2015

Stimulating entrepreneurial activity in Botswana: a path to sustainable and broad based inclusive growth

Lesego Sekwati
University of Wollongong

UNIVERSITY OF WOLLONGONG

School of Accounting, Economics and Finance

Stimulating entrepreneurial activity in Botswana: a path to sustainable and broad based inclusive growth

Lesego Sekwati

"This dissertation is presented as part of the requirements for the award of the Degree of Doctor of Philosophy of the University of Wollongong"

March 2015

CERTIFICATION

I, Lesego Sekwati, declare that this dissertation, submitted as part of the requirements for the award of the Degree of Doctor of Philosophy of the University of Wollongong, is my work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Lesego Sekwati
March 2015

ACKNOWLEDGEMENTS

Developing a doctoral dissertation is a long arduous journey. I am indebted to my mentors Associate Professor Charles Harvie of the School of Accounting, Economics and Finance, Faculty of Business, University of Wollongong and Dr. Eduardo-Fernandez Pol, Senior Lecturer, School of Accounting, Economics and Finance, Faculty of Business, University of Wollongong for their unparalleled guidance, support, and sacrifice, without which I would not have reached my destination. I am forever thankful.

My gratitude also goes to my sponsor, the University of Botswana, for giving me the opportunity to embark on this life changing journey. I would also like to thank the Centre for Small Business and Regional Research (CSBRR), University of Wollongong, in particular the Director, Associate Professor Charles Harvie, for the financial support extended to me to undergo training in efficiency and productivity analysis, an important component required to complete this dissertation. A thank you also to the Faculty of Business of the University of Wollongong for the financial support extended to me to travel and present my research findings in international conferences. This work has benefited from the feedback received from these conferences. Citations can be seen in Appendix E. I would also like to acknowledge the assistance of Statistics Botswana for giving me access to data on Botswana's small and medium enterprises (SMEs). These data have been useful for components of this study.

Furthermore, I would like to thank my friends Abbas Mohammadzadeh, Behnam Forouhandeh, Bolanda Hewa Priyantha Thilakaweera, Mohammad Tariful Bari, Nguyen Quoc Cong, Sayyed Mehdee Araee, and Thanh Phuong Le. This work has benefitted from interacting and sharing ideas with them. A thank you also goes to my Higher Degree Research group, led by Associate Professor Charles Harvie. This work has benefited from sharing of ideas through this forum.

Finally, heartfelt thanks to my family, a pillar of strength throughout this journey.

****

Dedicated to my little princess, Setso.

****

ABSTRACT

Botswana is a natural resource dependent developing country in Sub-Saharan Africa (SSA) constantly in search of ways to diversify its economy so as to avoid economic stagnation. This is important as the economy's mainstay, diamond mining, is expected to decline significantly in the next 15 years, with adverse implications for the country's development prospects. A diversified economic base is likely to generate sustainable growth beyond diamond depletion. Economic diversification is also essential in generating broad-based, inclusive growth. Despite being able to sustain positive rates of economic growth over the past five decades, a significant proportion of Botswana's population has not benefitted from this growth. An increasingly diversifying economy is likely to generate more productive employment opportunities for the population. This may in turn promote broad based, inclusive growth. The 2008 global financial crisis, which resulted in significant loss of national income, provided further evidence of the importance of economic diversification for Botswana. A diversified economy is essential to mitigating the impact of external shocks and commodity price fluctuations on the economy.

Entrepreneurial activity, especially the kind revolving around Small and Medium Enterprises (SMEs), has been identified by the Botswana Government as one avenue through which economic diversification can be pursued. This study investigates ways in which the Botswana Government can effectively promote entrepreneurial activity. The study relies on existing literature, specifically on policies likely to promote entrepreneurial activity in different contexts. It also relies on empirical evidence from analyses of technical efficiency of Botswana's SMEs. Technical inefficiency of SMEs is likely to impact on feasibility and profitability of engaging in entrepreneurial activity, with the likelihood that promoting entrepreneurial activity may be difficult to achieve. Improving technical efficiency of these production units is likely to yield economic gains.

A review of the literature revealed that in designing policies to effectively promote entrepreneurial activity, policy makers must take into cognisance a country's stage of development as challenges faced by entrepreneurs differ according to stages of development. At Botswana's present stage of development, well-developed public and private institutions, quality infrastructure, stable macroeconomic environment, healthy and educated workforce,

higher education and training, goods market efficiency, labour market efficiency, financial market sophistication, technological readiness, and market size are fundamental. Developing entrepreneurship framework conditions is also paramount. These include availability and accessibility of finance for SMEs, the extent to which public policy gives support to entrepreneurship, the extent to which national research and development leads to new commercial opportunities and is available to SMEs, presence of property rights, entry regulations, presence of programs that directly assist SMEs, the extent to which entrepreneurship education is incorporated in the education system, as well as the extent to which social and cultural norms encourage entrepreneurship.

Recommendations for the design of policies to promote entrepreneurial activity in Botswana are drawn from this literature. These include reforms to the education system to ensure it incorporates entrepreneurship education, improving access to and affordability of entrepreneurial finance, encouraging national research and development, improving macroeconomic stability, encouraging foreign direct investment, optimising on market access afforded by existing bilateral and multilateral trade agreements, reducing barriers to trading across borders, and addressing the apparent skills mismatch in the labour market.

The analysis of technical efficiency of SMEs proceeds in four steps. The first step involves estimation of technical efficiency of SMEs. A variant of Data Envelopment Analysis (DEA) is used for this purpose. The study relies on data obtained from the World Bank Enterprise Survey database. The data relate specifically to SMEs involved in manufacturing activities in Botswana. Two cross-sectional datasets for 2006 and 2010 are pooled to enhance the sample size, with 2006 used as the base year. Estimations are carried out in MATLAB using the codes of Valentin Zelenyuk who adopted earlier codes of Leopold Simar. Both Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS) technologies are used to estimate the efficient frontier and how far each of the firms in the sample is from the estimated efficient frontier. The second step involves identifying potential determinants of technical inefficiency of SMEs. This is achieved through an exhaustive review of the literature on potential determinants of technical inefficiency. Based on data availability and relevance to the context of Botswana, the impact of financing constraints, export orientation, firm age, entrepreneurs' education and experience on technical inefficiency of SMEs is tested in this study.

The third step involves carrying out regression analyses of the impact of these factors on technical inefficiency of SMEs. The method of Simar and Wilson (2007) which applies the bootstrap approach is used for this purpose. This method not only permits comparatively better inference, but performs statistically better than conventional methods such as the Tobit and Ordinary Least Squares (OLS) frequently used in studies similar to this one. The fourth step involves drawing policy implications and recommendations for the design of policies to reduce technical inefficiency of SMEs from the results of the estimation. Recommendations for the design of policies to reduce technical inefficiency of SMEs include reducing regulatory burdens that impact on SMEs, improving access to entrepreneurship education, and reducing financing constraints on SMEs.

Besides its policy significance, the study makes unique contributions to present knowledge. Firstly, it brings together fragmented strands of the literature to describe the relationship between entrepreneurial activity and economic growth. Secondly, through the conceptual framework assembled by the researcher from existing literature, it summarises the relationship between entrepreneurial activity and economic growth, together with factors relevant to the design of policies to promote entrepreneurial activity. Thirdly, it is the first study to examine the technical efficiency of Botswana's SMEs. It also provides empirical evidence on the impact of some determinants of technical inefficiency of SMEs that have received very little attention in the literature, in particular, attributes of entrepreneurs and the effects of natural resource dependence.

While this study makes important contributions towards the design of policies to promote entrepreneurial activity in Botswana, including evidence on technical inefficiency of SMEs, the analyses of technical efficiency has been significantly constrained by data limitations. However, the study provides an important starting point for future studies when comprehensive data becomes available.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AGOA	Africa Growth Opportunity Act
BCA	Botswana College of Agriculture
BEMA	Botswana Exporters and Manufacturers Association
BITC	Botswana Investment and Trade Centre
BITRI	Botswana Institute of Technology, Research and Innovation
BIUST	Botswana International University of Science and Technology
BOCCIM	Botswana Chamber of Commerce, Industry and Manpower
BOCRA	Botswana Communications Regulatory Authority
BSE	Botswana Stock Exchange
BWP	Botswana Pula
CEDA	Citizen Entrepreneurial Development Agency
CSBRR	Centre for Small Business and Regional Research
CRS	Constant Returns to Scale
DEA	Data Envelopment Analysis
DMU	Decision Making Unit
EDD	Economic Diversification Drive
EFCs	Entrepreneurial Framework Conditions
EFTA	European Free Trade Agreement
FDI	Foreign Direct Investment
FTA	Free Trade Agreement
GDP	Gross Domestic Product
GEM	Global Entrepreneurship Monitor
GNFCs	General National Framework Conditions

HDI	Human Development Index
HRDC	Human Resources Development Council
ICT	Information and Communications Technology
IMF	International Monetary Fund
LEA	Local Enterprise Authority
MERCOSUR	Mercado Cum del Sur
MTI	Ministry of Trade and Industry
NACA	National AIDS Coordinating Agency
NAFTRC	National Food Technology Research Centre
NDP	National Development Plan
NEER	Nominal Effective Exchange Rate
OECD	Organization for Economic Cooperation and Development
PTA	Preferential Trade Agreement
R&D	Research and Development
REER	Real Effective Exchange Rate
SACU	Southern African Customs Union
SADC	Southern African Development Community
SBC	Small Business Council
SBI	Sustainability Budget Index
SDR	Special Drawing Rights
SFA	Stochastic Frontier Analysis
SMEs	Small and Medium Enterprises
SSA	Sub Saharan Africa
TEA	Total Early-Stage Entrepreneurial Activity
TIDCA	Trade, Investment and Development Cooperation

UB	University of Botswana
UNCTAD	United Nations Conference on Trade and Development
US/USA	United Sates of America
VRS	Variable Returns to Scale
WEF	World Economic Forum
ZAR	South African Rand

1 INTRODUCTION

This chapter presents the big picture about this dissertation. Naturally, to achieve such a picture largely requires a broad brush which hides details from view. The details will be considered in subsequent chapters.

1.1 Background, motivation and objective

In the past five decades, Botswana has used its mineral wealth, and in particular diamonds, to transform itself from being one of the poorest countries in the world to upper-middle income status. According to IMF (2012, p. 33) Botswana was by far the best performing economy in Sub Saharan Africa (SSA), and one of the best in the world in the past five decades, with real per capita Gross Domestic Product (GDP) growing from US$3,500 in 1980 to almost US$12,500 (in constant 2005 US dollars) in 2010, an average annual real growth rate of per capita GDP of 4.3 percent. This sustained growth has been attributed to prudent management of diamond resources (see Hill 1991, Norberg & Blomstrom 1993, Acemoglu *et al.* 2001, Iimi 2007, Humphreys *et al.* 2007, Pegg 2010, Seidler 2010 and IMF 2012).

Although diamonds have been essential for Botswana in the past five decades, it has become increasingly evident that the economy cannot continue to rely on this non-renewable resource. Empirical studies suggest that Botswana's diamond reserves are likely to be exhausted in the next 15 years (see Basdevant 2008). Critically, the economy remains heavily dependent on this resource, underlining the importance of diversification of the country's production base. Available statistics reveal that Botswana's mining sector, which is dominated by diamonds, accounts for almost 40 percent of fiscal revenues (see Bank of Botswana 2013a) and nearly 70 percent of export revenues (see Statistics Botswana 2011). With mining activities expected to decline significantly in coming years, an important policy

question is, how does Botswana prepare for life without diamonds? This study is a contribution to the growing literature exploring answers and policy frameworks to this all important question.

The importance of economic diversification to Botswana does not only lie in achieving sustainable growth beyond diamond depletion, it is also essential in facilitating broad based, inclusive growth. As exhaustively examined in chapter two, while Botswana has been able to sustain positive rates of growth over an extended period, a significant proportion of the population does not benefit from this growth. For example, the unemployment rate is estimated at 18 percent while the poverty headcount ratio is estimated at 19.3 percent (see Statistics Botswana 2013a). This clearly shows that a sizable proportion of the population does not benefit from the economy's growth rate. As underscored by the impact of the 2008 global financial crisis on the economy, economic diversification is also essential to ensuring that the economy is better equipped to deal with external shocks and commodity price fluctuations. As a result of its limited industrial/production base and heavy reliance on diamond mining, Botswana suffered significant loss of national income following the 2008 global financial crisis, with consequences on government revenues and implementation of national development plans. A diversified economic base will reduce the impact of such incidents on the economy.

While the debate continues on which diversification policies are likely to succeed, as policies that work well in one place can fail dramatically elsewhere, promoting entrepreneurial activity has become a central component of facilitating economic diversification in a lot of developing economies (see OECD/United Nations 2011). Emphasis on promoting entrepreneurial activity is consistent with increasing support for entrepreneurial activity as a

potential driver of economic growth in the literature. In this literature, it is believed that entrepreneurial activity increases innovation and competition within the market place, and, consequently, economic growth and development. Empirical evidence supporting these arguments can be seen in Audretsch and Thurik (2000), Carree *et al.* (2002), van Sten *et al.* (2005), Carree and Thurik (2005), and Thurik *et al.* (2008). Policies aimed at promoting entrepreneurial activity are thus expected to yield economic gains.

According to the OECD/United Nations (2011), focus on promoting entrepreneurial activity is also gaining momentum in Sub-Saharan Africa, including countries such as Angola, Kenya, South Africa and Tunisia. Botswana, on which this study exclusively focuses, has been no exception[1]. In this respect, the Botswana Government keeps searching for effective ways of promoting entrepreneurial activity, especially around SMEs (see Ministry of Commerce and Industry 1998, 1999)[2]. A description of the economic significance of Botswana's SMEs, which underscores why emphasis on them is a logical starting point for nurturing the entrepreneurial sector is provided in chapter 2. Worth highlighting too is that Botswana's emphasis on SMEs is consistent with recent trends in both developed and developing economies. A survey of the literature reveals increasing attention being paid to SMEs by researchers and policy makers alike (see for example, Wennekers & Thurik 1999, and Thurik & Wennekers 2001, 2004).

[1] While this study focuses exclusively on Botswana, the research framework used to identify factors critical to the design of policies to promote entrepreneurial activity in Botswana is applicable to different countries with similar characteristics, including those at different stages of economic development. In this respect, the research framework described in chapter three has wider applicability.

[2]SMEs are a heterogeneous group of non-subsidiary independent firms involved in various economic activities (OECD 2005). The most frequent upper limit designating SMEs is 250 employees (*ibid*). In Botswana, SMEs are defined with an upper limit of 100 employees (see Ministry of Commerce and Industry 1999).

As emphasized by Wennekers and Thurik (1999), the way in which SMEs are perceived by researchers and policy makers has changed drastically in the past two decades. This change is partly the result of the increasing realization of the economic significance of SMEs. Evidence of the increasing economic significance of SMEs can be seen in chapter 2 (also see Loveman & Sengenberger 1991, Carlsson 1992, 1999, Acs 1999, OECD 2005 and Ayyagari *et al.* 2007). The chapter also describes some of the reasons that account for the ascendancy of SMEs (also see Piore & Sable 1984, Brock & Evans 1989, Loveman & Sengenberger 1991, Acs 1992 and Carlsson 1992). Chapter 3, which describes present knowledge on the role of entrepreneurial activity on economic growth, highlights how the role of entrepreneurship and small firms has changed since the emergence of endogenous growth theory (also see Audretsch 1995, Acs *et al.* 2004 and Braunerhjelm *et al.* 2010). These developments have resulted in increasing interest in policies designed to support SMEs. The Global Entrepreneurship Monitor (GEM), considered to be the most authoritative research initiative on the role of entrepreneurial activity on economic growth, is one of the leading proponents of policies designed to promote entrepreneurial activity around SMEs (see Amoros *et al.* 2014).

The objective of this study is to investigate ways in which the Botswana Government can effectively promote entrepreneurial activity, and, in particular, policies that promote the growth, development and sustainability of SMEs. The study relies on existing literature on entrepreneurial activity. It also relies on results of an empirical investigation of the technical efficiency of Botswana's SMEs[3]. The results are used to draw recommendations for design of policies to reduce technical inefficiency.

[3] Kumbhakar and Lovell (2000) define technical efficiency as the ability of a decision making unit (DMU) or production unit to produce maximal output from a given input vector.

1.2 Research questions and approach to addressing them

The main research question this study addresses is,

How can Botswana effectively promote entrepreneurial activity that revolves around SMEs, in order to diversify the economy's production/industrial base and achieve a job-rich and inclusive growth?

To address this research question the study relies on existing literature on entrepreneurial activity and effective policies for promoting it. This literature is described in chapter three. The chapter describes present knowledge on the relationship between entrepreneurial activity and economic growth. Importantly, it identifies factors critical to the design of policies to promote entrepreneurial activity. This study draws from this literature to identify policies likely to promote entrepreneurial activity in an economy such as Botswana's. The study also relies on empirical evidence emerging from analyses of technical efficiency of SMEs. The objective is to estimate the degree of technical inefficiency of SMEs and identify determinants of technical inefficiency. Policy recommendations for design of policies to reduce technical inefficiency are drawn from these results. This component of the study addresses the following research questions,

i. What is the extent of technical inefficiency in Botswana's SMEs?
ii. What are the candidate determinants of technical inefficiency of SMEs?
iii. What is the correlation between the determinants selected for testing and technical inefficiency?
iv. What policy implications may be drawn from results of the analyses?

In line with these research questions the investigation proceeds in four steps. The first step, which relates to research question (i), involves estimation of the technical efficiency of a sample of Botswana's SMEs using a variant of Data Envelopment Analysis (DEA) estimators. This approach allows one to estimate an efficient production frontier for a sample of firms included in the study. The efficiency of each firm is then estimated relative to this frontier. A comprehensive description of the DEA approach to estimating technical efficiency is described in chapter four. The chapter also highlights the reasons for the choice and appropriateness of the approach.

The second step, which relates to research question (ii), involves identification of candidate determinants of technical inefficiency. Worth noting is that there is no single theory that guides the choice of determinants of technical inefficiency in an investigation. The standard practice is to compile a list of potential determinants from relevant literature. The determinants one chooses to include are then isolated from this list based on relevance and data availability. This study follows a similar approach. A description of potential determinants of technical inefficiency of SMEs, from which those selected to be subjected to testing in this study are highlighted in chapter 5. These determinants are categorised into three groups considered critical to the competitive stance of a firm; these are: features of the business environment, firm-specific characteristics, and attributes of entrepreneurs. As will become apparent in subsequent chapters, determinants of technical inefficiency relating to these categories are related to factors identified in chapter 3 as critical to promoting entrepreneurial activity. This suggests a degree of consistency between the empirical component of the study and the framework for policies to promote entrepreneurial activity described in chapter 3.

The third step, which relates to research question (iii), involves testing of the empirical relationship between determinants selected for testing and technical inefficiency of SMEs in the sample. The empirical regularities (or hypothesis) tested in respect of selected determinants, together with proxies used to represent these determinants are highlighted in chapter six. The study follows the method of Simar and Wilson (2007) which involves the use of the bootstrap, following the original work of Efron and Tibshirani (1993), in the analyses of determinants of technical inefficiency. A description of the approach, together with why it is considered appropriate for this study is provided in chapter 4. Worth noting is that the approach permits analyses of determinants of technical inefficiency in a DEA framework. The fourth step, which relates to research question (iv), involves drawing recommendations for design of policies to reduce technical inefficiency from the results. Results of the analyses are reported in chapter 6. Recommendations drawn from these results are described in chapter 7.

1.3 Contribution of the study

This study contributes to the debate on the design of policies to promote entrepreneurial activity in Botswana. Policy recommendations emerging from the study are described in chapter 7. The study also makes a contribution to present knowledge in various ways. Firstly, it makes a unique contribution to the literature on the relationship between entrepreneurial activity and economic growth. A description of this contribution is provided in chapter 3. It also makes a unique contribution to present knowledge on determinants of technical inefficiency of SMEs. As will become apparent in chapter 5, there are determinants of technical inefficiency of SMEs that have received very little attention in the literature. This study provides empirical evidence on the likely impact of these determinants. In addition, as the first study to examine the technical efficiency of Botswana's SMEs, the study makes an original contribution to the understanding of technical efficiency of Botswana's SMEs. It can thus be used by future studies as a starting point.

1.4 Organization of the dissertation

The purpose of this chapter has been to provide a broad picture of this study, without going into details. Details are provided in subsequent chapters. This section provides a synopsis of the contents of these chapters. Chapter 2 describes the significance of economic diversification to Botswana. It begins with a description of the evolution and structure of Botswana's economy post-independence. It then describes fundamental reasons that underscore the importance of economic diversification to Botswana. This is followed by a description of the Government's programmes and policies to promote entrepreneurial activity. This description provides evidence on how the economic importance of SMEs has changed over the last two decades and highlights some of the reasons that account for this rising prominence of SMEs. The chapter also describes the economic significance of

Botswana's SMEs, which also underlines why emphasis on them is a logical starting point for nurturing entrepreneurial activities.

Given that the study focuses on entrepreneurial activity, a description of what the literature says about the role of entrepreneurial activity on economic growth is warranted. In this respect, chapter 3 describes present knowledge on this relationship. It starts with a description of how entrepreneurial activity has been treated in the economic growth literature. This is followed by a description of the relationship between entrepreneurial activity and economic growth. This description identifies factors critical to the design of policies aimed at promoting entrepreneurial activity. Chapter 4 describes the approach this study follows to carry out these analyses. The chapter begins with a description of why technical inefficiency is economically undesirable, which underlines why it is important for policy makers to design policies aimed at reducing it. The chapter goes on to describe the approach the study follows to check technical efficiency of SMEs. It also describes the choice and appropriateness of the approach adopted.

Chapter 5 provides a review of the literature on determinants of the technical inefficiency of SMEs. The chapter also identifies determinants selected for testing. It also identifies determinants of technical inefficiency selected for testing in this study. Chapter 6 presents results of the analyses. It begins with a description of empirical models estimated, the data, variables and empirical regularities (or hypotheses) tested. This is followed by a description and interpretation of the results. Chapter 7 concludes with policy recommendations emerging from the study. Chapter 8 provides a brief summary of the study, conclusions and policy recommendations. It also highlights the contribution of the study to the literature as well as opportunities for further research.

2 BOTSWANA ECONOMY: DIVERSIFY OR STAGNATE

2.1 Introduction

The preceding chapter provided a brief description of the motivation and objective of this study. This chapter extends this description to provide more details. The chapter is organised as follows. Section 2.2 describes the evolution and structure of Botswana's economy post-independence[4]. Section 2.3 describes why economic diversification is essential for Botswana. Section 2.4 describes the economic significance of SMEs in Botswana. Due to data constraints, this description is limited to the proportion of the business population accounted for by SMEs and their share of private sector employment. In the literature, the economic significance of SMEs is normally described in terms of their contribution to gross value added, exports, proportion of the business population and employment shares (see for example, OECD 2005 and Ayyagari *et al.* 2007). All of these could not be undertaken as data on the contribution of SMEs to value added and exports were not available. Section 2.5 provides concluding remarks.

2.2 Evolution and structure of the economy post-independence

Despite facing unfavourable conditions at independence, buoyed by revenues from diamond resources Botswana managed to transform itself from one of the most impoverished nations to upper-middle income status in three decades subsequent to independence. According to the IMF (2012) Botswana's per capita GDP at independence was estimated at US$284. At this time, Botswana was coming to the end of a five-year drought cycle (Dahl 1981). There was

[4] Botswana is a former Protectorate of Great Britain. The Protectorate was formed in 1885 in response to the threat posed to the British by Germany's annexation of present day Namibia in 1884 (Beulier 2003). Under the terms of the agreement, the British prohibited any invasions into the Protectorate. Besides protection from invasion, Britain had no real interest in actively managing the Protectorate (Beulier 2003). The Protectorate became independent within the Commonwealth in September 1966.

hardly any infrastructure, with most of the country being without electricity and telephone systems (Acemoglu *et al.* 2001). Water or sewage systems were also almost non-existent (*ibid*). Only 12 kilometres of paved roads existed. The level of human capital was critically low, with only 22 citizens being university graduates and 100 being secondary school graduates (*ibid*). Historians maintain that the British maintained a policy of benign neglect for Botswana as they did not see any promising returns from investing in the Protectorate (Dale 1995). Beulier (2003) claims that the British neglected investing in social and physical infrastructure in Botswana as they thought the country did not have valuable resources. These conditions made it seem unlikely that Botswana would do well in subsequent years.

A combination of factors changed Botswana's economic landscape in the late 1960s, namely the discovery of diamond and copper nickel deposits, and the successful re-negotiation of the customs union agreement with South Africa (Dahl 1981)[5]. The customs union agreement ensured Botswana's continued dependence on South Africa for trade and investment, but, more importantly, an increase in customs and excise revenues (Kirk & Stern 2005). As will become evident later in this chapter, customs and excise revenues constitute the second most important source of fiscal revenue for Botswana. According to Dahl (1981) as a result of these factors Botswana's exports increased nearly 700 percent between 1969 and 1975, with the upswing further strengthened by strong export demand for Botswana beef. Dahl (1981) notes that the throughput of cattle exported by Botswana increased from 127,000 during the calendar year 1970 to 209,000 during 1974, while the effective price more than doubled.

[5] The Southern African Customs Union (SACU) whose members include Botswana, Lesotho, Namibia, South Africa and Swaziland dates back to 1910. However, the 1910 negotiations included only Britain and South Africa (Kirk & Stern 2005). The 1910 agreement lasted until the mid-1960s when the British protectorates gained independence culminating in the re-negotiation and signing of the 1969 agreement. The defining characteristic of the Union is the economic dominance of South Africa. Kirk and Stern (2005) note that the 1910 agreement in effect reflected this dominance prompting calls for reform. The signing of the 1969 agreement ensured continued dependence of the other members on South Africa for imports and to a lesser extent exports, but more significantly a new revenue sharing formula for customs and excise revenues. A more comprehensive agreement between the member countries was signed in 2002 following South Africa's transition to democracy.

These events set in motion an expansion of overall demand in the economy and imports especially, with imports increasing by more than 375 percent during the period 1968/69 to 1975/76 (*ibid*). From this period onwards the economy entered a phase of expansion.

Appendix A.1 shows the composition of Botswana's Gross Domestic Product (GDP) for the period 1974/75 - 1994/95 in 1993/94 constant prices. The data shows GDP more than doubled (in real terms) in the decade 1974/75 - 1984/85, rising from BWP1,759.7 million during 1974/75 to BWP5,300.2 million during 1984/85[6]. A decade later, GDP had increased to BWP11,397.6 million. During this period 1974/75 - 1994/95 the economy grew at a positive average annual growth rate of 9.9 percent. The increase was driven primarily by mining, in particular diamonds, although further impetus was drawn from the services sector (see Appendix A.1). Inspection of Appendix A.1 also shows that throughout the period 1974/75 - 1994/95, mining value added accounted for a significant proportion of GDP. This pattern is also observed with per capita GDP.

Although its dominance has declined in the last decade mining remains important for Botswana (see Appendices A.2 and A.3). Appendix A.2 shows the composition of Botswana's GDP over the last decade, while Appendix A.3 shows Botswana's principal export commodities for the period 2009-2010 for which diamonds are dominant. Appendix A.2 shows that the contribution of mining to GDP has been declining over the last decade, particularly after 2008. For example, while mining accounted for 28.3 percent of GDP during 2007 (see column 7 of Appendix A.2), its contribution fell to 14.6 percent during 2009 (see

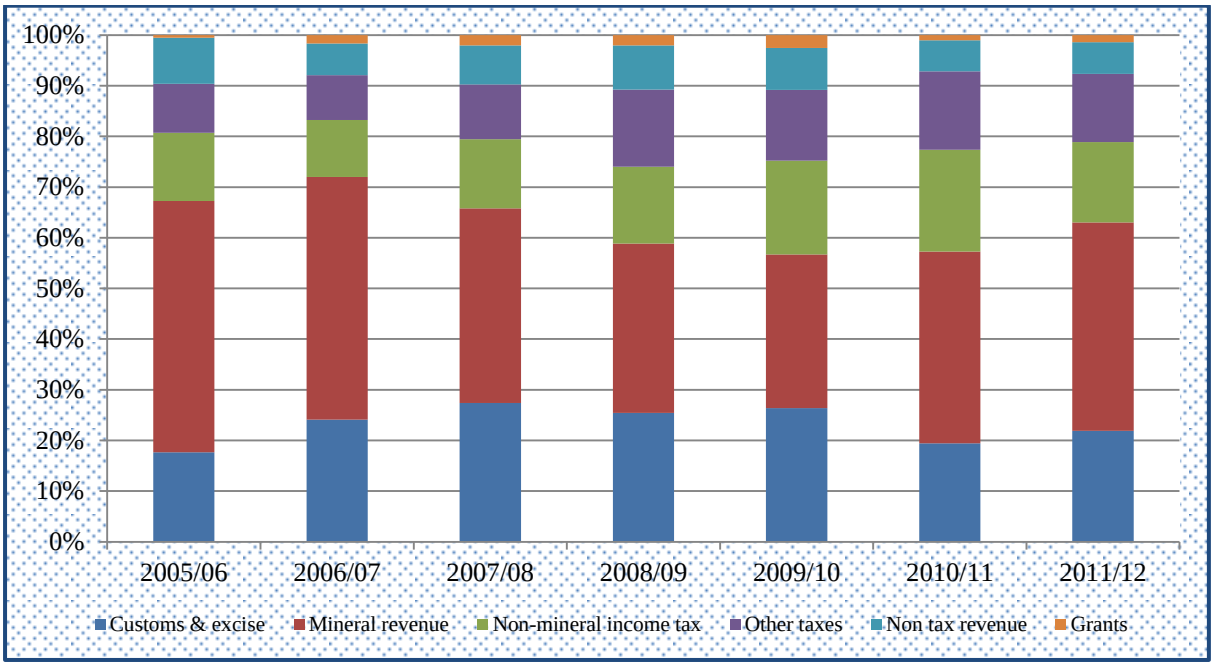
[6] BWP or Pula is the national currency of Botswana, introduced in 1975. At independence (1966), Botswana was a member of the Rand Monetary Union and the South African Rand served as the national currency. Botswana announced a decision to withdraw from the Rand Monetary Area in 1974 and introduced the Pula in the subsequent year. Details on the history of the Pula can be seen at www.bankofbotswana.bw.

column 9 of Appendix A.2). During 2012, mining accounted for 13.5 percent (see column 12 of Appendix A.2) of the country's GDP, and the sector continues to struggle to return to pre-recession levels (2008) in terms of contribution to GDP. As will become apparent, Botswana suffered an unprecedented loss of national income owing to the sharp fall in commodity prices following the 2008 global financial crisis.

While its contribution to GDP has fallen in recent years, mining remains Botswana's principal export sector. An assessment of Appendix A.3 for example shows that diamonds accounted for 62.6 percent of Botswana's exports during 2009, that is, BWP15,234,115 out of a total of BWP24,317,597 (see column 3 of Appendix A.3). During 2010, diamonds accounted for 68.1 percent of exports, that is, BWP21,779,885 out of a total of BWP32,002,007 (column 3 of Appendix A.3). In total, mining (copper, nickel and diamonds) accounted for 77.5 percent and 81.3 percent of Botswana's exports during 2009 and 2010 respectively (see columns 2 and 3 of Appendix A.3).

Mining also remains the principal source of government revenues as reflected in Figure 2.1. Figure 2.1 shows the composition of government revenues for fiscal years 2005/6-2011/12. The data in Figure 2.1 shows that during fiscal year 2011/12, for example, mineral revenues accounted for almost 40 percent of fiscal revenues, twice as much as customs & excise revenues, the second main contributor to fiscal revenues after mining. This pattern is perceptible for other fiscal years during the period 2005/6 - 2011/12.

Figure 2:1 Fiscal revenues for Botswana (2005/6 - 2011/12)



Source: Author's computation based on Bank of Botswana (2013a)

It should be clear that Botswana has performed reasonably well following a growth strategy based on diamond mining. Diamonds, as has been shown, have been the propelling force underlying Botswana's economic development. For reasons that will become apparent in the next section, this strategy does not appear to be sustainable, underlining the need to facilitate economic diversification in the coming years.

2.3 Why economic diversification is essential for Botswana

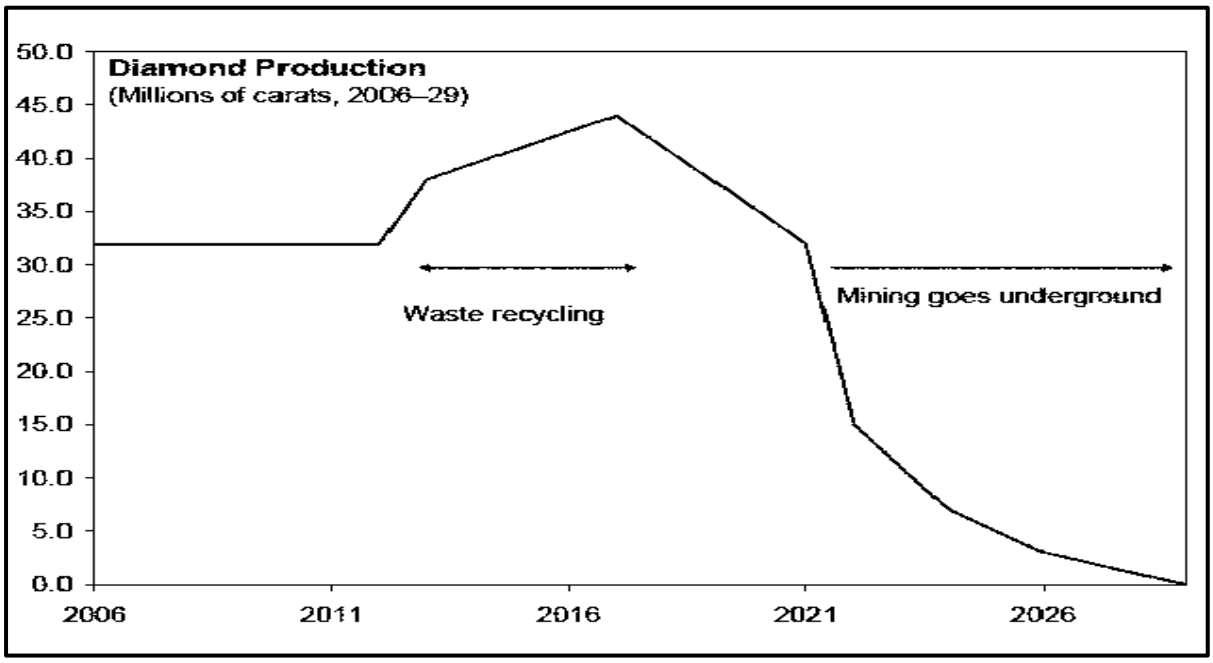
Firstly, one needs to underline the fact that diamonds are not forever. Using the permanent income hypothesis Basdevant (2008) analysed Botswana's reliance on diamonds and predicts that the country's diamond reserves are likely to be depleted in the next 15 years. Figure 2.2 shows the projected path of diamond depletion according to Basdevant's (2008) estimations. According to Basdevant's (2008) estimation, diamond extraction in Botswana will increase from 32 million carats to 44 million carats between 2005 and 2017. From 2017 to 2021,

diamond production is expected to decrease as diamond reserves are drawn down and surface mines are closed. From 2021 to 2029 mining is expected to go underground as reserves continue to be depleted.

Basdevant (2008) argues that this scenario does not only underline the importance of fiscal adjustment in the coming years, but economic diversification. According to Basdevant (2008) as diamond resources are drawn down, fiscal revenue is expected to shrink by about two-thirds in the period 2021-2029. The expected fall in fiscal revenues has important implications for Botswana's development objectives as it implies a reduction in government revenue per capita, with likely lasting impact on expenditure per capita. While fiscal adjustment will be necessary in the coming years, a diversified economic base, including relevant tax reform such as the value added tax to maintain and expand the revenue base, would compensate for the expected decline in diamond production.

Basdevant (2008) predicts that, without economic diversification, Botswana could experience a period of low growth during 2018-2024, including a steep recession in 2022, as diamond production declines sharply. He argues that this negative impact could be temporary if economic diversification takes place. Basdevant (2008) argues that Botswana would likely need to attract more foreign investment, encourage partnerships with the private sector to finance investment in infrastructure and human capital as part of the measures to encourage economic diversification.

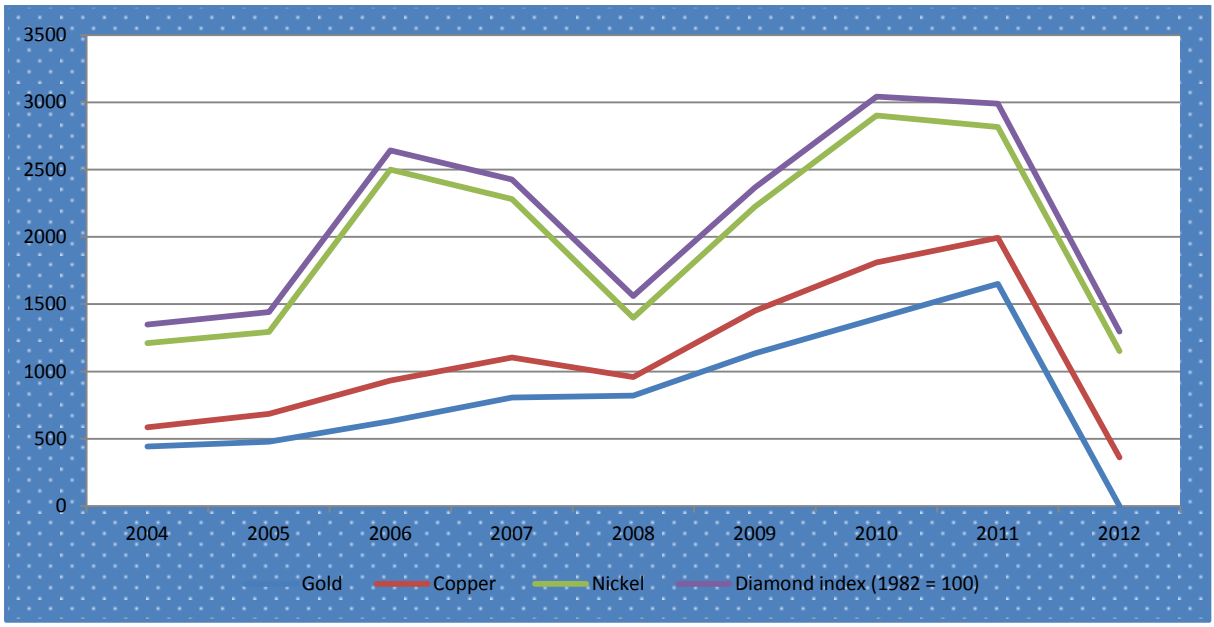
Figure 2:2 Projected path of diamond depletion



Source: Adapted from Basdevant (2008, p. 6).

Secondly, Botswana's over-reliance on diamonds exposes the economy to external shocks and fluctuations in commodity prices. This was highlighted by the 2008 global financial crisis, which resulted in a sharp decline in commodity prices (see Figure 2.3). During the 2008/2009 financial year, mineral revenues (royalties, dividends, annual lease charges and sundries) collected were about 32 percent lower compared to 2007/2008 receipts (Ministry of Finance and Development Planning 2010). During 2009, mining output declined by 31.4 percent and real GDP also declined by 4.6 percent. A similar fall in commodity prices is apparent during the year 2011 (see Figure 2.3). A more diversified economy could mitigate the impact of incidents of this nature on the economy.

Figure 2:3 Selected commodity prices (2004 - 2012)



Source: Author's computation based on Bank of Botswana (2013b)

Notes: Gold = monthly average prices in US dollars per ounce derived from daily prices; Copper and Nickel = monthly average prices quoted on the London Metal Exchange in US cents per pound; Diamonds = Antwerp Diamond Index – based on prices in US dollars (see Bank of Botswana 2013b).

Fluctuations in commodity prices and volatility of national income are one of several problems often associated with natural resource dependence. In the literature, it is frequently suggested that countries endowed with substantial natural resources tend to grow less rapidly than those without (see Humphreys *et al.* 2007). This phenomenon is often referred to as the 'resource curse'. The principle has been borne out of a series of quantitative studies across a comprehensive sample of countries (see for example Sachs & Warner 1995, Ross 1999, and Manzano & Rigobon 2001). A description of the mechanisms through which the phenomenon affects economic growth can be seen in Auty (2000), Collier (2007), Humphreys *et al.* (2007), Frankel (2010) and Cox and Harvie (2010).

A decline in the terms of trade for primary commodities, instability of international commodity markets, poor economic linkages between the resource and non-resource sectors and a condition referred to as the 'Dutch Disease' are often cited as the primary causes of this phenomenon (see Ross 1999)[7]. Humphreys *et al.* (2007) include insufficient investment in human capital, health and other productivity enhancing resources e.g. infrastructure among the primary causes of the phenomenon. Humphreys *et al.* (2007) argue that in most resource dependent countries, there is a tendency to invest less in human capital, health, physical infrastructure and so on, as these are not necessary for the realization of current income. The impact of this often becomes pronounced at a later stage when a country attempts to diversify into other sectors.

While challenges remain, Botswana is often cited as a model of prudent management of natural resources (see for example Hill 1991, Norberg & Blomstrom 1993, Acemoglu *et al.* 2001, Iimi 2007, Humphreys *et al.* 2007, Seidler 2010, Pegg 2010 and IMF 2012). The IMF (2012, pp. 33) shows that Botswana has been able to sustain high rates of economic growth over the past decades (in contrast to the resource curse phenomenon) owing to its prudent management of mineral wealth. Hill (1991) identifies the important role played by fiscal policy in this process. According to Hill (1991), by saving revenues during boom periods, government was able to maintain a fairly constant growth rate in real expenditures overtime. He also argues that government investment, as measured by development or capital expenditure, has been based on long run revenues as has current expenditure.

