporting whilst export oriented FDI was measured by looking at those firms that are foreign invested and at the same time also export[70]. Results for these two types of FDI models are shown on tables 4.10 and 4.11 below.

The variable firm size measured using number of permanent employees in the firm has a positive and significant effect on outward oriented FDI but has a negative and significant effect on market seeking multinationals. This means that economies of large scale and efficient production through learning by doing are important for vertical but not horizontal multinationals. This is supported by descriptive statistics in that the average size of inward oriented firms is 114 compared to 217 for outward looking firms. This could imply that horizontal FDI firms are conservative and risk averse and so by starting small they are able to minimise losses from their investments. This could be true for those African economies with

[70] This analysis is in comparison to those firms that are foreign invested only.

a history of political instability and unstable economic policies. The positive effect of size on export FDI confirm the common finding in the literature that size does matter when it comes to exporting (see Clerides eta l, 1998; Soderbom and Teal,2003; Rankin et al, 2006; Elbadawi et al, 2007). It is also possible that exporting can lead firms to grow in size but with available cross sectional data, it is difficult to determine the true direction of causality between size and export oriented FDI. The firm age variable is generally positive but insignificant for both types of FDI. Although being old could be associated with better knowledge of local market conditions and survival strategies this knowledge could still be obtained by hiring experienced managers and therefore age does not matter for FDI (Reuber and Fischer, 1997). The unionization variable though largely insignificant for both FDI cases is negative for vertical multinationals and positive for market seeking foreign producers something counter intuitive. However labour quality is generally negative and insignificant for the two types of FDI suggesting that low skilled labour environments are attractive. The reason for this could be that low skilled labour is cheap and thus minimizes production costs of multinationals seeking low cost areas. This could imply that these multinationals produce goods that are less capital intensive and hence require less skilled and relatively expensive manpower. The distance variable that we used to proxy international transport costs is negative and significant for vertical FDI but positive and significant for horizontal foreign investors. Thus being far from major markets increases transport costs and reduces the competitiveness of exports produced by foreign multinationals. However for domestic oriented foreign investors being far from markets enhances the attractiveness of the host country. Instead of domestic oriented multinationals exporting to the host country market, they establish an affiliate to service the host country from within. This result is sustained even when using alternative transport costs indicators calculated using c.i.f. and f.o.b. ratios measured at sectoral level.

However, domestic transport costs are insignificant for all types of FDI though positive for export oriented and negative for inward looking. Poor domestic transport infrastructure harms market accessibility for horizontal FDI but has a weak positive and counter intuitive impact on vertical foreign producers[71]. As expected, the market size variable is positive and statistically significant for market seeking FDI. To capture market access, we interacted the market size variable with domestic transport costs and found that it is positive and significant

[71] This could also be attributed to the problems of using perception indicators in that they sometimes measure anything else different from what you want to proxy.

determinant of inward FDI. Controlling for market access, result in market size being insignificant but still positive. We also interacted market size with power outages and found the variable negative and significant. This suggest that, for inward FDI a huge market size in a country with electricity problems makes it difficult to service the market and discourages investment. Other infrastructure variables like average number of days to both import and export is negative but insignificant for inward FDI but positive for outward investment whilst number of days it takes to export is negative and significant for vertical FDI. Import clearing days are however negative but insignificant for outward FDI. Electricity problems have a generally negative and significant impact on the location of outward FDI but positive and significant for inward oriented foreign investors. This suggests that poor domestic electricity infrastructure encourages horizontal FDI but discourages vertical multinationals. As for telecommunications, this variable is negative and significant for market seeking FDI but positive and insignificant for vertical foreign investors.

Controlling for internet connection in these FDI models shows that firms value using the internet to communicate with clients and suppliers both in the domestic market and for the purpose of exporting. This is true also for outward FDI where even the alternative telecommunication variable like number of hours/ days without a telephone connection is positive and insignificant. Water problems do not seem to matter much for inward FDI firms. The variable is negative but insignificant for inward FDI but results are mixed for outward investors. The negative effect supports the argument that water matters for production regardless of whether you are an exporting foreign firm or not.