[7] The first published article referring to this term can be found in *The Economist*, November 26th, 1977, pp. 82-83. The term was originally derived from the adverse effects on Dutch manufacturing from the natural gas discoveries of the 1960s, through the subsequent appreciation of the Dutch real exchange rate and increased public sector expenditure. Corden and Neary (1982) and Corden (1984) provide a comprehensive treatment of this condition. A number of empirical studies have since examined possible channels through which effects of this phenomenon could be transmitted through the economy (see for instance, Corden & Neary 1982, Corden 1984, Sachs & Warner 1995, and Cox & Harvie 2010). These channels include, but are not limited to, the resource movement effect, spending effect, revenue effect, current account effect and real exchange rate effect.

Hill (1991) argues that the booms in revenue did not lead to increased expenditure above previously planned levels. Unexpected gains were mainly saved in the form of international reserves and not increased domestic spending[8]. The Pula Fund in particular has played an important role in this process, and has served as an important vehicle for transferring wealth across generations and providing a mechanism for revenue stabilization during periods of economic downturns (see IMF 2012)[9]. Hill (1991) also argues that the strategy of saving and increasing international reserves during booms to sustain expenditure and growth during busts, combined with management of the nominal exchange rate helped Botswana to avoid real exchange rate appreciations suffered by other natural resource based developing countries[10].

Acemoglu *et al.* (2001) emphasize the importance of Botswana's good institutions. They associate Botswana's good institutions to the pre-colonial institutional arrangements of the Tswana tribe which encouraged broad based participation and placed constraints on the political elite. These institutions limited the powers of leaders by forcing them to seek public consensus. Acemoglu *et al.* (2001) argue that British colonial rule in Botswana was very light, leaving Tswana institutions unchanged. This ensured a smooth transformation from a traditional society to the modern state. Acemoglu *et al.* (2001) also emphasize that it was also

[8] Since 1994 fiscal policy in Botswana has been guided by a Sustainability Budget Index (SBI) principle, which seeks to ensure that current spending is financed only with non-resource revenues; resource revenues are either used to finance investment or saved in the Pula Fund to transfer mineral wealth to future generations (IMF 2012, pp. 34). There is also a medium-term fiscal objective for the cumulative budget balance over the five-year period of each National Development Plan (NDP) and a cap on the expenditure-to-GDP ratio; these, however, are objectives rather than binding constraints and have been generally observed with some flexibility.

[9] The Pula Fund, managed by the Bank of Botswana, is composed of the Government Investment Account, which reflects both savings from accumulated fiscal surpluses and inflows of additional government debt, and the broader accumulation of national savings in excess of the Bank of Botswana's target for liquid reserves (IMF 2012, pp. 35).

[10] Prior to 2005, Botswana operated a fixed peg regime, in which the Botswana Pula (BWP) was pegged to a basket of currencies comprising the South African Rand (ZAR) and the Special Drawing Rights (SDR). A fixed peg was deemed appropriate to avoid substantial appreciation of the Pula due to a large inflow of foreign exchange from mineral exports. This regime was replaced with a crawling band mechanism in which the rate of crawl is based on the differential between the inflation objective and the forecast inflation in trading partners (see Bank of Botswana 2007).

in the best economic interests of the political elite to enforce property rights. Seidler (2010) argues that the result has been an underlying set of good institutions of property rights, secured by an efficient legal system that also provides for transparency and keeps corruption relatively low.

However, while Botswana has done relatively well in managing its natural resource wealth to maintain high rates of growth, a number of challenges that underline the importance of economic diversification to Botswana, and the policy significance of this study in identifying ways in which entrepreneurial activity could be enhanced with a view to facilitating economic diversification, remain. The first is the lack of a diversified production base and continued heavy reliance on diamond mining as highlighted earlier. The second, also described earlier, is the vulnerability of the economy to fluctuations in commodity prices. The third is the limited employment generation capacity of the economy which is partly related to heavy reliance on the diamond mining sector, which by its nature is capital intensive.

Statistics Botswana (2011) reveals that while mining dominates the economy, it constitutes a paltry 3.2 percent of total private and parastatal employment in Botswana. With unemployment estimated at 17.8 percent (Statistics Botswana, 2013a), accelerating growth in non-mining sectors in the coming years could be important in expanding productive employment opportunities for the country's labour force. This is also important for promoting broad based, inclusive growth. Bank of Botswana (2011) reveals that Botswana's non-resource sectors account for a larger share of employment than mining. According to Bank of Botswana (2011), commerce accounts for the largest share of total private and parastatal employment in Botswana at 31.6 percent, followed by manufacturing at 17.9 percent, and

finance and business services at 13.5 percent. Accelerating growth in these sectors as well as other areas in the services sector could go some distance in expanding employment opportunities in the economy. Expanding productive employment opportunities is also necessary to create a durable response to widespread poverty and inequality that currently exists in Botswana. Although poverty levels have been falling in recent years, Statistics Botswana (2013a) reveals that an estimated 19.3 percent of the population lives below the national poverty line. During 2002/03 the proportion living below the national poverty line was estimated at 30.6 percent. The proportion of people living below one dollar a day, on the other hand, is estimated at 6.4 percent, down from 23.4 percent reported during 2002/03 (Statistics Botswana 2013a).

Table 2.1 shows trends in Botswana's Human Development Index (HDI) between 1980 and 2012. The data shows that Botswana's HDI has generally been increasing over the last four decades, particularly in education and income. Botswana's performance in the health area however, remains low (see Table 2.1 column 3). Compared to other Sub-Saharan African countries at a similar level of development (including Angola, Gabon, Namibia, Seychelles and South Africa), Botswana is only bettered by Seychelles, which is classified as having high human development. For example, the HDI for Seychelles for 2012 was estimated at 0.756 (see UNDP 2013). Although Botswana is ranked medium human development as is the case with Gabon, South Africa and Namibia, it is ranked higher than all these countries. Among this group of countries, only Angola is ranked low human development. Important to note though is that while Botswana has made some inroads in terms of development, including gains in education and income as reflected in Table 2.1, a significant proportion of the population has yet to benefit from Botswana's growth and development achievements. A

diversified economic base would create a sustainable base for addressing poverty through wage employment, and where possible self-employment as the economy expands.

Table 2:1 Botswana HDI trends (1980 - 2012)

	HDI	*HDI-Health*	*HDI-Education*	*HDI-Income*
2012	0.634	0.521	0.683	0.720
2011	0.634	0.523	0.693	0.716
2010	0.633	0.525	0.693	0.710
2009	0.629	0.523	0.689	0.704
2008	0.626	0.518	0.684	0.706
2007	0.619	0.508	0.679	0.702
2006	0.611	0.496	0.680	0.696
2005	0.604	0.482	0.673	0.688
2000	0.587	0.487	0.637	0.663
1990	0.586	0.696	0.497	0.622
1980	0.449	0.641	0.275	0.516

Source: UNDP (2013)

2.4 Intent to promote entrepreneurial activity and significance of SMEs

2.4.1 Intent to promote entrepreneurial activity

Botswana's intent to promote entrepreneurial activity with a view to facilitating economic diversification can be traced through various national development plans (see Ministry of Finance and Development 1973, 1991, 1997, 2003, and 2009) which provided the basis for subsequent policies and programmes aimed at promoting entrepreneurial activity[11]. For example, the financial assistance policy (1982) which consisted of a capital grant to assist the

[11] Also see Ministry of Commerce and Industry (1998 and 1999).

start up or expansion of SMEs; the reserved sectors policy (1982), aimed at reserving certain economic activities for citizens; the local procurement programme (1997), aimed at reserving 30 percent of government purchases to local producers; and recently the economic diversification drive (2010) which provides SMEs with preferential margins for government procurement (see Zizhou 2009 and Ministry of Trade and Industry 2010).

Given Botswana's continuing heavy reliance on diamond mining, one can plausibly argue that these policies have not had a significant impact on developing strong local enterprise and entrepreneurial activity capable of sustaining the economy when diamond stocks are depleted. It is important to note that while the intent to promote entrepreneurial activity with a view to facilitating economic diversification has been there for years, Botswana has not had a comprehensive strategy for promoting entrepreneurial activity, except piecemeal policies adopted in the past. While one cannot completely blame this oddity, it is plausible that the lack of a clear direction has contributed to the difficulties encountered in promoting entrepreneurial activity. The purpose of this study is to contribute to the design of policies aimed at promoting entrepreneurial activity, with a specific focus on SMEs.

While the debate on the importance of SMEs to employment generation, productivity enhancement and economic growth continues (see Beck *et al.* 2005), evidence from a number of regions the world over indicates growing orientation towards smaller sized businesses. The experience of the United States (US) during the 1970s and 1980s provides perhaps the most impressive of this evidence. According to Carlsson (1992, 1999), the period between 1970 and 1996 saw the employment share of the 500 US largest firms (the so called Fortune 500) drop from 20 percent in 1970 to 8.5 percent in 1996. Acs (1999) further reveals that the employment share of small firms stabilised at 51 percent between 1982 and 1992, peaking at

52 percent between 1985 and 1997. In the literature, one encounters a subset that attempts to explain the shift of production form large firms towards smaller sized businesses. A description of this literature is provided in chapter 3.

Loveman and Sengenberger (1991), however, emphasize that this trend did not only occur in the US but elsewhere in the industrialized world. The OECD (2005) reveals that SMEs account for 66 percent of private sector employment in Organization for Economic Cooperation and Development (OECD) countries. In addition, they constitute the dominant form of business organization in these economies (*ibid*). The OECD (2005) further reveals that SMEs account for up to 99 percent of the business population in some OECD countries. While their employment shares vary across countries, Ayyagari *et al.* (2007) show that SMEs account for a significant proportion of employment in developing countries. However, they show that a significant proportion of SMEs in developing countries are informal (see Ayyagari *et al.* 2007). The significance of SMEs to Botswana is highlighted in the next section.

Reading through the literature, one encounters a number of reasons put forward to explain the ascendancy of SMEs. According to Piore and Sable (1984), the ascendancy of SMEs may be associated with the instability of markets and technology change in the 1970s which led to the demise of mass production while promoting flexible specialization, coupled with innovation as a source of competitiveness. This is consistent with developments in multinational corporations at this time as they focused on core business and subcontracted or outsourced parts of the production process to SMEs. The measures also facilitated reduction in business risk for large firms arising from rapid changes in consumer tastes and uncertainty in global markets. Brock and Evans (1989) emphasize the increase in labour supply leading

to lower real wages and coinciding with an increasing level of education, changes in consumer tastes, relaxation of entry regulations, and the process of creative destruction.

Loveman and Sengenberger (1991) emphasize devolution of production which has resulted in large firms being broken up into smaller plants or the creation of new subsidiary companies (known as product fragmentation). They argue that as a result of devolvement, large firms ceased to own units directly but instead engaged in licensing or franchising to retain revenue links. Carlsson (1992) emphasizes intensification of global competition, market uncertainty and growth in market fragmentation. This helped to reduce firm risk, enhance flexibility and maintain cost competitiveness.

Thurik and Wennekers (2004) emphasize that while SMEs have always mattered to policy makers, the perception of SMEs has changed drastically since the 1970s and 1980s. Acs (1992) stresses that in addition to making important contributions to entrepreneurial activity in the economy through their role in the spillover of knowledge, they generate much of the market turbulence that not only creates an additional dimension of competition not captured in the traditional static measure of market structure, but also stimulating industry evolution and thus serving as agents of change in the economy.

2.4.2 Economic significance of SMEs to Botswana

2.4.2.1 Proportion of the business population accounted for by SMEs

For a long time, Botswana has not had a comprehensive database for SMEs[12]. This situation, one might argue, has not only impacted on development planning, but research in general about the role of SMEs in Botswana. During the 2006/7 financial year, however, the Central Statistics Office of Botswana conducted its maiden census of enterprises. The report was published in 2010 (see Central Statistics Office 2010). In this report, it was revealed that the census will henceforth be conducted every five years, which is positive for policy makers and researchers alike. This study relies on the information from this census to highlight the proportion of the business population accounted for by SMEs in Botswana[13]. Worthy of note is that the census included only formally registered enterprises. Informal enterprises were not captured in the census. It is the case that the indicators of economic significance of SMEs highlighted in this study exclude the contribution of informal enterprises[14].

Figure 2.4, compiled from the 2010 census report data, shows the distribution of enumerated enterprises by economic activity and size. It reveals that SMEs accounted for a significantly large proportion of enumerated enterprises in all economic sectors. In agriculture, for example, all enterprises enumerated were SMEs. In community, social & personal services, financial intermediaries, hotels & restaurants, health and social work, wholesale & retail trade

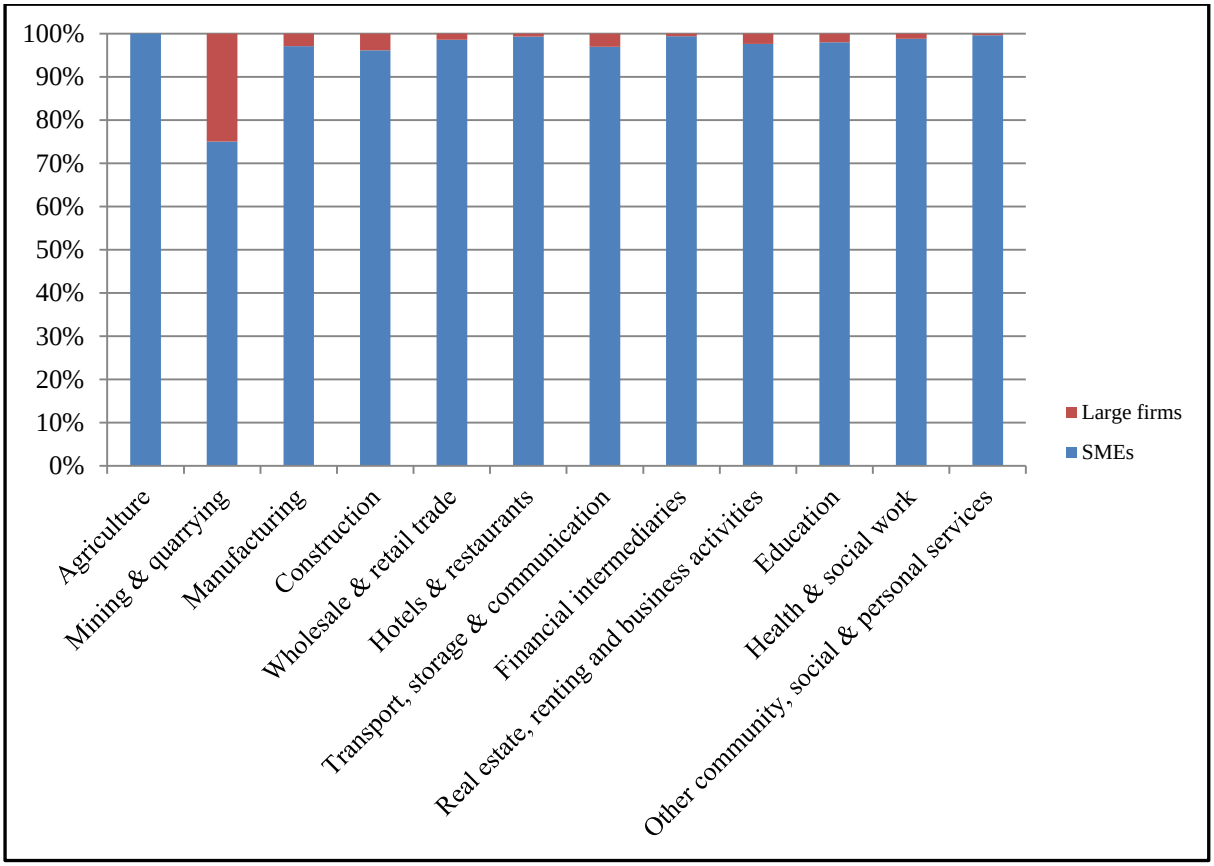
[12] As highlighted in chapter one, SMEs are defined with an upper limit of 100 employees in Botswana (see Ministry of Commerce and Industry 1999).

[13] It is important to note that while the information from this census has been useful for this part of the dissertation, it could not be used in the empirical investigation of technical efficiency of SMEs and determinants of technical inefficiency due to insufficient data for the variables required for the analysis. The study relied on data from the World Bank Enterprise Survey on Botswana for this purpose (see chapter four for more details).

[14] Worth noting also is that the empirical component of the study excludes informal enterprises. The data used for this study does not contain information on informal enterprises. In chapter seven, however, reference is made to the importance of policies aimed at reducing regulatory burdens on SMEs, which may encourage formalization. Formalization is likely to increase the chances of small businesses accessing institutional credit among others.

as well as manufacturing, SMEs accounted for at least 95 percent of enumerated enterprises. This suggests that only a few large firms were operating in Botswana during the conduct of the survey.

Figure 2:4 Distribution of enterprises by economic activity and size



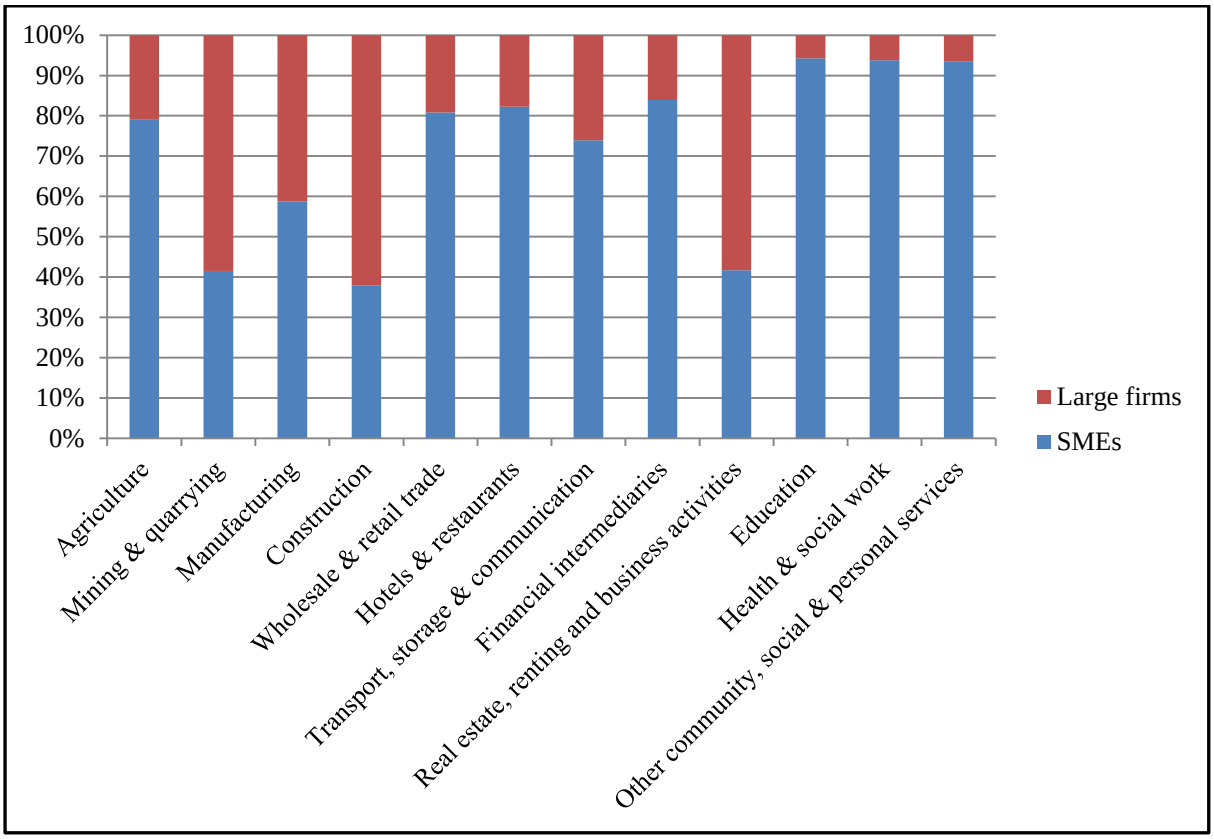
Source: Author's computation based on Central Statistics Office (2010)

2.4.2.2 Employment share of SMEs

Figure 2.5, also compiled from the 2010 census report data, reveals that SMEs accounted for a significant proportion of employment in enumerated enterprises. In education, health & social work, and community, social & personal services, SMEs accounted for at least 90 percent of employment. In other service sectors (financial intermediaries, hotels & restaurants, and wholesale & retail), they accounted for at least 80 percent of employment.

These employment shares are consistent with patterns highlighted in OECD (2005) for OECD countries and Ayyagari *et al.* (2007) for other developing countries. From Figure 2.5, it can be concluded that SMEs play a significant role in employment generation within Botswana.

Figure 2:5 Employment share of enterprises by economic activity



Source: Author's computation based on Central Statistics Office (2010)

While data on the contribution of SMEs to the country's national income are not available, the dominance of Botswana's SMEs in terms of business population and employment share suggest that SMEs are playing a significant role in Botswana's economy. A policy of promoting entrepreneurial activity revolving around these production units thus seems logical. This, however, does not suggest that entrepreneurial activity in large firms is less

important. As emphasized by Acs (2006), economic prosperity is the result of the combined force of both small and large firms. On account of data limitations and methodological considerations, however, entrepreneurial activity regarding large firms is outside the scope of this study. It is an aspect that should be explored in future studies however.

2.5 Conclusion

The purpose of this chapter has been to provide details of the motivation and objective of this study. The objective of the study consists of an investigation of effective ways of promoting entrepreneurial activity in Botswana with a view to facilitating economic diversification. A number of reasons why economic diversification is essential for Botswana, which also underline the significance of this study, were highlighted. Firstly, to avoid economic stagnation as the country's diamond mining sector declines. Secondly, to mitigate the impact of external shocks and commodity price fluctuations on the economy. Thirdly, to enhance the economy's capacity to generate productive employment opportunities. Entrepreneurial activity has been identified as one avenue through which economic diversification can be pursued. As a contribution towards the realization of this objective, this study investigates effective ways of promoting it. Policy recommendations on how entrepreneurial activity can be effectively promoted are drawn from this investigation.

The next chapter describes current literature on the role of entrepreneurial activity on economic growth. It also identifies factors relevant to the design of policies aimed at promoting entrepreneurial activity. This literature has been used to identify factors that policy makers in Botswana need to take into account when designing policies to enhance entrepreneurial activity. The recommendations emerging from this description of the literature are discussed in chapter 7.

3 ENTREPRENEURIAL ACTIVITY AND ECONOMIC GROWTH

3.1 Introduction

This chapter describes present knowledge on the relationship between entrepreneurial activity and economic growth[15]. It also highlights factors policy makers are encouraged to take into account when designing policies to promote entrepreneurial activity. Developing countries such as Botswana can draw lessons from this literature.

Before describing this relationship, a description of attempts to incorporate entrepreneurship into endogenous growth models is provided. It must be noted that until the emergence of endogenous growth theory, and in particular the second generation of endogenous growth models, the role of entrepreneurship was hardly addressed in the growth literature[16]. A brief description of this literature is provided in section 3.2.

The rest of the chapter is organised as follows. Section 3.3 provides the definition of entrepreneurship used in this study. Entrepreneurship as noted by Wennekers *et al.* (2002) is a complex phenomenon with varied definitions. This study relies on the definition used by

[15] Entrepreneurial activity, as emphasized by Bosma *et al.* (2009), is multi-faceted. This presents a problem for researchers to define and measure entrepreneurial activity with precision. According to Bosma *et al.* (2009), however, one important aspect of entrepreneurial activity is the extent to which people in a population create business activity. Researchers often define some proxy, for example self-employment rate or the business ownership rate (see Branchflower 2000 and Carree *et al.* 2002). The Global Entrepreneurship Monitor, which according to Amoros *et al.* (2014) is the most authoritative research on the role of entrepreneurial activity on economic growth, has, over the years, used a Total early-stage Entrepreneurial Activity (TEA) index to conduct research on entrepreneurship (see for example Minniti *et al.* 2006, Bosma & Harding 2007, and Bosma *et al.* 2008 and Bosma *et al.* 2009). The index measures the percentage of a country's working age population actively trying to start new businesses (nascent entrepreneurs) and those running new businesses for less than 3 and a half years. These proxies, it must be noted, have shortcomings (see Acs & Szerb 2010) but provide useful approximations of entrepreneurial activity.

[16] Endogenous growth models were formalised by Romer (1986) and Lucas (1988). These pioneering works are cited as the first generation of endogenous growth models in the literature (see for example Braunerhjelm *et al.* 2010, p. 106). Schmitz (1989), Segerstrom *et al.* (1990), Segerstrom (1991), Aghion and Howitt (1992), and Cheng and Dinopoulos (1992) are cited as the second generation (*ibid*).

the Global Entrepreneurship Monitor[17]. This definition is in line with the conceptual model developed by the Global Entrepreneurship Monitor in its study of the role of entrepreneurial activity on national economic growth (see for example, Reynolds *et al.* 1999, Bosma *et al.* 2009, Amoros *et al.* 2014). This study relies on this conceptual model to illustrate the relationship between entrepreneurial activity and economic growth. The definition is consistent with relationships illustrated in the model. This section also distinguishes between the type of entrepreneurial activity most likely to contribute positively to economic growth and that least likely to do so. It also describes the role of SMEs in facilitating entrepreneurial activity. This study, as noted in the previous chapter, revolves around entrepreneurial activity regarding SMEs in Botswana. It is thus worthwhile to highlight what the literature says, in general, about the role of SMEs in facilitating entrepreneurial activity.

Section 3.4 highlights present knowledge on the relationship between entrepreneurial activity and economic growth, together with policies likely to promote entrepreneurial activity. This section also highlights the contribution this study makes to this literature. Section 3.5 summarises key points of the chapter.

3.2 Entrepreneurship in growth theory

Until the emergence of the second generation of endogenous growth models, one cannot help but notice the absence of explicit attempts to incorporate the role of entrepreneurial activity in growth models. Endogenous growth models, as noted in the previous section, were formalised by Romer (1986) and Lucas (1988). In the words of Romer (1994),

[17] The Global Entrepreneurship Monitor (GEM), as noted by Amoros *et al.* (2014), is regarded as the most authoritative global research on the role of entrepreneurial activity on national economic growth. The objective of this research initiative is to contribute to global economic development by conducting and disseminating world class research that uncovers and measures factors impacting the level of entrepreneurial dynamics among economies (Amoros *et al.* 2014). It is also aimed at identifying policies that may lead to appropriate levels of entrepreneurial activity (*ibid*).

> *"the phrase endogenous growth theory embraces a diverse body of theoretical and empirical work that emerged in the 1980s. This work distinguishes itself from neoclassical growth by emphasizing that economic growth is an endogenous outcome of an economic system, not the result of forces that impinge from outside….the theoretical work does not invoke exogenous technological change to explain why per capita income has increased by an order of a magnitude since the industrial revolution. The empirical work does not settle for measuring a growth accounting residual that grows at different rates in different countries. It tries instead to uncover the private and public sector choices that cause the rate of growth of the residual to vary across countries"* Romer (1994, p. 3).

Economic growth in the post-war era according to Acs *et al.* (2004) was seen to be driven by investment in physical capital, and economic activity based on physical capital was organised in large-scale operations. This view corresponded with interpretation of the Solow (1956) model in which physical capital and labour were seen as key factors of production (see Acs *et al.* 2004). While technical change was shown to be an important component of an economy's growth rate, it was considered to be an unexplained residual (*ibid*). The policy debate thus revolved around capital deepening and labour augmentation with economic activity organised in large firms (Acs *et al.* 2004).

According to Acs *et al.* (2004), the emergence of endogenous growth models provided two fundamental contributions that shifted the policy debate from emphasis on enhancing physical capital and labour. First, advancing that the formation of knowledge and human capital takes place as a response to market opportunities (Acs *et al.* 2004). Second, that investment in knowledge is likely to be associated with large persistent spillovers to other agents in the economy (*ibid*). According to Acs *et al.* (2004) these contributions led to the priority of public policy shifting to knowledge and human capital accumulation.

According to Acs *et al.* (2004) following what came to be known as the 'European Paradox' throughout the 1990s, came a realization that investment in new knowledge alone does not guarantee economic growth and employment creation. Acs *et al.* (2004) note that despite high levels of investment in new knowledge and human capital, growth rates in a number of countries in Europe remained stagnant and employment creation sluggish during this period. The experience was seen as a limitation of the first generation of endogenous growth models. Acs *et al.* (2004) emphasize that while knowledge spillovers were decidedly important in these models, how knowledge spillovers occurred was not adequately addressed. The process was assumed to be exogenous (*ibid*). This limitation according to Acs *et al.* (2004) was addressed to some extent in the second generation of endogenous growth models (see for example Schmitz 1989, Segerstrom *et al.* 1990, Segerstrom 1991, Aghion & Howitt 1992, Cheng & Dinopoulos 1992, and Segerstrom 1995) in which entrepreneurship emerges as one of the mechanisms that facilitates knowledge spillovers. Schmitz (1989), for example, considered an imitative type of entrepreneur in the spilling of knowledge.

Building on Audretsch (1995) who introduced the knowledge spillover theory of entrepreneurship, recent attempts to incorporate the role of entrepreneurship in an endogenous growth framework have considered the role of a knowledge worker in an incumbent firm in the spillover of knowledge. In his knowledge spillover theory of entrepreneurship, Audretsch (1995) assumes an economic agent endowed with knowledge in an incumbent firm. Audretsch (1995) emphasizes that inherent characteristics of new knowledge (i.e. uncertainty, asymmetry and transaction costs), combined with a broad spectrum of institutions, rules and regulations create a divergence in the valuation of knowledge between the decision making hierarchy of an incumbent firm and economic

agents. While the decision making hierarchy of the incumbent firm may decide not to commercialise new ideas, economic agents may think they are potentially valuable (*ibid*).

Endowed with knowledge, an economic agent will choose to stay in an incumbent firm if he can pursue the idea within the organizational structure of the incumbent firm and appropriate roughly the expected value of that knowledge (Audretsch 1995). If he places greater value in his idea than the decision making hierarchy of the incumbent firm does, he may choose to start a new firm (*ibid*). By choosing to start a new firm, entrepreneurship becomes a conduit for knowledge spillovers and commercialization facilitating economic growth. Audretsch (1995) predicts that contexts rich in knowledge are likely to offer more entrepreneurial opportunities inducing more entrepreneurial activity, *ceteris paribus*. This suggests a potential role for policy targeted at generating knowledge with a view to creating entrepreneurial opportunities. The critical issue for policy makers is to design policies facilitating knowledge generation.

In developing countries such as Botswana, policies aimed at generating knowledge could be particularly important in expanding entrepreneurial opportunities which may in turn encourage entrepreneurial activity. How to achieve this is the critical issue for policy makers. Audretsch (1995) also predicts a positive relationship between entrepreneurship capital and economic growth. According to Audretsch (1995) entrepreneurship capital reflects the legal, institutional, and social factors that influence the entrepreneurial behaviour that shapes the capacity for entrepreneurial activity in an economy. This also suggests a potential role for policy in creating an economic environment that facilitates entrepreneurial activity. Policies targeted at reducing regulatory constraints, for example, may facilitate exploitation of entrepreneurial opportunities which may in turn facilitate economic growth. The policies

relevant for each particular economy are likely to depend on country specific conditions, which underline the importance of studies such as ours in identifying areas that must be targeted by policy makers in Botswana. Empirical evidence supporting Audretsch (1995) can be found in Audretsch and Thurik (2000), Carree *et al.* (2002), Audretsch and Fritsch (2002), Holtz-Eakin and Kao (2003), Acs and Armington (2003), Braunerhjelm and Borgman (2004), Acs *et al.* (2004), Audretsch and Keilbach (2004), Acs and Varga (2005), Audretsch (2005), van Stel *et al.* (2005), Carree and Thurik (2005), Audretsch *et al.* (2006), Mueller (2006).

To incorporate the behaviour of such economic agents (i.e. endowed with knowledge with economic value in an incumbent firm) and their likely influence on the spilling of knowledge and facilitating economic growth, Braunerhjelm *et al.* (2010) assume that such individuals will choose to start new firms if the expected net payoff from becoming an entrepreneur is larger than the expected net payoff from remaining an employee, adjusted for personal differences in risk. If this is so, then there exists a probability that the choice of being an entrepreneur is optimal for the individual (*ibid*). If the same argument is extended to a subset of individuals in a given population, then a share of the population will shift from being employees to entrepreneurs, thereby using knowledge to commercialise new products, which simultaneously results in new knowledge (Braunerhjelm *et al.* 2010). They suggest that at the aggregate level, entrepreneurial activity in the economy depends on entrepreneurial ability and factors influencing the knowledge filter (i.e. factors that influence how knowledge is transformed into knowledge with economic value e.g. regulatory burdens)[18]. Their findings are consistent with predictions made by Audretsch (1995) in his knowledge spillover theory of entrepreneurship.

[18]A more comprehensive treatment of the framework can be seen in Braunerhjelm *et al.* (2010).

While Braunerhjelm *et al.* (2010) acknowledge their framework is a preliminary attempt to separate the contribution to economic growth from entrepreneurial spillovers relative to incumbents which could be enhanced with more rigorous research in the future, they argue that their framework suggests that economic gains are likely to be realised from policies that focus on instruments that influence the entrepreneurial choice, facilitating knowledge commercialization. A business environment with reduced regulatory burdens may increase the expected utility from becoming an entrepreneur and enhance commercialization of knowledge contributing to economic growth (*ibid*). This suggests that developing countries such as Botswana looking to promote entrepreneurial activity as an avenue for economic diversification may derive economic gains from policies that not only encourage knowledge generation, but facilitate knowledge commercialization as well.

3.3 Understanding entrepreneurship

3.3.1 Definition of entrepreneurship

Entrepreneurship, as noted in the introductory section of this chapter, is a complex phenomenon with varied definitions[19]. This study relies on the definition used by the Global Entrepreneurship Monitor in its study of the role of entrepreneurial activity on economic growth. This definition takes a broader view of entrepreneurship and focuses on the behaviour of individuals starting new businesses and the behaviour of individuals in established firms, also called *employee entrepreneurial activity* or *corporate entrepreneurship* (see Reynolds *et al.* 1999)[20]. In this respect the GEM defines entrepreneurship as,

[19] Some of the early contributions in this literature can be found in Hebert and Link (1989) and Wennekers and Thurik (1999).

[20] In its study of the behaviour of individuals starting new businesses, the Global Entrepreneurship Monitor focuses on total early-stage entrepreneurial activity (TEA) which measures the percentage of a country's working age population actively trying to start new businesses and those running new businesses for less than 3

> *"any attempt at new business or new venture creation such as self-employment, a new business organization, or the expansion of an existing business, by an individual, a team of individuals or an established business"*
>
> Reynolds *et al.* (1999, p.3).

While this study relies on this definition, it is not particularly clear whether it takes into account employees starting new businesses. It is reasonable to think that employees working in a particular firm, with the knowledge that they have, may start new businesses while working for the firm at the same time. In the literature on entrepreneurship in general, there is very little work, if any, done on this cohort. It is the view of the researcher that this cohort warrants the attention of researchers and policy makers and should be explored in future studies not only for Botswana, on which this study focuses, but the literature in general to enhance the understanding of entrepreneurship.

3.3.2 Which type of entrepreneurial activity is good for growth?

According to Reynolds *et al.* (2002), while entrepreneurial activity is likely to exert a positive influence on economic growth, it is important to recognise that the impact on economic growth from entrepreneurial activity depends on the type of entrepreneurial activity. According to Reynolds *et al.* (2002) individuals participate in entrepreneurial activity either because they perceive an *'entrepreneurial opportunity'* or they feel compelled to start businesses because all other options for work are either absent or unsatisfactory. It must be noted that the concept of entrepreneurial opportunity is difficult to define clearly. For example, Sarasvaty *et al.* (2003) define entrepreneurial opportunity as

---

and a half years (see Reynolds *et al.* 1999). Unless otherwise specified, when we talk about entrepreneurial activity relating to individuals starting new businesses, we refer to total early-stage entrepreneurial activity in line with GEM on which our study significantly relies on.

> *"a set of new ideas or inventions that may or may not lead to the achievement of one or more economic ends that become possible through those ideas or inventions; beliefs about things favourable to the achievement of possible valuable ends; and actions that generate and implement those ends through specific new economic artefacts such as products and services and/or entities such as firms and markets and/or institutions such as standards and norms"*
>
> Sarasvaty *et al.* (2003, p. 142).

According to Reynolds *et al.* (2002), the impact on economic growth from entrepreneurial activity (as measured by total early-stage entrepreneurial activity) induced by recognition of an entrepreneurial activity varies greatly from that which is induced by lack of options. According to Reynolds *et al.* (2002) entrepreneurs who are induced by recognition of entrepreneurial opportunities expect their ventures to produce more high-growth firms and provide more new jobs. They claim that as a result of the expected high growth of firms of these types of entrepreneurs, entrepreneurial activity induced by recognition of entrepreneurial opportunity is likely to exert a positive influence on economic growth. In contrast, those compelled by a lack of options are thought to have little ambitions, if any, of achieving high growth and employment in their firms. The impact on economic growth of entrepreneurial activity induced by necessity is thus thought likely to have very little impact, if any, on economic growth since very little in terms of growth of firms and employment creation is expected from such entrepreneurs.

Reynolds *et al.* (2002) refer to entrepreneurs motivated by recognition of an entrepreneurial opportunity as '*opportunity entrepreneurs*', and those compelled by lack of options as '*necessity entrepreneurs*'. It is not particularly clear in the literature, however, whether it was Reynolds *et al.* (2002) who originated this terminology. The terminology has however gained popularity in recent literature on entrepreneurship and is used extensively in studies

conducted by the Global Entrepreneurship Monitor (see for example Wennekers *et al.* 2005, Acs & Varga 2005, Acs 2006, Minniti *et al.* 2006, Bosma & Harding 2007, Bosma *et al.* 2008, Amoros *et al.* 2011, Bosma *et al.* 2012, and Amoros *et al.* 2014).

Acs (2006) employs entrepreneurship data (total early-stage entrepreneurial activity) from the 2004 Global Entrepreneurship Monitor report to construct a proxy for the ratio of opportunity entrepreneurship (starting a business to exploit a perceived entrepreneurial opportunity) and necessity entrepreneurship (starting a business out of lack of options) in countries included in the report[21]. Acs (2006) explains that he uses this ratio to approximate the importance of opportunity (desirable) entrepreneurship relative to necessity entrepreneurship. The values of this ratio for the countries included in his study ranged from 1.1 for Brazil to 16.7 for Iceland. He then fitted a polynomial regression line to examine the correlation between this ratio and a country's national income (as measured by per capita GDP)[22]. He found a positive correlation between the ratio and per capita GDP, with per capita GDP appearing to be higher in countries with a higher opportunity ratio (for example Belgium and Iceland) and lower in countries with a lower opportunity ratio (for example Uganda and South Africa).

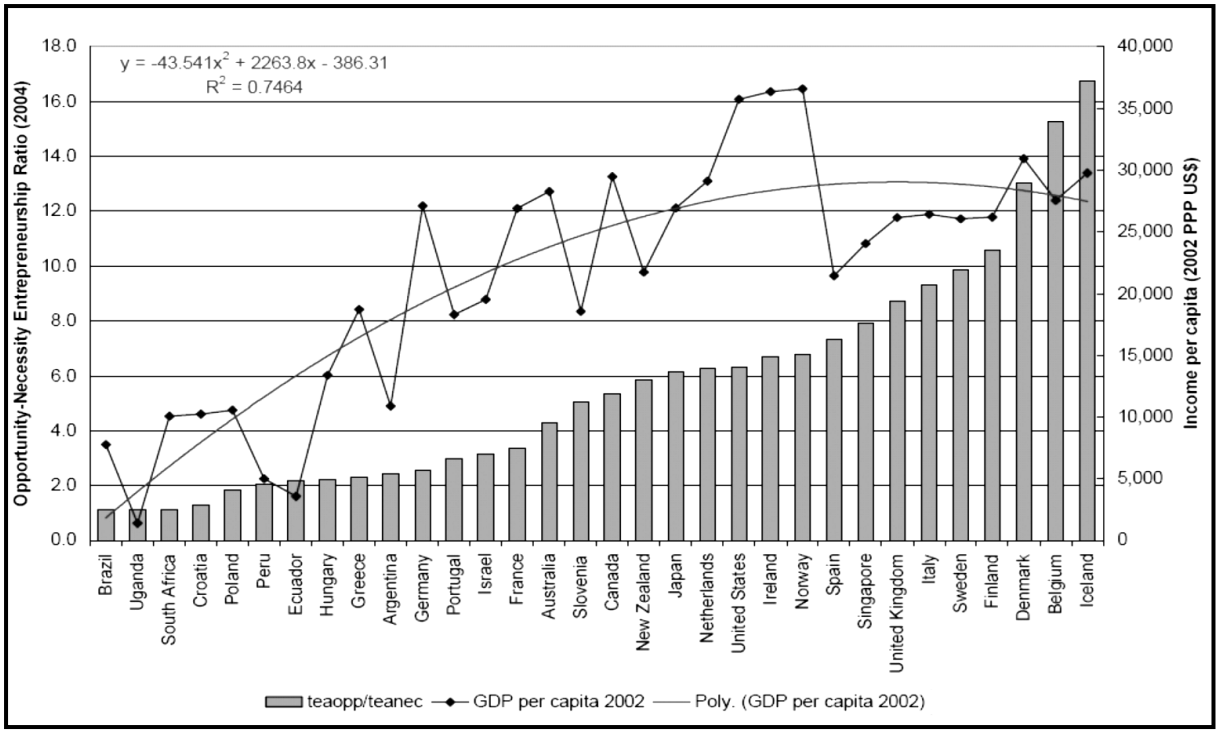
The positive relationship estimated by Acs (2006) is shown in Figure 3.1 which is adapted from Acs (2006, p. 102). In this Figure, the opportunity-to-necessity ratio for each individual

[21] In GEM studies, individuals are asked to indicate whether they started businesses out of lack of options or from opportunity recognition. It should be clear that this information cannot be interpreted as a perfect measure of motives for being engaged in entrepreneurship. Acs (2006) notes that in GEM surveys, it is possible that some respondents are tempted to state that they are pursuing an opportunity rather than being involved in entrepreneurial activity because they have no other option for work, even if the latter best describes these people. This suggests then that the information from these surveys cannot be interpreted as perfect measures, but they provide useful approximations to assess the ratio of opportunity to necessity entrepreneurship in a particular country. The countries included in Acs' (2006) study are Brazil, Uganda, South Africa, Croatia, Poland, Peru, Ecuador, Hungary, Greece, Argentina, Germany, Portugal, Israel, France, Australia, Slovenia, Canada, New Zealand, Japan, Netherlands, United States, Ireland, Norway, Spain, Singapore, United Kingdom, Italy, Sweden, Finland, Denmark, Belgium and Iceland.