Table 4.10: Export oriented FDI

Variables	Probit Model (1)	Probit Model (2)	Linear Probability Model (3)	Probit Model Hours (4)	Probit Model Days (5)	Marginal Effects Using (4)
Dependent variables	Fdi_export	Fdi_export	Fdi_export	Fdi_export	Fdi_export	Fdi_export
Country dummies	No	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes
Market size	0.5674		0.3458			
	(0.7893)		(0.8912)			
Firm size	0.3297	0.3738	0.1016	0.4916	0.4292	0.1733
	(0.0966)***	(0.1488)**	(0.0380)***	(0.1186)***	(0.1120)***	(0.0418)***
Labour quality	-0.0218	-0.0552	-0.0149	0.1795	-0.2035	0.0632
	(0.0351)	(0.1555)	(0.0400)	(0.748)***	(0.0752	(0.0264)
Power outages (hrs)				-0.3789	-0.0042	-0.1335
				(0.1416)**	(0.0959)	(0.0501)***
Water problems				0.0791	-0.03127	0.0279
(hrs)				(0.0423)*	(0.1599)*	(0.0150)*
Telephone probs				0.0247	0.1232	0.0087
(hrs)				(0.0332)	0.1659)	(0.0117)
Firm age	-0.0079	0.1533	-0.0326	0.0608	0.0855	0.0215
	(0.1103)	(0.1664)	(0.0432)	(0.1345)	(0.1263)	(0.0474)
unionisation	-0.5189	-0.2418	-0.0595	-0.5667	-0.4635	0.1944
	(0.2979)*	(0.5157)	(0.1345)	(0.3741)	(0.3655)	(0.1237)
Export clearing				-0.1935		0.0682
days				(0.0245)**		(0.0439)
Import clearing				-0.1467		-0.0517
days				(0.1031)		(0.0364)
Average customs clearing days					0.1030	
					(0.0707)	
LogFMA			-0.4841	-0.3366	-0.4574	-0.1179
			(0.2037)**	(0.1721)*	(0.1296)**	(0.0616)*
Internet connection					0.8756	
					(0.3241)**	
Electricity index	-0.3682	0.7311	-0.1910			
	(0.2225)*	(0.4021)*	(0.1042)*			
Telecommunication	0.0262	0.9804	0.2633			
index	(0.2434)	(0.5701)*	(0.1415)*			
Domestic Transport	0.1908	0.4834	0.1322			
index	(0.2387)	(0.3280)	(0.0869)			
Customs Reg Index	-0.1231	-0.2022	-0.0529			
	(0.2738)	(0.3869)	(0.1036)			
Observations	**201**	**201**	**201**	**148**	**162**	148

Absolute values of standard errors in parenthesis
***Significant at 10% level; *** significant at 1% level, ** significant at 5% level**

Table 4.11: Market seeking FDI

Variables	Probit Model (1)	Linear Probability Model (2)	Probit Model Hours (3)	Probit Model Hours (4)	Marginal effects (3)
Dependent variables	Fdi_inward	Fdi_inward	Fdi_inward	Fdi_inward	Fdi_inward
Country dummies	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes
Firm size	-0.3738	0.1016	-0.3207	-0.2936	-0.0972
	(0.1488)**	(0.380)***	(0.0948)***	(0.0976)***	(0.0330)***
Labour quality	-0.0552	0.0149	-0.2013	-0.1496	-0.0959
	(0.1554)	(0.0400)	(0.1322)	(0.1731)	(0.0559)*
Power outages (hrs)			0.1872	4.3646	0.0170
			(0.1079)*	(2.2285)**	(0.0194)
Water problems (hrs)			-0.0181	-0.0189	-0.0120
			(0.0659)	(0.344)	(0.0096)
Telephone probs (hrs)			-0.0523	-0.0818	-0.0181
			(0.1257)	0.0387)**	(0.0113)
Firm age	0.1532	0.0326	-0.0943	0.1224	-0.0276
	(0.1664)	(0.0432)	(0.1126)	(0.1211)	(0.0384)
unionisation	0.2418	0.0595	0.1840	0.1583	0.0710
	(0.5157)	(0.1345)	(0.2969)	(0.3153)	(0.0974)
Market size	0.7538	0.5854	0.3456	0.0101	0.2812
	(0.3779)*	(0.2163)**	(0.0674)**	(1.1476)	(0.3038)
Internet connection				0.3556	
				(0.1541)*	
Average customs clearing days			-0.0429	-0.0229	-0.0118
			(0.0437)	(0.0502)	(0.0147)
Marketsize_power outages interaction				-0.2832	
				(0.1459)*	
Electricity index	0.7311	0.1910			
	(0.4021)*	(0.1042)*			
Telecommunication index	-0.9804	0.2634			
	(0.5701)*	(0.1416)*			
Domestic Transport index	-0.4835	-0.1322			
	(0.3280)	(0.0869)			
Customs Reg Index	0.2022	0.0529			
	(0.3869)	(0.1036)			
Market size_transport interaction				0.1151	
				(0.0519)**	
Sectoral cif/fob			0.5740		0.2496
			(0.3415)*		(0.1680)
logFMA	0.36770	0.4841			
	(0.1576)*	(0.2303)**			
Observations	**201**	**201**	**148**	**170**	**170**

Absolute values of standard errors in parenthesis
***Significant at 10% level; *** significant at 1% level, ** significant at 5% level**

4.7. Conclusions

The primary objective of this chapter was to examine the role played by the quality of infrastructure and firm heterogeneity on probability of being foreign invested. Several model specifications such as 2SLS linear probability and probit models were used for this purpose. We also differentiated FDI into export oriented and market seeking to see whether there are differences in the impacts of infrastructure on these two types of foreign investments.

Results show that foreign investors are generally attracted to firms that are larger in size particularly multinationals that are export oriented. However it appears domestic oriented investors prefer firms that are small in size and this could be a way of them playing safe or being cautious particularly since the performance of their investment is heavily reliant on the performance of the economy that they are not too familiar with. There also exist a positive relationship between size and vertical FDI but the direction of causality is difficult to ascertain using our cross sectional data set. It also appears that firm age does not matter even though export oriented investors weakly prefer young firms whilst horizontal multinationals are weakly attracted to older firms. Labour quality and unionization appear to be less important in enhancing the probability of being foreign invested even for both types of foreign investment. Results generally show that foreign firms weakly prefer low skilled labour and are negatively affected by the unionization of labour.

On location specific variables, it appears that foreign firms are attracted to a market bigger in size and that access to that market is also very important. However market size or market access appears to be also important for inward oriented multinationals but not vertical foreign producers as expected. These results also showed that a big market in an environment characterized by acute power problems negatively affects market seeking FDI. Customs problems generally have a weak negative effect on the probability to be foreign invested particularly inward FDI, but days to export matter to outward looking foreign producers. Power outages seem to have a strong negative impact on foreign multinationals and this is also true for export oriented FDI but there is a positive and significant impact on inward oriented FDI. Thus it appears that for horizontal multinational power problems probably act as a barrier attractive to multinationals interested in making monopoly profits. However for vertical multinationals power outages may affect productivity and this could impact on the competitiveness of their exports. Telephone problems do not seem to matter for outward FDI but have a negative and significant effect on inward FDI. The general significance of the

internet connection variable also suggest that good internet infrastructure which enables good internet connection is very important in attracting outward looking foreign direct investment Water problems do not seem to matter for FDI firms in this sample even though the variable has a negative and weak effect on market seeking foreign investors. Probably the ability of firms to drill boreholes to overcome water problems could be one of the reasons why the variable is insignificant. The statistics however show that about 33% of foreign invested firms have a borehole and about 36% of inward oriented FDI firms own a borehole compared to about 60% of outward looking foreign firms. Distance (proxy for international transport costs) from major exporting markets also appears to be important for outward oriented FDI firms and international costs measured using c.i.f. -f.o.b. ratio are positive and significant for horizontal multinationals. Thus foreign market access appear to be important for vertical multinationals but high international transport costs encourage inflows of market seeking foreign producers. These results basically show that although the impact of infrastructural variables vary depending on the type of foreign direct investment, they are very important in attracting FDI inflows. It is important therefore for governments to channel more resources or find alternative ways of improving their investment climates.

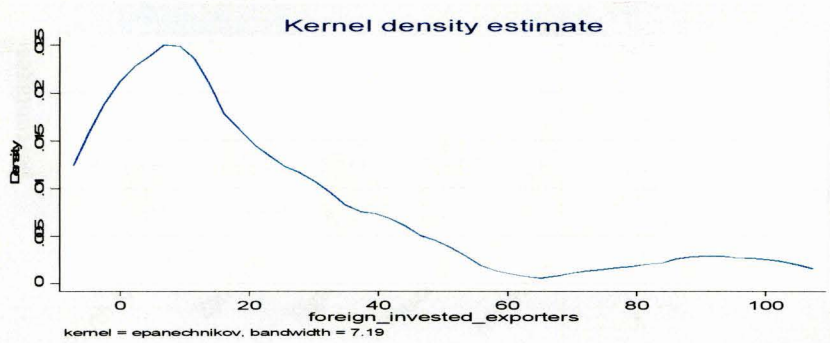
CHAPTER 4 APPENDIX:

Table A4.1: list of variables

Variables	Definition
FIRM RELATED CHARACTERISTICS	
pexport	Percentage exported by each firm
anyfor	Foreign ownership dummy=1 if there is foreign ownership and 0 otherwise
firm size	Internet dummy=1 if firm ha internet or website
firm age	Percentage amount that is foreign invested in each firm
unionisation	Dummy=1 if workers in a firm belong to a union
FDI_inward	Dummy=1 if anyfor ==1 and pexport==0
FDI_outward	Dummy =1 if anyfor==1 and pexport>0
LOCATION VARIABLES	
Foreign market access: (LogFMA)	Measured using distance from nearest port to each country's trading partner
Market size	Measured using GDP times proportion of city population in each country (proxy for market size)
Labour quality	Measured by using labour force with secondary and tertiary weighted by proportion of the city population in each country
Water problem hours	Number of hours or days without water per day and month respectively
Power outage hours	Number of hours or days without electricity per day and month respectively
Telephone problem hours	Number of hours or days per day and month without telephone connection
Export clearing days	Average number of days to export
Import clearing days	Average number of days to import
Customs clearing days	Average number of days to export and import
Sectoral cif_fob	International transport costs measured using cif and fob data measured at sector level
Infrastructure perceptions indicator	**Used sector –regional averages**
TelecomIV	Average perception indicator calculated per sector in each city
TransportIV	Average perception indicator calculated per sector in each city
CustomsIV	Average perception indicator calculated per sector in each city
electriIV	Average perception indicator calculated over all firms per sector in each city
COUNTRY DUMMIES	
dumtanzania	Dummy=1 if country is Tanzania
dumuganda	Dummy=1 if country is Uganda
dumzambia	Dummy=1 if country is Zambia
dums_africa	Dummy=1 if country is South Africa
dums_mauritius	Dummy=1 if country is Mauritius
SECTORAL DUMMIES	
Textile_Garment	
Food_agriculture	
Chemical_pharmacy	
Plapackaging	Plastic, paper and packaging sectors
Wood_furniture	
Construction_metal	