[22] The data on national income was obtained from the 2002 United Nations Development Programme Human Development Report.

country is represented by the grey horizontal bars. As can be seen from Figure 3.1 the opportunity ratio as represented by these horizontal bars rises with an increase in per capita GDP. The per capita GDP for each individual country is represented by the corresponding dot point for each horizontal bar. The smooth line represents the polynomial adjustment fitted by Acs (2006). This regression line also suggests a positive association between the opportunity ratio and per capita GDP as suggested by Acs (2006).

Figure 3:1 Opportunity-to-necessity ratio and income per capita



Source: Adapted from Acs (2006, p. 102).

Although he does not provide empirical results supporting his claim, Acs (2006) suggests that he found evidence that the ratio tracks positively with development variables such as exports, licensing receipts, research and development (R&D) expenditures and education spending. Acs (2006) does not address causality between this ratio and per capita GDP. He argues that

the positive correlation between the ratio and per capita GDP, together with the positive correlation between this ratio and other development variables, suggests that entrepreneurial activity is likely to be good for economic growth if it is motivated by opportunity recognition rather than lack of options. In line with Reynolds *et al.* (2002), he claims that since entrepreneurs who are motivated by recognition of entrepreneurial opportunities have high growth ambitions for their firms, entrepreneurial activity driven by such motives is likely to have a positive influence on economic growth as such entrepreneurs are likely to create high impact firms rather than low or no impact firms associated with necessity entrepreneurs.

Acs (2006) suggests that the opportunity-to-necessity ratio also serves as an indicator of economic development. He suggests that the composition of entrepreneurial activity (as suggested by this ratio) is likely to vary with the level of economic development. According to Acs (2006), entrepreneurial activity in low per capita GDP countries is likely to be dominated by necessity entrepreneurship. His arguments for this claim will be provided shortly. He however argues that the opportunity ratio for countries at this level of development is likely to be low as a result of a higher percentage of necessity entrepreneurship relative to opportunity entrepreneurship (see Figure 3.1). In contrast, this ratio is likely to be higher in countries at higher levels of per capita GDP as a result of a higher percentage of opportunity entrepreneurship relative to necessity entrepreneurship. Reasons for this claim will be provided shortly. In his estimated relationship between the opportunity ratio and per capita GDP he did find that this ratio was higher for countries with higher per capita GDP as shown in Figure 3.1.

As mentioned before, Acs (2006) does not address causality in this study, but bases his conclusions on the correlation between the opportunity ratio and per capita GDP. While Acs

(2006) is an important contribution to the understanding of the relationship between the opportunity ratio (used as a proxy for the importance of opportunity entrepreneurship relative to necessity entrepreneurship), future studies could extend this contribution by investigating the causal relationship between this ratio and per capita GDP. Such research could reveal important information that could assist in the design of policies to promote economic development.

Acs (2006) argues that not only does the composition of entrepreneurial activity vary according to the stage of economic development as suggested by the opportunity ratio, so does the level of entrepreneurial activity. According to Acs (2006) the level of entrepreneurial activity is likely to be higher in countries at lower levels of per capita GDP. As the economy moves towards higher levels of per capita GDP, the level of entrepreneurial activity is expected to pick up again. He thus distinguishes three stages of economic development across which the composition and level of entrepreneurial activity is thought likely to differ.

According to Acs (2006), in the first stage of economic development an economy is likely to specialise in the production of agricultural products and small manufacturing craft activities. This stage is likely to be marked by high rates of entrepreneurial activity (Acs 2006). Entrepreneurial activity is however likely to be dominated by necessity entrepreneurship, due to limited opportunities for better waged-employment at this stage (*ibid*). The only option that individuals have to make a living, therefore, is to engage in small manufacturing activities such as handicrafts. Entrepreneurial activity is thus likely to be dominated by necessity entrepreneurship as people try to make a living out of entrepreneurship in an economic environment with limited waged-employment opportunities which are likely to be more

remunerative than necessity entrepreneurship, and this is typical of most developing countries where opportunities for more remunerative waged-employment are limited. The opportunity ratio is thus likely to be low in such economies due to the higher percentage of necessity entrepreneurship relative to opportunity entrepreneurship. Figure 3.1 revealed that this ratio was low in countries at lower levels of per capita GDP in Acs' (2006) study.

The second stage of development according to Acs (2006) is likely to be marked by decreasing rates of entrepreneurial activity. He argues that if individuals have different endowments of managerial ability, then, as the economy becomes wealthier, the average firm size should increase and better managers run large scale firms which may be state-owned or privately owned (multinational corporations). According to Acs (2006) the average firm size can be seen as an increasing function of the wealth of an economy if capital and labour are substitutes. He argues that if labour and capital are substitutes, an increase in the capital stock (through private enterprises, foreign direct investment or government ownership) increases returns from working and decreases returns from being an entrepreneur in a small firm involved in low value adding activities.

As the economy advances, therefore, marginal managers find that they can earn more being employed by somebody else (Acs 2006). As the economy develops, therefore, fewer people are expected to be pursuing entrepreneurial activity. The composition of entrepreneurial activity is expected to change as the percentage of necessity entrepreneurship relative to opportunity entrepreneurship falls. This stage is typical of middle income economies in which the industrial sector starts to expand offering more remunerative waged-employment opportunities, so that the number of people involved in necessity entrepreneurship falls as people find stable and more remunerative jobs in large firms. The quality of entrepreneurial

activity as suggested by the opportunity ratio also changes as the necessity entrepreneurs find employment in large firms. The expanding industrial sector is also likely to provide opportunities for opportunity entrepreneurship in an economic environment that increasingly allows exploitation of entrepreneurial opportunities.

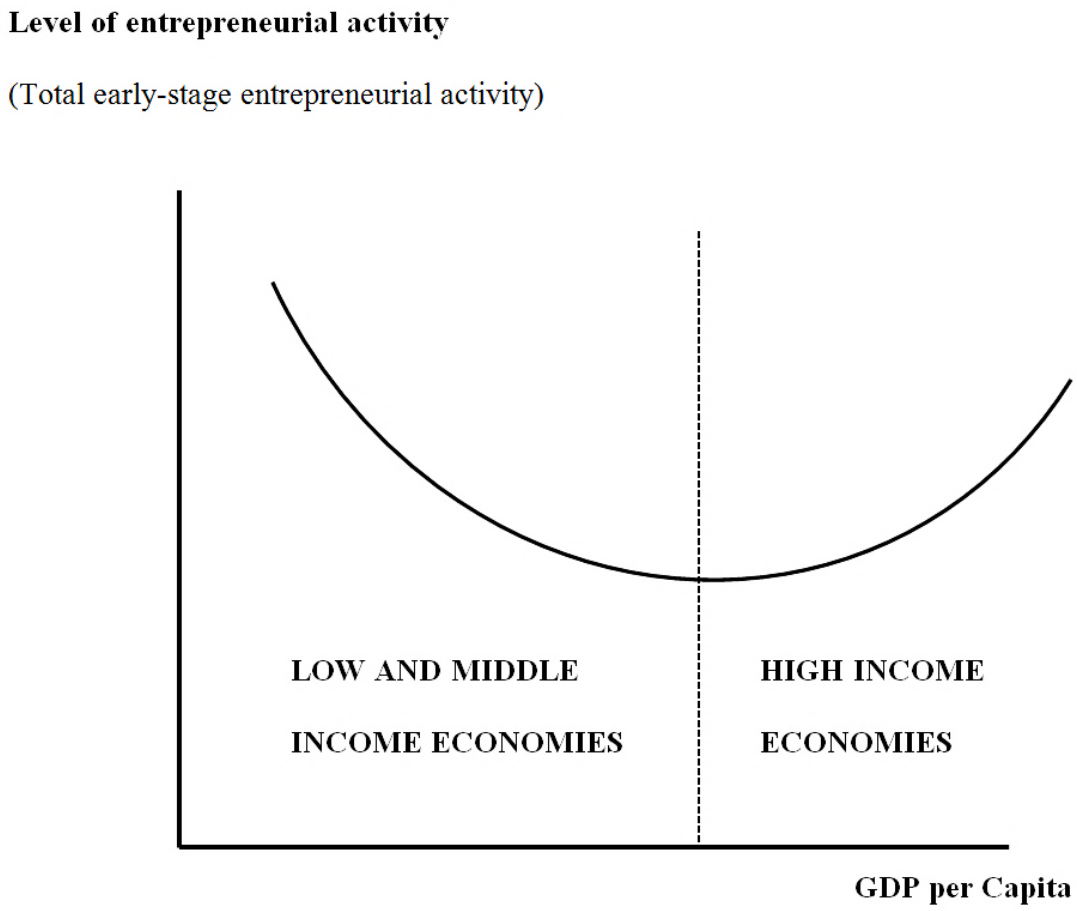
The third stage according to Acs (2006) is likely to be marked by an increase in entrepreneurial activity. He identifies three main reasons why this is likely. Firstly, that the share of manufacturing in the economy is expected to decrease. He argues that virtually all industrialised countries experienced a decline in the share of manufacturing during the 1970s. The service sector he argues tends to expand relative to manufacturing at this stage of economic development. According to Acs (2006) service firms are on average smaller than manufacturing firms. Average firm size is thus expected to decline economy-wide as the service sector expands and manufacturing declines. Acs (2006) therefore argues that service firms provide even more opportunities for entrepreneurship in a business environment that permits exploitation of business opportunities. Start-up costs for service firms are thought to be generally less prohibitive and therefore more attractive to individuals willing to give up waged-employment to run their own businesses.

Secondly, technological change in the post war era has been biased towards industries in which entrepreneurial activity is important, thus increasing opportunities for entrepreneurship (*ibid*). Thirdly, in an economy characterised by higher values of aggregate elasticity of factor substitution, a higher level of development, more entrepreneurs and smaller firms should be expected (Acs 2006). Acs (2006) argues that a high value of the elasticity of factor substitution makes it easier for individuals to become entrepreneurs. In this stage of economic development, therefore, entrepreneurial activity is thought to be dominated by opportunity

entrepreneurship. The opportunity ratio is thus expected to be higher as a result. Figure 3.1 did show that this ratio is higher for countries at higher level of per capita GDP.

According to Acs (2006) this implies that a U-shaped relationship exists between the level of entrepreneurial activity and economic development. In the first stage, entrepreneurial activity is high but dominated by necessity entrepreneurship. In the second stage, entrepreneurial activity is falling and accompanied by changes in the composition of entrepreneurial activity as people leave necessity entrepreneurship for more remunerative waged-employment in large firms. In the third stage, entrepreneurial activity begins to increase, but dominated by opportunity entrepreneurship. This U-shaped relationship can be seen in Figure 3.2 which is developed by the researcher from Acs' (2006) conclusions. Figure 3.2 shows a higher level of entrepreneurial activity (as measured by total early-stage entrepreneurial activity) at lower levels of per capita GDP; falling rates of entrepreneurial activity as per capita GDP increases; and then rising again in economies as per capita GDP continues to increase.

Figure 3:2 Entrepreneurial activity and economic development



Source: Author's compilation based on Acs (2006).

This U-shaped relationship has also been demonstrated by the Global Entrepreneurship Monitor in a number of studies on the role of entrepreneurial activity on economic development (see for example Minniti *et al.* 2006, Bosma & Harding 2007, and Bosma *et al.* 2008). According to Acs (2006) this U-shaped relationship suggests that policies designed to promote entrepreneurial activity must take into account challenges faced by economies at different stages of economic development. He stresses that policies and conditions favourable for entrepreneurship in one country may not be effective or favourable in another (that is, one size does not fit all) hence the need to develop country specific policies bearing in mind where a particular country is in the path of economic development. Section 3.4 highlights

policies that Acs (2006) suggests are likely to promote entrepreneurial activity at each stage of economic development.

As stated previously, Acs (2006) does not address the issue of causality. A more rigorous theoretical and empirical analysis of this relationship is necessary. This is beyond the scope of this study, however, but is worth considering in future studies. Important information that may be used in development policy may be drawn from such research. It would also be interesting if future research could examine what determines the slope of this U-shaped relationship. The slope of the relationship one imagines would have implications for the impact of entrepreneurial activity on economic development.

3.3.3 The role of SMEs in facilitating entrepreneurial activity

According to Wennekers and Thurik (1999), SMEs, where entrepreneurs often have a controlling stake, are now more than ever before seen as vehicles for entrepreneurial activity, for example early-stage entrepreneurial activity[23]. SMEs according to Wennekers and Thurik (1999) rose to prominence as vehicles of entrepreneurial activity in the mid-1990s partly due to the 'European Paradox' referred to earlier in section 3.2. It was noted that following this experience, entrepreneurship emerged as the missing link between knowledge investments and economic growth, with small firms seen as critical to facilitating entrepreneurship and spillover benefits. Economic gains are expected from policies aimed at supporting SMEs. Some of the factors that policy makers are encouraged to take into account when designing policies to support SMEs are highlighted in the next section.

[23] As noted in section 3.2.1, however, entrepreneurship may also occur in established firms (i.e. employee entrepreneurial activity). Emphasis here is placed on SMEs in line with the objective of the study.

3.4 Entrepreneurial activity-economic growth nexus

Entrepreneurship as acknowledged in the latest Global Entrepreneurship Monitor report (see Amoros *et al.* 2014) is a 'black box' which underlines the difficulty in explaining relationships thought to exist between entrepreneurial activity and economic growth. With a simplified conceptual model an attempt has been made by the Global Entrepreneurship Monitor to provide insights about this black box. This study relies on this conceptual model to illustrate some of the relationships thought to exist between entrepreneurial activity and economic growth. It must be noted though that this model cannot be considered as revealing all that goes on in this 'black box'. It does provide, however, a useful representation of some of the relationships between entrepreneurial activity and economic growth, from which policy implications on how economic growth can be fostered may be drawn.

3.4.1 GEM model of entrepreneurial activity and economic growth

3.4.1.1 GEM I

Paul Reynolds is credited with developing the first GEM model that reflects mechanisms through which entrepreneurial activity is said to influence economic growth. In line with the GEM definition of entrepreneurship, the model takes a broader view and recognises the behaviour of individuals in starting their own firms (early-stage entrepreneurial activity) and the behaviour of individuals in established firms (employee entrepreneurial activity). In this respect the model gives a comprehensive picture of mechanisms through which entrepreneurial activity is likely to influence national economic growth. This model can be seen in Figure 3.3. The Figure is reproduced from Reynolds *et al.* (1999, p. 11). The top half of Figure 3.3 directly relates to entrepreneurial activity in established firms while the bottom half relates to individuals starting their own businesses.

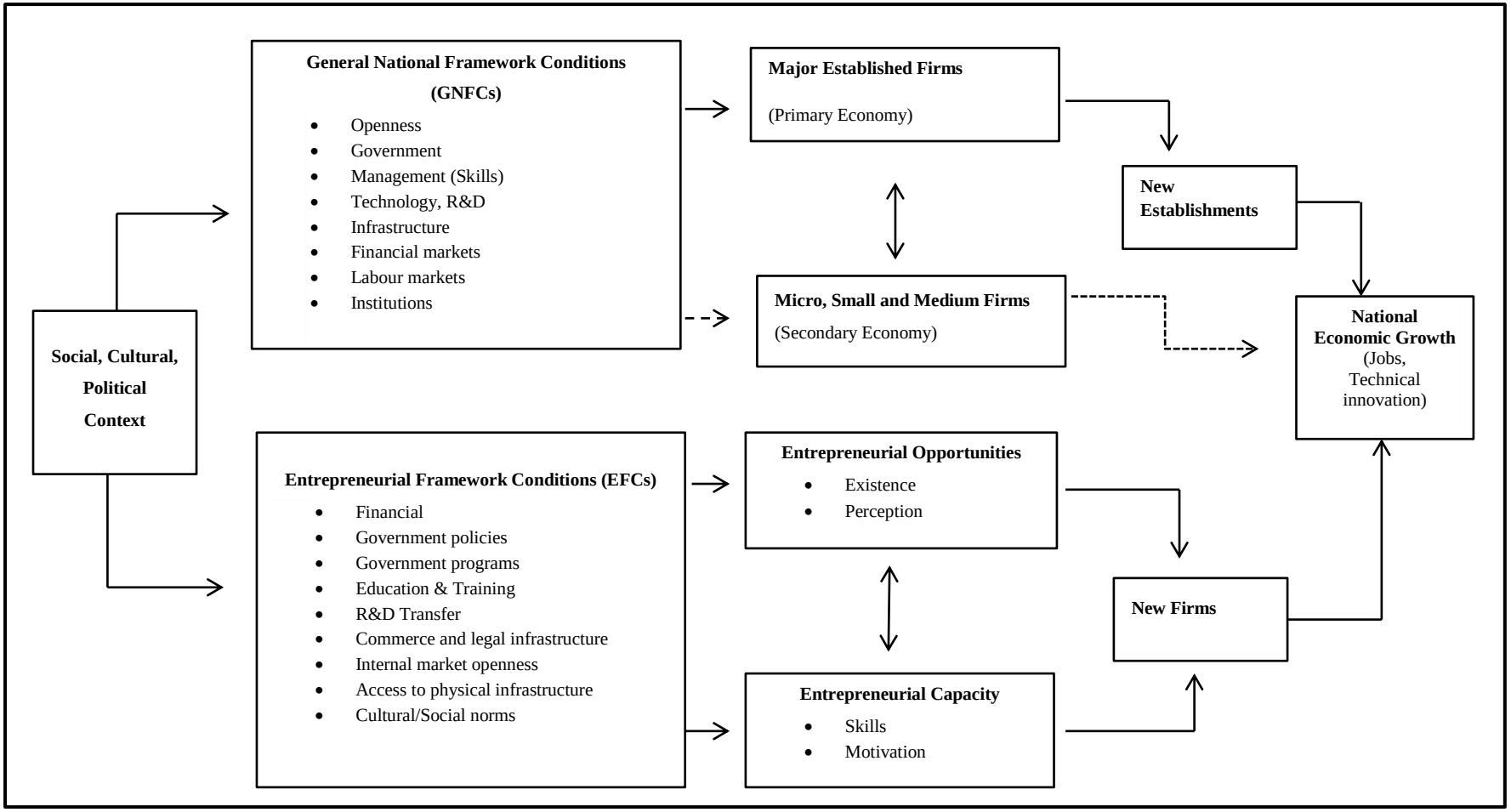
Moving from the left to the right of Figure 3.3 it is thought that there are social, cultural and political factors (i.e. demographic structure, investment in education, social norms and attitudes associated with the perception of entrepreneurs) that shape general national framework conditions (GNFCs) and entrepreneurial framework conditions (EFCs) that in turn influence entrepreneurial activity (both early-stage entrepreneurial activity and corporate entrepreneurship). The GNFCs and EFCs appear in the second column of Figure 3.3. The GNFCs are thought to comprise national contextual factors such as the role of government and financial institutions, levels of research and development (R&D), quality of physical infrastructure, labour market efficiency, and robustness of the legal and social institutions (see Figure 3.3). Some of these factors, for example levels of research and development, were identified by Audretsch (1995) in his knowledge spillover theory of entrepreneurship as likely to influence knowledge generation which may in turn facilitate entrepreneurial activity.

EFCs on the other hand are thought to comprise availability and accessibility of finance, the extent to which public policy gives support for entrepreneurship, R&D transfer, presence of property rights, commercial, accounting and other legal and assessment services and institutions that support or promote entrepreneurship, entry regulation, ease of access to physical resources at a reasonable price, as well as the extent to which social and cultural norms encourage entrepreneurship (see Figure 3.3). These elements are also consistent with factors identified by Audretsch (1995) as likely to influence entrepreneurial activity.

The third column of Figure 3.3 shows entrepreneurial activity in established firms being directly influenced by GNFCs leading to new establishments (column 4), which in turn influences national economic growth (column 5). In terms of individuals starting businesses (see bottom half of Figure 3.3, column 3) it is thought that the decision to start a business is

influenced by additional characteristics (i.e. EFCs) within the existing business environment (i.e. GNFCs). These conditions, together with the existing business environment are said to influence both the existence of entrepreneurial opportunities and recognition of those entrepreneurial opportunities by potential entrepreneurs. However, it is recognised that the existence and perception of entrepreneurial opportunities is not enough, in that individuals should also have the capacity (skills) to pursue those opportunities. When successfully combined these conditions are thought to lead to offshoot businesses (see bottom half of column 4), which in turn will increase innovation and competition within the market place, and consequently economic growth (see column 5 of Figure 3.3). This is also consistent with earlier contributors such as Audretsch (1995) who highlighted the important role that knowledge generation plays in influencing economic development.

Figure 3:3 GEM I



Source: Adapted from Reynolds *et al.* (1999, p. 11).

This model, as emphasized by Acs (2006), shows that a nation's economic development is likely to be associated with the behaviour of individuals in starting off firms as well as that of individuals in established firms, but that entrepreneurial activity is likely to be shaped by general national framework conditions (GNFCs) and entrepreneurial framework conditions (EFCs) as appearing in column 2 of Figure 3.3. Audretsch (1995) showed that while entrepreneurial activity is an important component of economic growth, it is likely to be influenced by legal, institutional, and social factors that influence entrepreneurial behaviour. Audretsch (1995) refers to these elements as entrepreneurship capital, and argues that economic gains are likely to result from policies that make it easier for individuals to engage in entrepreneurial activity[24].

Important conclusions on how economic growth may be fostered through entrepreneurial activity may thus be drawn from this conceptual model. According to Acs (2006), however, policies designed to promote entrepreneurial activity must take into account the stage of economic development of a particular country. He argues that policies adopted at each particular stage must address specific challenges faced by countries in those stages of development. According to Acs (2006) economies at low levels of economic development are likely to benefit from policies targeted at strengthening GNFCs (see top half of column 2, Figure 3.3). These are expected to facilitate growth of large established firms (state-owned or private) which are likely to be important for economic development at lower levels of per capita GDP. He suggests that middle income economies are likely to benefit from adopting a balanced approach that targets both GNFCs and EFCs with priorities dictated by country specific conditions[25]. As a middle income economy, Botswana would be expected to benefit

[24] This has also been demonstrated in recent studies such as Acs *et al.* (2004) and Branerhjelm *et al.* (2010) who examined the role of entrepreneurial activity on economic growth in an endogenous growth theory framework.
[25] EFCs are highlighted in column 2, bottom half of Figure 3.3.

from such policies although policy design will have to be informed by an examination of factors that are relevant, which makes our study important. This study attempts to identify areas that policy makers must be looking into in the design of policies to improve the performance of SMEs with a view to facilitating economic diversification. Important policy implications are thus expected from this investigation.

Building on the strength of GNFCs, EFCs are expected to encourage opportunity driven entrepreneurship as the economy continues to advance. According to Acs (2006) the average firm size is expected to decline in the third stage as production switches more towards smaller firms, and the service sector expands creating even more opportunities for smaller firms. The entrepreneurial sector he argues begins to play a more important role at this stage. Acs (2006) suggests that economies at this stage are likely to benefit from strengthening EFCs in order to ensure sustained competitiveness and growth.

3.4.1.2 GEM II

What is referred to as GEM II is the current model being used by the Global Entrepreneurship Monitor in its study of the role of entrepreneurial activity on economic growth. It is a revised version of GEM I. The model first appeared in the 2008 GEM report (see Bosma *et al.* 2009). The model builds on Porter *et al.* (2002) who emphasize that successful economic development must be seen as a process of successive upgrading, in which businesses and their supporting environment co-evolve to foster increasingly sophisticated ways of producing and competing. According to Porter *et al.* (2002, p. 17), seeing economic development as a sequential process of building not just macroeconomic stability but also interdependent factors such as the quality of governance, societal capacity to advance its technological capability, more advanced modes of competition, and evolving forms of firm

organizational structure helps expose important potential pitfalls in economic policy. Lack of improvement in any important area can lead to a plateau in productivity and stalled economic growth (see Porter *et al.* 2002).

Porter *et al.* (2002) identify three successive stages in the evolution of economies, namely factor-driven, efficiency-driven, and innovation-driven stages[26]. According to Porter *et al.* (2002), economic growth in the factor-driven stage is determined primarily by the mobilization of primary factors of production: land, primary commodities and unskilled labour. The main challenge facing economies at this stage is to get basic factor markets working properly. The role of government, therefore, is to provide overall political and macroeconomic stability and sufficiently free markets to permit effective utilization of primary commodities and unskilled labour by both indigenous firms and through attracting foreign direct investment (see Porter *et al.* 2002). According to Porter *et al.* (2002) firms at this stage of development produce commodities or relatively simple products using long standardised technology assimilated through imports, foreign direct investment, and imitation. They also note that companies compete on the basis of price and focus mostly on assembly, labour intensive manufacturing, and resource extraction. Their role in the value chain is thought to be limited at this stage.

Porter *et al.* (2002) emphasize that economies at this stage are highly sensitive to world economic cycles, commodity price trends, and exchange rate fluctuations. Maintaining competitiveness is thus thought to revolve around well-functioning public and private institutions, well-developed infrastructure, a stable macroeconomic environment, and a healthy and increasingly educated workforce. In subsequent reports published by the World

[26] Schwab (2014) provides the latest classification of economies according to these stages.

Economic Forum (WEF), in which Porter is one of the major contributors (see for example Porter & Schwab 2008, Schwab 2009, 2010, 2011, 2012, 2013, and 2014), these elements have been referred to as *basic requirements*. Reports of the Global Entrepreneurship Monitor published since 2009 to date also use this terminology (see for example Kelley *et al.* 2012, Xavier *et al.* 2013, and Amoros *et al.* 2014). The terminology is also used in the conceptual model we refer to as GEM II.

Porter *et al.* (2002) note that as economies advance, government priorities need to focus increasingly on improvements in physical infrastructure (telecommunications, roads), and regulatory arrangements (customs, taxation, company law) to allow the economy to integrate more fully with global markets. Efficiency in producing standard products and services becomes a dominant source of competitiveness (Porter *et al.* 2002). The products and services produced at this stage of development thus become more sophisticated, but technology and designs still come from abroad *(ibid*). This technology is accessed through licensing, joint ventures, foreign direct investment, and imitation. According to Porter *et al.* (2002), however, countries at this stage of development not only assimilate foreign technology, but also develop the capacity to improve on it. The business environment must therefore be such that it supports investment in efficient infrastructure and modern production methods. Porter *et al.* (2002) note that countries at this stage are generally susceptible to financial crises since they rely on foreign capital flows as well as external sector specific demand shocks.

They emphasize that competitiveness at this stage revolves around higher education and training (human capital), well-developed goods markets, well-functioning labour markets, well-developed financial markets, the ability to harness the benefits of existing technologies,

and a large domestic and foreign market. In subsequent reports published by the WEF, these elements have been referred to as *efficiency enhancers* (see for example, Porter & Schwab 2008, Schwab 2009, 2010, 2011, 2012, 2013, and 2014). The Global Entrepreneurship Monitor in its recent reports also uses this terminology (see for example, Kelley *et al.* 2012, Xavier *et al.* 2013, and Amoros *et al.* 2014).

The transition from the efficiency-driven stage to the innovation-driven stage according to Porter *et al.* (2002) is perhaps the hardest[27]. They emphasize that this requires a direct government role in fostering a high rate of innovation, through public and private investments in research and development, higher education, and improved capital markets and regulatory systems that support the start-up of high technology enterprises. At this stage, enterprises are thought to become less hierarchical, with much more delegation of authority to sub-units within the enterprise. Buyers and suppliers and corporate sub-units are thought to be linked together in flexible networking arrangements that facilitate innovations and rapid shifts in the division of labour within the organization. Firms are also thought to invest heavily in continual training and upgrading of their workforce. Firms within an industry are thought to become much more interactive, with deep industrial clusters characterised by a sophistication of division of labour, increasing flows of workers between enterprises, and a mix of fierce competition and cooperation among enterprises within an industry. According to Porter *et al.* (2002), companies at this stage compete on the basis of unique strategies that are often global

[27] In the literature, economies that find it difficult to make the transition are thought to be caught in a 'middle-income trap'. Even though this literature is embryonic, this terminology, as acknowledged by Im and Rosenblatt (2013), has entered common parlance in the development community, particularly in East Asia following a protracted period of subpar performance subsequent to the 1997 regional financial crisis. The terminology, it must be noted, is yet to be precisely defined. A number of varied definitions can be found in the literature however (see for example Woo 2009, Kharas & Kolhi 2011, and Im & Rosenblatt 2013). A number of countries including Brazil, Panama, Thailand, and Malaysia are thought to be caught up in this middle-income trap (see Im & Rosenblatt 2013). While conceptual and theoretical issues are yet to be addressed, there seems to be an agreement that there is a need for policies designed to assist countries make a successful transition from one stage to the next.

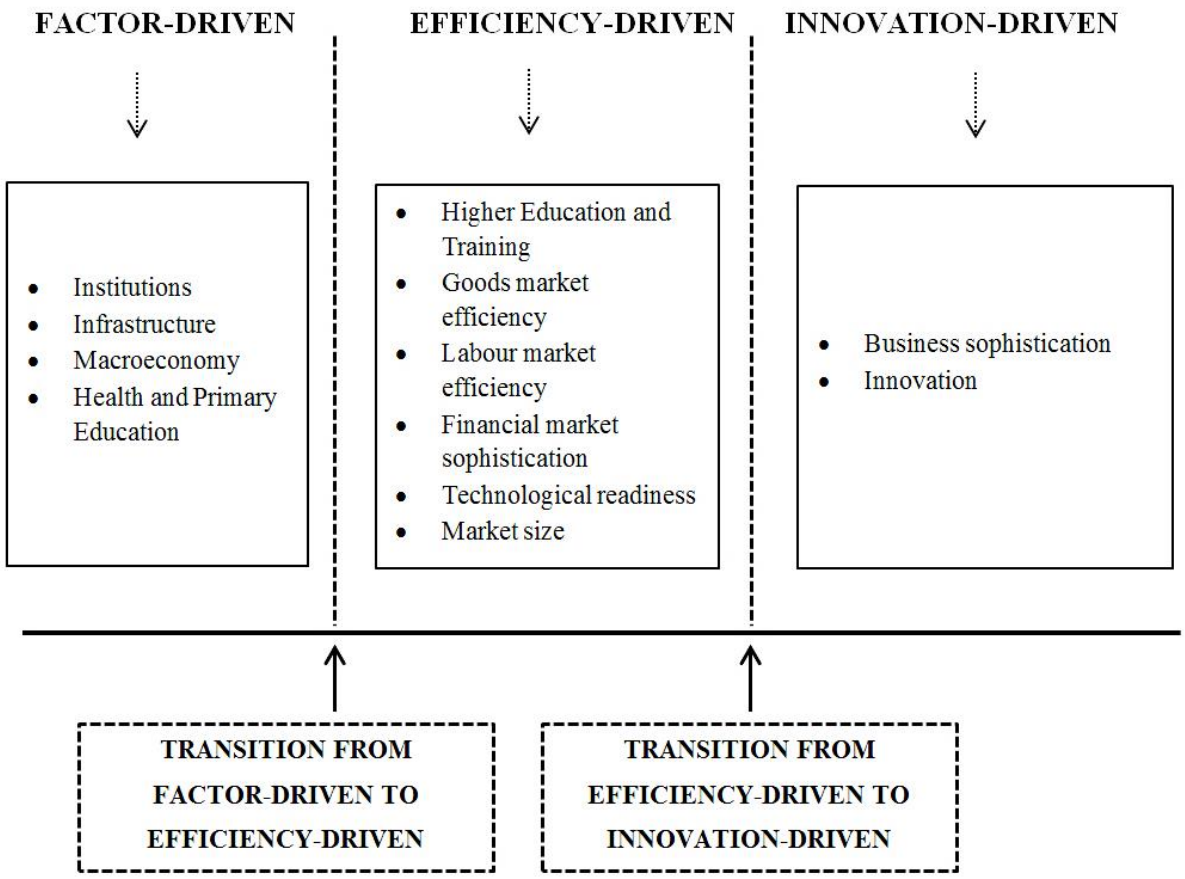
in scope. Maintaining competitiveness is thus thought to revolve around innovation and business sophistication.

This is consistent with endogenous growth theory, in which innovation and knowledge intensity are considered critical to fostering economic growth. Audretsch (1995) for example argued that economies that are rich in knowledge tend to experience higher growth than those with paucity of knowledge underlining the importance of knowledge intensity and spillovers as a source of competitiveness. In subsequent reports published by the WEF, the elements identified by Porter *et al.* (2002) as important for maintaining competitiveness in the innovation-driven stage have been referred to as *innovation and business sophistication factors* (see for example Porter & Schwab 2008, Schwab 2009, 2010, 2011, 2012, 2013, and 2014). The Global Entrepreneurship Monitor in its recent reports also uses this terminology (see for example, Kelley *et al.* 2012, Xavier *et al.* 2013, and Amoros *et al.* 2014).

Porter *et al.* (2002) characterise economies falling in between the factor-driven and efficiency-driven stage or between the efficiency-driven and innovation-driven stage as being 'in transition'. According to Porter *et al*. (2002) some countries find it difficult to make a successful transition, if appropriate measures are not undertaken to enable a successful transition[28]. Priorities for a particular economy depend on country specific conditions. As emphasized by Porter *et al.* (2002) this framework helps to highlight why some countries enjoy significant economic progress for a period and then appear to stall later in their development if appropriate measures are not undertaken to facilitate successful transition. Figure 3.4, assembled by the researcher based on Porter *et al.* (2002), summarises this framework.

[28] This is also consistent with the so called middle-income trap referred to earlier.

Figure 3:4 Stages of economic development



Source: Author's compilation based on Porter *et al.* (2002).

It is interesting to note that these successive stages of development are consistent with the stages of development identified by Acs (2006), which he argues signify that any attempt to foster economic development must take into account differences in challenges faced by economies at different stages of economic development. As highlighted in section 3.3.2, according to Acs (2006), the level and quality of entrepreneurial activity is likely to differ across different stages of economic development, so that policies designed to foster economic growth must take into account these differences.

GEM II builds on Porter *et al.* (2002) and recognises differences in stages of economic development and hence policies required to foster economic growth at each stage. This is also consistent with Acs (2006) who recognises the importance of designing policies that are relevant for each particular stage of economic development.

Entrepreneurship in factor-driven economies

In GEM II it is recognised that countries at low levels of economic development are typically characterised by an agricultural sector that provides subsistence to the majority of the population (see Bosma *et al.* 2009). This situation according to Bosma *et al.* (2009) changes as industrial activity starts to develop. In factor-driven economies, industrial activity is likely to develop around a resource sector (Bosma *et al.* 2009). As the industrial sector develops, triggering economic growth, it prompts surplus population from the agricultural sector to migrate to the industrial sector (usually from rural to urban areas) looking for waged-employment. Those who cannot get waged-employment go into necessity entrepreneurship to make a living (*ibid*). It is important to note, though, that industrial activity around a resource sector is likely to be capital intensive, so that migration of surplus labour from the agricultural sector to the resource based industrial sector is likely to be minimal. The oversupply of labour from the agricultural sector is thus likely to feed necessity entrepreneurship in non-resource sectors[29]. This underlines the importance of policies that facilitate diversification of the industrial base from the resource sector into non-resource

[29] In countries such as Botswana, for instance, the extractive sector accounts for only 5.7 percent of total formal employment (see Bank of Botswana 2011). It is reasonable to argue that in economies such as Botswana an extractive sector is not likely to generate significant waged-employment opportunities, so that surplus labour from the agricultural sectors may feed necessity entrepreneurship in non-resource sectors. As a capital intensive sector it is unlikely that the surplus labour from the agricultural sector will feed necessity entrepreneurship in the resource-based industrial sector, but necessity entrepreneurship in non-resource sectors such as small manufacturing crafts.

sectors to provide further impetus for growth and waged-employment generation as the economy advances.

Building on Porter *et al.* (2002) who highlighted that the main challenge facing economies at this stage of economic development is to get basic factor markets working properly, GEM II recognises the importance of developing well-functioning public and private institutions, well-developed infrastructure, a stable macroeconomic environment, and an increasingly healthy and educated workforce. These elements are expected to create an environment that facilitates growth of the resource-based industrial sector as well as growth of the industrial sector in non-resource sectors, not only to provide impetus for economic growth but to generate more waged-employment opportunities for the surplus labour involved in necessity entrepreneurship. These elements are also consistent with conditions emphasized by Acs (2006) as likely to foster economic growth in countries at low levels of income.

Entrepreneurship in efficiency-driven economies

As the industrial sector continues to grow, institutions that support further industrialization and the build-up of scale economies emerge (Bosma *et al.* 2009). These institutions according to Bosma *et al.* (2009) are shaped to favour large state businesses which may be state owned or private owned. As emphasized by Porter *et al.* (2002), at this stage companies rely on technology from abroad accessed through joint ventures, foreign direct investment, and imitation. Porter *et al.* (2002) stress that efficiency in the production of existing products and services become critical. Bosma *et al.* (2009) note that as efficiency improves the economy advances and the industrial sector expands, and people in necessity entrepreneurship find stable employment in large firms where they can earn more. Necessity entrepreneurship

gradually falls as a result. At the same time the growth of the increasing productivity of the industrial sector may expand opportunities for entrepreneurship (*ibid*).

Building on Porter *et al.* (2002), GEM II recognises the importance of promoting efficiency as a source of competitiveness at this stage. Economies at this stage are thus encouraged to focus on higher education and training, well-developed goods markets, well-functioning labour markets, well-developed financial markets, the ability to harness the benefits of existing technologies and a large domestic and foreign market. These elements are thought likely to be important not only to promote efficiency and continued growth of the industrial sector, but to create an economic environment that allows for opportunity entrepreneurship as the economy advances.

Entrepreneurship in innovation-driven economies

As an economy matures and its wealth increases, industrial activity is likely to shift gradually toward an expanding service sector that caters to the needs of an increasingly affluent population (Bosma *et al.* 2009)[30]. This is also consistent with Acs (2006) who noted that at higher levels of income the service sector is likely to expand relative to the manufacturing sector. The industrial sector according to Bosma *et al.* (2009) is likely to evolve and experience improvements in variety and sophistication. This development is thought to be associated with increasing research and development and knowledge intensity as knowledge generating institutions in the economy gain momentum, which is consistent with endogenous growth theory (see Audrestch 1995, Acs *et al.* 2004 and Braunerhjelm *et al.* 2010). This, according to Bosma *et al.* (2009), is likely to result in innovation, opportunity seeking

[30] As noted in section 3.3.2, since the 1970s there has been a general decline in mass production in manufacturing, for example, in almost all industrial countries (mostly now taking place in developing economies).

entrepreneurship, in which smaller firms become more important. Innovation, opportunity seeking entrepreneurial activity is thus likely to emerge as one of the most important drivers[31] of economic growth and wealth creation, which is consistent with assertions by Porter *et al*. (2002).

GEM II which includes aspects of Porter *et al.* (2002), Acs (2006) and other contributions by the GEM community (see Bosma *et al.* 2009) can be seen in Figure 3.5. This Figure is reproduced from the latest GEM report (see Amoros *et al.* 2014, p. 21). Moving from left to right of Figure 3.5, it is noted that there are social, cultural, and political factors (i.e. demographic structure, investment in education, social norms and attitudes associated with the perception of entrepreneurs) that shape factors that influence entrepreneurial activity (both individuals starting their own firms and corporate entrepreneurship). These factors are shown in column 2 of Figure 3.5. The first two boxes in column 2 of Figure 3.5 relate to elements identified by Porter *et al.* (2002) as likely to be associated with competitiveness in the factor-driven stage and efficiency-driven stages of economic development. As highlighted earlier these elements have been referred to as *basic requirements* and *efficiency enhancers* in publications of the WEF and the GEM. Similarly, Figure 3.5 captures these elements to as basic requirements and efficiency enhancers.

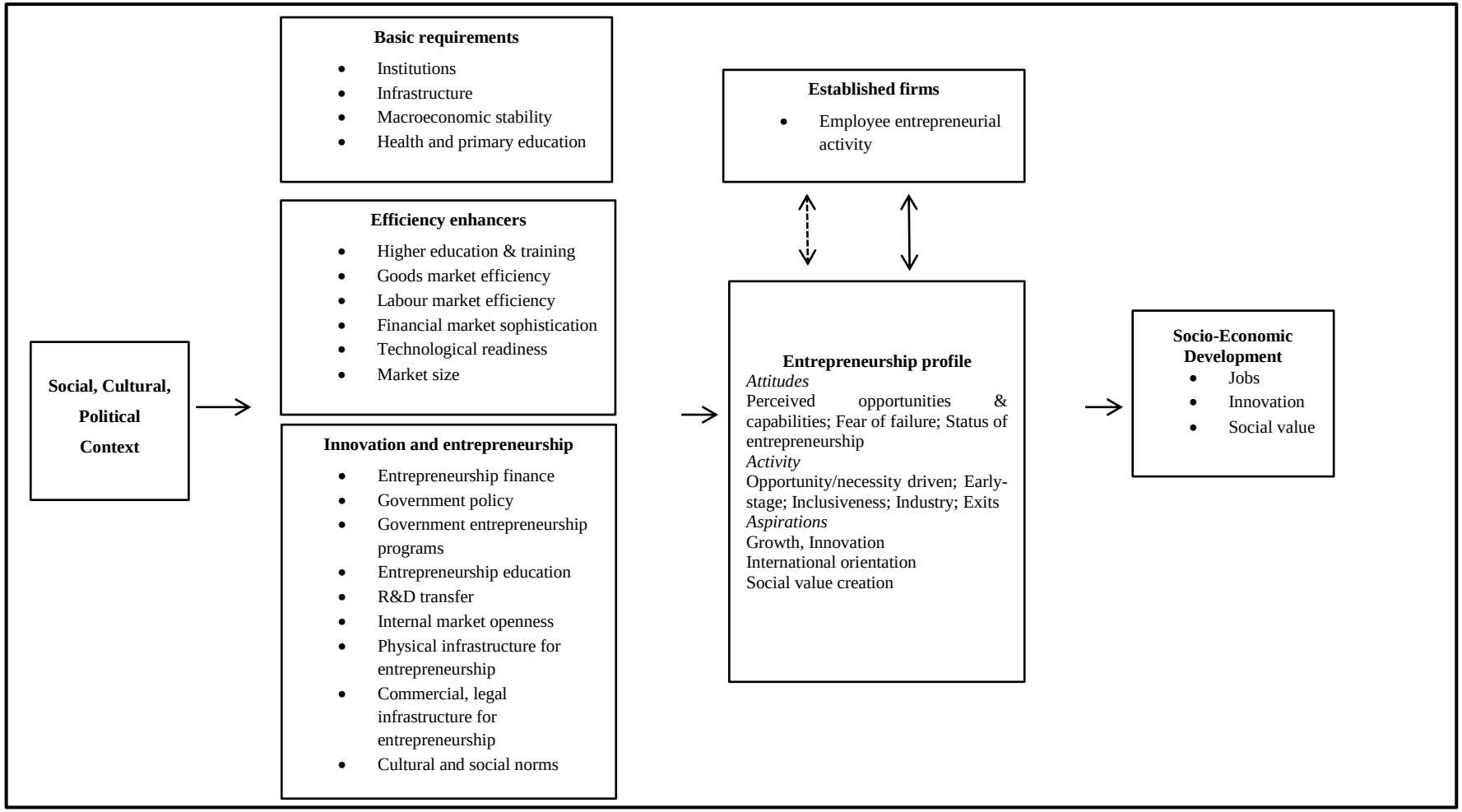
The third box in column 2 shows components added by the GEM community to Porter *et al.* (2002) regarding innovation and business sophistication. These are considered to be critical for maintaining competitiveness in innovation-driven economies[32]. In GEM II, economic

[31] As highlighted in the GEM I and GEM II, however, economic growth is the result of the combined force of established firms as well as new entrepreneurial (small) firms.