Fig A4.1 Kernel densities

Density for FDI firms that export



K-Density for proportion invested in all foreign owned firms only

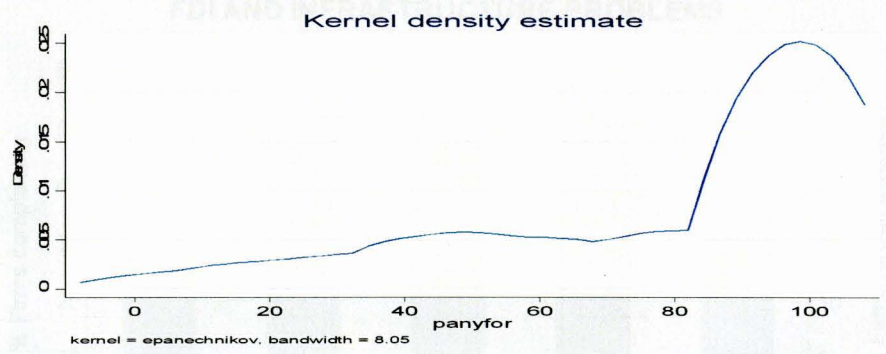


Fig A4.2 FDI Structure at country level

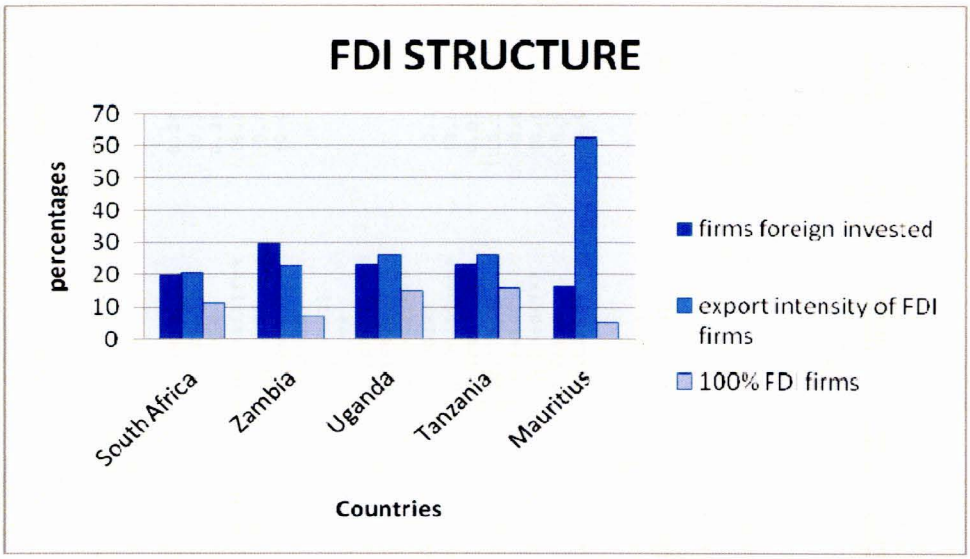
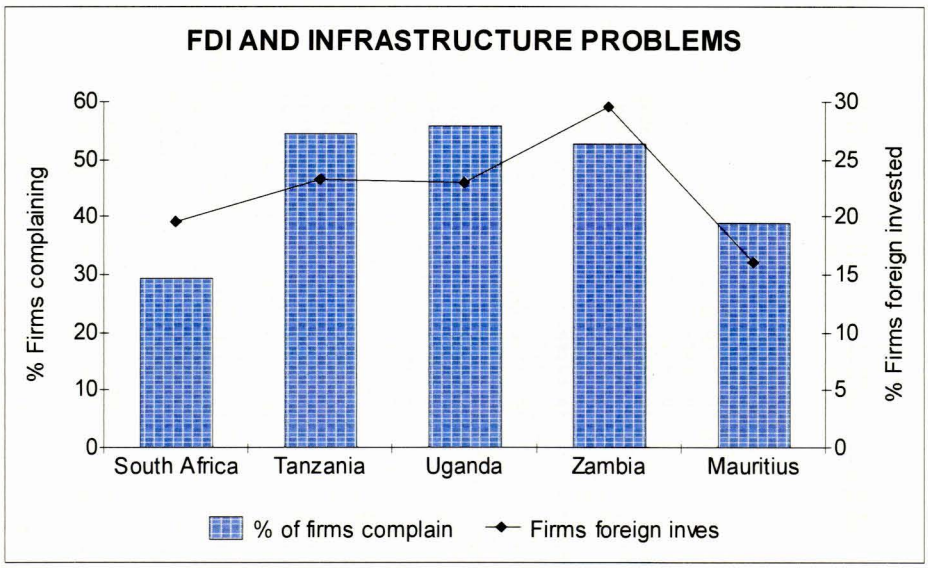


Fig A4.3 Relationship between FDI and infrastructure problems in each country



Source: Investment Climate Surveys

Table A4.2: Probit Models using different levels of FDI

Variables	[10% -49%] Days (3)	[10% -49%] Hours (4)	[50% - 100%] Days (1)	[50% - 100%] Hours (2)	100% Days (5)	100% Hours (4)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes
Market size	0.24285	0.35192	0.12135	0.028033	0.28439	0.28440
	(0.43845)	(0.48037)	(0.26727)	(0.29743)	(0.32669)	(0.34913)
Firm size	0.25331	0.25419	0.37587	0.36268	0.28916	0.28114
	(0.09380)***	(0.09780)***	(0.51530)***	(0.05315)***	(0.05452)***	(0.05571)***
Labour quality	0.02726	-0.01663	0.02606	0.02279	-0.01986	-0.03486
	(0.09911)	(0.10777)	(0.05771)	(0.06137)	(0.06806)	(0.07097)
Power outages (days)	0.05978		-0.04783		-0.05789	
	(0.12917)		(0.04726)		(0.05321)	
Water problems (days)	0.16709		0.11369		0.15099	
	(0.12519)		(0.06831)*		(0.07660)**	
Telephone prob (days)	-0.06644		0.16821		0.16514	
	(0.19982)		(0.06819)**		(0.07543)**	
Firm age	0.10537	0.06163	-0.22332	-0.21004	-0.20432	-0.19842
	(0.11019)	(0.11117)***	(0.05969)***	(0.06147)***	(0.06339)***	(0.06514)***
unionisation	-0.61612	-0.54456	0.14781	0.10582	0.08807	0.05056
	(0.28650)**	(0.29511)*	(0.16379)	(0.17015)	(0.17957)	(0.18498)
Export clearing days	-0.04113	-00284	-0.02199	0.00105	-0.44440	-0.01705
	(0.03420)	(0.04225)**	(0.01956)	(0.02364)	(0.22604)**	(0.02749)
Import clearing days	0.11325	0.05074	0.04215	-0.01788	0.03634	-0.02628
	(0.04652)**	(0.05869)	(0.02493)*	(0.03071)	(0.02812)	(0.03635)
LogFMA	0.11034	0.44118	0.21910	0.52962	0.30534	0.65560
	(0.91012)	(0.89537)	(0.43183)	(0.51142)	(0.54035)	(0.57098)
Power outages (hrs)		-0.04251		0.08266		-0.04936
		(0.07829)		(0.04211)**		(0.04201)
Water problems (hrs)		-0.00084		0.01212		0.00515
		(0.02529)**		(0.01251)		(0.01269)
Telephone probs (hrs)		0.00491		-00146		-0.00728
		(0.02095)**		(0.01055)		(0.01095)
Observations	725	644	725	670	725	670

Absolute values of standard errors in parenthesis, *Significant at 10% level; * significant at 1% level, ** significant at 5% level**

CHAPTER 5

5.0 CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Conclusions

The primary aim of this study was to investigate the role that is played by the quality of infrastructure on export participation and on foreign direct investment using firm level data gathered by the World Bank through their investment climate surveys done in five Sub Saharan African countries. In addition to contributing to the ongoing debate on the role of infrastructure on economic development, this study also introduces a different dimension to the analysis of these variables by using firm level data. Thus most studies so far have concentrated much on country level data despite the fact that decisions to invest and export are made at firm level.

Although descriptive statistics show that exporting firms are older, larger in size, are more attractive to foreign investors, uses internet and rate infrastructural constraints more than non exporters, results from regressions are somehow mixed and the impact of these supply side constraints appear to vary from sector to sector as well as from country to country. The statistical significance of firm specific variables like size, foreign ownership and internet access confirm a number of literature findings (Clarke 2004 who looked at 8 SSA countries, Clerides et al (1998) who looked at Columbia, Mexico and Morocco, Grenier et al (1999) for Tanzania, Bigstern et al (2004), Soderborm and Teal (2003) for Sub-Saharan African; countries Bigstern et al, 2000; Tybout and Westbrook, 1995; Bernard and Jansen, 1995). This therefore means that governments must remove measures that restrict firm growth, create an environment that promotes productivity and is attractive to foreign investors as well as design policies that improve internet accessibility.

The significance of the international distance, electricity, customs and electricity- generator ownership interaction variables means that infrastructure and distance matter in influencing export participation. Thus the reason why very few firms in Africa are outward oriented is partly because of poor market access and poor electricity and customs infrastructure.

For foreign direct investment, results show that outward oriented foreign investors are generally attracted to firms that are larger in size compared to horizontal FDI firms. It also

appears that firm age does not matter even though export oriented investors weakly prefer young firms whilst horizontal multinationals are weakly attracted to older firms. Labour quality and unionization appear to be less important in enhancing the probability of being foreign invested even for both types of foreign investment. Results generally show that foreign firms weakly prefer low skilled labour and are negatively affected by the unionization of labour.

On location specific variables, it appears that foreign firms are attracted to a market bigger in size and that access to that market is also very important. However market size or domestic market access appears to be also important for inward oriented multinationals but not vertical foreign producers as expected. These results also show that a big market in an environment characterized by acute power problems negatively affects market seeking FDI. Customs problems generally have a weak negative effect on the probability to be foreign invested particularly inward FDI, but days to export matter to outward looking foreign producers. It also appears that for horizontal multinational power problems probably act as a barrier attractive to multinationals interested in making monopoly profits. This is because power outages have a positive and significant impact on inward oriented FDI. However for vertical multinationals, negative significance implies that power outages may adversely affect productivity and this could impact on the competitiveness of their exports. The general significance of the internet connection variable also suggest that good internet infrastructure which enables good internet connection is very important in attracting outward and inward looking foreign direct investment. Water problems do not seem to matter for FDI firms in this sample even though the variable has a negative and weak effect on market seeking foreign investors. Probably the ability of firms to drill boreholes and thus overcome water problems could be one of the reasons why the variable is insignificant. These results also show that foreign market access appear to be important for vertical multinationals but high international transport costs encourage inflows of market seeking foreign producers.

Generally results from estimated regressions support the common finding in the literature that infrastructure is very important for investment and exporting but the level of significance vary across products and also depend on the direction of investment (inward or export oriented). Thus generally, the quality of infrastructure is critical to any development process and from the results, it appears investment and trade cannot occur without good power sources as well as functional roads, transportation and efficient customs systems. The

importance of good infrastructure is even more pronounced now because globalization and liberalization initiatives have increased the extent of interdependence among world economies. Therefore it will be increasingly difficult for Africa to remain competitive in the global market if its infrastructure systems continue to be sub-standard and underperforming. Current infrastructural problems imply that the continent's competitiveness in the global economy requires a complete overhaul. It is important therefore for governments to channel more resources or find alternative ways of improving investment climates in their respective countries.