[32] As emphasized earlier the emphasis on knowledge at this stage of economic development is consistent with conclusions by Acs *et al.* (2004) and Braunerhjelm *et al.* (2010), who examine the role of entrepreneurial activity on economic growth in an endogenous growth framework.

growth in innovation and entrepreneurship driven economies is thought to revolve around entrepreneurship finance, government policy, government entrepreneurship programmes, entrepreneurship education, research and development transfer, internal market openness, physical infrastructure for entrepreneurship, commercial and legal infrastructure for entrepreneurship, and cultural and social norms. These elements are referred to as *innovation and entrepreneurship factors* in Figure 3.5 and they are consistent with what is described by Audretsch (1995) as entrepreneurship capital. The bottom half of Column 3 shows components that influence entrepreneurial activity, namely opportunity recognition and capacity to exploit those opportunities. The top half reflects entrepreneurial activity in established firms. Column 4 shows that socio-economic development (as measured by jobs created, innovation, and social value) depends on entrepreneurial activity.

Figure 3:5 GEM II



Source: Adapted from Amoros *et al*. (2014, p. 21).

3.4.1.3 Contribution of this study to a better understanding of the entrepreneurial activity-economic growth nexus

Reading through the literature on the association between entrepreneurial activity and economic development we found that this literature is fragmented, making it difficult for researchers to gain a good understanding of the subject. As a contribution of this study to a better understanding of this literature, this study has put together the different strands of this literature to provide a fairly comprehensive description of this association. It is the view of the researcher that future studies will benefit from this description.

As a further contribution to this literature, this study assembled a fairly simple, but comprehensive, conceptual framework that highlights the present knowledge on the association between entrepreneurial activity and economic growth. As emphasised earlier, however, entrepreneurship due to its complexity is considered to be a black box, so that any attempt to describe the association between entrepreneurial activity and economic growth must be considered as an approximation. This is also true for Figure 3.6. Figure 3.6, therefore, cannot be considered to be revealing of all that goes on in this 'black box', but, rather, a reasonable approximation of key relationships involved. It is thus considered to be a useful framework for research on the subject. Policy implications on how economic development may be fostered through entrepreneurial activity may be drawn from this conceptual framework.

Figure 3.6 identifies the stages of evolution of economies attributed to Porter *et al.* (2002). As emphasized by Porter *et al.* (2002), looking at economic development as a process of successive upgrading reveals why some economies achieve progress in the early stages but stall in the latter stages if appropriate measures are not undertaken to prepare them for

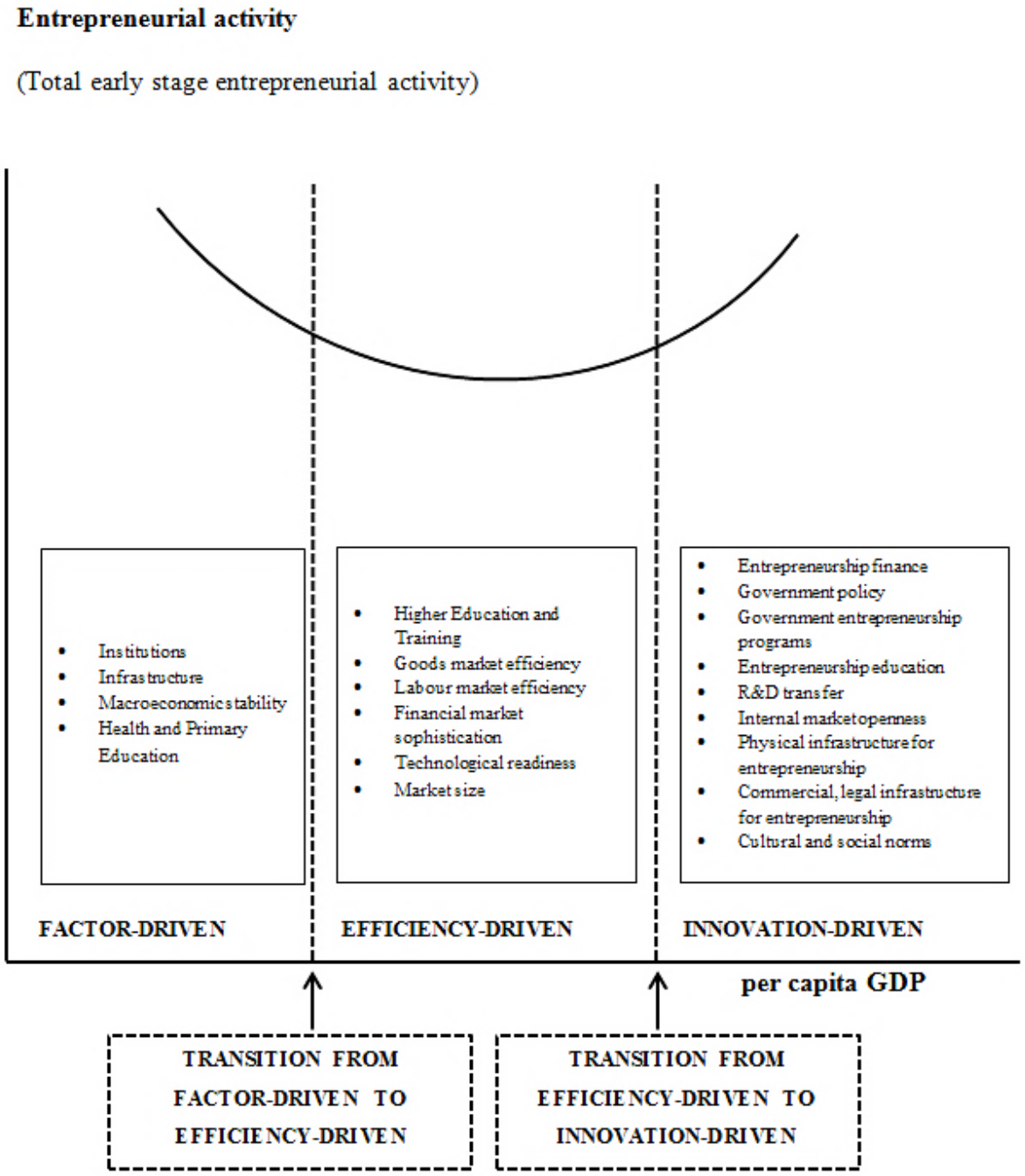
successful transition. It identifies factors Porter *et al.* (2002) encourage policy makers to target at each stage of development.

Figure 3.6 also identifies the U-shaped relationship between entrepreneurial activity and economic development attributed to Acs (2006). This relationship has also been highlighted in GEM publications, in which Zoltan Acs is one of the main contributors (see for example Acs 2006, Minniti *et al.* 2006, Bosma & Harding 2007, and Bosma *et al.* 2008). Similar to Porter *et al.* (2002) who highlight the importance of policies tailored to stages of development, Acs (2006), and the GEM community also stress the importance of tailoring policies to stages of development. The set of factors policy makers are encouraged to target at each stage by Acs (2006) and the GEM community are consistent with those suggested by Porter *et al.* (2002). For the innovation-driven stage, however, the GEM community adds entrepreneurship factors to innovation factors identified by Porter *et al.* (2002) to highlight the role of the entrepreneur in innovation at this stage.

The contribution of this study, as mentioned earlier, has been to bring together the ideas of Porter *et al.* (2002), Acs (2006) and the GEM community to provide a simplified but comprehensive roadmap for development policy as reflected in Figure 3.6. Figure 3.6 highlights not only the likely role of entrepreneurial activity on economic growth as suggested by these contributors, but that policy aimed at fostering economic growth through entrepreneurial activity must evolve with the stage of development to ensure sustained growth. Figure 3.6 highlights factors policy makers should take into account in designing policies aimed at fostering economic growth at each stage of development. Failure to design and implement appropriate policies is likely to result in economies not being able to make a successful transition from one stage to the next. Policy makers in countries such as Botswana

who are looking to promote entrepreneurial activity with a view to facilitating economic diversification may draw some lessons from this conceptual framework. In chapter seven of this dissertation, this framework is used to identify Botswana's present stage of development. Policy recommendations for the design of policies to enhance entrepreneurial activity in Botswana are then drawn from the framework based on Botswana's present stage of development and what is thought to be required at that stage, complemented by results of the empirical investigation of technical efficiency of SMEs.

Figure 3:6 Entrepreneurial activity and economic development: a synthesis of the literature



Source: Author's compilation based on Porter *et al.* (2002), Acs (2006) and the GEM community.

3.5 Conclusion

The purpose of this chapter has been to describe present knowledge about the association between entrepreneurial activity and economic growth with a view to providing a better understanding of this relationship and its changing nature. As noted in the chapter, this literature is fragmented making it difficult for researchers to have a clear understanding of relationships involved. By bringing together different strands of the literature on the subject, this chapter has provided a fairly comprehensive and clearer description of this association. It goes without saying that the present knowledge on this association is embryonic.

A further contribution of this study to this literature has been to integrate different strands of this literature in the form of Figure 3.6 to highlight not only the likely changing role of entrepreneurial activity on economic growth, but that policy aimed at fostering economic growth through entrepreneurial activity must evolve with the stage of development. It was noted that policy makers in countries at different stages of development may draw lessons about factors that are relevant for their countries from this framework. Chapter seven of this dissertation, which describes policy implications and recommendations for the design of policies to enhance entrepreneurial activity in Botswana, builds on this framework to identify Botswana's present stage of development and factors relevant to design of policies to enhance entrepreneurial activity at that stage. A description of recommendations for design of policies to promote entrepreneurial activity in Botswana emerging from this framework can be seen in chapter seven.

As noted in the introductory chapter, this study relies on existing literature to draw recommendations for the design of policies to enhance entrepreneurial activity in Botswana. This literature was the subject of the present chapter (chapter three). In addition to this

literature, the study relies on empirical evidence from investigation of technical efficiency of Botswana's SMEs and determinants of their technical inefficiency. The evidence is used to draw recommendations for the design of policies to reduce technical inefficiency. An improvement in technical efficiency is expected to enhance feasibility and profitability of engaging in entrepreneurial activity, which may in turn encourage more entrepreneurial activity. The next three chapters (that is, chapters four, five and six) focus on this component of the study. Chapter four describes the methodological approach the researcher followed to carry out the analyses of technical efficiency and determinants of technical inefficiency of SMEs included in the study; chapter five reviews the literature on determinants of technical inefficiency of SMEs (from which determinants selected for testing in this study are isolated); while chapter six describes results of the analyses. Recommendations emerging from the results are described in chapter seven.

4 TECHNICAL EFFICIENCY OF SMES IN BOTSWANA: A METHODOLOGICAL CONSTRUCT

4.1 Introduction

This chapter describes the methodological approach followed in analysing the technical efficiency of SMEs and determinants of technical inefficiency. Worth noting is that the steps followed in carrying out this investigation relate to research questions specified in chapter one. The first step, which relates to research question (i), involves estimation of technical efficiency of SMEs in the sample. There are two principal approaches that one may use for this purpose. One relies on a variant of a data envelopment analysis (DEA) estimator, while the other relies on a variant of a stochastic frontier analysis (SFA) estimator. Under different assumptions, these methods permit estimation of technical efficiency relative to an estimated frontier[33]. This study uses a variant of the DEA estimator and this chapter provides details of how technical efficiency may be estimated using this approach. A brief description of how technical efficiency may be estimated with SFA is provided in Appendix B.1 (also see Kaparakis *et al*. 1994, Kalirajan & Shand 1999, Kumbhakar & Lovell 2000, Ondrich & Ruggiero 2001, Murillo-Zamorano 2004, Coelli *et al*. 2005 and Fried *et al*. 2008).

As emphasized by Fried *et al*. (2008), choosing one method over the other is not damning the other. Fried *et al*. (2008) argue that the choice of one method over the other must be based on careful consideration of the data utilised, among others. They suggest that what researchers should be concerned about is whether the two methods provide consistent results when applied to the same data, and the answer is that the higher the quality of the data, the greater the concordance between the two sets of estimates.

[33] These approaches also permit analysis of determinants of technical inefficiency.

A description of advantages of the DEA approach which make it suitable for this study can be found in Alvarez and Crespi (2003), Murillo-Zamorano (2004), Coelli *et al*. (2005), and Wilson (2006). The most obvious of these advantages according to Wilson (2006) is that one need not specify a functional relationship between production inputs and outputs in the estimation of technology as is the case with SFA methods. Seiford and Thrall (1990) note that unlike statistical procedures that are based on central tendencies, DEA is an external process. It analyses each production unit separately and measures relative efficiency with respect to the entire set being evaluated (*ibid*). Sathye (2001) underlines the flexibility of DEA in dealing with small sample sizes as is the case in this study. Murillo-Zamorano (2004) stresses the flexibility of DEA in dealing with the relative importance of inputs and outputs. He argues that DEA makes no *a priori* distinction between the relative importance of inputs and outputs considered as relevant in the firm's decision making process.

The second step of the empirical investigation, which relates to research question (ii), involves identification of potential determinants of technical inefficiency of SMEs. It should be clear that quantitative formalisms such as DEA are unable to provide a researcher with factors that may have an impact on technical efficiency of SMEs. It is the researcher who has to compile a list of tentative factors from relevant literature. From this list the researcher chooses factors to be subjected to empirical testing based on data availability and relevance to the study. A survey of determinants of technical inefficiency of SMEs, together with a list of those selected for empirical testing in this study is provided in chapter five.

The third step, which relates to research question (iii), involves empirical testing of the association (correlation) between selected factors and the technical inefficiency of SMEs. Details of procedures followed to conduct such empirical tests are provided later in this

chapter. It is important to note, however, that this study makes a significant departure from previous studies in the procedure followed in the analysis of determinants of technical inefficiency. The standard practice in previous studies using DEA has been to use the Tobit and least squares regression[34]. This study uses recently developed methods of inference. More precisely, it employs the method of Simar and Wilson (2007) which applies the bootstrap approach[35]. This method not only permits comparatively better inference but performs statistically better than the Tobit and least squares regression methods[36]. Simar and Wilson (2007) propose two bootstrap procedures (i.e. the single and double bootstrap) for this type of analysis. The single bootstrap permits comparatively better inference even though it does not take account of the bias of efficiency estimates. The double bootstrap on the other hand not only permits comparatively better inference but also corrects for the bias of estimates of efficiency. The main aspects of these procedures are described in this chapter[37].

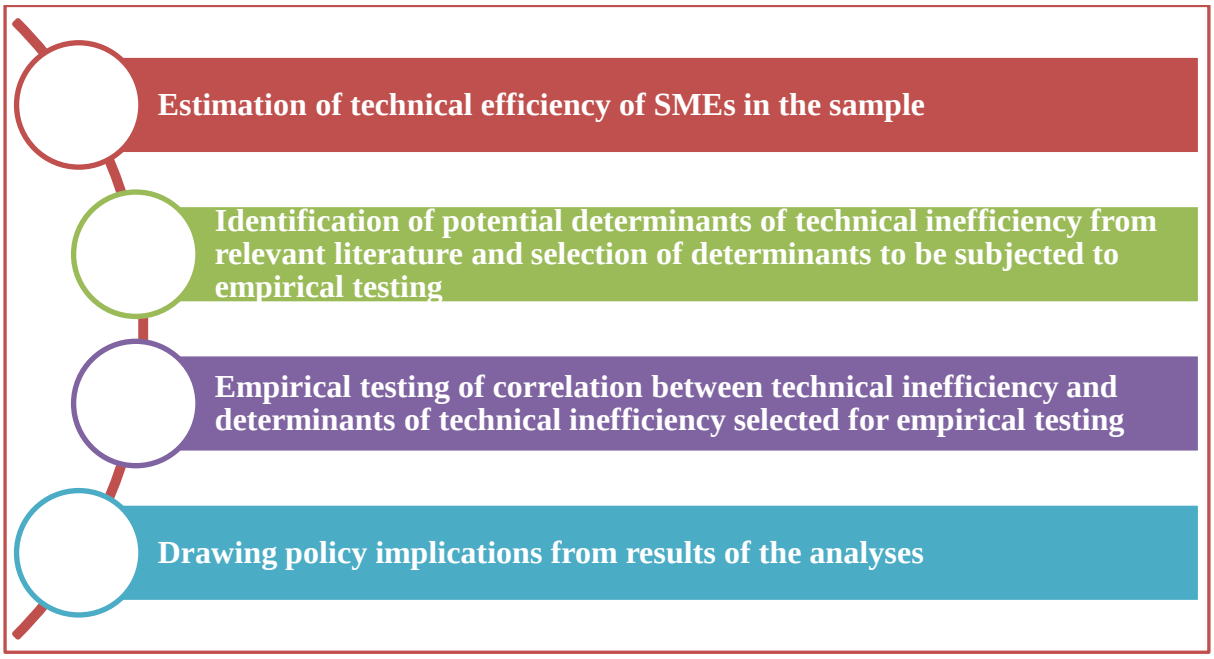
To the best of the knowledge of the researcher, this study is one of the few that has applied this method in the analysis of determinants of technical inefficiency of SMEs. Unlike other studies that have applied this approach however, see for example Halkos and Tzeremes (2010), this study uses both the double bootstrap and the single bootstrap. The double bootstrap is used as the primary method of analysis while the single bootstrap is used as a robustness check. In addition, to the best of the knowledge of the researcher, this approach has not been applied to studies on the technical inefficiency of SMEs in Botswana. Incidentally, to the best of knowledge of the researcher, this study is the first to examine the technical efficiency of SMEs in Botswana. The study is thus not only an original contribution

[34] See Ameyiya (1973) and McDonald (2009) for a discussion of how Tobit regression and least squares regression models are used in this type of analysis.
[35] Following the work of Efron and Tibshirani (1993).
[36] Simar and Wilson (2007) use Monte Carlo experiments to examine the statistical performance of their estimators.
[37] A more comprehensive treatment of the procedures can be seen in Simar and Wilson (2007).

to the understanding of technical efficiency of SMEs in Botswana, but is unique in terms of the approach followed in the analysis of determinants of technical inefficiency.

The fourth step, which relates to research question (iv), involves drawing policy implications and recommendations from the results of the analysis. A summary of the steps followed in the empirical investigation are summarised in Figure 4.1.

Figure 4:1 Summary of steps involved in the empirical investigation

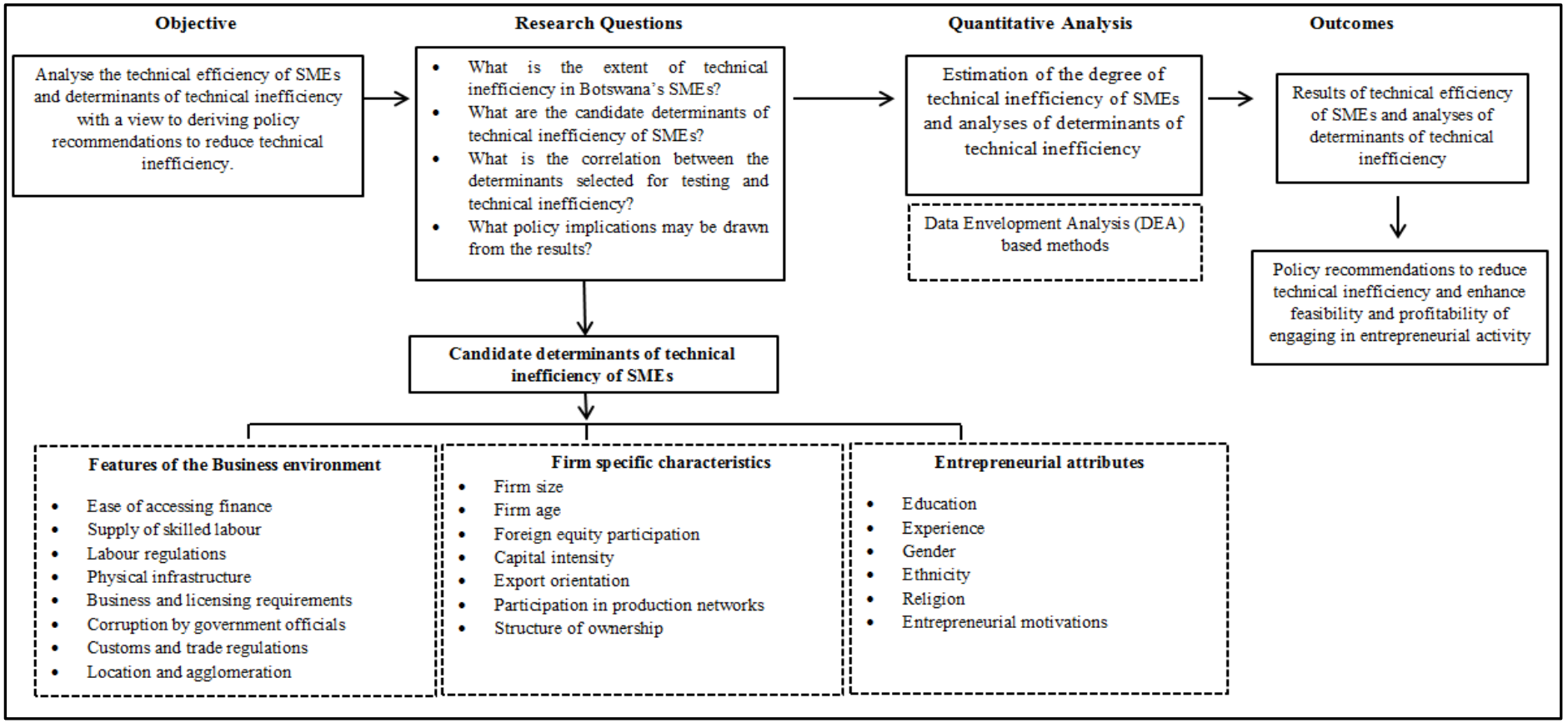


Source: Author's compilation

Figure 4.2 summarises the framework for carrying out the analyses of technical efficiency of SMEs in Botswana. It flows from the left to the right. The first column identifies the objective of the analyses. The second column identifies research questions. The third column identifies the approach used to address these research questions. This column also identifies

the candidate determinants of technical inefficiency emerging from the description of the literature in chapter five. It identifies determinants relating to features of the business environment, firm-specific characteristics, as well as attributes of entrepreneurs. Determinants selected for testing in this study are isolated from this list. The final column identifies the expected outcomes.

Figure 4:2 Framework for analyses of technical efficiency of SMEs



Source: Author's compilation.

This chapter is organised as follows. Section 4.2 describes why technical inefficiency is economically undesirable. This description underlines the importance of policies designed to reduce technical inefficiency. Section 4.3 describes the DEA approach to estimating technical efficiency. Section 4.4 describes the approach followed to analyse determinants of technical inefficiency. Section 4.5 describes data requirements and data source. Section 4.6 provides concluding remarks.

4.2 The economic significance of technical inefficiency

In the words of Farrell (1957),

> "*the problem of measuring the productive efficiency of an industry is important to both the economic theorist and the economic policy maker. If the theoretical arguments as to the relative efficiency of different economic systems are to be subjected to empirical testing, it is essential to be able to make some actual measurement of efficiency. Equally, if economic planning is to concern itself with particular industries, it is important to know how far a given industry can be expected to increase its output by simply increasing its efficiency, without absorbing further resources*" Farrell (1957, p. 11)

Building on this pioneering work, Fried *et al.* (2008) highlight three reasons why the study of technical efficiency is important. First, by measuring efficiency, one can explore hypotheses concerning the sources of efficiency differentials (see Fried *et al.* 2008). Identification of sources of performance variation is essential to the institution of policies designed to improve performance. Second, macroeconomic performance depends on microeconomic performance and so the same argument applies to the study of the growth of nations (*ibid*). Third, efficiency measures are success indicators or performance metrics by which producers are evaluated (Fried *et al.* 2008).

Mathematical and pictorial illustrations can be used to demonstrate why technical inefficiency is economically undesirable[38]. Let labour (L) and capital (K) be the only two inputs necessary to produce a product whose quantity is denoted by Q. An ordered pair of

[38] The proof, including Figure 4.3 is due to Dr Eduardo Pol, a Senior Lecturer in the School of Accounting, Economics and Finance, Faculty of Business, University of Wollongong, New South Wales, Australia.

inputs (L, K) is called an input combination. We can assume that the set F represents the collection of all (L, K) that is feasible.[39]

Let

$$Q = f(K, L): (L, K) \in F, \tag{4.1}$$

be a well-behaved production function[40]. Output level Q' is said to be produced efficiently using the input combination $(L', K') \in F$ if $Q' = f(K', L')$ and the input combination (L', K') is called a technically efficient input combination. A technically inefficient input combination, denoted by $(\widetilde{L}, \widetilde{K})$, produces an output level Q such that $Q < \tilde{Q}$, where $f(\widetilde{L}, \widetilde{K}) = \widetilde{Q}$ and $(\widetilde{L}, \widetilde{K}) \in F$.

A least-cost input combination (L^*, K^*) must be able to produce a given output level Q^* in a technically efficient manner because the first-order conditions for the constrained-output cost-minimization problem requires that $f(L^*, K^*) = Q^*$, where $f(L, K)$ denotes the production function. If $(\bar{L}, \bar{K})$ is a profit-maximizing input combination it is not difficult to show that $(\bar{L}, \bar{K})$ must be a least-cost input combination.

Let the maximum total profit be $\bar{\pi}$. Then, the following implications are true: $(\bar{L}, \bar{K})$ is profit-maximizing $\Rightarrow (\bar{L}, \bar{K})$ is cost-minimizing $\Rightarrow (\bar{L}, \bar{K})$ is technically efficient, and

$\bar{\pi} > \pi(L, K)$ for all $(L, K) \in F$ but $(\bar{L}, \bar{K})$ is excluded.

[39] To simplify things it is assumed that F is the non-negative quadrant.
[40] A well-behaved production function is strictly quasi-concave and displays strictly positive marginal products.

Proposition 1

Let $\overline{\Pi}$ be the maximum industry total profit obtained under conditions of technical efficiency. If the industry is producing using a technically inefficient input combination $(\widetilde{L}, \widetilde{K})$, the industry can maximize profits, but the total profit so obtained, denoted by $\widetilde{\Pi}$, must be less than $\overline{\Pi}$.

Proof

The combination $(\widetilde{L}, \widetilde{K})$ cannot possibly be a cost-minimizing input combination, and, therefore, it is impossible for $\widetilde{\Pi}$ to be greater than $\overline{\Pi}$.

Proposition 2

Let $\overline{L}$ be the level of employment corresponding to the profit-maximizing output level $\overline{Q}$. If the industry is using a technically inefficient input combination $(\widetilde{L}, \widetilde{K})$ to produce the current output level (denoted by $\breve{Q}$), then the employment level $\tilde{L}$ must be less than $\overline{L}$.

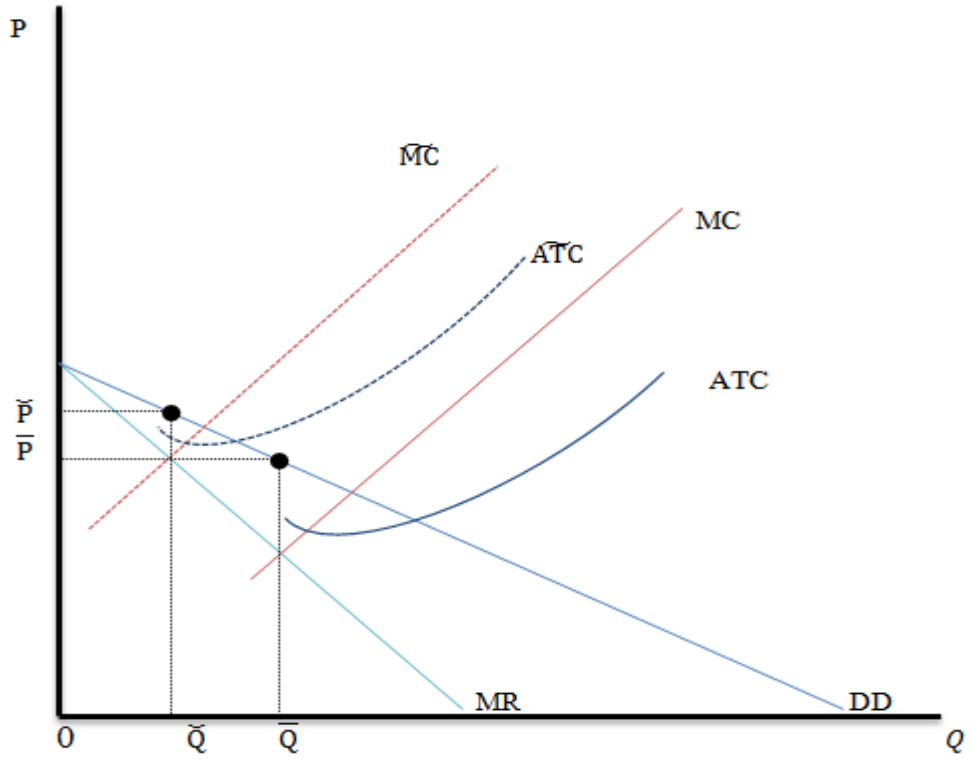
Pictorial Description

Propositions 1 and 2 can be diagrammatically illustrated. We assume that the demand conditions are given and constant, represented by $\mathrm{P} = \mathrm{P}(\mathrm{Q})$. To simplify things we assume that this function is a straight line. The linear demand curve facing the industry is DD and the corresponding marginal revenue curve is MR (see Figure 4.3). The average total cost curve and the marginal cost curve derived under conditions of inefficiency are denoted by $\widetilde{\mathrm{ATC}}$ and $\widetilde{\mathrm{MC}}$, respectively.[41] A glance at Figure 4.3 shows that $\breve{\mathrm{Q}}$ is the profit-maximizing output level under conditions of inefficiency. The maximum total profit, denoted by $\widetilde{\Pi}$, is positive.

[41] The marginal cost curve is assumed to be linear to simplify the diagram.

A successful industry policy would mean a downward shift of both the average total cost and marginal cost curves. If we denote by ATC and MC the average total cost and marginal cost curves under conditions of technical efficiency, we find that $\overline{Q} > \breve{Q}$; $\overline{\Pi} > \tilde{\Pi}$; and $\overline{L} > \tilde{L}$. In other words, a movement from inefficiency to efficiency increases the output level, profits and employment. It is interesting to note also that the profit-maximizing price under conditions of technical efficiency, denoted by $\overline{P}$, is less than the profit-maximizing price when the industry is technically inefficient, denoted by $\breve{P}$. This means that not only producers, but also consumers are beneficiaries from the elimination of technical inefficiency.

Figure 4:3 Economic implications of technical inefficiency



Source: This Figure 4.3 is due to Dr Eduardo Pol, a Senior Lecturer in the School of Accounting, Economics and Finance, Faculty of Business, University of Wollongong, New South Wales, Australia

4.3 Estimating technical efficiency in a DEA framework

The idea of estimating technology (which permits measurement of efficiency) dates back to the original work of Debreu (1951) and Farrell (1957). Distance functions[42] are extensively used in this literature to characterize production technology under weak input and output disposability[43], respectively (see Fare *et al*. 1994 and Fare & Primont 1995). The original distance function introduced by Shephard (1953) is a direct input distance function defined on the direct input correspondence (Fare *et al*. 1994). This distance function treats outputs as given and contracts input vectors as much as possible consistent with technological feasibility of the contracted input vector. The reciprocal of the direct input distance function is what was proposed by Debreu (1951) as a coefficient of resource utilization and Farrell (1957) as a measure of technical efficiency (see Fare *et al*. 1994).

Fare *et al*. (1994) note that the theoretical and practical significance of the direct input distance function is that it provides a complete characterization of the structure of the efficient production technology and is a reciprocal measure of the distance from each producer to that efficient technology. The direct output distance function introduced by Shephard (1970) can also be used to characterize the structure of efficient production technology to measure efficiency relative to that technology (Fare *et al*. 1994). Fare and Primont (1995) illustrate how one can model technology using distance functions. Following Fare and Primont (1995), if a vector of N inputs can be denoted by $x = (x_1, \ldots . x_N)$ and a vector of M outputs by $y = (y_1, \ldots . y_N)$, then a technology set T can be defined by $T = \{(x, y): x \in \mathbb{R}_+^N, y \in \mathbb{R}_+^M, x \text{ can produce } y\}$, where $\mathbb{R}_+^N$ is the set of nonnegative real *n*-tuples.

[42] See Shephard (1953). Shephard (1953, 1970 and 1974) also developed a great deal of the *duality theory* relating to distance functions (see Fare & Primont 1995).
[43] Disposability of inputs and outputs is treated comprehensively in Fare *et al*. (1994).

For a given T and the assumption that $M = 1$, the production function $F: \mathbb{R}_+^N \to \mathbb{R}_+$ can be defined by,

$$F(x) = \max_y\{y: (x, y) \in T\} \tag{4.2}$$

One may instead start with a production function F and define the technology set by,

$$T^* = \{(x, y): F(x) \geq y, y \in \mathbb{R}_+\}. \tag{4.3}$$

Under certain weak conditions, these two approaches are equivalent i.e. if F is defined from T by (4.2) and if T^* is defined from F using (4.3) then $T^* = T$ (Fare & Primont 1995). Following Fare and Primont (1995) an output distance function[44] $D_o: \mathbb{R}_+^N \text{x} \mathbb{R}_+^M \to \mathbb{R}_+ \cup \{+\infty\}$ may be defined as,

$$D_o(x, y) = \inf_\theta\{\theta > 0: (x, y/\theta) \in T\} \tag{4.4}$$

Alternatively, one can define the output distance function in terms of the output correspondence such that if for each input vector x, and $P(x)$ a set of feasible (producible) outputs (i.e. $P(x) = \{y: (x, y) \in T\}$), then the output correspondence may be defined as,

$$P: \mathbb{R}_+^N \to 2^{\mathbb{R}_+^N}, \tag{4.5}$$

[44] The output distance function is assumed to be well defined. This means that the production function satisfies the regularity axioms of production stated in Appendix B.2.

which maps each x in $\mathbb{R}_+^N$ to an output set $P(x) \subseteqq \mathbb{R}_+^M$. Note that $(x, y) \in T$ if and only if $y \in P(x)$, thus $T = \{(x, y): y \in P(x), x \in \mathbb{R}_+^N\}$. In view of this relationship between T and P, an alternative and equivalent definition of the output distance function is given by,

$$D_o(x, y) = \inf_\theta\{\theta > 0: (y/\theta) \in P(x)\} \text{ for all } x \in \mathbb{R}_+^N. \quad (4.6)$$

Fare and Primont (1995) also show that if an input (requirement) set can be defined as,

$$L(y) = \{x: (x, y) \in T\} \quad (4.7)$$

where T is the set of all feasible input-output vectors i.e.

$$T = \{(x, y): x \in L(y), y \in \mathbb{R}_+^M\} \quad (4.8)$$

then one may define an input distance function $D_i: \mathbb{R}_+^M \text{x} \mathbb{R}_+^N \to \mathbb{R}_+ \cup \{+\infty\}$ as,

$$D_i(y, x) = \sup_\lambda\{\lambda > 0: (x/\lambda) \in L(y)\} \text{ for all } y \in \mathbb{R}_+^M \quad (4.9)$$

Following Fare and Primont (1995) the input and output oriented measures of technical efficiency may be obtained as follows. For a feasible production plan (x, y), the production plan is input efficient if $x' \notin L(y)$ for all $x' \leq x$ (i. e. $x' \leqq x$ and $x' \neq x$). Thus (x, y) is input efficient if x belongs to the efficient subset of $L(y)$ which is defined by,

$$\text{Eff } L(y) = \{x: x \in L(y), x' \leq x \Longrightarrow x' \notin L(y)\}, y \geq 0_M \quad (4.10)$$

Thus if $x \in \text{Eff } L(y)$, then any reduction in one more of the inputs will render y an infeasible output vector. Alternatively, one may use the slightly weaker notion, input-isoquant

efficiency. A feasible production plan (x, y) is input-isoquant efficient if $\lambda x \notin L(y)$ for all $\lambda < 1$ (see Fare & Primont 1995). Thus (x, y) is input-isoquant efficient if x belongs to the isoquant of $L(y)$ which is defined by,

$$\text{Isoq } L(y) = \{x: x \in L(y), \lambda < 1 \Longrightarrow \lambda x \notin L(y)\}, y \geq 0_M. \quad (4.11)$$

On the output side (x, y) is output efficient if y belongs to,

$$\text{Eff } P(x) = \{y: y \in P(x), y' \geq y \Longrightarrow y' \notin P(x)\}, x \geqq 0_N \quad (4.12)$$

and is output-isoquant efficient if y belongs to,

$$\text{Isoq } P(x) = \{y: y \in P(x), \lambda > 1 \Longrightarrow \lambda y \notin P(x)\}, x \geqq 0_N \quad (4.13)$$

The extent of the input-isoquant efficiency may be calculated using the input distance function (recall Equation 4.9). The greater the value of $D_i(y, x)$, the less efficient x is in producing y. The reciprocal of $D_i(y, x)$ yields an efficiency measure that lies between zero and one and that takes higher values the more efficient x is in producing y (Fare & Primont 1995). This measure can be calculated as,

$$(1/D_i(y, x)) = \inf_\lambda\{\lambda : \lambda x \in L(y)\} \quad (4.14)$$

This efficiency measure (i.e. Equation 4.14) is known as the Farrell (1957) input-oriented measure of technical efficiency. According to Fare and Primont (1995) this notion of efficiency is also found in Debreu (1951). The extent of the output-isoquant efficiency is

calculated using the output distance function (recall Equation 4.13). The efficiency measure so obtained is known as the Farrell (1957) output-oriented measure of technical efficiency. This study uses this measure (i.e. the output-oriented measure) of efficiency. The Farrell (1957) output-oriented measure is preferred as it not only satisfies desirable mathematical properties but is fairly easy in terms of computation and interpretation[45].

Linear programming models, traditionally assimilated into DEA, provide a succinct way of simultaneously constructing frontier technology from actual data and calculating the distance to that frontier for individual observations or activities (Fare *et al*. 1994). The frontier technology is formed as linear combinations of observed best practice activities yielding a frontier consisting of facets (*ibid*). While Dantzig (1963) has been closely associated with linear programming, Charnes and Cooper (1961) made considerable contributions to both the theory and application in the early development of linear programming and popularized its application in DEA in the late 1970s (see Fare *et al*. 1994 and Cooper *et al*. 2004)[46]. Fare *et al*. (1994) provide a catalogue of early contributions to linear programming models, for example, Leontief (1941, 1953), Koopmans (1951, 1957), Shephard (1953, 1970, and 1974), Afriat (1972), Dugger (1974) and Deprins *et al*. (1984).

Fare and Primont (1995), illustrate how Farrell's (1957) measures of technical efficiency may be computed. This requires a set of observations $(x^k, y^k), k = 1, \ldots, K$ of inputs and outputs, where $x^k = (x_{k1}, \ldots, x_{kN})$ is observed to produce $y^k = (y_{k1}, \ldots, y_{kM}), k = 1, \ldots K$. Each observation is interpreted as a feasible production activity. The technology is constructed

[45] Russell (1990, 1997) provides an account of these properties (also see Coelli *et al*. 2005, Demchuk & Zelenyuk 2009 and Shiu & Zelenyuk 2011).
[46] See Charnes *et al*. (1978).

using activity analysis methods (Fare & Primont 1995). It is assumed that $x_{kn} \geqq 0$ and $y_{km} \geqq 0, n = 1, \ldots., N, m = 1, \ldots., M$ and $k = 1, \ldots., K$. In addition, it is assumed that,

(i) $\sum_{k=1}^{K} y_{km} > 0,\ m = 1, \ldots., M;$

(ii) $\sum_{m=1}^{M} y_{km} > 0,\ k = 1, \ldots., K;$

(iii) $\sum_{k=1}^{K} x_{kn} > 0, n = 1, \ldots., N$ and;

(iv) $\sum_{n=1}^{N} x_{kn} > 0, k = 1, \ldots., K$

Condition (i) says that a positive amount of each output can be produced by at least one activity; condition (ii) states that each activity k can produce a positive amount of at least one output; condition (iii) requires that a positive amount of each input is used by at least one activity; and condition (iv) says that every activity must use a positive amount of at least one input (see Fare & Primont 1995).