Inefficient infrastructure systems pose high economic and opportunity cost to Africa. This is not just to the producer or consumer in terms of a higher economic price and additional investment required to alleviate the problems of inadequate infrastructure, but higher costs in form of lost jobs, incomes, improved standards of living of the Africans as well as lost opportunities to expand investment and therefore markets (Simuyemba, 2000). According to Hummels (2007), freight costs are a far more restrictive barrier to African exports than tariffs and reducing transport costs would not only lead to improved competitiveness in the international market place, but would also result in lower input, production and consumer costs and ultimately to better economic performance of African economies. According to Simuyemba (2000), as long as Africa continues to export primary commodities and source its raw materials from outside Africa, Africa's transportation systems will remain "outward oriented and sea bound" rather than "inward oriented and hinterland bound." For the current trend to be reversed and intra regional trade to be improved, Africa's industrial and trade patterns must undergo dramatic transformation.

5.2 Recommendations

In light of these results, it is important therefore for African governments with the help of the private sector, international organizations to channel more resources or find alternative ways of boosting infrastructural investment. This could be through a number of variants of private – public sector programmes like Build Own Operate and Transfer (BOOT). Proponents of aid for trade under the World Trade Organization's Doha Rounds, United Nations through the Almaty treaty[72], the World Bank etc, have shown an increasing interest in addressing these

[72] Thus the Almaty Programme of Action initiated by United Nations deals with infrastructure development and maintenance, transit policy issues and trade facilitation measures in mostly landlocked developing countries.

supply side infrastructural constraints faced by developing countries so as to foster their integration into the global economy. If these efforts are complemented by African governments and funds utilized properly, infrastructure inadequacies in the continent would eventually be improved.

Public Private Partnership programs (PPPs) are the most vibrant, visible and competitive example of private sector participation in regional infrastructure operations in Africa (Infrastructure Consortium for Africa, 2008). These are a combination of public needs with private capability and resources to create a market opportunity through which the public need is met and a profit is made (UNECA, 2005). The advantage of these programmes is that they transfer the financial and skills burden of these infrastructure projects from the government to the private sector. Thus the main objective of PPPs is to ensure the delivery of public infrastructure and services cost effectively by leveraging private sector expertise and innovation. This method does not substitute but complement other public service delivery methods and these PPPs differ by the extent of the risk that each party assumes in the project. (For an elaborate spectrum of types of PPPs, see fig A5.1 appendix).

Public Private Partnership programs are not about privatisation but about delegating delivery of certain public service outputs to the private sector where a more cost effective solution can be offered. The high start up costs associated with infrastructural projects are paid by private investors and this act as an incentive for them to ensure that the infrastructure project gets built on time, and that it is maintained to an agreed standard over the full working life of an asset. Thus for countries without access to international capital markets and without developed local bond markets, a feature characteristic of many African countries, PPPs are the only remaining method to get infrastructure projects built now.

Thus PPP arrangements can accelerate the pace and scale at which investments are made in public infrastructure in Africa and besides getting value for money from these arrangements, governments can also benefit through building new capacity, new skills and new ways of doing business. PPPs also present an alternative by which current public service performance can be compared and also leave a legacy of change in the way infrastructure assets and services are delivered. However this move from conventional procurement to PPPs requires strong political commitment; long term political stability; transparent and predictable

regulations; institutional reforms; capacity to design, contract and regulate private sector participation; quality control; strong financial markets and a competitive private sector as well as access to long term financing (ICA, 2008). It is therefore important for governments in many of these African countries to work towards meeting some of these requirements so that the private sector can participate effectively in infrastructural development.

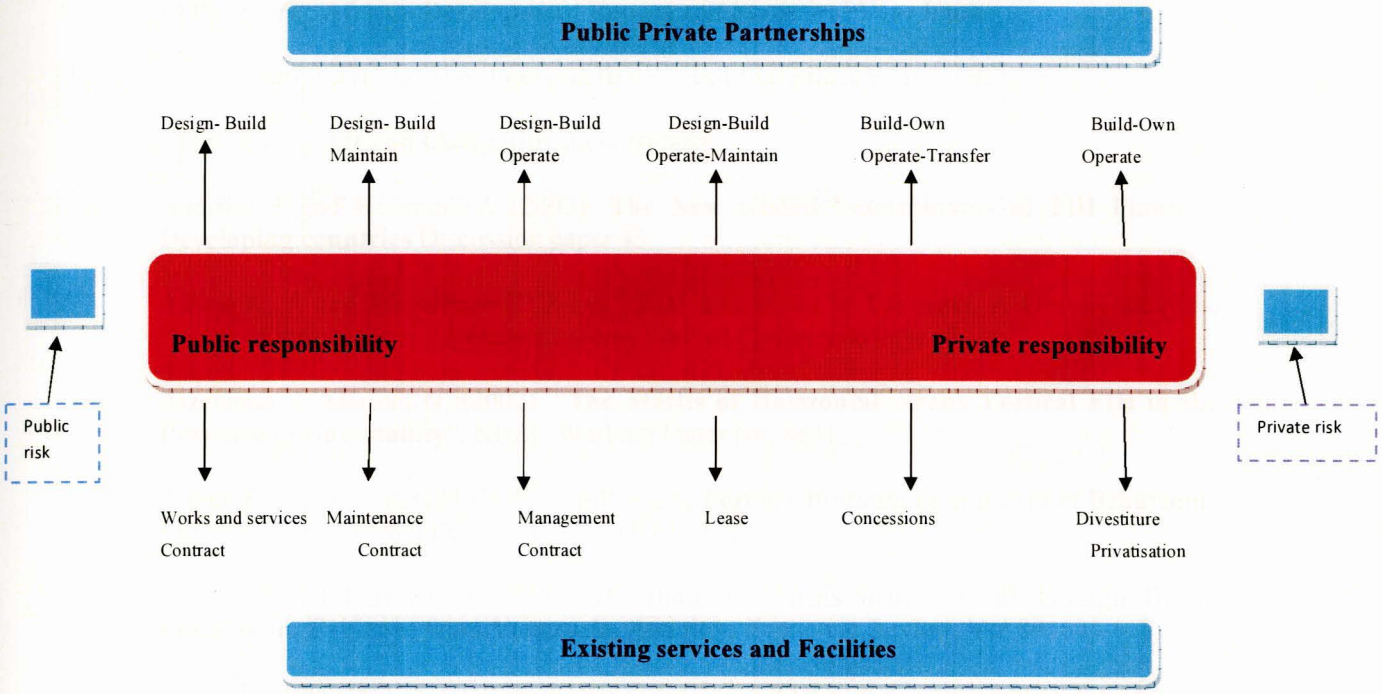
Results of FDI and exporting have also shown that poor customs facilitation is also the biggest constraint to trade in Africa. This could be because of the use of systems that are not streamlined and harmonized across countries, multiplicity of documentation and procedures, different nomenclatures that are not standardized or harmonized, poor customs practices, corruption practices as well as inadequate physical facilities or equipment (UNCTAD, 2008). The adoption of the UN custom designed customs software called Automated System for Customs Data (ASYCUDA) by many countries in West Africa is also helping in harmonising and streamlining customs procedures in these countries and this is one avenue that other African countries could follow or adopt to improve customs efficiency at their borders. ASYCUDA is a computerized customs management system which covers most foreign trade procedures and it accelerates customs clearance by simplifying clearance through computerization (UNCTAD, 2008). This cuts costs for businesses and shortens the time it takes to process goods. Governments gain from improved control of customs, increased revenue and availability of reliable and timely statistical information. Thus regional agreements intended to promote trade in Africa such as the proposed COMESA and SADC Free Trade Areas will have limited impact if cross-border trade facilitation is not improved. As long as Africa continues to operate as small discrete markets each with its own systems, rules and regulations, regional integration will not achieve the desired results and benefits for Africa (UNECA, 2008).

The 2008 Commission for Africa report also states that for southern Africa, studies have shown that delays at major border posts cost the region about US$60 million annually. This is an additional cost to business and to the economy. Introduction of a computerized customs system that is regionally linked would greatly improve cross-border facilitation. Such systems like ASYCUDA would, provided there was concurrence by governments, result in shorter transit time through quick clearance of goods.

Finally, Africa's population is predominantly rural. Of Africa's 750 million people, 63 percent are in the rural areas, 37 percent live in the urban areas and only 11 countries have urban populations of 50 percent or more (UNECA, 2005). Another characteristic is that African countries are small both in terms of population and economic size or income levels. This has implications on the pattern and nature of African infrastructure development. There are three fundamental principles that determine private sector participation in any economy. The first is the political will and ideology to embrace private participation. The second is putting in place the macro-economic environment and policy framework to support private sector participation and the third is market size to support investment and high volume of exports. Integration of these African markets through free trade and the formation of regional infrastructural arrangements can also boost investment and trade in the region. Thus the ultimate objective for Africa should be to create a single market of 750 million people that is competitive within itself and within the global economy and this can be facilitated by regional infrastructure integration and development across the continent.

CHAPTER 5: APPENDIX SECTION

Fig A5.1: PPP Spectrum



Source: Infrastructure Consortium for Africa, 2008

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