Using activity analysis, various technologies can be constructed from the K observed feasible activities. Following Fare and Primont (1995) and supposing that one wants to specify a technology T that exhibits constant returns to scale globally, then $(x^k, y^k) \in T$ for all $z_k \geqq 0$ by constant returns to scale. The variable z_k is the intensity level of activity k. Assuming additivity of activities (i.e. if $(z_k x^k, z_k y^k) \in T, k = 1, \ldots., K)$ then $(\sum_{k=1}^{K} z_k x^k, \sum_{k=1}^{K} z_k y^k) \in T$. Assuming, in addition, strong disposability of outputs (i.e. if $y \in P(x)$ and $y' \leqq y$ then $y' \in P(x)$ so that if $(x, y) \in T$ and $y' \leqq y, then\ (x, y') \in T)$ and strong disposability of inputs (i.e. if $x \in L(y)$ and $x' \geqq x$ then $x' \in L(y)$ so that if $(x, y) \in T$ and $x' \geqq x,$ then $(x', y) \in T$), if $(\sum_{k=1}^{K} z_k x^k, \sum_{k=1}^{K} z_k y^k) \in T, x \geqq \sum_{k=1}^{K} z_k x^k$ and $y \leqq \sum_{k=1}^{K} z_k y^k,$ then $(x, y) \in T$. Combining all these assumptions,

$$T = \{(x, y): \sum_{k=1}^{K} z_k y^k \geqq y \geqq 0_M, \sum_{k=1}^{K} z_k x^k \leqq x, z_k \geqq 0, k = 1, \ldots . K\} \quad (4.15)$$

According to Fare and Primont (1995) this technology is the smallest convex cone that contains all of the data points. The input requirement set that corresponds to T is given by:

$$L(y) = \{x: \sum_{k=1}^{K} z_k y^k \geqq y, \sum_{k=1}^{K} z_k x^k \leqq x, z_k \geqq 0, k = 1, \ldots . K\} \quad (4.16)$$

The input requirement set may alternatively be stated in more detail as,

$$L(y) = \{x: \sum_{k=1}^{K} z_k y_{km} \geqq y_m, m = 1, \ldots ., M, \sum_{k=1}^{K} z_k x_{kn} \leqq x_n, n = 1, \ldots ., N, z_k \geqq 0, k = 1, \ldots . K\} \quad (4.17)$$

The input-oriented efficiency score for any observation $k', k' = 1, \ldots . K$ may thus be computed as the solution to the linear programming problem:

$$\begin{aligned}(1/D_i(y^{k'}, x^{k'})) &= \min_{\lambda z}\{\lambda: \lambda x^{k\prime} \in L(y^{k\prime})\} \\ &= \min_{\lambda z}\{\lambda: \sum_{k=1}^{K} z_k y_{k'm} \geqq y_m, m = 1, \ldots ., M, \sum_{k=1}^{K} z_k x_{kn} \leqq \lambda x_{k'n}, n = \\ &1, \ldots ., N, z_k \geqq 0, k = 1, \ldots . K\} \quad (4.18)\end{aligned}$$

Normally if the same output can be produced with proportionally less input, then, alternatively, proportionally more output could be produced with the same input. This alternative view of efficiency defines the output-oriented Farrell (1957) measure of technical efficiency, that is,

$$(1/D_o(x,y)) = \max_\theta\{\theta: \theta y \in P(x)\}$$
$$= \max_\theta\{\theta: x \in L(\theta y)\} \quad (4.19)$$

This study relies on this measure of technical efficiency since it is considered appropriate in the context of SMEs where the existence of multiple impediments to accessing inputs cannot be overlooked. Under constant returns to scale (Equation 4.19) is the reciprocal of (Equation 4.14). If the assumption of constant returns to scale is relaxed, however, the input and output oriented efficiency measures may provide different information (see Fare & Primont 1995). To check for consistency in the estimation results, this study estimates both constant and variable returns to scale technology.

Despite their appealing attributes DEA based methods have met some resistance from some economists due in large part to the fact that no account is taken of noise or measurement error (see Fare *et al.* 1994). The resulting frontier is non-stochastic (*ibid*). Another frequently raised concern is that efficiency measures may be sensitive to outliers in the dataset. Thompson *et al*. (1990), Burgess and Wilson (1993) provide evidence to the contrary (see Fare *et al*. 1994). Fare *et al.* (1994) emphasize that even though these concerns are well founded, alternative computational techniques such as SFA share the outlier problem and are subject to specification error problems.

Recent developments in the literature have made it possible for researchers to define models that allow for determination of statistical properties of programming based frontier estimators by using asymptotic results or by using the bootstrap (see Murillo-Zamorano 2004). Grosskopf (1996) provides a survey of the literature on statistical inference in studies based on programming methods. He highlights the work of Timmer (1971) who attempted to

modify Farrell's (1957) original idea to adjust for the possibility of the frontier being determined by contaminated data. This approach was taken up and formalized by authors such as Land *et al*. (1988, 1993) and Olesen and Petersen (1995). A critique of the approach is found in Desai *et al*. (1994). Grosskopf (1996) also highlights the work of Sengupta (1987), Valdmanis (1992), Seaver and Triantis (1992), and Wilson (1993, 1995) among others.

Murillo-Zamorano (2004) brings to light limitations in the approach followed in these earlier studies including that of Grosskopf (1996), Kneip *et al*. (1998) and Park *et al*. (2000). According to Murillo-Zamorano (2004) these studies are based on asymptotic results and therefore may be misleading when used in conjunction with small samples. In addition, there is likelihood of extra noise introduced when estimates of the unknown parameters of the limiting distributions are used in constructing confidence intervals (*ibid*). Murillo-Zamorano (2004) argues that the asymptotic sampling distributions presented in Grosskopf's (1996) paper are only available for univariate DEA frameworks whereas most of the applications in DEA frequently deal with multivariate frameworks. Murillo-Zamorano (2004) underlines the importance of the bootstrap in providing a suitable way of analysing statistical properties of DEA efficiency estimators by avoiding the drawbacks of asymptotic sampling distributions.

The bootstrap relies on the fact that sufficiently large re-sampling from the data gives a good approximation to the true distribution of any parameter of interest if the data generating process that led to the observed sample can be approximated well enough (see Mooney & Duvall 1993, Simar & Wilson 1998, Brummer 2001 and Simar & Wilson 2000). The idea is to frequently repeat the parameter calculation with data that has been re-sampled by mimicking the data generating process, and then take the observed parameter distribution as

an estimate of the true parameter distribution (Brummer 2001). This in turn requires consistent estimation of the unknown distribution of the parameters of interest (*ibid*). Although their method was later criticised by Simar and Wilson (1999a, 1999b) for yielding inconsistent estimates, Ferrier and Hirschberg (1997) made a contribution to this literature by introducing a stochastic element into technical efficiency scores obtained using DEA techniques (see Murillo-Zamorano 2004).

To address some of the shortcomings of previous work on incorporating a statistical element into DEA, Simar and Wilson (1998, 2000) proposed two procedures that rely on the use of the bootstrap. These procedures are treated comprehensively in Simar and Wilson (1998, 2000). While Murillo-Zamorano (2004) cautioned that some issues still remain to be resolved in allowing for statistical noise in a non-parametric frontier framework, the methods of Simar and Wilson (1998, 2000) address some of the drawbacks of non-parametric approaches to efficiency estimation.

4.4 Analysis of determinants of technical inefficiency

Once technical efficiency scores have been estimated the next step is to identify from relevant literature factors which may impact on the technical efficiency of SMEs[47]. The researcher then isolates factors relevant to the study, bearing in mind availability of data. A survey of the literature on determinants of technical inefficiency of SMEs is provided in the next chapter. The chapter also identifies factors emerging from this literature selected for empirical testing in this study. The proxies used to represent selected factors are defined in chapter six, together with empirical regularities tested in respect of these factors. These empirical regularities are examined through regression analysis following the method of Simar and

[47] These factors are also called determinants of technical inefficiency.

Wilson (2007). This section highlights the main aspects of this method and why it is preferred to the Tobit and least squares regression methods used extensively in previous studies.

Studies (on SMEs) that have used the Tobit and least squares regression methods in studying the correlation between technical inefficiency and determinants of technical inefficiency of SMEs include Alvarez and Crespi (2003), Wu *et al*. (2007), Faruq and Yi (2010), and Vixathep and Matsunaga (2012). Simar and Wilson (2007) provide a more comprehensive catalogue of studies that have used these methods across different fields. According to Simar and Wilson (2007) none of the studies that employ these methods describe the underlying data generating process on which the regression analysis is based. Since the data generating process is not described there is some doubt about what is being estimated (Simar & Wilson 2007). Simar and Wilson (2007) note that authors that use this approach normally argue that DEA efficiency estimates are somehow censored since there are typically numerous estimates equal to one, but no coherent account of how censoring has occurred is offered.

Others regress ratios of efficiency estimates, Malmquist indices or differences in efficiency estimates in the second stage. Simar and Wilson (2007) argue that although these avoid boundary problems they still lack coherent description of a data generating process that would make such regressions sensible. A more fundamental problem identified by Simar and Wilson (2007) with these approaches is the fact that DEA efficiency estimates are serially correlated. The serial correlation arises in finite samples from the fact that perturbations of observations lying on the estimated frontier will in many and perhaps all cases cause changes in efficiencies estimated for other observations (Simar & Wilson 2007, p. 33). A similar problem arises in least squares regression where the estimated residuals are serially correlated

in finite samples even when the underlying true residuals are not (*ibid*). Consequently, the standard approaches to inference in most of these studies are invalid (Simar & Wilson 2007).

Simar and Wilson (2007) propose two bootstrap procedures to resolve the problems associated with the use of conventional methods of inference. The first procedure, the single bootstrap (also called Algorithm I), is designed to improve on inference but does not take account of the bias of efficiency estimates. The second procedure, the double bootstrap (also called Algorithm II), is designed to improve on inference and take account of the bias of efficiency estimates[48]. What is worth noting is that Simar and Wilson (2007) proved that not only do these procedures permit comparatively better inference in the regression analysis of inefficiency against selected variables but they also perform better statistically than conventional methods of inference[49].

In addition to finding evidence that their bootstrap procedures perform statistically better than conventional inference methods, Simar and Wilson (2007) also find that because the double bootstrap takes into account the bias of efficiency estimates it performs better statistically than the single bootstrap which does not take account of the bias, although the single bootstrap still performs better than conventional methods. A number of empirical studies across a number of fields for example Latruffe *et al*. (2008), Zelenyuk (2009), Demchuk and Zelenyuk (2009), Halkos and Tzeremes (2010), Alexander *et al*. (2010), Assaf and Agbola (2011), Shiu and Zelenyuk (2011), Wolszczak-Derlacz and Parteka (2011), Barros and Garcia-del-Barrio (2011), Arocena and Oliveros (2012), and Ferrier and Trivitt (2012) employ this method.

[48] A comprehensive treatment of bootstrap procedures can be found in Simar and Wilson (2007).
[49] See Simar and Wilson (2007) for details of Monte Carlo experiments they carried out to evaluate the statistical performance of their procedures in comparison with conventional inference methods.

This study relies on the double bootstrap as the primary method of analysis while the single bootstrap is used to check robustness. The double bootstrap, as mentioned before, not only permits valid inference but also corrects for the bias of efficiency estimates while the single bootstrap permits valid inference but does take account of the bias of efficiency estimates, hence the decision to use the double bootstrap as the primary method. To carry out both the single and double bootstrap procedures in this study MATLAB and the codes of Valentin Zelenyuk which adopted earlier codes of Leopold Simar were used. The specific regression model estimated together with estimation results can be seen in chapter six.

4.5 Data requirements and data source

Estimation of technical efficiency requires observed data on inputs and outputs for each production unit in the sample. The analysis of determinants of technical inefficiency also requires data on determinants selected for testing for each production unit in the sample. Typical of most developing countries, SMEs in Botswana are not well documented. Challenges were thus encountered in getting the data required for the estimation. To date only one census of enterprises has been conducted by Statistics Botswana[50]. Published during the year 2010 this census is the first to have been carried out in Botswana. Ideally, one would expect a census to be a rich source of data given the sheer number of enterprises one would expect to be included in a census and the geographical and sectoral coverage of enterprises. One would also expect the census to cover a number of topics that may be relevant to a study such as this one. In this study, the data from this census was useful as a starting point. However, the data could not be used in the estimation of technical efficiency of SMEs and

[50] Statistics Botswana is the principal data collecting, processing and disseminating agency responsible for coordinating, monitoring and supervising the national statistical system. See www.cso.gov.bw for more details about Statistics Botswana, their mandate and activities.

analysis of determinants of technical inefficiency due to missing and sometimes implausible values on inputs, outputs, and determinants of technical inefficiency.

The data used in the analysis was instead obtained from the World Bank Enterprise Surveys Unit. The data was collected through interviews with SMEs[51]. It must be noted that based on data availability, the analysis of technical efficiency of SMEs in Botswana was carried out only for SMEs involved in manufacturing. It is important for future studies to consider technical efficiency of other economic sectors. Worth noting is that two cross sectional datasets for 2006 and 2010 were pooled to enhance the sample size[52]. In these surveys a firm is classified as small if it has less than 20 employees. This is the definition adopted for this study as well. The definition is also in line with the definition adopted by the government of Botswana (see Ministry of Commerce and Industry 1999). A medium firm on the other hand is one which employs at least 20 but less than 100 people. This definition (also in line with the definition of a medium firm adopted by the government of Botswana) is also adopted for this study. After deleting firms with missing and implausible values, a sample of 132 firms remained comprising light and heavy industries (see Table 4.1). Estimation results presented in chapter seven are based on information relating to these firms.

[51] The data collection instrument is available at enterprisesurveys@worldbank.org. The website provides implementation notes of the surveys as well. It is important to note also that the firms included in these surveys are formally registered.

[52] 2006 is used as the base year. In the regression analysis of determinants of technical efficiency a year dummy is included to capture unobserved time effects.

Table 4:1 Distribution of firms by size and industry

	Light industry	Heavy industry	Total
Small	58	38	96
Medium	17	19	36
Total	75	57	132

Notes: The classification of firms into light and heavy industry follows Shiu and Zelenyuk (2011). Light industry includes firms in garments, textiles, electronics, wood and furniture, and other manufacturing activities. Heavy industry includes firms in machinery and equipment, chemicals, non-metallic minerals, and metals and metal products.

It is important to note that because of the cross sectional nature of the data, this study does not capture changes in technical efficiency over time. The analysis is for a specific point in time (i.e. it is static). A possible extension of this study when longitudinal data becomes available is to incorporate a dynamic aspect to see how the technical efficiency of SMEs has changed over time and possible causes of these changes.

4.6 Conclusion

The purpose of this chapter was to describe the methodological approach followed to carry out the empirical investigation. The investigation follows four steps. The first step involves estimating technical efficiency of SMEs using DEA. The second step involves identification of determinants of technical efficiency of SMEs from relevant literature. The third step involves empirical testing of the association or correlation between selected factors and technical efficiency of SMEs in the sample, while the fourth step involves drawing policy implications and recommendations from the results. The method of Simar and Wilson (2007) is used to carry out these tests. The analyses rely on firm level data on SMEs in Botswana, and in particular those involved in manufacturing activities, collected by the World Bank Enterprise Surveys Unit as part of the Africa Enterprise Survey initiative.

5 SURVEY OF THE LITERATURE ON DETERMINANTS OF TECHNICAL INEFFICIENCY OF SMES

5.1 Introduction

The preceding chapter described the steps followed in the investigation of technical efficiency of SMEs and determinants of technical inefficiency. This chapter relates to the second step, which involves a review of relevant literature on the determinants of technical inefficiency. It must be noted that there is a vast number of papers that evaluate the likely impact of different factors on the technical efficiency of SMEs. To make the literature described in this chapter manageable and easy to comprehend, the papers evaluated have been categorised into three groups. The first group investigates the relationship between technical inefficiency and firm-specific characteristics (or attributes). The second group investigates the relationship between technical inefficiency and entrepreneurial attributes. The third group investigates the relationship between technical inefficiency and features of the business environment. This categorization is consistent with that in Figure 4.2 which summarises the research framework for this study[53].

Papers which investigate the relationship between technical inefficiency and firm-specific characteristics are reviewed in section 5.2.1 while papers which investigate the relationship between technical inefficiency and entrepreneurial attributes are reviewed in Section 5.2.2. Papers which investigate the relationship between technical inefficiency and features of the business environment are reviewed in section 5.2.3. As will become apparent in sections 5.2.1 through 5.2.3 empirical findings on estimated relationships do not show uniformity

[53] It is important to note that the potential determinants of technical inefficiency relating to these three categories are consistent with basic requirements, efficiency enhancers and entrepreneurship framework conditions identified in chapter three and summarised in Figure 3.6. This shows consistency between Figure 3.6 and the determinants of technical inefficiency identified in this chapter and summarised in Figure 4.2.

which suggests that country specific studies are an important task to avoid erroneous policy focus[54]. The factors selected for empirical testing in this study are isolated from this literature.

The rest of this chapter is organised as follows. Section 5.3 identifies factors selected for empirical testing in this study while section 5.4 summarises the key points of the chapter.

5.2 Determinants of technical inefficiency of SMEs

5.2.1 Firm-specific characteristics and technical inefficiency

In this subset of the literature, technical inefficiency is often linked to firm characteristics such as size, age, quality of labour and capital, capital intensity, outward orientation, subcontracting activities, research and development (R&D) intensity, pattern of financing, and structure of ownership (see for instance Aggrey *et al.* 2010, Romero & Rodriguez 2010, Faruq & Yi 2010, and Vixathep & Matsunaga 2012). Other studies consider the relationship between inefficiency and product differentiation and variability of sales (see Alvarez & Crespi 2003). In most instances, results from these studies do not show consistency in the estimated relationships. Estimated relationships tend to vary across sectors or industries and countries.

Firm size is one firm attribute that has received considerable attention in this literature. At the heart of the debate is that small firms operate at a level too small to sufficiently exhaust economies of scale. Hill and Kalirajan (1993) claim that if firms are not exploiting economies of scale they are not taking advantage of relative savings on inputs that can be achieved from operating at or close to the minimum efficient scale. Based on this view it is often predicted

[54] A summary of the papers evaluated is also provided in Appendix C.

that small firms are likely to be inefficient. While some studies estimate a negative correlation between firm size and inefficiency (see Harris 1991, Lundvall & Battese 2000, Mini & Rodriguez 2000, Hossain & Karunaratne 2004, Chapelle & Plane 2005, Oczkowski & Sharma 2005, Margono & Sharma 2006, Bhandari & Maiti 2007, Mouelhi 2009, and Romero & Rodriguez 2010), others suggest that inefficiency is not intrinsic to small firms (see Alvarez & Crespi 2003, Badunenko *et al.* 2006, and Vixathep & Matsunaga 2012). Biggs *et al.* (1996), Kim (2003), Faruq and Yi (2010), and Aggrey *et al.* (2010) estimate a non-linear relationship between inefficiency and firm size. Yang and Chen (2009) find an ambiguous relationship.

Similar to firm size, the relationship between firm age and technical inefficiency has received considerable attention in the literature. On the one hand it is argued that firms become more efficient as a result of the growing stock of knowledge in the industry. This relationship is said to be reinforced by learning-by-doing effects (see Lundvall & Battese 2000). Aggrey *et al.* (2010) also note that new firms are often unaware of their abilities and need time to decide on their optimal size over time. On the other hand it is argued that older firms use equipment that does not embody recent technological advances, and are therefore, likely to be more inefficient. In rapidly changing sectors in particular, 'technology lock in' may be a distinct disadvantage hence younger firms may have the advantage (Pitt & Lee 1981). Pitt and Lee (1981) argue that younger firms are able to adopt the most efficient technologies at the time of their conception hence are likely to be more efficient.

Empirical findings show no regularity, with some studies estimating zero correlation between firm age and inefficiency (see Mini & Rodriguez 2000, Soderbom & Teal 2004, and Vixathep & Matsunaga 2012), others a positive correlation (see Burki & Terrell 1998, Bhandari &

Maiti 2007) while others estimate a negative correlation (see Yang & Chen 2009 and Romero & Rodriguez 2010). Lundvall and Battese (2000), Driffield and Kambhampati (2003), and Margono and Sharma (2006) find that the effects vary across sectors. Alvarez and Crespi (2003) investigate the relationship between input quality (measured in terms of years of experience of workers, and the age of physical capital) and inefficiency, and find that years of experience of workers reduce inefficiency and that modernization of physical capital also reduces inefficiency.

Hossain and Karuratne (2004), Wu *et al.* (2007), Diaz and Sanchez (2008), Faruq and Yi (2010), and Vixathep and Matsunaga (2012) consider the relationship between capital intensity (measured by the capital-labour ratio) and technical inefficiency. The question being addressed here is: does a higher capital-labour ratio reduce technical inefficiency? This has important implications for the choice of input mix by firms or public support programs to enhance investment in capital or labour. In studies examining this relationship it is often thought that industries that have higher capital intensities use resources more efficiently, as they cannot afford the rental cost of unused capital. These industries have a higher incentive to economise on the cost of capital. Faruq and Yi (2010) argue that developing countries may have a comparative advantage in labour intensive methods due to the availability of labour and the relative scarcity of capital and infrastructure. They argue that in a developing economy a firm with a high labour-capital mix is more likely to be operating close to the efficient level.

Faruq and Yi (2010) find evidence supporting their claim in Ghana's manufacturing industries (except textiles). Hossain and Karunaratne (2004) estimate a similar relationship for Bangladesh manufacturing (also see Diaz & Sanchez 2008 and Vixathep & Matsunaga

2012). In contrast, Wu *et al.* (2007) finds that capital intensity reduces inefficiency for watch and clock manufacturing firms in China. The sector of operation is indeed likely to play a role. Higher capital intensity may be important for some sectors, while for others a higher labour-capital mix may be important if that sector is by nature labour intensive.

Kim (2003), Driffield and Kambhampati (2003), Wu *et al.* (2007), and Yang and Chen (2009) examine the relationship between process innovation and the technical inefficiency of SMEs, with intensity of R&D expenditure used as a proxy for process innovation. Wu *et al.* (2007) and Yang and Chen (2009) claim to find a negative correlation between R&D intensity and technical inefficiency. Kim (2003) claims to find varying effects of R&D intensity across different sectors. So do Driffield and Kambhampati (2003). It is the view of the researcher that there is no conceptual basis linking process innovation with technical inefficiency. The standard analysis of technical inefficiency presupposes that the production technology is available to each and every firm. Therefore it seems difficult to connect process innovation with technical inefficiency.

Other studies, albeit a few, have looked at the relationship between the pattern of financing and the inefficiency of SMEs (see Gokcecus 1995 and Kim 2003). In a study involving 48 countries Beck *et al.* (2008) find that firms in most developing countries (and some developed countries, including the United States, United Kingdom and Germany) use a significantly higher proportion of internal resources to finance their investment. They also show that for transitional economies, internal financing can be as high as 90 percent. Beck *et al.* (2008) also find that the most common source of external finance is bank credit. Gokcecus (1995) investigates the relationship between the pattern of financing and inefficiency of

SMEs in the Turkish rubber industry. He finds that the way a firm finances itself has no significant effect on inefficiency. Kim (2003) finds unsystematic effects across sectors.

Another firm attribute that has received attention in the literature is the structure of firm ownership. Studies that focus on this attribute often look at the relationship between inefficiency and whether a firm has foreign equity participation or not, or whether the firm is state-owned or not (see Pitt & Lee 1981, Harris 1991, Soderbom & Teal 2004, Oczkowski & Sharma 2005, Margono & Sharma 2006, Tran *et al.* 2008, Pham *et al.* 2009, Mouelhi 2009, Halkos & Tzeremes 2010, Romero & Rodriguez 2010, and Faruq & Yi 2010). Others disaggregate private ownership into different forms (e.g. joint ventures, limited company) and look at the relationship between inefficiency and different forms of private ownership (see Vixathep & Matsunaga 2012).

In this subset of the literature, it is often argued that firms with foreign equity participation benefit from greater management experience and superior organizational structure and are therefore likely to be more technically efficient than domestically owned firms (see Pitt & Lee 1981). Harris (1991) also argues that firms with foreign equity participation are more likely to be engaged in exporting whereby competition drives them to become more efficient. Unfortunately, the results of the research show no regularity (see Appendix C). While Harris (1991), Mouelhi (2009), Halkos and Tzeremes (2010), Romero and Rodriguez (2010), and Faruq and Yi (2010) estimate a negative correlation between technical inefficiency and foreign equity participation, Oczkowski and Sharma (2005) estimate a zero correlation. Soderbom and Teal (2004) also estimate a zero correlation. In contrast, Pitt and Lee (1981) and Pham *et al.* (2009) find that domestically owned firms are more efficient than foreign owned firms.

A negative relationship is also thought to exist between technical inefficiency and private ownership. Margono and Sharma (2006) estimate such a relationship for Indonesian manufacturing. Tran *et al.* (2008) find that the effects of private ownership vary across sectors. Pham *et al.* (2009) estimate a zero correlation. Vixathep and Matsunaga (2012) investigate the relationship between technical inefficiency and different forms of private ownership in the Vietnamese garment industry and conclude that joint ventures tend to be more technically efficient.

The relationship between technical inefficiency and whether or not a firm is involved in exporting has also attracted some attention in the literature (see Hill & Kalirajan 1993, Kim 2003, Driffield & Kambhampati 2003, Alvarez & Crespi 2003, Hossain & Karunaratne 2004, Oczkowski & Sharma 2005, Mouelhi 2009, Pham *et al.* 2009, Romero & Rodriguez 2010, and Vixathep & Matsunaga 2012). The main interest is in whether being export oriented reduces inefficiency. The self-selection hypothesis suggests that only firms that are efficient will survive in highly competitive export markets. Exporting firms are also said to benefit from learning-by-exporting effects. Empirical results on the relationship show no regularity. While Hill and Kalirajan (1993), Hossain and Karunaratne (2004), Pham *et al.* (2009), Mouelhi (2009), Romero and Rodriguez (2010), and Vixathep and Matsunaga (2012) estimate a negative correlation between inefficiency and exporting, Alvarez and Crespi (2003) and Oczkowski and Sharma (2005) estimate a zero correlation. Driffield and Kambhampati (2003) and Kim (2003) find that effects vary across sectors.

A number of studies have focused on the relationship between technical inefficiency and outsourcing. A subset of this literature focuses on firms that outsource some of their activities (see Taymaz & Saatci 1997, Fixler & Siegel 1999, and Girma & Gorg 2004). According to

Heshmati (2003) efficient firms allocate their resources to activities for which they enjoy a comparative advantage. Activities that do not enjoy such advantages are often outsourced to external suppliers, with outsourcing expected to involve production cost savings relative to internal production because outside suppliers benefit from economies of scale, smoother production schedules and concentration of expertise (*ibid*). Taymaz and Saatci (1997), Fixler and Siegel (1999), and Girma and Gorg (2004) find that firms that outsource some of their activities tend to be more efficient.

Given that SMEs are more likely to participate in production networks than outsourcing some of their activities, a different subset of this literature focuses on the relationship between participating in production networks and technical inefficiency. According to Yang and Chen (2009) SMEs stand to benefit from factor division involved in participating in production networks. Yang and Chen (2009) argue that SMEs are often identified with labour intensive technologies and lack finance to engage in R&D. SMEs participating in production networks can reduce the risk of R&D by working as subcontractors for large enterprises, while benefiting from specialization on the production side (*ibid*). Yang and Chen (2009) find evidence that participating in production networks reduces inefficiency in the Taiwanese electronics industry. Burki and Terrell (1998) and Tran *et al.* (2008) also find evidence that participating in production networks reduces technical inefficiency.

5.2.2 Entrepreneurial attributes and technical inefficiency

The relationship between the attributes of entrepreneurs and inefficiency has received very little attention in the literature. Save for a few studies (Burki & Terrell 1998, Alvarez &

Crespi 2003, and Roudaut 2006)[55], one rarely comes across studies that investigate the possible impact of entrepreneurial attributes on technical inefficiency. Horne *et al.* (1992) emphasize that the competitive stance of a firm not only lies on its resources and scope for growth in the existing business environment, but on entrepreneurial factors. This suggests that studies that attempt to understand determinants of technical inefficiency without consideration of entrepreneurial factors miss out on this potentially important dimension.

While there is a dearth of studies on the role of entrepreneurial attributes on technical inefficiency (mainly due to data limitations) that a researcher may use as a guide to possible factors that may lead to inefficiency of SMEs (with the exception of Burki & Terrell 1998, Alvarez & Crespi 2003, and Roudaut 2006), there are a number of studies that a researcher may use as a starting point (see Jo & Lee 1996, Chawla *et al.* 1997, Lee & Tsang 2001, and Man *et al.* 2008). These studies focus on the relationship between performance and personality traits and the psychology of the entrepreneur, their knowledge and skills background, as well as their orientations and motivations for being self-employed. Using a competency based approach Man *et al.* (2008) develop a conceptual model that attempts to link personality traits, skills and knowledge of SME owners-managers to the long term performance of their firms. They claim that the long term performance of a firm depends on the ability to recognise and develop market opportunities; management of interaction within and outside the firm; an understanding of complex information; decision making and risk

[55] These studies find no regular pattern on the relationship between technical inefficiency and entrepreneurial attributes. While Burki and Terrell (1998) estimate a negative correlation between inefficiency and education, Alvarez and Crespi (2003) find that a higher level of education is positively related to inefficiency. They argue that owners with higher education probably have a higher opportunity cost of monitoring the labour force and therefore focus less attention on these activities. Alvarez and Crespi (2003) also examine the relationship between inefficiency and entrepreneur experience. They find no evidence that the experience of managers reduces inefficiency. In a study of manufacturing firms in the Cote d'Ivoire, Roudaut (2006) examines the relationship between entrepreneur origin and inefficiency and finds that being an African (non-Ivorian) contributes to technical inefficiency.

taking; organizing resources; evaluating and implementing strategies of the firm; and having the drive to forge ahead with the business.

In a study involving 168 entrepreneurs in Singapore, Lee and Tsang (2001) find evidence that personality traits (internal locus of control and need for achievement) can contribute positively to venture growth. They also find that industrial and management experience has a positive effect on venture growth (also see Jo & Lee 1996 and Chawla *et al.* 1997). Hessels *et al.* (2008) consider entrepreneurs' motives and their likely influence on performance. They find that people for whom increasing wealth is the prime motive for being self-employed are more likely to be job growth and export oriented. Hessels *et al.* (2008) also find that entrepreneurs who are motivated to start businesses out of necessity are less likely to have high ambitions for their businesses (recall the distinction between opportunity and necessity entrepreneurship highlighted in chapter three).

Other studies consider the possible influence of ethnic and religious or non-religious background on performance. Leff (1979) finds little evidence of ethnic and religious factors having a contribution on firm performance. Kilby (1983) finds that non-indigenous entrepreneurs have a superior initial endowment of capital, knowledge of markets and technology and acquired traditions that raise productivity. Ramachandran and Shah (1999) compare growth rates of indigenously owned (African) firms in Kenya, Tanzania, Zambia and Zimbabwe with firms owned by entrepreneurs of European or Asian (Indian) descent. After controlling for firm size and age, and other entrepreneurial characteristics, sector and country differences, they find that non-indigenously owned firms start out larger and grow significantly faster than indigenously owned firms because of informational and financial networks which enable them to access credit, information and better technology. They argue

that indigenous (African) entrepreneurs do not have access to these networks and, therefore, have significant disadvantages. However, Ramachandran and Shah (1999) find that formal education at the secondary and university levels serve as a substitute for these networks.

Recent studies have incorporated gender differences. Rosa *et al.* (1996) find significant differences in the entrepreneurial performance of female and male business owners. They find that female business owners are less likely to own multiple businesses, less eager to plan expansion, and where expansion is planned their strategies for growth differ markedly from those of their male counterparts. They note, however, that access to and control over resources may be playing a part in inhibiting female business owners from seeking lateral expansion. Using a sample of Canadian firms, Fischer (1992) also finds evidence of inferior performance by women entrepreneurs. Du Rietz and Henrekson (2000) also test the female underperformance hypothesis on a sample of 4200 Swedish entrepreneurs and find that male entrepreneurs tend to perform better than female entrepreneurs in the four performance variables included in their study (i.e. profitability, sales, employment, and number of orders). However, female underperformance seems to disappear with a number of controls, particularly in profitability, employment and number of orders (see Du Rietz & Henrekson 2000).

Kalleberg and Leicht (1991), Johnson and Storey (1993), Fischer *et al.* (1993), find no significant difference between the performance of female and male owned businesses. Fischer *et al.* (1993) argue that female owned businesses tend to grow slower because of some systematic disadvantages that require policy intervention. Robb and Watson (2012) note that a number of studies that seem to confirm the female underperformance hypothesis are usually based on performance measures that do not control for demographic differences.

In their study, they use a longitudinal database of more than 4000 new ventures in the U.S to examine potential differences in the performance of female and male owned firms. They examine 4-year closure rates, return on assets, and a risk adjusted measure, while controlling for demographic differences and find that there is no significant difference in performance between female and male owned businesses.

While there are a limited number of studies on the relationship between technical inefficiency of SMEs and attributes of entrepreneurs, the list of factors reviewed provide guidance on possible factors to consider.

5.2.3 Features of the business environment and technical inefficiency

While outside the control of managers, it is often suggested that the business environment can have an impact on the performance of a firm. According to Fried *et al.* (1999) the business environment can affect the ability of managers to transform inputs into outputs. It also affects their ability to access important resources such as finance (*ibid*). According to the OECD (2004) the business environment encompasses the legal and regulatory frameworks that establish the rules of the game and govern the way in which government, enterprises, and civil society interact with each other. It also includes the macroeconomic environment, infrastructural development, institutional development, access to resources at competitive prices, domestic demand, and access to foreign markets (International Bank for Reconstruction and Development/World Bank 2012).

According to the International Bank for Reconstruction and Development/World Bank (2012) if the legal and regulatory frameworks that establish rules of the game and govern economic interaction are poorly designed they become an obstacle to businesses, adding to their

transaction costs. In chapter three, we provided an overview of the status of business regulations across a number of regions including Sub-Saharan Africa. The data provided showed variations in the state of business regulations across regions.

A number of studies examine the relationship between the technical inefficiency of SMEs and different features of the business environment (see Goksecus 1995, Taymaz & Saatci 1997, Driffield & Kambhampati 2003, Alvarez & Crespi 2003, Hossain & Karunaratne 2004, Oczkowski & Sharma 2005, Chapelle & Plane 2005, Badunenko *et al.* 2006, Margono & Sharma 2006, Tran *et al.* 2008, Pham *et al.* 2009, Aggrey *et al.* 2010, and Vixathep & Matsunaga 2012). Like the other two groups of factors that are thought to possibly influence the technical inefficiency of SMEs (i.e. firm-specific characteristics and attributes of entrepreneurs), empirical results show no regularity with factors relating to different business environment features shown to affect firms in different sectors differently.

One business environment factor that has received some attention in this literature is trade liberalization. According to Hossain and Karunaratne (2004) the implications of a liberal trade regime for growth, total factor productivity, and economic efficiency are derived from the neo-classical case for trade liberalization which is based on perceived benefits from the division of labour, widening of markets, and comparative advantage. Driffield and Kambhampati (2003) note that trade liberalization is generally expected to increase welfare by increasing imports into sectors where the domestic price is higher than the world price, by increasing output in sectors with excess profits, by allowing firms in sectors with unexploited scale economies to increase output, and by reducing technical inefficiency. Hossain and Karunaratne (2004) and Oczkowski and Sharma (2005) estimate a negative correlation between trade liberalization and inefficiency, with trade protection thought to discourage cost

reduction. Pham *et al.* (2009) and Goksecus (1995) further find that a reduction in trade protection reduces inefficiency. Driffield and Kambhampati (2003) find that the effects of trade liberalization vary across sectors.

Some studies consider the relationship between technical inefficiency and effects of agglomeration and urbanization, with a negative correlation between inefficiency and agglomeration and urbanization predicted where agglomeration and urbanization economies exist (see for example Badunenko *et al.* 2006, Tran *et al.* 2008, and Vixathep & Matsunaga 2012). Badunenko *et al.* (2006) estimate a negative correlation between inefficiency and location of a firm. Margono and Sharma (2006) find that the effects vary across sectors. Aggrey *et al.* (2010) estimate a zero correlation for firms located in the main cities of Kenya and Uganda, but a negative correlation for firms located in the main city of Tanzania. Taymaz and Saatci (1997) also estimate a zero correlation between location and inefficiency. Other studies that attempt to capture agglomeration and urbanization economies use public infrastructure (e.g. Chapelle & Plane 2005), with agglomeration economies said to exist when firms in an urban area share a public good as input into production. Chapelle and Plane (2005) estimate a zero correlation between public infrastructure and inefficiency for Ivorian manufacturing firms.

The relationship between technical inefficiency and difficulty in accessing institutional credit has also received some attention in this literature (see Alvarez & Crespi 2003, Chapelle & Plane 2005, and Sena 2006). According to Beck and Demirguc-Kunt (2006) financing obstacles are more growth constraining for SMEs than large firms. They argue that financing obstacles are often reflected in their financing patterns with SMEs using a smaller share of formal financial sources than large firms to finance their investment and working capital.

Beck and Demirguc-Kunt (2006) argue that in a world of fixed transaction costs and information asymmetries, SMEs with their demand for smaller loans face higher transaction costs and higher risk premiums since they are typically opaque and have less collateral.

In a study of Chilean manufacturing firms Alvarez and Crespi (2003) estimate a zero correlation between access to external credit and inefficiency although they argue that the impact of the variable may be incorporated in the age of capital as firms with less access to credit invest less in capital. Alvarez and Crespi (2003) find that firms which use older capital are less efficient. Chapelle and Plane (2005) also estimate a zero correlation between inefficiency and difficulty of obtaining institutional credit. Sena (2006) finds that financial constraints may reduce technical inefficiency as they may motivate firms to become more efficient.

Chapelle and Plane (2005) investigate the relationship between inefficiency and trade unionism. According to them trade unionism may influence inefficiency in the following ways: on the one hand the presence of a trade union may contribute to restricting the set of managerial decisions by reducing the speed of adjustment of the labour force to the business cycle and the trade liberalization process, possibly contributing to inefficiency. On the other hand the presence of a trade union can be a source of positive stimulation for the emergence of procedural arrangements that encourage a high level of effort and loyalty within the organization. They find that trade unionism contributes to inefficiency in the Ivorian food processing and textile industries.

5.3 Factors selected for empirical testing

The preceding section reviewed potential determinants of technical inefficiency of SMEs. The factors selected for empirical testing in this study are isolated from this literature. The choice of factors selected and hence the scope of this study was significantly constrained by data limitations. A description of data constraints encountered in this study was provided in chapter four. Only factors for which data was available were thus chosen for empirical testing. These factors were also chosen on the basis of relevance to the context of Botswana. This section identifies factors selected for empirical testing in this study.

Financing constraints

One significant characteristic of Botswana that had to be taken into account is its natural resource dependence. In the literature, it is frequently suggested that in resource dependent economies, there is a tendency for the resource sector to squeeze out non-resource sectors in terms of access to resources e.g. finance, skilled labour etc. (see for example Corden & Neary 1982, Corden 1984, Sachs & Warner 1995, Ross 1999, Auty 2000, Collier 2007, Cox & Harvie 2010), with possible negative consequences on SMEs operating in these sectors. In this study this possibility was considered. It is thought that it is likely that SMEs in non-resource sectors like manufacturing are constrained by difficulties in accessing resources (i.e. *resource movement effect*). This study considered this possibility for SMEs in the sample.

It is worth noting that the effect of resource dependence on technical inefficiency of SMEs is an aspect that has not been considered in previous studies. By considering this aspect, this study provides some empirical evidence on this relationship. However, it is recognised that financing constraints may not just be a result of resource dependence, but also related to the level of development of the financial sector. An underdeveloped financial sector can have

limiting effects on opportunities for SMEs to access finance. As a measure of financial depth Cihak *et al.* (2012) estimate bank private credit to GDP in Botswana at 22.3 percent. In countries at a similar stage of development (i.e. upper-middle income) this figure is estimated at 44.5 percent, double the figure estimated for Botswana (*ibid*). In high income countries the figure is estimated at 105.9 percent. Stock market capitalization to GDP, a measure of depth of financial markets, is estimated at 29.1 percent in Botswana. The average for upper-middle income countries is 36.5 percent and high income countries 58.4 percent (Cihak *et al.* 2012). Furthermore, Cihak *et al.* (2012) estimate that only 40.8 percent of small firms in Botswana have a line of credit. It is thus not inconceivable that the financial sector may be placing some limitations on SMEs.

The proxy used to represent financing constraints, together with the empirical regularity tested are described in chapter six. Results of the empirical tests carried out can also be seen in chapter six.

Export orientation

The relationship between export orientation and technical inefficiency as noted in section 5.2.1 is normally meant to capture learning by exporting effects and the so called self-selection hypothesis. Policy implications on the design of export promotion policies are often drawn from results of such analyses. Empirical results on this relationship as noted in section 5.2.1 show no regularity. It was noted that country specifics and sector of operation sometimes determine the direction and significance of the estimated relationship. This suggests that country and sector specific studies are important to avoid erroneous policy focus. The proxy used to represent export orientation, together with the empirical regularity tested and results of the tests are described in chapter six.

Firm age

The effect of firm age is normally meant to capture learning by doing effects. Empirical results on this relationship as with many other factors, tended to show no regularity, which also underlines the importance of country and sector specific studies to avoid erroneous policy focus. The proxy used to represent firm age, together with the empirical regularity tested, and results of the tests are described in chapter six.

Entrepreneurs' education

The education of the entrepreneur is likely to contribute to the ability of the entrepreneur to successfully manage their business. Of the few studies that have looked at the relationship between this variable and technical inefficiency, results are mixed. From a policy point of view, investigation of this relationship is important to avoid erroneous policy focus for Botswana. The empirical evidence on the subject is also important to the understanding of the relationship between this attribute and technical inefficiency of SMEs. The proxy used to represent the education of the entrepreneur, together with the empirical regularity tested is described in chapter six. The chapter also reports results of the empirical tests.

Entrepreneurs' experience

Similar to education, the experience of the entrepreneur is likely to contribute to the ability of the entrepreneur to successfully manage their business. It is meant to capture the importance of learning by doing effects. The proxy used to represent the experience of the entrepreneur, together with the empirical regularity tested and results of the empirical tests are described in chapter six.

Table 5.1 provides a list of the factors described above that will be subjected to empirical testing in this study.

Table 5:1 List of factors to be subjected to empirical testing

Financing constraints
Export orientation
Firm age
Entrepreneur's education
Entrepreneur's experience

5.4 Conclusion

The purpose of this chapter has been to provide a survey of the literature on determinants of technical inefficiency of SMEs. It was noted that there is no single theory that provides the researcher with factors thought likely to impact on technical efficiency of SMEs. The researcher has to compile a list of possible factors, from which factors to be subjected to empirical testing are then isolated based on data availability and relevance to the study. A survey of candidate determinants of technical inefficiency relating to features of the business environment, firm-specific characteristics as well as attributes of entrepreneurs was provided. It was noted that a lot of attention in the literature has been paid to features relating to firm-specific characteristics, while the attributes of entrepreneurs together with the business environment have received very little attention. In addition to providing empirical evidence from which this study draws recommendations for the design of policies to improve technical efficiency of SMEs in Botswana, it is expected that this study will make an empirical

contribution on the relationship between technical efficiency and some of the features relating to attributes of entrepreneurs and features of the business environment.

As highlighted in section 5.3, the factors selected for empirical testing in this study are financing constraints (a feature of the business environment), export orientation of a firm, the age of the firm (firm-specific characteristics), the entrepreneur's education as well as their experience (attributes of entrepreneurs). Selection of these factors was significantly influenced by data availability. Results of the empirical tests are provided in the next chapter.

6 RESULTS OF THE ESTIMATION OF TECHNICAL EFFICIENCY AND ANALYSES OF DETERMINANTS OF TECHNICAL INEFFICIENCY

6.1 Introduction

This chapter presents results of the estimation of technical efficiency of the sample of SMEs included in this study and analysis of determinants of technical inefficiency. The findings are regarded to be an original contribution to the study of technical efficiency of SMEs in Botswana. The chapter is organised as follows. Section 6.2 describes empirical models estimated to generate the results. The section is divided into two parts. The first part (section 6.2.1) describes the models estimated to generate estimates of the technical efficiency of SMEs in the sample. The second part (section 6.2.2) describes the model estimated to analyse determinants of technical inefficiency.

Section 6.3 describes the data and variables used in the estimation of technical efficiency and analysis of determinants of technical inefficiency. The section is also divided into two parts. The first part (section 6.3.1) relates to data and variables used in the estimation of technical efficiency of SMEs in the sample. The second part (section 6.3.2) relates to data and variables used in the analysis of determinants of technical inefficiency. The empirical regularities (or hypothesis) tested, together with expected relationships are also specified in this section. Section 6.4 reports empirical results. The section is divided into two parts. The first part (section 6.4.1) reports results of the estimation of technical efficiency while the second part (section 6.4.2) reports results of the analysis of determinants of technical inefficiency. Section 6.5 summarises key findings.

6.2 Empirical models

6.2.1 Estimation of technical efficiency

This study as noted in chapter four relies on a variant of the data envelopment analysis (DEA) estimator for the estimation of technical efficiency. In the DEA literature, it is commonly assumed that all production units in the sample have access to the same technology for transforming a vector of N inputs, x, into a vector of M outputs, y (see Fare *et al.* 1994). The technology it is assumed can be characterised by a technology set. Following Fare *et al.* (1994), a technology set, T may be specified as,

$$T = \{(x, y) \in \mathbb{R}_+^N \text{ x } \mathbb{R}_+^M : x \in \mathbb{R}_+^N \text{ can produce } y \in \mathbb{R}_+^M\} \quad (6.1)$$

The technology set is assumed to satisfy the standard regularity axioms of production (see Fare & Primont 1995)[56]. While all production units in the sample are assumed to have access to the same technology, some production units will be either on or away from the frontier of such technology (Shiu & Zelenyuk 2011). The distance from each production unit in T to the frontier is the technical inefficiency of the production unit. This study relies on the Farrell (1957) type output-oriented measure of technical efficiency. This measure not only satisfies desirable mathematical properties, but is fairly easy to compute and interpret. These properties were highlighted in chapter four. They include various forms of continuity, weak monotonicity, commensurability, homogeneity, and a weak indication for all technologies

[56] Fare and Primont (1995) assume that inaction is possible (i.e. given any input vector it is always possible to produce nothing). They also assume weak disposability of outputs (i.e. if y is produced using x, then outputs can be freely disposed of along a ray from the origin through y). This axiom allows for the possibility that one of the outputs is bad (Fare & Primont 1995). Fare and Primont (1995) also assume that inputs are weakly disposable. In addition, they assume that output sets are bounded (i.e. finite amounts of inputs can only produce finite amounts of output). This assumption is also referred to as the scarcity assumption. Fare and Primont (1995) also assume input and output closedness. In addition, they assume input and output convexity. See Fare and Primont (1995) for a comprehensive treatment of these assumptions (also see Appendix B.2).

satisfying regularity conditions (also see Russell 1990, 1997). For a production unit $\in \{1, \ldots., n\}$, this measure can be expressed as,

$$TE^j \equiv TE(x^j, y^j) = \max_\theta \{\theta: (x^j, \theta y^j) \in T\} \quad (6.2)$$

When TE^j is equal to one, the production unit is considered to be efficient. When TE^j is greater than one, the production unit is said to be inefficient, and $[1 - (1/TE^j)]$ x 100% represents the percentage of inefficiency (Shiu & Zelenyuk 2011 and Demchuk & Zelenyuk 2009). Since the true T is unobserved, one has to estimate the efficiency measure of each individual production unit based on observed data. The DEA estimate of T obtained can be denoted, $\hat{T}$ obtained through the activity model,

$$\hat{T} = \{(x, y) \in \mathbb{R}_+^N \text{ x } \mathbb{R}_+^M : \sum_{k=1}^n z^k y_m^k \geq y_m, m = 1, \ldots., M,$$
$$\sum_{k=1}^n z^k x_i^k \leq x_i, \quad i = 1, \ldots., N, \quad z^k \geq 0, \quad k = 1, \ldots., n\} \quad (6.3)$$

where $\{z^k: k = 1, \ldots., n\}$ are the intensity variables over which optimization (6.2) is made. In this study, estimates of technical efficiency are generated from estimation of both variable returns to scale (VRS) and constant returns to scale (CRS) technologies. Estimating both technologies permits assessment of whether there are notable differences between estimates from the two technologies which could be suggestive of scale effects. It must be noted though that whatever differences are noted, they are only suggestive of possible scale effects. Empirical tests would have to be undertaken before a conclusion can be drawn on whether these effects have statistical relevance or not. In the literature on SMEs, scale effects are often tested by including a variable for size in the analysis of determinants of technical

efficiency. A conclusion can then be drawn from the significance and direction of the estimated relationship. This type of analysis is carried out in this study.

To facilitate estimation of variable returns to scale technology, a convexity constraint $\sum_{k=1}^{n} z^k = 1$ is added to Equation (6.3). Applying the DEA estimator yields estimates of the true inefficiency scores, $\{TE^j : j = 1, \ldots, n\}$ denoted, $\{\widehat{TE}^j : j = 1, \ldots, n\}$[57].

6.2.2 Analysis of determinants of technical inefficiency

In this analysis, the objective is to test the marginal impact of each determinant on technical efficiency of SMEs in the sample. To facilitate this analysis the following regression model is assumed and tested,

$$TE^j \approx a + Z_j\delta + \varepsilon_j, \qquad j = 1, \ldots, n \tag{6.4}$$

where a is the constant term, ε_j is statistical noise, and Z_j is a row vector of observation specific variables for production unit j expected to impact on the efficiency score of the production unit, TE^j defined in Equation (6.2), through the vector of parameters δ (common for all j) that need to be estimated (see Shiu & Zelenyuk 2011). The elements of Z_j include determinants of technical efficiency identified in Table 5.1 in the previous chapter. The regression analysis is carried out using the method of Simar and Wilson (2007) and in

[57] The estimates have the same range as the true scores, and as in many other extreme value type estimates are subject to small sample bias which nevertheless vanishes asymptotically as the estimates are consistent with their true counterparts (Shiu & Zelenyuk 2011). Kneip *et al.* (1998, 2008) discuss the consistency and rates of convergence of the DEA estimator.

particular the double bootstrap[58]. Following Simar and Wilson (2007), instead of using the unobserved regressand TE^j in Equation (6.4) its bias corrected estimate $\widehat{TE}_{bc}^{j}$ obtained using the heterogeneous parametric bootstrap that they proposed is used. The distribution of ε_j is assumed to be a truncated normal distribution with a mean zero, unknown variance, and a left truncation point determined by $\varepsilon_j \geq 1 - a - Z_j\delta$ (see Simar & Wilson 2007). Because both sides of Equation (6.4) are bounded by unity the distribution of ε_j is restricted by the condition $\varepsilon_j \geq 1 - a - Z_j\delta$. The econometric model can formally be defined,

$$\widehat{TE}_{bc}^{j} \approx a + Z_j\delta + \varepsilon_j, \quad j = 1, \ldots, n \tag{6.5}$$

$$\varepsilon_j \sim N(0, \sigma_\varepsilon^2), \text{ such that } \varepsilon_j \geq 1 - a - Z_j\delta, \quad j = 1, \ldots, n. \tag{6.6}$$

This econometric model is estimated by maximising the corresponding likelihood function with respect to $(a, \delta, \sigma_\varepsilon^2)$[59]. The bootstrap confidence intervals for the estimates of the parameters $(a, \delta, \sigma_\varepsilon^2)$ are obtained by using the parametric bootstrap for regression that incorporates information on the parametric structure (6.4) and the distributional assumption of the error term (6.6).

6.3 Data and variables used in the estimation

The data used in this study, as highlighted in chapter four, is from a sample of 132 SMEs involved in manufacturing activities in Botswana. The data was collected by the World Bank Enterprise Surveys Unit on Botswana as part of the Africa Enterprise Survey initiative[60].

[58] A description of why this is the preferred method was provided in chapter four. It should be noted also that while this study uses the double bootstrap, the single bootstrap is carried out as a robustness check.
[59] The regression model is estimated for estimates from variable returns to scale technology as well as estimates from constant returns to scale technology as a further robustness check.
[60] A description of the data collection method including the data collection instrument can be seen at enterprisesurveys@worldbank.org.

6.3.1 Data used in the estimation of technical efficiency

A DEA model with three inputs (capital, intermediate goods, and labour) and one output was estimated to generate estimates of technical efficiency for SMEs in the sample. This specification has also been used in Wu *et al.* (2007) and Shiu and Zelenyuk (2011).

The data collected by the World Bank Enterprise Surveys Unit is measured in Botswana Pula (BWP), the local currency of Botswana, and so the proxies used for output and inputs are expressed in millions of Botswana Pula. Total annual sales were used as the proxy for output (also Alvarez & Crespi 2003 and Halkos & Tzeremes 2010). According to Alvarez and Crespi (2003) sales tend to have less measurement error in surveys. Alvarez and Crespi (2003), Wu *et al.* (2007) and Shiu and Zelenyuk (2011) use the net value of fixed assets as the proxy for capital. This study followed a similar approach, albeit with a slight variation due to data limitations. The proxy used for fixed capital in this study includes machinery, vehicles, and equipment but excludes land and buildings. Total expenses on intermediate goods were used as the proxy for intermediate inputs (also see Demchuk & Zelenyuk 2009). For labour, total expenses on labour, including wages, salaries, bonuses and social security payments were used. This approach is also followed in Demchuk and Zelenyuk (2009). Table 6.1 provides a summary of descriptive statistics for the variables used in this study.

Table 6:1 Descriptive statistics for inputs and outputs

	Mean	***Median***	***Maximum***	***Minimum***	***Standard Deviation***
All firms (132)					
Output: Annual sales (BWP millions).	5.6031	1.6525	59.3220	0.0850	9.4318
Capital input: Machinery, vehicles, and equipment (BWP millions).	0.9967	0.2731	7.6271	0.0186	1.5767
Intermediate input: Intermediate inputs (BWP millions)	0.6080	0.2107	5.0847	0.0140	1.0480
Labour input: Labour, including wages, salaries, bonuses and social security payments (BWP millions).	1.0131	0.3475	8.7900	0.0150	1.5302

Notes: Descriptive statistics were computed in *Eviews* 7.

6.3.2 Data used in the analysis of determinants of technical inefficiency

The variables used here constitute elements of Z_j in model (6.4) - (6.6). They represent the determinants of technical inefficiency identified in Table 5.1 in the previous chapter. The objective of the regression analysis is to draw inferences about the marginal impact of each determinant on technical efficiency. This section describes variables used to represent candidate determinants of technical efficiency identified in Table 5.1.

Financing constraints

A dummy variable (D1) was used to represent financing constraints, with the dummy variable being equal to one for a firm that perceived financing constraints and zero otherwise. The empirical regularity (or hypothesis) tested with respect to this variable is:

- *Financing constraints are positively correlated with technical inefficiency.*

The expected relationship is positive, suggesting that financing constraints reduce the technical efficiency of SMEs. Such a relationship is to be expected as firms that are faced with financing constraints are likely to find it difficult to invest in optimal technologies for example. Such firms are more likely to be technically inefficient.

Export orientation

A dummy variable (D2) was used to represent a firm's export orientation, with the dummy variable being equal to one for a firm that is exporting and zero otherwise. The empirical regularity (or hypothesis) tested with respect to this variable is:

- *Export orientation is negatively correlated with technical inefficiency.*

The expected relationship is negative, suggesting that exporting improves technical efficiency since firms that are involved in exporting activities are likely to benefit from learning-by-exporting effects. Firms not involved in exporting activities are thus likely to be technically inefficient as unlike their peers they do not benefit from learning-by-exporting effects.

Firm age

The number of years a firm has been in operation was used to represent firm age. The empirical regularity (or hypothesis) tested with respect to this variable is:

- *Firm age is negatively correlated with technical inefficiency.*

The expected relationship is negative, suggesting that learning-by-doing effects are important in reducing technical inefficiency. Older firms are thus expected to be more technically efficient than younger firms.

Entrepreneurs' education

A dummy variable (D3) was used to represent the education of the entrepreneur, with the dummy variable being equal to one for an entrepreneur who has university education and zero otherwise. The empirical regularity (or hypothesis) tested with respect to this variable is:

- *Education is negatively correlated with technical inefficiency.*

The expected relationship is negative, suggesting that being educated improves efficiency of the firm. Being educated is expected to have a positive impact on the competency of entrepreneurs in managing their businesses and so entrepreneurs who are educated are expected to contribute positively to efficiency of their firms.

Entrepreneurs' experience

The number of years an entrepreneur has worked in industry was used to represent their level of experience in the running of the business. The empirical regularity (or hypothesis) tested with respect to this variable is:

- *Experience is negatively correlated with technical inefficiency.*

The expected relationship is negative, suggesting that experience is important. Experience is expected to have a positive influence on the competency of entrepreneurs and so entrepreneurs who have more experience are expected to contribute positively to the efficiency of their firms.

Table 6.2 provides a summary description of variables used in the analysis. Table 6.3 summarises expected relationships between technical efficiency and these variables, while Table 6.4 provides descriptive statistics of the variables.

Table 6:2 Descriptions of explanatory variables for the regression

Variable	***Description***
Financing constraints	Dummy, D1: D1 is equal to 1 for a firm that perceives financing constraints
Export orientation	Dummy, D2: D2 is equal to 1 if the firm is exporting
Firm age	Measured in number of years the firm has been operational
Entrepreneur's education	Dummy, D3: D3 is equal to one if the entrepreneur has university education
Entrepreneur's experience	Measured in number of years the entrepreneur has worked in industry

Table 6:3 Expected relationships between explanatory variables and technical inefficiency

Explanatory variable	Expected relationship
Financing constraints	Positive
Export orientation	Negative
Firm age	Negative
Entrepreneur's education	Negative
Entrepreneur's experience	Negative

Notes: The technical inefficiency score obtained from estimating the model (6.1)-(6.3) is the dependent variable in the regression analysis. The objective of the analysis is to evaluate the marginal impact of each explanatory variable on technical inefficiency. A positive relationship between an explanatory variable and the dependent variable suggests the explanatory variable reduces technical efficiency. A negative relationship on the other hand suggests the explanatory variable improves technical efficiency.

Table 6:4 Descriptive statistics for explanatory variables

Variable description	***Mean***	***Median***	***Maximum***	***Minimum***	***Standard Deviation***
Financing constraints: dummy variable, D1. D1 is equal to 1 for a firm that perceives financing constraints.	0.7197	1.0000	1.0000	0.0000	0.4509
Export orientation: dummy variable, D2. D2 is equal to one for an exporting firm.	0.1667	0.0000	1.0000	0.0000	0.3740
Firm age: measured in years a firm has been operational.	11.4394	10.0000	37.0000	1.0000	8.2622
Entrepreneur's education: dummy variable, D3. D3 is equal to one if the entrepreneur has university education.	0.5833	1.0000	1.0000	0.0000	0.4949
Entrepreneur's experience: measured in number of years the entrepreneur has worked in the field.	14.1970	12.0000	40.0000	1.0000	10.1413

Notes: Descriptive statistics were computed in *Eviews* 7.

6.4 Empirical results

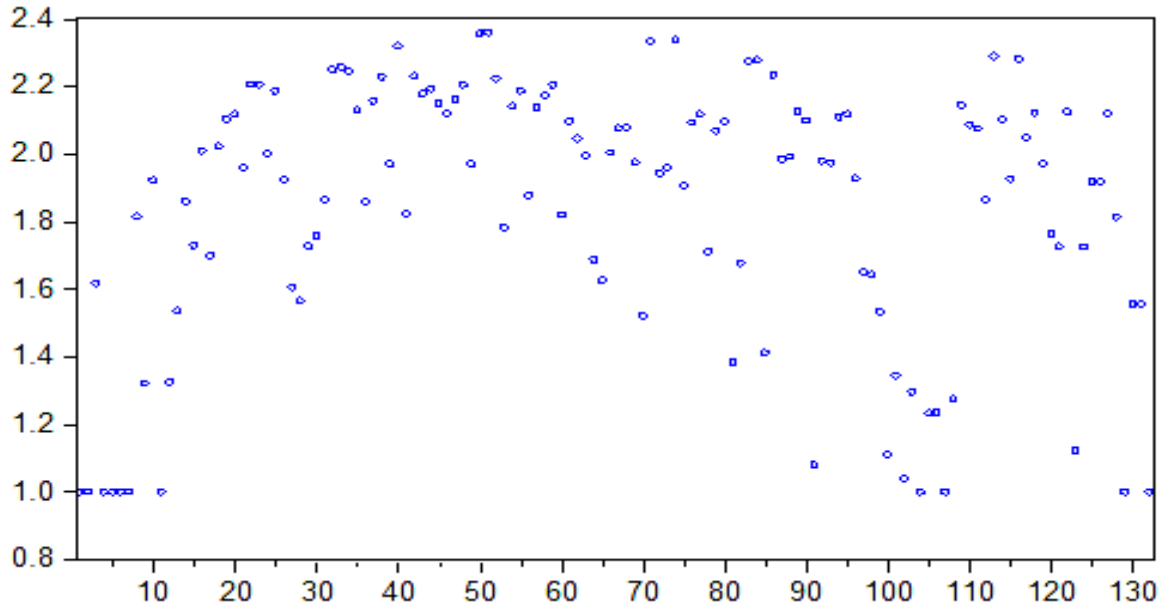
6.4.1 Estimation of technical efficiency

This section reports results of the estimation of technical efficiency of SMEs in the sample. The section is divided into two parts. Section 6.4.1.1 reports estimation results from variable returns to scale technology. Section 6.4.1.2 reports estimation results from constant returns to scale technology. As noted in section 6.2.1, an efficient production unit is expected to have an estimated technical efficiency score of unity. Any production unit with an estimated technical efficiency score more than unity is technically inefficient. The estimated percentage technical inefficiency score for a production unit is given by $\left[1-(1/\widehat{TE}^{j})\right]$ x 100%. For example, an efficiency estimate of 1.3 implies that percentage technical inefficiency of $\left[1-(1/\widehat{TE}^{j})\right]$ x $100\% = [1-(1/1.3)] * 100\% = 23.1$ percent for the production unit in question. Stated differently, the percentage efficiency of the production unit is 76.9 percent.

6.4.1.1 Estimation results from variable returns to scale technology

Figure 6.1 is a dot plot of estimates of technical efficiency of SMEs in the sample from variable returns to scale technology (VRS). From Figure 6.1 it is apparent that the majority of firms in the sample lie away from the estimated efficient frontier. Only a few lie on the efficient frontier (see Figure 6.1). Moving from the left to the right of Figure 6.1 on the horizontal axis, the first 96 firms are small firms according to the categorization provided in chapter five while the remaining 36 firms are medium firms (see Table 4.1). The spread of the technical efficiency estimates in Figure 6.1 suggests that technical inefficiency is not synonymous with small firms, although it appears that more small firms lie away from the efficient frontier than medium firms.

Figure 6:1 Plot of efficiency estimates from VRS technology estimation



Notes: The estimates of technical efficiency were computed in MATLAB using the codes of Valentin Zelenyuk which adopted earlier codes of Leopold Simar.

Table 6.5 provides a summary of descriptive statistics of estimates of technical efficiency estimates for the firms in the sample. The mean and median values are estimated at 1.8380 and 1.9696 respectively. These estimates suggest mean and median technical inefficiency values of 45.4 percent and 49.2 percent respectively. That is,

$\left[1-(1/\widehat{TE}^{j})\right]$ x $100\% = [1-(1/1.8380)]$ x $100 = 45.4$ percent and

$\left[1-(1/\widehat{TE}^{j})\right]$ x $100\% = [1-(1/1.9696)]$ x $100 =$ 49.2 percent respectively.

These values together with estimates that can be seen in Figure 6.1 suggest there is considerable technical inefficiency in the sample.

Table 6:5 Descriptive statistics of efficiency estimates from VRS technology estimation

	Mean	Median	Standard Deviation
Descriptive statistics	1.8380	1.9696	0.3927

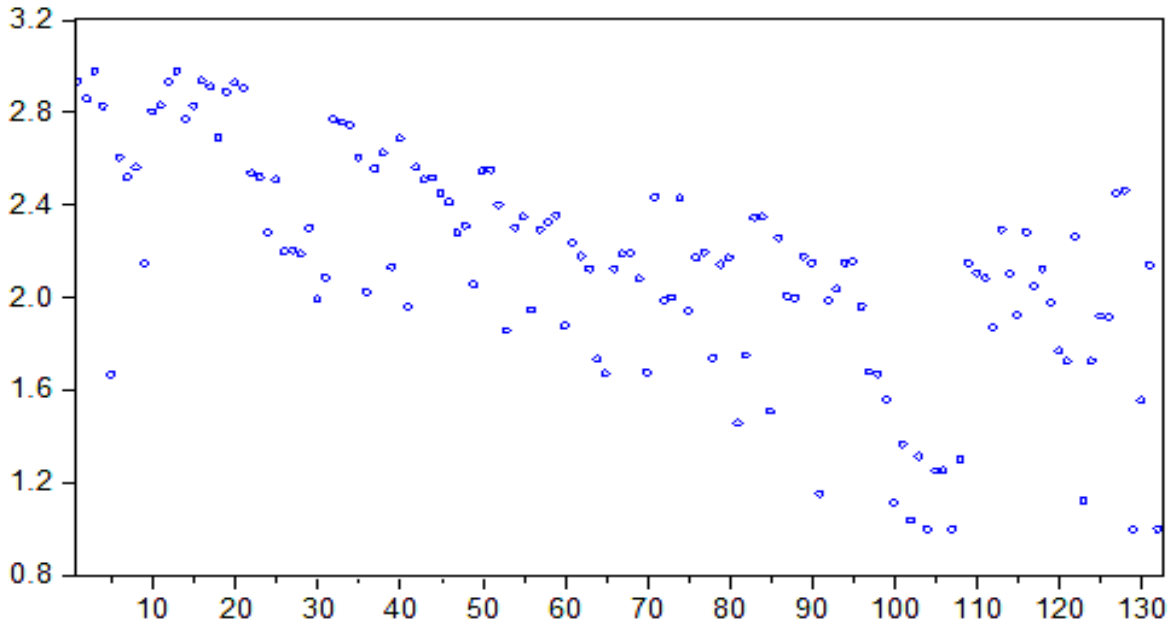
Notes: Descriptive statistics were computed in *Eviews* 7 based on estimates of technical efficiency computed in MATLAB using the codes of Valentin Zelenyuk which adopted earlier codes of Leopold Simar.

6.4.1.2 Estimation results from constant returns to scale technology

Figure 6.2 is a scatter plot of estimates of technical efficiency from constant returns to scale (CRS) technology. The estimates suggest considerable technical inefficiency in the sample. Only a few firms lie on the efficient frontier (see Figure 6.2). Technical inefficiency seems to reduce as one moves from the left of Figure 6.2 (the first 96 firms on the horizontal axis on the plot) towards medium firms (the last 36 firms on the plot). While technical inefficiency seems to reduce as one moves from the left (small) to the right (medium), Figure 6.2 still suggests that inefficiency is not synonymous with small firms.

Table 6.6 provides a summary of descriptive statistics of the estimates. The mean and median values are estimated at 2.1469 and 2.1703 respectively. These imply a percentage mean technical inefficiency value of 53.4 percent and a median value of 53.9 percent. These statistics and the estimates shown in Figure 6.2 suggest considerable technical inefficiency in the sample.

Figure 6:2 Plot of efficiency estimates from CRS technology estimation



Notes: The estimates of technical efficiency were computed in MATLAB using the codes of Valentin Zelenyuk which adopted earlier codes of Leopold Simar.

Table 6:6 Descriptive statistics of efficiency estimates from CRS technology estimation

	Mean	Median	Standard Deviation
Descriptive statistics	2.1469	2.1703	0.4856

Notes: Descriptive statistics were computed in *Eviews* 7 based on estimates of technical efficiency computed in MATLAB using the codes of Valentin Zelenyuk which adopted earlier codes of Leopold Simar.

As noted in section 6.2.1, one of the purposes of estimating efficiency from both VRS and CRS technologies was to assess whether there are notable differences in the estimates which could be suggestive of scale effects. A comparison of descriptive statistics (mean and median) from estimates of technical efficiency from VRS and CRS technologies suggests there are some differences in the estimates (see Table 6.5 and Table 6.6). It should be noted however that these differences do not necessarily imply statistical relevance. Statistical

relevance has to be tested before a conclusion can be drawn. In studies on technical efficiency of SMEs, a size variable is normally included in the regression analysis of determinants of technical inefficiency to test if size matters. In this study, size is also included in the analysis to evaluate if there are scale effects. Results are reported in the next section.

So what conclusion may be drawn from the results of the estimation of technical efficiency? There is considerable technical inefficiency in the sample. This appears to be the case irrespective of the technology estimated, that is, whether estimates are generated from variable returns to scale technology or constant returns to scale technology.

6.4.2 Regression analysis of determinants of technical inefficiency

Results were generated from estimating the regression model (6.4) - (6.6) the objective being to evaluate the marginal impact on technical efficiency of explanatory factors included in the analysis. The analysis was carried out using the double bootstrap method of Simar and Wilson (2007). However, the single bootstrap was also used as a robustness check. This section reports results generated from both the double bootstrap and the single bootstrap. Section 6.4.2.1 reports results of the analysis based on the double bootstrap while section 6.4.2.2 reports results of the analysis based on the single bootstrap. Both the double and single bootstrap were carried out on estimates from VRS and CRS technologies. Calculations were done in MATLAB using codes of Valentin Zelenyuk which adopted some earlier codes of Leopold Simar.

To ensure that all variables of interest were captured in the analysis despite the relatively small sample, the regression model (6.4)-(6.6) was estimated four times in each case (that is, four times for the double bootstrap and four times for the single bootstrap). The regression as

will be recalled focused on the impact of financing constraints, exporting and firm age, as well as entrepreneurs' education and experience. As a result of the relatively small sample size, the impact of all these variables could not be investigated in a single estimation. To ensure no information was lost by excluding some of these variables in the analysis, four estimations with interchanging of these variables were carried out. In the first estimation, focus was on the impact of financing constraints, exporting, and the entrepreneur's education on technical efficiency of SMEs.

In the second estimation, the entrepreneur's education was replaced with the entrepreneur's experience and the model re-estimated with financing constraints, export orientation, and the entrepreneur's experience. Next, export orientation was replaced with the variable firm age, and the model re-estimated with financing constraints, firm age, and the entrepreneur's education. Lastly, the entrepreneur's education was replaced with experience, and the model re-estimated with financing constraints, firm age, and the entrepreneur's experience.

Worthy of note is that in each of the four estimations an industry dummy was included to account for unobserved industry specifics possibly important in influencing technical efficiency. It is natural to expect that industry specifics such as regulation may influence technical efficiency. The industry dummy was measured as being equal to one for a firm operating in light industry and zero for a firm operating in heavy industry (see chapter five for details of this classification). As noted in section 6.4.1 a size variable was also included in the analysis to assess if there is a statistical relationship between firm size and technical inefficiency. Following Zelenyuk and Zheka (2006) and Shiu and Zelenyuk (2011) firm size was measured as the logarithm of output. A year dummy was also included to capture

unobserved time effects of data pooling with the dummy variable being equal to one for the year 2010.

6.4.2.1 Regression results from the double bootstrap

Results from the double bootstrap (variable returns to scale technology)

Results from the double bootstrap (variable returns to scale technology) are summarised in Table 6.7 and are interpreted as follows:

Financing constraints

A positive relationship was expected between financing constraints and technical inefficiency, suggesting that financing constraints reduce technical efficiency. As expected, estimation results suggest there is a positive and significant relationship between financing constraints and technical inefficiency in all the four estimations (see Table 6.7). The estimated relationship is significant at the 5 percent level in the four estimations. In the preceding chapter, it was noted that financing constraints faced by SMEs in Botswana could be a result of one or a combination of resource dependence effects (in particular the resource movement effect), the level of development of the financial sector as well as characteristics of SMEs themselves that possibly make them less attractive to lenders. While it was difficult to separate the marginal impact of each of these possible components due to data limitations, the significance of the estimated relationship suggests that SMEs faced with financing constraints are more likely to be technically inefficient.

Export orientation

A negative relationship was expected between exporting and technical inefficiency, suggesting that exporting improves technical efficiency. Surprisingly, estimation results

suggest a positive and significant relationship between exporting and technical inefficiency. The relationship is significant at the 5 percent level in both estimation 1 and estimation 2 (see Table 6.7). In a study similar to this one, Kim (2003) estimated a similar relationship. She argued that such a relationship is possible if exporting is more closely associated with excess production capacity than with beating international competition. This argument does not appear to be convincing and cannot be used to explain the relationship estimated in this study. It is the view of the researcher that this result reflects the possibility that exporting SMEs are using sub-optimal technology.

One reason could be financing constraints. If SMEs are finding it difficult to access financial resources, then it is less likely that they will invest in optimal technologies. Another reason could be lack of skilled labour. In the literature on resource dependent economies it is frequently suggested that the resource sector tends to squeeze out non-resource sectors in terms of access to skilled labour (see Collier 2007, Frankel 2010, and Cox & Harvie 2010). Further research is necessary to establish why exporting firms appear to be more inefficient. It could also be that the result is influenced by the limited sample size. The results, however, suggest that export promotion policies will yield positive economic gains only if they are accompanied by complimentary policies that reduce constraints on exporting SMEs.

Firm age

A negative relationship was expected between firm age and technical inefficiency suggesting that learning-by-doing effects associated with firm age are important. Estimation results suggest a positive and significant relationship between firm age and technical inefficiency. The relationship is significant at the 5 percent level in both estimation 3 and estimation 4 (see Table 6.7). These results suggest that younger firms are likely to be more technically efficient

than older firms. In the literature, empirical evidence on this relationship is mixed. Some studies estimate zero correlation, some positive correlation, others negative correlation (see Lundvall & Battese 2000, Driffield & Kambhampati 2003, Margono & Sharma 2006, Bhandari & Maiti 2007, Yang & Chen 2009, and Romero & Rodriguez 2010). These studies, however, show that the effect of firm age on technical efficiency tends to vary according to the sector of operation. Due to data limitations, however, the effect of firm age on technical inefficiency in this study could not be examined across different sectors. A disaggregated analysis when comprehensive data becomes available could be more insightful.

Entrepreneurs' education

A negative relationship was expected between entrepreneurs' education and technical inefficiency, suggesting that education is important to reducing technical inefficiency. Estimation results also reveal a negative relationship between entrepreneurs' education and technical inefficiency, suggesting that firms led by entrepreneurs with university education are likely to be more technically efficient. The relationship is significant at the 5 percent level in both estimation 1 and estimation 3 (see Table 6.7).

The entrepreneurs' experience

A negative relationship was expected between entrepreneurs' experience and technical inefficiency, suggesting that experience is important to reducing technical inefficiency. Estimation results however suggest a positive and significant relationship between years of experience and technical inefficiency suggesting that experience is not necessarily important to reducing technical inefficiency. The relationship is significant at the 5 percent level in both estimation 2 and estimation 4 (see Table 6.7).

One possible explanation could be that older entrepreneurs do not necessarily have the requisite skills to succeed in business, that is, long years of working in an industry do not automatically translate into being successful in running a business. It could be that younger entrepreneurs through improvements in the education system are better placed to succeed. This is reinforced by the estimated relationship found between education and technical efficiency. It must be noted however that the importance of experience is likely to differ according to the sector of operation. Due to data limitations however, this study could not examine the effects of experience on technical inefficiency across different sectors. The policy implications that may be drawn from these results are described in the next chapter.

Industry, size and year effects

Results suggest that there are some industry specifics (unobserved) that impact on the efficiency of SMEs. The industry dummy is significant in all the four estimations at the 5 percent level of significance (see Table 6.7). The size variable is also significant in all the four estimations suggesting presence of scale effects (see Table 6.7). This suggests that smaller firms tend to be more inefficient, suggesting that smaller firms are likely to be affected more by determinants of technical inefficiency than medium firms. These results are consistent with the distribution reflected in Figure 6.1 and Figure 6.2. In other words, size does matter. The effect of size as noted in the preceding chapter is however likely to depend on the sector of operation. Due to data limitations however, this study could not examine in which sectors specifically firm size does matter. The significance of the year dummy indicates some time effects (unobserved) from pooling of the data.

Table 6:7 Regression results from the double bootstrap (VRS technology)

	Estimation 1	**Estimation 2**	**Estimation 3**	**Estimation 4**
Financing constraints	0.2263*	0.2273*	0.2280*	0.2294*
Export orientation	0.1518*	0.1444*	-	-
Firm age	-	-	0.0023*	0.0013*
Entrepreneur's education	-0.0841*	-	-0.0585*	-
Entrepreneur's experience	-	0.0042*	-	0.0033*
Industry dummy	0.0960*	0.0922*	0.0909*	0.0896*
Size	-0.0953*	-0.0920*	-0.0859*	-0.0909*
Year dummy	0.2987*	0.2836*	0.2894*	0.3167*
σ^2	*0.1975**	*0.1994**	*0.1949**	*0.1972**

* implies significance at the 5 percent level.

Notes: The regressand is the bootstrap-biased-corrected DEA estimate of the inefficiency score of firm *j*. The bootstrap confidence intervals are estimated using Algorithm II of Simar and Wilson (2007), with 1000 and 2000 replications for bias correction and for the confidence intervals respectively. All calculations are done by the author in MATLAB using the codes of Valentin Zelenyuk which adopted some earlier codes of Leopold Simar. The estimated confidence intervals are provided in Appendix D.1. It is not inconceivable that some of the variables are related to each other. However, a first approximation is to keep them separated.

Results from the double bootstrap (constant returns to scale technology)

Results can be seen in Table 6.8. Table 6.8 shows similar relationships to those estimated under VRS technology and summarised in Table 6.7. For example, the estimated relationship between financing constraints and technical inefficiency is positive in all the four estimations shown in Table 6.8. The relationship is significant at the 5 percent level in all the four estimations. This is a similar relationship as that estimated under VRS technology (see Table 6.7). Similar relationships estimated under VRS technology can also be seen under CRS technology for export orientation and technical inefficiency, firm age and technical inefficiency, entrepreneur's education and technical inefficiency as well as entrepreneur's experience and technical inefficiency (see Table 6.8). Similar relationships can also be seen

for industry, size and year variables (see Table 6.7 and Table 6.8). This is a good sign which suggests that the same conclusions can be drawn from the results.

Table 6:8 Regression results from the double bootstrap (CRS technology)

	Estimation 1	**Estimation 2**	**Estimation 3**	**Estimation 4**
Financing constraints	0.0185*	0.0284*	0.0379*	0.0415*
Export orientation	0.1533*	0.1201*	-	-
Firm age	-	-	0.0031*	0.0021*
Entrepreneur's education	-0.1791*	-	-0.1664*	-
Entrepreneur's experience	-	0.0001*	-	0.0005*
Industry dummy	0.0879*	0.0870*	0.0841*	0.0861*
Size	-0.0764*	-0.0705*	-0.0794*	-0.0745*
Year dummy	0.2622*	0.2428*	0.2365*	0.2192*
σ^2	*0.2225**	*0.2277**	*0.2165**	*0.2199**

* implies significance at the 5 percent level.

Notes: The regressand is the bootstrap-biased-corrected DEA estimate of the inefficiency score of firm *j*. The bootstrap confidence intervals are estimated using Algorithm II of Simar and Wilson (2007), with 1000 and 2000 replications for bias correction and for the confidence intervals respectively. All calculations are done by the author in MATLAB using the codes of Valentin Zelenyuk which adopted some earlier codes of Leopold Simar. The estimated confidence intervals are provided in Appendix D.2. It is not inconceivable that some of the variables are related to each other. However, a first approximation is to keep them separated.

6.4.2.2 Regression results from the single bootstrap

The single bootstrap as noted earlier was used to assess if similar quantitative results and qualitative conclusions may be drawn from the estimated relationships. The single bootstrap was also carried out on estimates from VRS and CRS technologies.

Results from the single bootstrap (variable returns to scale technology)

Table 6.9 summarises results of the single bootstrap on VRS estimates. An examination of Table 6.9 shows quantitatively similar results to those in Table 6.7 which shows results of the double bootstrap on VRS estimates. For example, results in Table 6.9 suggest a positive and significant relationship between financing constraints and technical inefficiency in all the

four estimations. A similar relationship was estimated for the double bootstrap on VRS estimates (see Table 6.7). Similar relationships can also be seen for export orientation, firm age, entrepreneur's education as well as entrepreneur's experience (see Table 6.7 and Table 6.9). Similar relationships can also be seen for the industry, size and year variables. The fact that similar relationships are established from both the double bootstrap and the single bootstrap is a good sign for policy inferences that may be drawn from the results.

Table 6:9 Regression results from the single bootstrap (VRS technology)

	Estimation 1	**Estimation 2**	**Estimation 3**	**Estimation 4**
Financing constraints	0.0717*	0.0732*	0.0546*	0.0637*
Export orientation	0.0742*	0.0251*	-	-
Firm age	-	-	0.0032*	0.0024*
Entrepreneur's education	-0.2011*	-	-0.1968*	-
Entrepreneur's experience	-	0.0013*	-	0.0019*
Industry dummy	0.0878*	0.0793*	0.0861*	0.0770*
Size	-0.0764*	-0.0686*	-0.0856*	-0.0705*
Year dummy	0.2621*	0.2655*	0.2563*	0.2601*
σ^2	0.1614*	0.1711*	0.1616*	0.1709*

* implies significance at the 5 percent level.

Notes: The bootstrap confidence intervals are estimated using Algorithm I of Simar and Wilson (2007), with 2000 replications for confidence interval estimation. All calculations are conducted in MATLAB using the codes of Valentin Zelenyuk which adopted some earlier codes of Leopold Simar. The estimated confidence intervals are provided in Appendix D.3. It is not inconceivable that some of the variables are related to each other. However, a first approximation is to keep them separated.

Results from the single bootstrap (constant returns to scale technology)

Results of the single bootstrap on CRS estimates are summarised in Table 6.10. An inspection of Table 6.10 shows quantitatively similar relationships to those in Table 6.8 which shows results of the double bootstrap on CRS estimates. For example, results shown

in Table 6.10 suggest a positive and significant relationship between exporting and technical inefficiency in both estimation 1 and estimation 2. The relationship is significant at the 5 percent level in both estimations. These results are similar to those shown in Table 6.8 for the same variable. Results in Table 6.10 also show similar relationships to those in Table 6.8 for financing constraints, firm age, entrepreneur's education as well as entrepreneur's experience. The same is also true for industry, size, and year variables. These similar relationships are a good sign for policy inferences that may be drawn from the results.

Table 6:10 Regression results from single bootstrap (CRS technology)

	Estimation 1	**Estimation 2**	**Estimation 3**	**Estimation 4**
Financing constraints	0.0181*	0.0272*	0.0329*	0.0376*
Export orientation	0.1222*	0.0949*	-	-
Firm age	-	-	0.0023*	0.0015*
Entrepreneur's education	-0.1528*	-	-0.1444*	-
Entrepreneur's experience	-	0.0003*	-	0.0006*
Industry dummy	0.0793*	0.0777*	0.0764*	0.0691*
Size	-0.0994*	-0.0958*	-0.0953*	-0.0992*
Year dummy	0.1510*	0.1373*	0.1512*	0.1383*
σ^2	0.1319*	0.1368*	0.1334*	0.1379*

* implies significance at the 5 percent level.

Notes: The bootstrap confidence intervals are estimated using Algorithm II of Simar and Wilson (2007), with 2000 replications for the confidence intervals. All calculations are conducted in MATLAB using the codes of Valentin Zelenyuk which adopted some earlier codes of Leopold Simar. The estimated confidence intervals are provided in Appendix D.4. It is not inconceivable that some of the variables are related to each other. However, a first approximation is to keep them separated.

6.5 Conclusion

The purpose of this chapter has been to present results of the estimation of technical efficiency of SMEs in the sample and analysis of determinants of technical inefficiency. Estimation of technical efficiency was based on the Farrell (1957) DEA output-oriented measure of technical efficiency. Estimates were obtained from both variable returns to scale (VRS) and constant returns to scale (CRS) technologies. The main conclusion drawn from the results from both technologies was that there is considerable technical inefficiency in SMEs in the sample which suggests a potential role for policies designed to reduce technical inefficiency of these production units.

The analysis of determinants of technical inefficiency (for which the double bootstrap and single bootstrap methods of Simar & Wilson 2007 were used), focused on the impact on technical inefficiency, of financing constraints, export orientation, firm age, entrepreneurs' education, and experience. Results revealed that technical inefficiency in SMEs in the sample is positively and significantly correlated with financing constraints. This relationship was expected as firms finding it difficult to access financial resources should be expected to find it difficult to invest in optimal technologies for example.

Somewhat surprisingly results revealed that exporting SMEs are more likely to be technically inefficient. A number of explanations were provided to rationalise this result. It is thought that exporting SMEs could possibly be using sub-optimal technologies. Exporting SMEs could also be finding it difficult to attract skilled labour.

Results also revealed that technical inefficiency of SMEs is positively and significantly associated with firm age. A negative relationship was expected based on the argument of

learning-by-doing effects. The estimated relationship it was concluded suggests that learning-by-doing effects are not important. It was noted however that the effect of firm age might differ across sectors. Due to data limitations, the analysis in this study could not be disaggregated to examine the effects of firm age across different sectors.

As expected, results revealed that technical inefficiency is negatively and significantly associated with education of the entrepreneur. Education of the entrepreneur is thought to have an influence on their competency in running the business. Against expectation, results revealed a positive and significant relationship between technical inefficiency and the experience of the entrepreneur. A negative relationship was expected between technical inefficiency and experience. Results suggest that experience is not necessarily important. It was noted however that the effects of experience might vary across different sectors. Due to data limitations, the analysis carried out in this study could not be disaggregated to examine the impact of experience across different sectors.

Results also showed that firm size does matter. The effect of size, however, is likely to depend on the sector of operation. Due to data limitations, the analysis carried out in this study could not be disaggregated to analyse the effect of firm size across different sectors. Results also showed that there are industry effects and time effects that impact on the technical efficiency of SMEs.

The next chapter (chapter seven) draws from these results, and the general framework outlined in Figure 3.6 to make recommendations for design of policies to enhance entrepreneurial activity in Botswana.

7 RECOMMENDATIONS FOR DESIGN OF POLICIES TO ENHANCE ENTREPRENEURIAL ACTIVITY IN BOTSWANA

7.1 Introduction

This study set out to investigate ways in which entrepreneurial activity could be enhanced in Botswana with a view to facilitating economic diversification. The concept of economic diversification implies a shift of a country's narrow production and export structure to one in which economic activity is spread across several economic sectors (see IMF 2014a). In this respect, economic diversification may be measured in terms of output diversification, which reflects the spread of a country's production structure across several sectors. It may also be measured in terms of export diversification, which reflects the diversity of a country's exports, and increased integration with trading partners. According to the IMF (2014a), however, economic diversification may also be viewed in terms of an improvement in the quality of existing products, which may assist a country build on existing comparative advantages and boost export revenues.

Recent times have witnessed an increase in interest on policies aimed at creating an enabling environment for economic diversification to occur in many developing countries. Such interest has been apparent in a number of countries in Sub-Saharan Africa, including Angola, Benin, Kenya, South Africa, and Tunisia. Botswana, on which this study exclusively focuses, has been no exception. According to the OECD/United Nations (2011), the increasing interest in policies designed to facilitate economic diversification is based on increasing evidence that diversified economies are better able to generate robust and sustainable growth[61]. Promoting entrepreneurial activity has become a central focus of policy in most of these economies

[61] While a positive correlation between economic diversification and economic prosperity has been established in the literature, the issue of causality is yet to be adequately explored.

(OECD/United Nations 2011). The strategy is in congruence with an increasing body of literature that stresses that economic prosperity hinges on getting framework conditions for entrepreneurship right (see for example, Bosma *et al.* 2009, Braunerhjelm *et al.* 2010, Amoros *et al.* 2011, Bosma *et al.* 2012, and Amoros *et al.* 2014). In this literature, it is suggested that entrepreneurial activity exerts a positive influence on economic growth. A description of present knowledge on this relationship can be seen in chapter 3. Worth noting is that entrepreneurial activity is thought likely to lead to an increase in innovation and competition within the market place, and, consequently, economic growth. It is reasonable to expect that expansion of economic activity due to entrepreneurial activity will promote growth across different economic sectors.

According to Audretsch (1995), however, while entrepreneurial activity can play an important role in fostering economic growth, it is likely to be significantly influenced by an economy's entrepreneurship capital, that is, legal, institutional, and social factors that influence not only willingness to engage in entrepreneurial activity, but feasibility and profitability of entrepreneurial activity. Contexts in which the legal, institutional, and policy framework are supportive of entrepreneurial activity are expected to have higher levels of entrepreneurial activity, with economic growth expected from increasing levels of entrepreneurial activity. Economic gains are thus expected from policies that make it easier for individuals to engage in entrepreneurial activity and benefit from it.

In line with this literature the Government of Botswana has also identified entrepreneurial activity, especially the kind revolving around SMEs, as one avenue through which economic diversification can be pursued (see Ministry of Finance and Development Planning 1973, 1991, 1997, 2003, and 2009 and Ministry of Commerce and Industry 1998 and 1999). While

the share of Botswana's national income attributable to SMEs is difficult to establish due to data limitations, chapter 2 of this dissertation revealed that Botswana's SMEs not only dominate the business population, but the share of private sector employment in the country as well. Emphasis on SMEs thus seems a logical starting point for Botswana. Through identification of ways in which entrepreneurial activity revolving around SMEs could be enhanced in Botswana, this study makes a contribution to an understanding of the role of entrepreneurial activity on economic growth and effective policies to promote it.

The importance of economic diversification to Botswana was highlighted in chapter 2. Firstly, it is essential to avoiding economic stagnation as the economy's mainstay of diamond mining declines, while ensuring sustainable growth beyond depletion of diamonds. Botswana's diamond reserves are expected to decline considerably in the next 15 years and possibly to be depleted by the year 2029. Economic growth is projected to slow down significantly during this period. According to Basdevant (2008), Botswana is likely to experience low growth during the period 2018-2024, with a possible steep recession in 2022. To the extent that the economy currently continues to rely heavily on this non-renewable resource, it is not difficult to imagine the possible impact of such a decline on the economy. A diversified economic base can mitigate the impact of the decline of the sector on the economy, while providing impetus for growth beyond diamond depletion.

Secondly, it is essential to moderating the impact of external shocks and commodity price fluctuations on the economy. The heavy reliance of the economy on diamond mining, it must be noted, exposes the economy to the vagaries of world markets. The impact of such incidents on the economy was underlined by the 2008 global financial crisis, following which Botswana experienced a significant loss of national income owing to a sharp fall in

commodity prices. A diversified economic base can lessen the impact of such incidents on the economy.

Economic diversification is also expected to contribute to expansion of productive employment opportunities in the economy. While Botswana has been able to maintain sustained growth in the past four decades, a significant proportion of the population has been left behind. Not only does unemployment remain relatively high, particularly among the youth, so does poverty and inequality. An increase in productive employment opportunities, through an increasingly diversifying economy, is likely to contribute to more inclusive growth. While conceptual issues relating to the terminology 'inclusive growth' are yet to be adequately addressed in the literature, the use of the terminology in the context of this study is in line with the United Nations Development Programme's view that there is 'good growth' and 'bad growth', based on the ideas of Nobel Laureate in Economics, Amartya Sen about human development. In the context of this study, to the extent that a significant proportion of the population has not benefitted from Botswana's growth, it could be characterised as 'bad growth', underlining the importance of policies aimed at promoting 'good growth' or 'inclusive growth'.

This chapter describes policy implications and recommendations emerging from this study[62]. It draws from the literature described in chapter three which highlighted factors critical to the

[62] This study it must be noted does not go as far as identifying sectors on which to concentrate support. The study takes a broad view that enhancing entrepreneurial activity is essential regardless of economic sector. In recent times however, it has become apparent that service sectors can play an important role in economic diversification. Botswana's value added data (recall chapter two) suggests that service sectors (as a percentage of value added), especially tourism (trade, hotels, and restaurants), finance (banks, insurance, and business services) have indeed been growing in importance over the years. For example, during the year 2013, the tourism sector accounted for 17.8 percent of the value added, 3.6 percent higher than that of the mining sector, while finance accounted for 15.2 percent of the value added, which is also higher than that of the mining sector (see Bank of Botswana 2014a). These data suggests that economic gains could result from enhancing entrepreneurial activity in these sectors.

design of policies to enhance entrepreneurial activity. It also draws from the empirical evidence emerging from the empirical investigation carried out in the study. The empirical evidence from this investigation constitutes an original contribution of this study. The investigation involved analysis of technical efficiency of a sample of SMEs in Botswana with a view to identifying determinants of technical inefficiency. In addition to the impact of features of the business environment and firm-specific characteristics, this study considered the impact of attributes of entrepreneurs on technical inefficiency of SMEs in Botswana[63]. To the best of knowledge of the researcher, this study is the first to analyse technical efficiency of SMEs in Botswana and determinants of technical inefficiency. Appropriate policies designed to reduce technical inefficiency are expected to enhance feasibility and profitability of engaging in entrepreneurial activity, which may in turn foster entrepreneurial activity in Botswana. Results of the empirical investigation were described in the previous chapter.

It is important to note, however, that the scope of the empirical investigation was significantly constrained by data limitations. Based on data availability the investigation focused on SMEs in manufacturing. Recommendations emerging from this investigation thus relate to SMEs in manufacturing in particular, although some of the findings could be relevant for SMEs in other economic sectors. One important policy implication emerging from the data challenges encountered in this study is the need to develop a comprehensive database on SMEs in Botswana with a view to improving availability and quality of data. Higher quality data is likely to enrich both research and policy formulation regarding SMEs. Establishment of a specific unit charged with the responsibility of compiling a comprehensive database on SMEs operating in Botswana is recommended. This could be done more cost

[63] As noted in chapter five, the impact of attributes of entrepreneurs on technical inefficiency of SMEs, as well as features of the business environment, and in particular, effects of resource dependence have received very little attention in the literature. This study provided empirical evidence on the likely relationships between technical inefficiency and these factors. Similar studies can build on these findings.

effectively within the confines of existing institutions such as the Local Enterprise Authority (LEA) which is charged with the responsibility of providing advisory services to SMEs in Botswana, or Statistics Botswana which is the main government agency charged with the responsibility of compiling national statistics in Botswana.

Chapter 3 highlighted that if policies aimed at promoting entrepreneurial activity are to be effective, they have to be designed in cognisance of a country's stage of development as countries at different stages encounter different challenges and obstacles. Based on the work of the World Economic Forum and the Global Entrepreneurship Monitor, section 7.2 of this chapter describes Botswana's present stage of development and factors critical to facilitating entrepreneurial activity at that stage. Section 7.3 draws from this description, together with the description in chapter three which provides a more comprehensive treatment of the literature on entrepreneurial activity to make recommendations for design of policies to promote entrepreneurial activity in Botswana. It also draws from the empirical evidence of the investigation of technical efficiency of Botswana's SMEs and conventional wisdom. Section 7.4 provides concluding remarks.

7.2 Botswana's stage of development

The World Economic Forum (WEF) and the Global Entrepreneurship Monitor (GEM) characterize Botswana as in transition from being factor-driven to being efficiency-driven (see Schwab 2014 and Amoros *et al.* 2014 respectively). Figure 3.6, assembled by the researcher from the ideas of Porter *et al.* (2002), Acs (2006), and the Global Entrepreneurship Monitor community (see for example Bosma *et al.* 2009), revealed that entrepreneurial activity at this stage of development revolves around a healthy set of basic requirements (well-developed public and private institutions, quality physical infrastructure, stable

macroeconomic environment, and a healthy and educated workforce at this stage) and efficiency enhancers (higher education and training, goods market efficiency, labour market efficiency, financial market sophistication, technological readiness, and market size).

Institutions are humanly devised constraints that structure political, social, and economic interaction (North 1991). They consist of customs, traditions and codes of conduct, laws and property rights. By reducing uncertainty in exchange, institutions determine transaction and production costs, and hence profitability and feasibility of engaging in entrepreneurial activity (North 1991). How well-developed institutions are is thus likely to have an influence on both the scope and quality of entrepreneurial activity. This implies that policies aimed at strengthening institutions (for example, improving transparency of the legal system) can play an important role in enhancing entrepreneurial activity. *Physical infrastructure* encompasses roads, railroad infrastructure, airport infrastructure, electricity supply and telecommunications. Infrastructure is critical to attracting foreign direct investment (FDI), among others. FDI is essential not only for technology transfer, but for transfer of skills, participation in international production networks and access to international markets. Policies aimed at improving the quality of infrastructure are therefore likely to enhance entrepreneurial activity.

Stability of the macroeconomic environment encompasses stability of macroeconomic variables such as inflation, interest rates, exchange rate, balance of payments, and public and private debt among others. In a stable macroeconomic environment businesses are able to assess the feasibility and profitability of entrepreneurial activity. A stable macroeconomic environment is thus expected to encourage entrepreneurial activity, which underlines the important role that macroeconomic policies can play in encouraging entrepreneurial activity.

Health and education relates to human capital formation. According to Barro (2001) a higher stock of human capital facilitates absorption of superior technologies with potential to increase efficiency in production. This underlines the important role that education and health policies can play in enhancing entrepreneurial activity. *Higher education and training* is considered particularly critical.

Goods market efficiency encompasses intensity of local competition, extent of market dominance, and effectiveness of anti-monopoly policy. The extent to which goods markets are efficient has the potential to encourage or suppress entrepreneurial activity. Well-functioning goods markets are likely to encourage entrepreneurial activity while poorly-functioning markets are not likely to. For example, in contexts where business formation is relatively easy and cheaper, entrepreneurial activity can be expected to be higher. Similarly, in contexts where anti-competitive legislation is effective in discouraging anti-competitive behaviour, entrepreneurial activity can be expected to be higher. Economic gains are expected from policies aimed at improving the efficiency of goods markets.

Just as efficiency of goods markets is important, so is the *efficiency of labour markets*. The efficiency of labour markets encompasses the extent to which there is cooperation in labour-employer relations, the extent to which there is flexibility in the determination of wages, and capacity to attract and retain talent. The extent to which labour markets are efficient also has potential to encourage or suppress entrepreneurial activity. If labour market regulations are so rigid that businesses find it difficult to recruit foreign skilled labour for, example, it may limit firms' ability to harness the benefits of latest technologies that require specific skills.

The *financial system*, which consists of financial markets and financial intermediaries, is expected to channel financial resources to their most productive use. The effectiveness with which the financial system performs this function can influence entrepreneurial activity in an economy. By reducing uncertainty in the financial system, and facilitating access to financial services at competitive prices, a well-functioning financial system is likely to encourage entrepreneurial activity, with economic gains expected from policies aimed at improving stability of the financial system and improving the relative ease with which businesses can access financial services, and at competitive prices.

Technological readiness comprises the extent to which an economy is able to harness the benefits of existing technologies and improve efficiency in the production of standard products and services. Improving efficiency in the production of standard products is likely to have a positive impact on the success of entrepreneurial activity. Economic gains are thus expected from policies aimed at improving an economy's technological readiness. The *market size* (local and international) also signifies feasibility and potential profitability of entrepreneurial activity. It is difficult to imagine that entrepreneurial activity will thrive where the market size is very limited. For economies that are limited in terms of the domestic market, policies aimed at increasing integration with trading partners and improving competitiveness of local businesses may play an important role in encouraging entrepreneurial activity.

In addition to developing a healthy set of basic requirements and efficiency enhancers, the Global Entrepreneurship Monitor research initiative emphasizes the importance of developing entrepreneurship framework conditions at this stage of development (see Bosma *et al.* 2009 and Amoros *et al.* 2014)). These include availability and accessibility of finance

(including debt, equity, grants, and subsidies) for SMEs; the extent to which public policy gives support to entrepreneurship; the extent to which national research and development (R&D) leads to new commercial opportunities and is available to SMEs, presence of property rights; commercial, accounting, and other legal and assessment services and institutions that support or promote SMEs; entry regulation; ease of access to physical resources telecommunications, utilities, transportation, land or space at a reasonable price; presence and quality of government programs directly assisting SMEs at all levels of government; the extent to which training in creating and managing SMEs is incorporated within the education system at all levels; as well as the extent to which social and cultural norms encourage entrepreneurship[64].

7.3 Recommendations

The recommendations outlined in this section are drawn from the literature described in chapter three on the role of entrepreneurial activity in fostering economic growth, and factors relevant to promoting entrepreneurial activity at Botswana's stage of development. They are also drawn from the empirical evidence emerging from the empirical investigation of technical efficiency of Botswana's SMEs. The empirical evidence constitutes an original contribution of this study. The empirical investigation was conducted with a view to identifying determinants of technical inefficiency and drawing recommendations for design of policies to reduce technical inefficiency. A reduction in technical inefficiency, through appropriate policies, is expected to enhance feasibility and profitability of engaging in entrepreneurial activity. The investigation focused on the impact of financing constraints, export orientation, firm age, entrepreneurs' education, and experience on the technical inefficiency of SMEs. Results of the analysis can be seen in chapter 6.

[64] Some of these conditions are influenced by the basic requirements and efficiency enhancers.

Recommendations are drawn especially from empirical evidence on the impact of financing constraints, export orientation and education of entrepreneurs. The impact of financing constraints has implications for policies aimed at improving SME access to finance, while export orientation has implications for policies aimed at encouraging SMEs to engage in export activities. Entrepreneurs' education has implications for education policies, especially higher education and training. For firm age and experience of entrepreneurs, further analysis is necessary before insightful conclusions and policy implications and recommendations can be arrived at. The impact of these factors tends to vary across sectors. Due to data limitations, a sectoral analysis could not be done in respect of these factors. Conventional wisdom is also used to draw some policy recommendations outlined in this section.

Two main categories of recommendations are outlined, namely, the macroeconomic context and the microeconomic context. Section 7.3.1 outlines recommendations relating to the macroeconomic context, while section 7.3.2 outlines recommendations relating to the microeconomic context. It should be noted that while recommendations made are dealt with separately in terms of these categories, the separation is artificial as the macroeconomic context and the microeconomic context are not mutually exclusive. It is the case that some of the factors identified with the microeconomic context are influenced by the macroeconomic context, which underlines the importance of ensuring consistency in policy design.

7.3.1 Macroeconomic context

Economic integration and international trade

Increased integration with trading partners offers opportunities for wider market access. As noted in the previous section, the size of the market is a critical component that influences entrepreneurial activity in an economy at Botswana's present stage of development. For Botswana, which has a small domestic market especially, wider market opportunities afforded by economic integration are critical. Statistics Botswana (2014) reveals that while a large percentage of Botswana's imports originated in countries within the Southern Africa Customs Union (SACU), Southern African Development Community (SADC) and the rest of Africa, a large percentage of Botswana's exports have been to Asia and Europe (see Statistics Botswana 2014)[65]. While Botswana has opened up for businesses in countries in SACU and SADC to export to Botswana, it appears it is not optimising on market access afforded by being a member of these regional blocks. Economic gains could result from encouraging SMEs to export to these countries.

Through the Botswana Investment and Trade Centre (BITC), and the Ministry of Trade and Industry (MTI), efforts should be made to assist SMEs not only identify market opportunities within SACU, SADC, and the rest of Africa but enable them to take advantage of these opportunities. Policies aimed at reducing trade barriers, (for example, the time spent on dealing with, and cost of regulatory procedures for trading across borders) will make it easier for SMEs to take advantage of these opportunities.

[65] SACU member states include Botswana, Lesotho, Namibia, South Africa, and Swaziland while SADC member states include Angola, Botswana, Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, United Republic of Tanzania, Zambia and Zimbabwe.

Empirical evidence emerging from the analysis of the relationship between technical inefficiency and export orientation carried out in this study revealed that exporting SMEs in Botswana are more likely to be technically inefficient than non-exporting SMEs. While the technical inefficiency of exporting SMEs could be a result of several factors, including lack of financial resources to invest in optimal technologies or lack of access to skilled labour, it is not inconceivable that regulatory burdens and compliance costs relating to trading across borders could also be impacting on the technical efficiency of exporting SMEs. Policies aimed at reducing regulatory burdens and compliance costs on exporting SMEs could reduce their technical inefficiency which may in turn boost the profitability of engaging in exporting.

Besides increasing integration with regional trading partners, economic gains could result from optimising on access to international markets in Asia and Europe which already exists, including identification of new opportunities in these markets. The Ministry of Trade and Industry, in collaboration with the Botswana Investment and Trade Centre, should actively seek new opportunities for exporting SMEs in these markets. In this respect, Botswana has to make use of bilateral agreements and multilateral trade agreements that it has already entered into or is still negotiating, including the Africa Growth and Opportunity Act (AGOA) which provides preferential access to markets in the United States of America (US), the SACU - Mercado Cum del Sur (MERCOSUR) Preferential Trade Agreement (PTA), which provides market access for countries in SACU to South American markets, the SACU - European Free Trade Association (EFTA) Free Trade Agreement (FTA), which provides duty free and quota free access to the Norwegian, Icelandic and Swiss markets for SACU member states, and the

ongoing SACU - India PTA, which is aimed at providing market access to the Indian market among others[66].

Health and education

Health and education, particularly higher education and training, are critical to enhancing human capital. At Botswana's present stage of development, human capital plays an important role in the absorption of technologies with the potential to increase efficiency in production. Improvement in efficiency is likely to increase the profitability of engaging in entrepreneurial activity.

While this study could not carry out an empirical analysis of the importance of the education of employees to technical efficiency of SMEs due to data limitations, the empirical evidence emerging from the analysis of the relationship between entrepreneurs' education and technical inefficiency revealed that entrepreneurs' education is critical to reducing technical inefficiency. The analysis revealed that SMEs led by entrepreneurs with university education are likely to be more technically efficient than SMEs led by entrepreneurs with no university education. This underlines the importance of education policies to improving technical efficiency. While analysis of the impact of education of employees could not be carried out, conventional wisdom suggests that it is likely to be as important as entrepreneurs' education to reducing technical inefficiency, with an improvement in technical efficiency expected to have a positive influence on feasibility and profitability of engaging in entrepreneurial activity.

[66] See www.mti.gov.bw

Botswana has, over the years, invested significant resources in education. As a proportion of government spending, education has been among the highest expenditure items. For example, for the 2014/15 financial year, the Ministry of Education and Skills Development received the largest share of the proposed Ministerial recurrent budget. If producing the right skills for the economy is used to reflect the quality of spending on higher education and training, one might argue that the skills mismatch apparent in Botswana's labour market (see IMF 2014b) reflects a problem with quality of spending in Botswana's higher education. In recent years the government has responded by approving the establishment of the Human Resource Development Council (HRDC) to coordinate national human resource development planning, with a view to aligning higher education and training with the needs of the labour market (see the Human Resource Development Bill of 2013). This policy implementation is currently on-going.

While aligning human resource development planning with the needs of the labour market is critical to improving the quality of spending on higher education and training, any reforms to higher education and training must incorporate entrepreneurship education. Entrepreneurship education as highlighted in the previous section is one of the most important factors critical to enhancing entrepreneurial activity. It is essential, however, for entrepreneurship education to also be incorporated at lower levels of education with a view to inculcating an entrepreneurship culture in Botswana.

With regards to wellness, a significant problem that threatens to negate advances made on human capital in the past is HIV/AIDS. While mortality rates due to HIV/AIDS have declined significantly due to the provision of free Anti-Retroviral drugs through the public health system, prevalence rates remain high, particularly for the age group 30-49. Preliminary

results of the latest AIDS Impact Survey indicate a national prevalence rate of about 16 percent, women being the most affected (see Statistics Botswana 2013b). The report also reveals that prevalence is higher in urban areas compared to rural areas, which have experienced a drop.

This is despite the fact that government, through the Ministry of Health and the National AIDS Coordinating Agency (NACA), has over the years facilitated public education programmes aimed at creating awareness with a view to curbing the rate of new infections. It appears that the uptake of these public education programmes is low, particularly in urban areas where prevalence rates are higher. As mentioned before, HIV/AIDS poses a significant threat to any gains made in human capital over the years. While the impact of HIV/AIDS on SMEs in Botswana has not been analysed due to data limitations in this study, intuition suggests extended absenteeism from work due to illness is likely to affect the productivity and efficiency of firms, and hence profitability of entrepreneurial activity. It is thus critical for efforts to be made to increase awareness and encourage behavioural change, particularly in urban areas.

National research and development (R&D)

At Botswana's present stage of development, national research and development (R&D), particularly through universities and other institutions of higher education and research, could play an important role in the design of improved methods of production, with the potential to enhance profitability of engaging in entrepreneurial activity. Given that economic activity in Botswana is dominated by SMEs (at least in terms of the number of enterprises and private sector employment) which are not likely to invest significantly in R&D due to limited financial resources, or have adequate technical skills to do so, national R&D is essential. The

crucial thing, however, is making sure that SMEs can benefit from national R&D. Establishing close links between national institutions undertaking R&D and associations representing SMEs, (such as the Small Business Council (SBC), the Botswana Exporters and Manufacturers Association (BEMA) as well as the Botswana Chamber of Commerce, Industry and Manpower (BOCCIM)) and institutions that support SMEs, (such as the Local Enterprise Authority (LEA)) is critical to facilitating R&D knowledge transfer to SMEs.

The Botswana International University of Science and Technology (BIUST), which started operating during 2012 was established with the objective of encouraging R&D, so was the Botswana Institute of Technology, Research and Innovation (BITRI)[67]. It is important to ensure, however, that the knowledge generated in these institutions, including other institutions such as the University of Botswana (UB), the Botswana College of Agriculture (BCA), and the National Food Technology Research Centre (NAFTRC) can be commercialised and benefit the economy in terms of facilitating entrepreneurial activity.

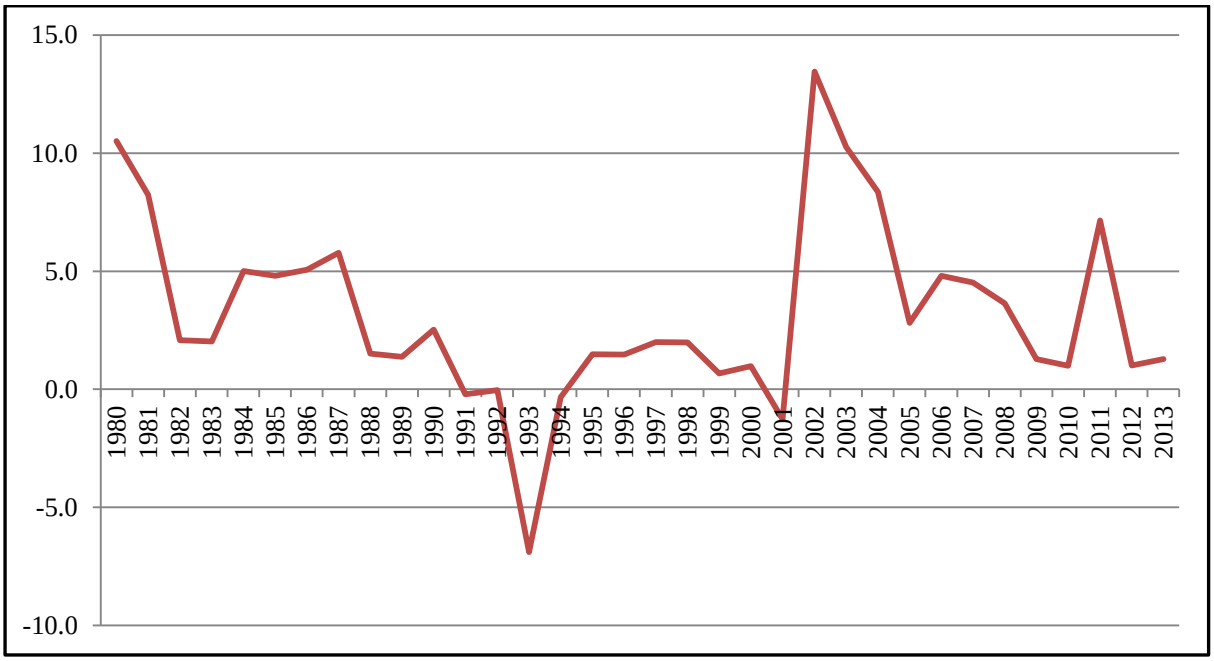
Openness to foreign direct investment (FDI)

UNCTAD (2003) revealed that Botswana has been open to FDI since independence in 1966, although a large percentage has been into the mining sector. Figure 7.1 shows the trend of FDI net inflows (as a percentage of GDP) for Botswana for the period 1980 - 2013, with FDI net inflows peaking at 13.5 percent of GDP in 2002. Since 2002, however, FDI net inflows have declined. In 2013, FDI net inflows were estimated at 1.3 percent of GDP. While it is difficult to identify specific causes of this decline in the context of this study, the data suggests Botswana is losing competitiveness in attracting FDI, which is likely to impact

[67] Worth noting is that R&D transfer to SMEs may also occur when graduates of these institutions start their own business once they complete their higher education certificates, diplomas or degrees, which underscores the importance of entrepreneurship education being incorporated into the curriculum in higher education.

negatively on efforts to enhance entrepreneurial activity. This underlines the importance of policies aimed at improving competitiveness with a view to attracting more FDI.

Figure 7:1 Botswana FDI net inflows (% of GDP)



Source: Author's computation based on World Development Indicators[68].

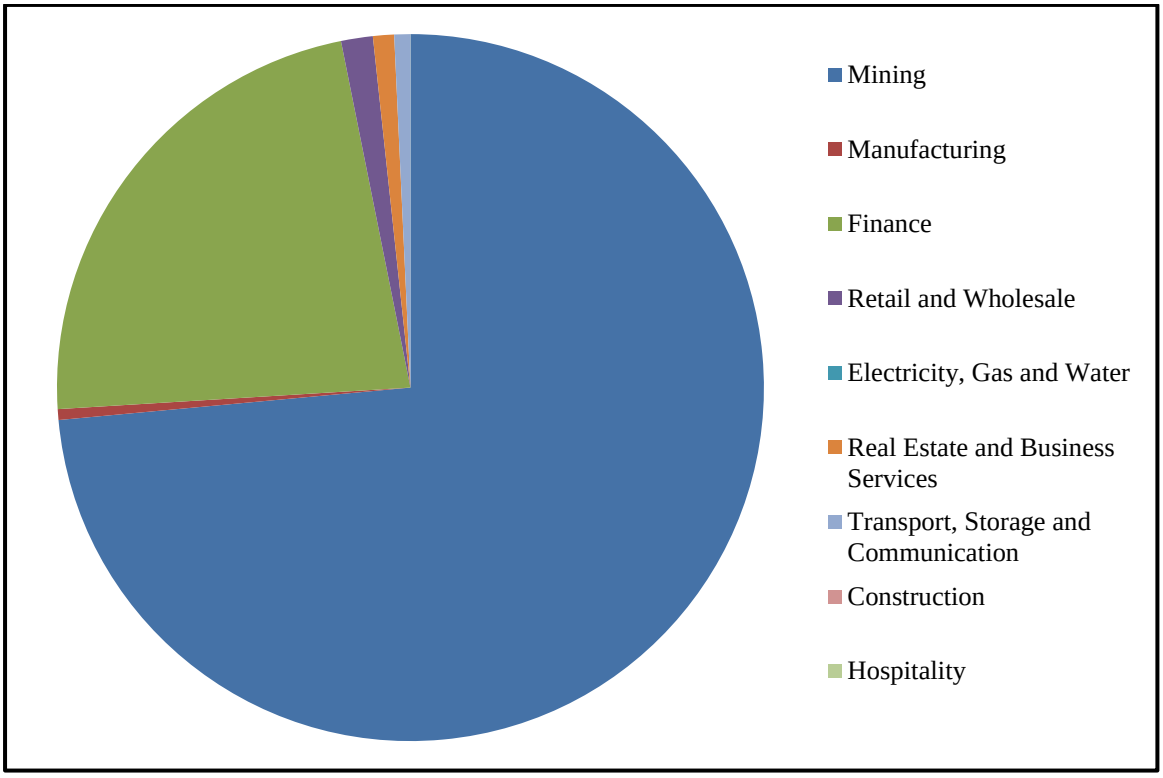
Figure 7.2 shows the percentage distribution of Botswana's FDI flows by industry in 2012 with mining dominating all other sectors, which underlines the importance of facilitating FDI inflows into other economic sectors. Some of the important determinants of FDI inflows include macroeconomic stability, openness to international trade, human capital, quality of infrastructure, tax incentives, and availability of venture capital which underscores the importance of improving the overall macroeconomic context with a view to boosting competitiveness and attractiveness of Botswana as a destination for FDI. Besides the macroeconomic environment, removing regulatory burdens (for example, cumbersome

[68] See databank.worldbank.org.

business registration procedures, cumbersome business licensing procedures, cumbersome tax registration and payment procedures, and customs and trade regulations) existent in these sectors could boost their attractiveness.

Government can also optimise on opportunities afforded by existing bilateral and multilateral trade agreements such as the SACU - United States of America (USA) Trade, Investment and Development Cooperation (TIDCA) which allows SACU member states, including Botswana, to benefit from cooperation and assistance from the USA. The ongoing SACU-India PTA offers an opportunity for Botswana as a member of SACU to impress on the importance of technology and skills transfer, particularly in the area of Information and Communications Technology (ICT) in which India is becoming one of the leading players globally.

Figure 7:2 FDI by industry, 2012 (% of total)



Source: Author's computation based on estimates of the Bank of Botswana[69]

Stability of the exchange rate

Botswana is currently operating a crawling peg exchange rate regime, implemented through continuous adjustment of the trade weighted Nominal Effective Exchange Rate (NEER) of the Pula (Botswana currency) at a rate of crawl based on the differential between the Bank of Botswana's inflation objective and the forecast inflation of trading partners. This regime was adopted in 2005 with the objective of improving stability of the Real Effective Exchange Rate (REER) and avoiding the need for sizable discrete devaluations which was the case with the fixed exchange rate system used previously. Avoiding discrete devaluations and revaluations is critical to maintaining credibility of the mechanism, with credibility expected

[69] See Bank of Botswana (2013b).

to impact business sentiment and willingness to engage in entrepreneurial activity positively. Credibility of the crawling peg mechanism, it must be noted, also depends on the stability of inflation and public debt, which implies that the conduct of monetary and fiscal policy is also important to maintaining credibility of the crawling peg mechanism.

7.3.2 Microeconomic context

Access to finance

Availability and accessibility of financial resources to SMEs as highlighted in chapter three, is one entrepreneurial framework condition essential to enhancing entrepreneurial activity (also see Amoros *et al.* 2014). The latest IMF article IV consultation report on Botswana reveals that while Botswana's banking system is well-capitalised, profitable and liquid, financial inclusion, particularly with regard to SMEs, is a concern (see IMF 2014b). This point is also emphasized in the latest monetary policy statement of the Bank of Botswana (see Bank of Botswana 2014b).

An original contribution of this study has been to investigate the impact of SMEs financing constraints on their technical efficiency. Results of the analysis, reported in chapter 6, revealed that SMEs facing financing constraints are more likely to be technically inefficient. Policies aimed at improving access to, and affordability of financial resources are likely to reduce their inefficiency, with improved efficiency expected to enhance feasibility and profitability of entrepreneurial activity, which may in turn boost entrepreneurial activity in Botswana. Encouraging competition in the banking sector (through liberalization of entry regulations) could improve availability, variety, flexibility, and affordability, of financial services available to SMEs.

While the Bank of Botswana should not be seen as directing banks on their allocation of loans, the Bank of Botswana could still play an active role in encouraging banks to extend loans to small businesses with viable business plans. It is important to note that, currently, Botswana does not have a centralised institution that compiles the credit history of businesses operating in Botswana. This makes it difficult for banks to assess the risk of small businesses, which may explain why they are reluctant to lend to SMEs, particularly given that most of them are not able to provide adequate collateral. The establishment of such an agency would reduce information asymmetry, making it easier for banks to assess the risk of lending to SMEs, which may improve their willingness to extend loans to them. Strengthening of property rights through improving efficiency and transparency of the legal system may also encourage institutional lenders to lend to SMEs. Strengthening of bankruptcy laws is also essential (see OECD 2014).

Ordinarily, institutional lenders would prefer to deal with formalised businesses, which in most cases keep proper accounting records that lenders may use to evaluate the health of their businesses. Informal SMEs rarely keep such records, which diminishes their chances of getting credit from institutional lenders. Encouraging formalization through reducing regulatory burdens associated with formalization may improve SMEs chances of accessing institutional credit.

Improving the effectiveness of existing subsidy schemes could also enhance SMEs' access to financial resources. In 2001 the government established the Citizen Entrepreneurial Development Agency (CEDA) to provide loans at subsidised interest rates as well as trade finance (invoice discounting, factoring, performance bonds, suppliers' guarantees and bank

guarantees) to financially viable local businesses[70]. Given that SMEs continue to experience difficulties in accessing financial resources as highlighted in IMF and Bank of Botswana reports (see IMF 2014b and Bank of Botswana 2014b), it is worth looking into the responsiveness of this initiative to the needs of SMEs with a view to identifying areas for improvement. It is also worth looking into the complexity and burden of administrative procedures involved in accessing funds through this initiative.

The local equity market is another avenue that could be used to improve SME access to financial resources. At the present moment SMEs are hardly able to raise funds through the Botswana Stock Exchange (BSE), possibly due to listing requirements and compliance costs. Liberalising listing requirements and reducing administrative burdens and compliance costs could make it easier for SMEs to raise funds through this avenue, especially medium firms.

Access to skilled labour

Access to skilled labour is likely to permit SMEs to absorb superior technologies with the potential of improving efficiency and hence profitability of entrepreneurial activity. In section 7.3.1, it was noted that one of the main problems facing Botswana with regard to the skills base of the workforce is the skills mismatch in the labour market. It was noted that government has in recent years responded by setting up the Human Resource Development Council (HRDC) to coordinate national human resource development planning, with a view to aligning higher education and training with the needs of the labour market (see the Human Resource Development Bill of 2013). This policy implementation, as noted in section 7.3.1, is on-going. Besides addressing the skills mismatch in the labour market, however, it is important for government to ease regulations and processes (for example, immigration laws

[70] www.ceda.co.bw

and procedures for acquiring working and residence permits) that impact on the ability of SMEs to engage expatriate skilled labour, especially for skills that are in short supply locally. Ensuring that the income tax system does not act as a disincentive to foreigners willing to work in Botswana is essential.

Business advisory services

In an economy trying to nurture entrepreneurial activity such as Botswana, provision of business advisory services to potential entrepreneurs can play an important role in assisting them develop viable business plans, developing marketing plans, identifying potential markets, identifying potential sources of raw materials, identifying potential sources of finance, as well as getting through registration and licensing. It can also be helpful in assisting existing businesses improve on product quality and branding, identifying new markets both locally and internally, as well as taking advantage of existing government support schemes for SMEs. One of the main institutions charged with the responsibility of providing business advisory services to SMEs in Botswana is the Local Enterprise Authority (LEA)[71]. Improving the capacity of staff of the Authority, especially through training on business evaluation, market research and identification of opportunities is essential to improving the impact of the advisory services they provide on enhancing entrepreneurial activity. Extending these services to rural areas will be critical to enhancing entrepreneurial activity in rural areas which may in turn promote rural development.

[71] www.lea.co.bw

Competition policy and business regulation

Anti-competitive behaviour may have a negative impact on entrepreneurial activity by suppressing new entries. During 2009 the government of Botswana adopted competition legislation which also established a competition authority and commission (the Botswana Competition Authority) charged with the responsibility of prevention of, and redress for anti-competitive behaviour (see Competition Act 2009)[72]. Transparency in the operations of the Authority is essential to ensuring credibility. Training of the staff of the Authority is key to improving operational efficiency.

Besides addressing anti-competitive behaviour, government has to adopt complementary policies aimed at reducing administrative and regulatory burdens on SMEs. While it is difficult to estimate the size of Botswana's informal SMEs sector (due to data limitations), one can reasonably argue that the higher the burden of regulation the higher the likelihood of SMEs operating in the informal sector. SMEs operating in the informal sector are likely to find it difficult to access not only institutional credit, but some of the support schemes meant to assist SMEs, which may further stunt their growth. Simplifying business registration and licensing forms and procedures and providing one stop shop services for registration and licensing services could assist, not only in encouraging SMEs in the informal sector to move into the formal sector where they would be able to access services, but encourage new business formations. Simplification of taxation forms and submission procedures could also be helpful. Provision of online services by tax authorities (Botswana Unified Revenue Services) could help in reducing the amount of time and money spent on dealing with taxation procedures and submissions.

[72] Also see www.competitionauthority.co.bw

Government policy

As noted by Amoros *et al.* (2014), the extent to which government policies, especially government procurement policies, are supportive of SMEs can influence entrepreneurial activity. The government of Botswana has over the years adopted a number of procurement policies aimed at increasing opportunities for SMEs to gain access to government procurement, notably the reserved sectors policy (1982), local procurement policy (1997), and recently the economic diversification drive (EDD) initiative. The EDD is intended to ensure that procuring entities support SMEs through a preference margin of 15 percent (see Ministry of Trade and Industry 2010). Monitoring of procuring entities is essential to ensure compliance. It is important, however, to ensure that administrative and registration procedures allowing SMEs to participate are simplified.

Property rights

By reducing uncertainty in exchange, property rights institutions determine transaction and production costs, and hence profitability of engaging in economic activity (North 1991). Botswana is considered to have a good set of property rights institutions secured by an efficient legal system that also provides for transparency (see Acemoglu *et al.* 2001, Iimi 2007, Humphreys *et al.* 2007, and Seidler 2010). Seidler (2010) emphasizes that the strength of property rights institutions has also assisted the country in minimising public sector corruption[73]. This does not imply, however, that improvements are not necessary. Improving the operational efficiency of the legal system is critical to reducing costs involved in addressing contract disputes. Independence and transparency of the operations of the judiciary are essential to maintain credibility of the system. It is also important for policy

[73] Botswana has over the years consistently been ranked the least corrupt country in Africa and one of the least corrupt developing countries in the world. In the latest report published by Transparency International, for example, Botswana is ranked 30th out of a total of 177 countries in perceived public sector corruption in the world (see Transparency International 2013).

makers to ensure that property rights and laws evolve with changing economic conditions so as to maintain relevance. Worth noting is that the perception of foreign investors of protection of property rights in Botswana can have an influence on their willingness to establish businesses in Botswana, which may further enhance entrepreneurial activity.

Provision of infrastructure

The ease with which SMEs can access physical resources (for example, telecommunications, utilities, transportation, land or space) at reasonable prices, as emphasized by Amoros *et al.* (2014), has an influence on entrepreneurial activity. Economic gains are expected from policies aimed at improving SMEs access to physical resources. Policies to improve SMEs access to physical resources include reducing the financial burden associated with electricity, water and telecommunication connections. Simplification of application procedures and reducing the waiting period for inspections and connections is also essential. Worth noting is that while the telecommunications sector has been liberalised, water and electricity supply remain state monopolies in Botswana. In recent years, Botswana has been experiencing acute shortages of water and significant interruptions in electricity supply, which not only has negative consequences on existing businesses, but can, affect investor sentiment and the ability to attract FDI. This point is also highlighted in the latest IMF article IV consultation report on Botswana (see IMF 2014b). Improving efficiency in the delivery of water and electricity supplies is essential. With regard to telecommunications, it is essential for the Botswana Communications Regulatory Authority (BOCRA) to ensure that pricing of telecommunications services is not to the exclusion of SMEs. Access to internet services at reasonable prices can allow SMEs to adopt internet based models of running businesses for example, electronic-commerce (E-commerce), which not only have potential to reduce transaction costs of operating businesses but improve visibility and market outreach.

7.4 Conclusion

The purpose of this chapter has been to describe policy implications and recommendations for the design of policies to enhance entrepreneurial activity in Botswana emerging from this study. The recommendations were drawn from the literature described in chapter three which provided a description of present knowledge on the role of entrepreneurial activity and economic growth, and factors thought to be critical to enhancing entrepreneurial activity at Botswana's stage of development. They were also drawn from the evidence emerging from the empirical investigation carried out in the study. This investigation, results of which constitute an original contribution of this study, involved analysis of technical efficiency of SMEs in Botswana with a view to identifying determinants of technical inefficiency. Appropriate policies designed to reduce technical inefficiency are expected to enhance feasibility and profitability of engaging in entrepreneurial activity, which may in turn boost entrepreneurial activity.

Recommendations drawn from this empirical evidence relate to policies aimed at addressing financing constraints faced by SMEs, for example, encouraging competition in the banking sector with a view to increasing financial products available to SMEs, establishing a centralised institution that compiles credit information relating to SMEs with a view to reducing information asymmetry to encourage financial institutions to lend to SMEs, strengthening property rights legislation with a view to protecting financial institutions lending to SMEs as well as easing listing and compliance burdens making it difficult for SMEs to raise funds through the stock market. They also relate to policies aimed at improving feasibility and profitability of engaging in exporting, for example, reducing regulatory burdens and compliance costs related to trading across borders, and assisting exporting SMEs to take advantage of market opportunities afforded by bilateral and

multilateral trade agreements that Botswana is signatory to. They also relate to policies aimed at improving entrepreneurs' access to and quality of higher education and training. A summary of the recommendations from the study can be seen in Table 7.1.

One important recommendation emerging from the conduct of this study, and not included in Table 7.1, is the need to develop a comprehensive database for SMEs operating in Botswana. As highlighted in the chapter, SMEs in Botswana are not well-documented, which has significantly constrained the scope of this study. It is reasonable to think that the lack of comprehensive data on SMEs has significantly impacted on the ability of policy makers to design policies aimed at improving their performance in the past as policy formulation is also dependent on reliable and quality data. Developing a comprehensive database for SMEs is thus likely to enrich both research on SMEs and design of policies aimed at improving their performance. A cost-effective way would be to set up a specific department or unit charged with the responsibility of compiling and continuous updating of such a database within existing government institutions such as the Local Enterprise Authority (LEA) or Statistics Botswana.

Table 7:1 Summary of recommendations

Macroeconomic context	Recommendations
Economic integration and openness to international trade	▪ Optimise on market access afforded by existing bilateral and multilateral agreements (SACU, SADC, AGOA, SACU- MERCOSUR, and the SACU-EFTA FTA) and the ongoing SACU-India PTAs. ▪ Reducing barriers to trading across borders (for example, the time spent on dealing with, and cost of regulatory procedures for trading across borders). ▪ Results of the empirical investigation carried out in the study with respect to exporting SMEs revealed that exporting SMEs are more likely to be technically inefficient than non-exporting SMEs. This technical inefficiency could be a result of some of these regulatory burdens and compliance costs. Reducing the burdens is likely to improve their technical efficiency, boosting revenues from exporting and enhancing feasibility and profitability of engaging in entrepreneurial activity.
Education and human resource development	▪ Results of the empirical investigation of the impact of entrepreneurs' education on technical inefficiency carried out in this study revealed that the entrepreneurs' education is negatively related to technical inefficiency, underlining the importance of education policies in improving the technical efficiency of SMEs. ▪ While the analysis of the impact of the education of employees on technical efficiency could not be carried out due to data limitations, conventional wisdom suggests that the extent to which labour is educated is likely to influence technical efficiency, which also underlines the importance of education policies to reducing the technical inefficiency of SMEs. ▪ Botswana has invested heavily in education over the years. However there is an apparent skills mismatch in the labour market. Addressing the skills mismatch is critical. In recent years the government has responded by approving the setting up of the Human Resource Development Council (HRDC) to coordinate national human resource development planning, with a view to aligning higher education and training with the needs of the labour market (see the Human Resource Development Bill of 2013). This policy implementation is currently ongoing. The success of this policy will be critical not only to improving the technical efficiency of SMEs. ▪ It is important however for reforms to the education system to incorporate

	entrepreneurship education at both basic levels and higher education with a view to improving the skills of entrepreneurs and inculcating an entrepreneurship/innovation culture in Botswana from a tender age. ▪ A significant problem that threatens to negate advances made on human capital in the past is HIV/AIDS. It is critical for efforts to be made to increase awareness and encourage behavioural change, particularly in urban areas.
National research and development	▪ Encourage research and development in higher institutions of learning through government funding and the dissemination of the knowledge generated. ▪ Ensure that the knowledge generated through these institutions has economic value through close cooperation with industry. ▪ Ensure that the knowledge generated is made accessible to SMEs. The transfer of knowledge could be facilitated through closer cooperation with associations representing SMEs, such as the Small Business Council, the Botswana Exporters and Manufacturers Association as well as the Botswana Chamber of Commerce, Industry and Manpower and institutions that support SMEs such as the Local Enterprise Authority.
Openness to foreign direct investment (FDI)	▪ Improve macroeconomic stability, openness to international trade, human capital, quality of infrastructure, tax incentives, and availability of venture capital. ▪ Reduce regulatory burdens (for example, cumbersome business registration procedures, cumbersome business licensing procedures, cumbersome tax registration and payment procedures, and customs and trade regulations). ▪ Optimise on opportunities afforded by existing bilateral and multilateral trade agreements. The ongoing SACU-India PTA offers an opportunity for Botswana as a member of SACU to impress on the importance of technology and skills transfer, particularly in the area of Information and Communications Technology (ICT) in which India is becoming one of the leading players globally.
Stability of exchange rate	▪ Avoid discrete devaluations and revaluations with a view to maintaining credibility of the crawling peg.

Microeconomic context	Recommendations
Access to finance	▪ Results of the empirical investigation carried out in the study revealed that SMEs facing financing constraints in Botswana are more likely to be technically inefficient, underlining the importance of policies aimed at improving not only access to but affordability of financial resources to SMEs. SMEs access to financial resources could be improved with the following: o Encourage competition in the banking sector o Encourage banks to extend loans to small businesses with viable business plans o Establish a centralised institution that compiles the credit history of businesses o Strengthen property rights laws with a view to encouraging institutional lenders to lend to SMEs o Improve effectiveness of existing subsidy schemes through simplification of application forms and administrative procedures among others o Liberalise listing requirements and compliance costs associated with raising funds through the Botswana Stock Exchange o Improve the breadth and depth of financial derivatives with relevance to the needs of SMEs o Develop venture capital markets o Devise effective credit guarantee schemes (role of government critical).
Access to skilled labour	▪ Address the skills mismatch in the labour market. ▪ Ease regulatory burdens on hiring of expatriate skilled labour (for example, immigration laws and procedures for acquiring working and residence permits). ▪ Ensure that the income tax system does not act as a disincentive to foreigners willing to work in Botswana is essential.
Competition policy and business regulation	▪ Maintain transparency in the operations of the Competition Authority and Commission. ▪ Training of the staff of the Competition Authority to improve operational efficiency. ▪ Simplification of business registration and licensing forms and procedures and their associated cost. This may also encourage formalization of SMEs currently operating in the informal sector. Formalization is likely to improve

	their chances of securing institutional credit among others. ▪ Provision of one stop shop services for registration and licensing services. ▪ Simplification of taxation forms and submission procedures which impact disproportionately on SMEs. ▪ Provision of online services by tax authorities. Policies aimed at improving SMEs access to internet services can make it easier for them to access these services.
Government procurement policy	▪ Monitoring of procuring entities to ensure compliance. ▪ Simplification of administrative and registration procedures which would make it easier for SMEs to take advantage of the opportunities offered by these schemes.
Property rights protection	▪ Improve operational efficiency of the legal system. ▪ Maintain independence and transparency of the judiciary. ▪ Ensure that property rights and laws evolve with changing economic conditions through continuous review.
Provision of business advisory services	▪ Improve capacity of the staff of the Local Enterprise Authority (LEA), through training on business evaluation, market research and identification of opportunities. ▪ Extend the services of the LEA to rural areas.
Provision of infrastructure	▪ Reduce the financial burden associated with electricity and water connections. ▪ Simplification of application procedures and reducing the waiting period for inspections and connections. ▪ Improve efficiency in the delivery of water and electricity supply. ▪ Reduce the financial burden associated with telecommunications services, especially internet services. These are essential to allowing SMEs to adopt internet based models such as E-commerce, which have the potential to reduce transaction costs, as well as improve visibility and market outreach.

8 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter provides a summary of the study, a brief description of the major findings (stylised facts), its contribution to the literature, and the policy recommendations. It also highlights limitations and opportunities for further research.

8.1 Summary of the study

The purpose of this study has been to investigate ways in which entrepreneurial activity could be effectively promoted in Botswana. Entrepreneurial activity has been identified by the Government as one avenue through which economic diversification can be facilitated. Economic diversification is essential to assisting the economy avoid stagnation as the country's diamond mining sector, the economy's mainstay, declines. Economic diversification is also essential in boosting the economy's capacity to generate productive employment opportunities to facilitate broad based inclusive growth. While Botswana has used its mineral revenues to propel the economy to upper middle income status, a significant proportion of the population is not benefitting from this growth. Unemployment, poverty and inequality remain high. An increasingly diversifying economy is also critical in mitigating the impact of external shocks and commodity price fluctuations on the economy. The vulnerability of the economy to such incidents was underscored by the 2008 global financial crisis following which Botswana experienced significant loss of national income.

In line with increasing evidence in support for entrepreneurial activity as a potential driver of economic growth (see for example, Bosma *et al.* 2009, Braunerhjelm *et al.* 2010, Amoros *et al.* 2011, Bosma *et al.* 2012, and Amoros *et al.* 2014), the government of Botswana has been searching for ways in which entrepreneurial activity could be effectively promoted. Entrepreneurial activity is thought to lead to an increase in innovation and competition within

the market place, and consequently economic growth. Emphasis is placed on entrepreneurial activity revolving around SMEs (see Ministry of Commerce and Industry 1998, 1999). While Botswana's SMEs are not well documented, Botswana's SMEs dominate not only the business population, but the share of private sector employment. SMEs could thus play an important role in facilitating growth of the entrepreneurial sector. As contribution towards government's objective of promoting entrepreneurial activity, this study investigates ways in which this could be done effectively. The study relies on existing literature on policies to promote entrepreneurial activity in different contexts as well as an empirical investigation of technical efficiency of a sample of Botswana's SMEs. A Data Envelopment Analysis (DEA) based approach is used for this purpose.

8.2 Major findings/Stylized facts

The study reveals that policies aimed at promoting entrepreneurial activity have to be designed with cognisance of the stage of development as countries at different stages of development encounter different challenges. A 'one size fits all' approach is not likely to be effective. According to Porter *et al.* (2002) there are three successive stages in the evolution of economies across which policies aimed at fostering economic growth must evolve. These are the factor-driven stage, the efficiency-driven stage, and the innovation-driven stage. Countries falling in between any two of these stages are said to be in transition. A comprehensive description is provided in chapter 3.

Porter *et al.* encourage policy makers in factor-driven economies to focus on developing well-functioning public and private institutions, providing quality physical infrastructure, maintaining a stable macroeconomic environment and ensuring a healthy and educated

workforce. These have been referred to as basic requirements in subsequent literature[74]. Building on a healthy set of these basic requirements, fostering economic growth in the efficiency-driven stage is said to revolve around higher education and training, well-developed goods markets, well-functioning labour markets, well-developed financial markets, the ability to harness the benefits of existing technologies, and a large domestic and foreign market (*ibid*). Subsequent studies, for example, Porter and Schwab (2008), Schwab (2009 and 2010) have referred to these factors as efficiency enhancers.

In the innovation-driven stage, fostering economic growth is said to revolve around business sophistication and innovation (see Porter *et al.* 2002). Depending on where a particular country is in its path of development, countries in transition are thought to require a balance between the basic requirements, efficiency enhancers and business innovations and sophistication factors (*ibid*). Porter *et al.* emphasize that the transition stage can be challenging if appropriate measures are not undertaken to facilitate a successful transition.

Building on this typology, together with the work of Acs (2006) who highlighted differences in entrepreneurial activity at different stages of economic development, the Global Entrepreneurship Monitor, regarded as the most authoritative global researcher on entrepreneurial activity, identified factors critical to promoting entrepreneurial activity at each of these stages (see Amoros *et al.* 2014). In line with Porter *et al.* (2002), the Global Entrepreneurship Monitor emphasizes the importance of developing well-functioning public and private institutions, providing quality physical infrastructure, maintaining a stable macroeconomic environment, and ensuring a healthy and educated workforce in the factor-

[74] See for example, Porter and Schwab (2008), Schwab (2009, 2010, 2011, 2012, 2013, and 2014).

driven stage[75]. Similarly, higher education and training, well-developed goods markets, well-functioning labour markets, well-developed financial markets, the ability to harness the benefits of existing technologies and a large domestic and foreign market are said to be critical in the efficiency-driven stage (Amoros *et al.* 2014)[76].

In addition to the business and sophistication factors identified by Porter *et al.* (2002), the Global Entrepreneurship Monitor emphasizes the importance of entrepreneurship factors (that is, entrepreneurship finance, government policy supporting entrepreneurship, government programs supporting entrepreneurship, entrepreneurship education, research and development transfer etc.) in the innovation-driven stage (*ibid*). Depending on where they are in their development path, countries in transition are encouraged to adopt a balanced approach between basic requirements, efficiency enhancers and entrepreneurship factors.

This literature is summarised in the form of Figure 3.6 which can be seen in chapter 3. Figure 3.6 identifies the relationship between entrepreneurial activity across the successive stages of development, and factors critical to the design of effective policies to promote it. This framework has been used to identify factors policy makers in Botswana should be looking at in the design of policies to enhance entrepreneurial activity. Based on the work of the World Economic Forum (see Schwab 2014) and the Global Entrepreneurship Monitor (see Amoros *et al.* 2014) who characterize Botswana as being in transition from the factor-driven stage to the efficiency-driven stage, this study has used this framework to locate Botswana and factors critical to promoting entrepreneurial activity. Promoting entrepreneurial activity at this stage revolves around a healthy set of basic requirements, efficiency enhancers, and

[75] The Global Entrepreneurship Monitor has also referred to these factors as basic requirements (see Kelley *et al.* 2012, Xavier *et al.* 2013 and Amoros *et al.* 2014).
[76] These factors have also been collectively referred to as efficiency enhancers by the Global Entrepreneurship Monitor community (see for example, Kelley *et al.* 2012, Xavier *et al.* 2013 and Amoros *et al.* 2014).

entrepreneurship factors. Recommendations for the design of policies to enhance entrepreneurial activity in Botswana are drawn from this information.

Recommendations are also drawn from the empirical evidence emerging from the analyses of the technical efficiency of SMEs. The evidence constitutes an original contribution of this study. Results of the analyses, which can be seen in chapter 6, reveal considerable technical inefficiency in the sample of SMEs included in the study, suggesting a role for policies designed to reduce technical inefficiency. With regard to financing constraints, results reveal that SMEs facing financing constraints are more likely to be technically inefficient, underlining the importance of policies aimed at reducing SMEs financing constraints. With respect to exporting, results reveal that exporting SMEs are likely to be more technically inefficient, underlining the importance of policies aimed at enhancing feasibility and profitability of engaging in exporting. With respect to entrepreneurs' education, results reveal that SMEs led by entrepreneurs with university education are likely to be more technically efficient, underlining the importance of policies aimed at improving entrepreneurs' access to and quality of higher education and training.

With regard to firm age and entrepreneurs' experience, further analyses are necessary before policy implications and recommendations can be drawn from the results. The impact of these factors tends to vary across sectors. Due to data limitations sectoral analyses of the impact of these factors could not be carried out in this study, making it difficult to draw substantive conclusions about what the results imply for policy design.

8.3 Contribution to the literature

In addition to its policy significance this study makes unique contributions to present knowledge. These are highlighted in this section.

8.3.1 Entrepreneurial activity and economic growth

Firstly, the study provides a fairly comprehensive description of present knowledge on the role of entrepreneurial activity on economic growth. This description is provided in chapter 3. It highlighted how entrepreneurship has been incorporated in the growth literature. It also made a distinction between entrepreneurial activity most likely to contribute positively to economic growth, this being that which is motivated by recognition of entrepreneurial opportunity, rather than lack of options. The description also highlighted current knowledge about the evolution of entrepreneurial activity in relation to stage of development. Entrepreneurial activity is said to vary across three successive stages of development, namely factor-driven, efficiency-driven, and innovation-driven stages, with economies falling in between any two of these classified as being in transition. The differences in challenges faced by entrepreneurs at these different stages signify the importance of tailoring policies aimed at promoting entrepreneurial activity to the stage of development.

This literature is fragmented, making it difficult for researchers to gain a good and clear understanding of the subject. By bringing together the different strands of this literature, the study provided a fairly comprehensive treatment of the subject, from which other researchers can benefit. It is hoped that the description provided by the researcher can motivate further research with a view to creating a better understanding of the role of entrepreneurial activity on economic growth, particularly within an endogenous growth framework. This could

enhance the design of policies and their effectiveness with the aim of promoting entrepreneurial activity.

Secondly, the researcher assembled a simple, but fairly comprehensive, conceptual framework that highlights present knowledge on the relationship between entrepreneurial activity and economic growth. This framework can be seen in Figure 3.6 in chapter 3. As noted in chapter 3 however, the framework should be seen as an approximation of the relationship between entrepreneurial activity and economic growth. This is due to the fact that the specific elements involved in the interaction between entrepreneurial activity and economic growth is still a 'black box'. Figure 3.6 is, however, considered to be a reasonable approximation. This framework can be used, not only in the study of the role of entrepreneurial activity on economic growth, but also in identifying factors relevant to promoting entrepreneurial activity at different stages of economic development. The framework has been used to draw recommendations for the design of policies to enhance entrepreneurial activity in Botswana.

8.3.2 Technical efficiency of SMEs

Firstly, to the best of knowledge of the researcher, this is the first study to examine technical efficiency of Botswana's SMEs. The study is thus regarded an original contribution to knowledge on the technical efficiency of Botswana's SMEs. Future studies on Botswana's SMEs can use it as a starting point. Secondly, to the best of knowledge of the researcher, this study is the first to explicitly incorporate the possibility of resource dependence impacting on the technical efficiency of SMEs. This aspect is considered through a variable representing financing constraints encountered by SMEs. As noted in chapter 5, in resource dependent economies, there is a tendency for the resource sector to squeeze out non-resource sectors in

terms of access to resources, financial resources in this particular case. This occurrence is referred to as the resource movement effect (see Corden & Neary 1982 and Corden 1984). While the researcher acknowledges that financing constraints encountered by SMEs could be the result of a combination of factors (including resource dependence, the level of development of the financial sector, or characteristics of SMEs that make them less attractive to lenders), the significance of the relationship estimated suggests this aspect warrants further attention. It is hoped that these findings motivate further research in this area.

Thirdly, the study considers the impact of attributes of entrepreneurs on the technical efficiency of SMEs. As highlighted in chapter 5, the impact of attributes of entrepreneurs on the technical efficiency of SMEs has received little attention in the literature. While only a few characteristics of entrepreneurs could be considered due to data limitations, by explicitly incorporating their characteristics in the analysis of determinants of technical inefficiency, this study provides empirical evidence that contributes to present knowledge on the subject. It is hoped that this study's findings motivate further research on the subject.

8.4 Policy recommendations

Recommendations emerging from the study were described in chapter 7. They were categorised into two main categories, namely, the macroeconomic context and the microeconomic context. A summary of the policy recommendations relating to each of these categories is provided below.

8.4.1 Macroeconomic context

- *Economic integration and openness to international trade*: offers opportunities for wider market access. Through the Botswana Investment and Trade Centre, and the Ministry of Trade and Industry, efforts should be made to assist SMEs take advantage of market opportunities afforded by bilateral and multilateral agreements Botswana is a signatory to, including the SACU and SADC agreements, the AGOA, the SACU - MERCOSUR PTA, and the SACU - EFTA FTA. Reducing trade barriers, regulatory burdens and compliance costs of trading across borders will make it easier for SMEs to take advantage of these opportunities.
- *Education and human resource development*: Government is currently implementing the establishment of the Human Resource Development Council to coordinate national human resource development planning. This is meant to align higher education and training with the needs of the labour market and address the skills mismatch apparent in the labour market. It is important however to ensure that reforms to higher education and training incorporate entrepreneurship education. Incorporating entrepreneurship education at lower levels of education is also required to inculcate a culture of entrepreneurship. A significant problem that threatens to negate advances made on human capital is HIV/AIDS. Effort needs to be made to increase awareness and encourage behavioural change, particularly in urban areas where prevalence rates are higher.
- *National research and development (R&D)*: Given that SMEs are not likely to invest significantly in R&D due to limited financial resources, national R&D is essential. It is crucial to ensure that SMEs benefit from the knowledge generated from national R&D. Establishing close links between national research institutions, associations

representing SMEs, and government institutions that support SMEs is critical to facilitating transfer of R&D knowledge to SMEs.

- *Openness to foreign direct investment*: Figure 7.1 in chapter 7 revealed that net FDI inflows to Botswana have been declining overtime, suggesting Botswana is losing competitiveness in attracting FDI, underlining the importance of policies aimed at improving competitiveness. Macroeconomic stability, openness to international trade, human capital, quality of infrastructure, tax incentives, and availability of venture capital are all crucial to boosting competitiveness and attractiveness of Botswana as a destination for FDI. Removal of regulatory burdens (for example, cumbersome business registration procedures, cumbersome business licensing procedures, cumbersome tax registration and payment procedures, and customs and trade regulations) is also essential. Optimising on opportunities afforded by existing bilateral and multilateral trade agreements such as the SACU - USA TIDCA is also important. The ongoing SACU-India PTA offers an opportunity for Botswana as a member of SACU to impress on the importance of technology and skills transfer, particularly in the area of Information and Communications Technology (ICT) in which India is becoming one of the leading players globally.
- *Stability of exchange rate*: Botswana is currently operating a crawling peg exchange rate regime, implemented through continuous adjustment of the trade weighted Nominal Effective Exchange Rate of the Pula at a rate of crawl based on the differential between the Bank of Botswana's inflation objective and the forecast inflation of trading partners. Avoiding discrete devaluations and revaluations is critical to maintaining credibility of the mechanism, with credibility expected to have a positive impact on business sentiment and willingness to engage in entrepreneurial activity. Credibility of the crawling peg also depends on the stability of inflation and

public debt, which implies that the conduct of monetary and fiscal policy is also important.

8.4.2 Microeconomic context

- *Access to finance*: Policies for improving access to finance include encouraging competition in the banking sector, establishing a centralised institution that compiles credit history and ratings of business with a view to reducing information asymmetry, strengthening property rights protection and bankruptcy laws, liberalising listing requirements and administrative burdens relating to raising finance through the Botswana Stock Exchange, encouraging formalization of small businesses, evaluating how responsive CEDA is to the needs of SMEs, and simplification of application forms and administrative procedures.
- *Access to skilled labour*: Besides improving access to and quality of education, policies to improve SMEs access to skilled labour include easing regulations and administrative processes (for example, immigration laws and procedures for acquiring working and residence permits) that impact on the ability to recruit expatriate labour, especially for skills that are in short supply locally, and ensuring that the income tax system does not act as a disincentive to foreigners.
- *Competition policy and business regulation*: Botswana adopted competition legislation which also established a competition authority and commission in 2009. Transparency is essential to ensuring credibility. Training of the staff of the Authority is crucial to improving operational efficiency. While it is difficult to estimate the size of Botswana's informal SMEs sector, simplification of business registration, licensing forms, and procedures is likely to encourage formalization and improve SMEs chances of accessing institutional credit. Simplification of taxation forms and

submission procedures could also be helpful. Provision of online services by tax authorities could help reduce transaction costs.

- *Government procurement policy*: During 2010 the Botswana Government introduced the economic diversification drive initiative, aimed at ensuring that procuring entities support SMEs through a preference margin of 15 percent. Monitoring of procuring entities is essential to ensure compliance. Ensuring that administrative and registration procedures allowing SMEs to participate are simplified is essential.
- *Property rights protection*: While Botswana is considered to have a good set of property rights institutions, secured by an efficient legal system that also provides for transparency, improving operational efficiency of the legal system is critical in reducing costs involved in addressing contract disputes. Independence and transparency of the judiciary is essential to maintaining credibility. It is also important to ensure that property rights and laws evolve with changing economic conditions to maintain relevance.
- *Provision of business advisory services*: The main institution responsible for providing business advisory services to SMEs is the Local Enterprise Authority. Improving the capacity of staff of the Authority, especially through training on business evaluation, market research, and identification of opportunities is essential to improving delivery. Extending the services offered by the Authority to rural areas is critical to enhancing entrepreneurial activity in rural areas which may in turn promote rural development.
- *Provision of infrastructure*: The ease with which SMEs can access physical resources (for example, telecommunications, utilities, transportation, land or space) at reasonable prices has an influence on entrepreneurial activity. Reducing the financial burden associated with accessing these resources is essential. Simplification of

application procedures and reduction of the waiting period for inspections and connections is also important. In recent years, Botswana has been experiencing acute shortages of water and significant interruptions in electricity supply. Improving efficiency in the delivery of water and electricity supplies is crucial. It is also imperative to ensure that pricing of telecommunications services is not to the exclusion of SMEs. Access to internet services at reasonable prices can allow SMEs to adopt internet based models of running businesses (for example, E-commerce), which have the potential to reduce transaction costs of operating businesses and improving visibility and market outreach.

8.5 Further research

The primary limiting factor for this study, in particular, the empirical investigation of technical efficiency of SMEs, has been lack of data on SMEs. The analysis requires data on SMEs inputs and outputs which are not available. Comprehensive data is also essential for analysis of determinants of technical inefficiency. These analyses were significantly constrained by lack of appropriate data. An important recommendation emerging from this study is the need to develop a comprehensive database for SMEs. This will enrich not only research on SMEs, but formulation of policy to enhance their performance.

On account of data limitations, the researcher was not able to carry out a number of things that could have improved the outcomes of the study. However, these represent opportunities for future research when comprehensive data becomes available. Firstly, the empirical investigation could only be done for SMEs involved manufacturing. The analyses could not be extended to SMEs in other economic sectors. As noted in chapter 7, this study takes a broad view that promoting entrepreneurial activity in any economic sector is likely to yield

economic gains. Extending the analyses to other economic sectors could reveal information that could enhance the design of policies aimed at improving the feasibility and profitability of engaging in entrepreneurial activity in those sectors.

Secondly, the analyses involving SMEs in manufacturing could only be done by pooling all SMEs rather than disaggregating them into different sub-sectors. Pooling all firms, however, has the potential to conceal some important differences across sectors. For example, a disaggregated analysis of the impact of firm age or entrepreneurs' experience could not be done as a result of data limitations. This made it difficult for substantive conclusions to be drawn on the impact of these determinants on technical inefficiency of SMEs. When comprehensive data becomes available, it would be worthwhile to examine the impact of these determinants across different sub-sectors of manufacturing. Similar disaggregated analyses could also be done if the study is extended to include other economic sectors.

Thirdly, analyses of determinants of technical inefficiency could only be carried out for a limited number of determinants for which data was available. Chapter 5 revealed a number of determinants of technical inefficiency that one may include in the analyses. Some of these determinants can also be seen in Figure 4.2 in chapter 4, which summarises the research framework for the analyses of technical efficiency of SMEs and determinants of technical inefficiency carried out in the study. Several of these could not be included in the study. While there is a limit on the number of variables (determinants) one may include in the regression (due to problems relating to degrees of freedom for example), this study and the empirical evidence emerging from it, could have been enhanced by the inclusion of more determinants than those captured in the study. When comprehensive data becomes available, one possible way of extending this study is to consider more variables in the regression of

determinants of technical inefficiency. The same could be done when extending the study to SMEs in other economic sectors.

Comprehensive data could also provide an opportunity to examine the same relationships examined in this study using different proxies. This study relied on the use of dummy variables in the investigation of some relationships. For example, a dummy variable was used as a proxy for financing constraints. As noted in chapter five, financing constraints could be a result of a combination of factors which cannot be adequately captured with a dummy variable. When comprehensive data become available, it may be worthwhile to disentangle financing constraints into different sources and examine the marginal impact of each. This may enrich design of policies aimed at reducing technical inefficiency. Finally, this study relied on pooled cross sectional data. As a result, the study could not investigate the performance of SMEs over time. When longitudinal data becomes available in the future, another possible way of extending this study is to analyse the performance of SMEs in a dynamic framework (using productivity analysis for example), which would permit analysis of changes in performance overtime, together with possible sources of such changes. Such a framework could also be used for analysing performance of SMEs in economic sectors not captured in this study.

Notwithstanding these limitations, through empirical evidence based on available data, the study has drawn important recommendations for the design of policies to reduce technical inefficiency of SMEs in Botswana.

APPENDIX A: BOTSWANA ECONOMIC ACTIVITY INDICATORS

This Appendix presents data on economic activities in Botswana. Appendix A.1 shows the composition of Botswana's Gross Domestic Product (GDP) by classification of economic activity in 1993/94 constant prices for the period 1974/75 - 1994/95. Appendix A.2 shows the composition of the Gross Domestic Product (GDP) by classification of economic activity (as a percentage of the total) in 2006 prices for the period 2002 - 2012. Appendix A.3 shows Botswana's exports by principal commodity groups for 2009 and 2010.

APPENDIX A.1: Composition of GDP by economic activity for the period 1974/75 – 1994/95 (BWP millions, 1993/94 constant prices)

Economic activity	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85
Agriculture	425.2	430.8	449.2	449.0	420.5	426.4	385.2	393.3	343.5	297.5	290.3
Mining	223.8	365.1	381.8	710.9	708.3	986.4	1333.2	1596.1	2318.6	2657.5	2730.6
Manufacturing	120.7	159.1	167.9	161.0	208.4	142.7	165.6	207.2	208.0	198.3	174.3
Water and Electricity	32.0	48.4	40.4	44.4	56.7	54.5	56.4	57.8	57.1	70.9	85.5
Construction	264.1	267.0	238.7	313.5	287.5	321.4	319.1	229.2	187.0	288.1	296.9
Trade, Hotels & Restaurants	159.9	178.8	187.5	183.7	247.8	199.4	159.6	191.8	134.2	104.4	248.4
Transport	26.2	23.5	29.5	33.1	31.9	56.7	57.7	66.3	75.4	85.5	112.3
Banks, Insurance & Business Services	88.6	97.5	109.4	107.8	148.7	220.7	183.0	211.9	223.5	239.8	302.0
General Government	248.2	304.8	344.6	351.0	395.4	408.3	465.9	502.1	550.4	608.9	683.6
Social and Personal Services	43.3	57.7	55.7	57.9	61.6	62.7	77.2	88.2	106.0	105.7	129.8
Total Value Added	1632.1	1932.7	2004.7	2412.1	2566.7	2879.3	3202.9	3544.0	4203.6	4656.7	5053.7
+ Adjustments items of which:											
FISIM	-9.8	-14.7	-27.7	-27.0	-39.3	-51.9	-58.6	-59.7	-69.8	-78.6	-78.3
Taxes on Imports	131.5	139.1	172.8	219.4	299.8	384.7	409.0	367.2	397.2	450.7	413.5
Taxes on products/production	13.6	25.1	20.1	12.4	23.4	79.5	71.0	65.3	18.1	25.2	13.9
Subsidies on products/production	0.0	0.0	-9.3	-1.3	-2.5	-0.8	-4.5	-19.0	-5.4	-2.5	-15.7
Total GDP aggregate at constant prices	1759.7	2083.5	2168.9	2594.3	2851.6	3255.9	3583.7	3875.9	4491.2	4975.9	5300.2
Total GDP excluding Mining Value added	1535.9	1718.3	1787.1	1883.4	2143.3	2269.5	2250.5	2279.8	2172.6	2318.4	2569.6
Total	2528.4	2861.9	2846.3	3251.0	3415.1	3725.3	3916.6	4062.8	4541.1	4849.8	4986.1
Excluding Mining	2206.8	2360.4	2345.3	2360.1	2566.9	2596.7	2459.6	2389.7	2196.8	2259.7	2417.3

Economic activity	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95
Agriculture	322.1	299.1	493.8	452.8	467.6	480.6	492.4	488.3	467.2	459.4
Mining	2,819.5	3,053.7	3,158.9	3,796.6	3,620.7	3,956.8	3,945.9	3,766.0	3,956.2	3,899.4
Manufacturing	227.1	253.5	350.5	442.3	444.1	471.4	518.9	499.2	430.5	531.5
Water and Electricity	114.2	126.5	144.7	156.2	197.0	168.4	179.0	209.4	240.3	256.4
Construction	263.2	304.6	361.8	585.1	710.2	764.4	791.1	666.4	710.1	722.5
Trade, Hotels & Restaurants	365.2	335.9	410.5	568.2	670.5	591.2	536.5	541.3	882.3	1,085.8
Transport	142.9	133.2	212.0	263.3	282.7	323.5	365.4	390.0	406.5	435.9
Banks, Insurance & Business Services	370.9	378.9	424.8	659.6	808.5	884.5	920.0	1,049.5	1,144.4	1,231.6
General Government	737.8	862.5	1,050.4	1,230.6	1,255.6	1,355.0	1,555.7	1,621.3	1,706.7	1,762.4
Social and Personal Services	146.9	162.3	215.5	339.9	393.5	421.1	442.7	455.8	470.1	504.1
Total Value Added, Gross	5,509.6	5,910.4	6,822.9	8,494.6	8,850.4	9,416.9	9,747.7	9,687.0	10,414.3	10,889.0
+ Adjustments items of which:										
FISIM	-115.8	-127.8	-148.5	-230.7	-237.0	-230.4	-237.7	-249.7	-294.6	-308.5
Taxes on Imports	375.6	448.0	503.8	576.0	625.0	812.3	1,077.3	1,067.2	792.7	673.8
Taxes on products/production	12.6	50.7	7.5	48.9	63.0	107.0	127.8	153.6	161.5	179.7
Subsidies on products/production	-16.5	-23.6	-36.0	-57.6	-56.3	-54.9	-54.5	-51.7	-32.5	-36.4
=Total GDP Aggregate at constant prices	5,708.1	6,199.9	7,123.0	8,791.2	9,201.3	10,009.8	10,634.2	10,612.0	11,041.3	11,397.6
Total GDP excluding Mining Value added	2,888.6	3,146.1	3,964.1	4,994.6	5,580.6	6,053.0	6,688.3	6,846.0	7,085.2	7,498.1
Total	5,175.0	5,424.2	6,011.0	7,149.1	7,222.4	7,583.8	7,858.1	7,657.9	7,781.0	7,843.8
Excluding Mining	2,618.8	2,752.5	3,345.2	4,061.6	4,380.4	4,586.0	4,942.3	4,940.3	4,993.0	5,160.2

Source: Bank of Botswana database. www.bankofbotswana.bw

APPENDIX A.2: Composition of GDP by economic activity for the period 2002 – 2012 (percentage of total)

Economic activity	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Agriculture	1.9	2.1	2.1	2.0	2.0	2.1	2.1	2.4	2.6	1.9	1.9
Mining	32.8	33.4	32.0	33.2	32.3	28.3	25.1	14.6	16.5	15.2	13.5
Manufacturing	5.9	5.0	4.9	4.8	5.2	6.1	5.8	6.6	6.3	6.5	6.4
Water and electricity	1.7	1.7	1.7	1.4	1.3	1.2	1.2	1.2	1.2	1.0	0.6
Construction	6.0	4.9	4.8	4.5	4.8	5.5	5.3	6.5	6.2	7.1	7.9
Trade, hotels and restaurants	11.0	11.1	10.2	10.1	11.8	12.7	14.4	16.2	16.3	17.5	17.8
Transport, post and telecommunications	3.7	3.4	3.3	3.6	3.8	4.1	4.3	5.4	5.2	5.3	5.6
Banks, insurance and business services	12.5	12.2	12.0	11.7	11.3	11.6	12.5	13.7	14.1	14.3	15.1
General government	14.7	14.7	15.5	14.7	13.3	12.9	12.4	13.9	13.9	14.0	13.8
Social and personal services	4.0	4.0	4.2	4.7	5.0	5.0	5.5	6.7	6.5	6.6	7.2
Gross Value Added	94.0	92.6	90.7	90.6	90.8	89.4	88.5	87.1	88.8	89.5	89.8
Adjustment items	6.0	7.4	9.3	9.4	9.2	10.6	11.5	12.9	11.2	10.5	10.2
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Bank of Botswana (2013a)

APPENDIX A.3: Botswana's exports by principal commodity groups

Period	Copper & Nickel	Diamonds	Hides & Skins	Iron, Steel & Related	Machine & Electric equip	Meat & Meat products	Plastic & Plastic products	Salt & Soda Ash	Textiles	Vehicle & parts	Other goods	Total Exports
						('000 Pula)						
Q1	749,760	1,888,364	8,128	32,063	126,027	89,070	26,468	42,896	500,391	89,148	232,608	3,777,922
Q2	756,731	4,715,279	6,065	29,116	133,031	284,685	25,066	75,973	260,324	121,667	570,260	6,978,195
Q3	1,116,680	4,329,887	11,305	29,845	152,777	230,921	26,921	69,396	406,799	159,913	354,915	6,889,358
Q4	998,056	4,307,585	8,527	65,484	153,568	203,742	26,266	123,300	250,094	120,381	415,119	6,672,122
2009 Total	3,621,226	15,234,115	34,025	156,508	565,403	808,418	104,720	311,564	1,417,607	491,109	1,572,903	24,317,597
Q1	858,452	5,644,251	6,179	34,868	180,755	183,155	29,536	237,012	232,924	136,869	324,245	7,868,246
Q2	944,928	5,020,210	13,100	48,611	197,121	338,697	29,771	122,106	145,351	108,229	389,177	7,357,301
Q3	1,511,965	5,236,462	10,281	40,493	157,617	297,930	31,996	154,144	276,511	107,200	406,957	8,231,554
Q4	915,922	5,878,961	12,701	80,372	175,954	263,102	36,219	113,748	463,664	148,093	456,170	8,544,905
2010 Total	4,231,267	21,779,885	42,260	204,345	711,446	1,082,884	127,521	627,010	1,118,450	500,391	1,576,549	32,002,007
						Percentage distribution						
Q1	19.8	49.8	0.2	0.8	3.3	2.4	0.7	1.1	13.2	2.4	6.2	100.0
Q2	10.8	67.6	0.1	0.4	1.9	4.1	0.4	1.1	3.7	1.7	8.2	100.0
Q3	16.2	62.8	0.2	0.4	2.2	3.4	0.4	1.0	5.9	2.3	5.2	100.0
Q4	15.0	64.6	0.1	1.0	2.3	3.1	0.4	1.8	3.7	1.8	6.2	100.0
2009 Total	14.9	62.6	0.1	0.6	2.3	3.3	0.4	1.3	5.8	2.0	6.5	100.0
Q1	10.9	71.7	0.1	0.4	2.3	2.3	0.4	3.0	3.0	1.7	4.1	100.0
Q2	12.8	68.2	0.2	0.7	2.7	4.6	0.4	1.7	2.0	1.5	5.3	100.0
Q3	18.4	63.6	0.1	0.5	1.9	3.6	0.4	1.9	3.4	1.3	4.9	100.0
Q4	10.7	68.8	0.1	0.9	2.1	3.1	0.4	1.3	5.4	1.7	5.3	100.0
2010 Total	13.2	68.1	0.1	0.6	2.2	3.4	0.4	2.0	3.5	1.6	4.9	100.0

Source: Bank of Botswana (2011).

APPENDIX B: ADDITIONAL INFORMATION ON METHODOLOGICAL ISSUES

APPENDIX B.1: Stochastic Frontier Analysis (SFA) based method of estimating technical efficiency

This Appendix provides a brief description of SFA based methods for estimating the technical efficiency of production units. It is one of two approaches (the other being DEA, described in chapter four) used in the estimation of technical efficiency of production units. The purpose of this description is to highlight the main aspects of the SFA approach.

SFA was originally developed independently by Aigner *et al.* (1977), Meeusen and van den Broeck (1977), and Battese and Corra (1977). Prior to these contributions, Aigner and Chu (1968), Afriat (1972) and Richmond (1974) had previously done some work on the estimation of frontier production functions by assuming a function giving maximum possible output as a function of certain inputs. According to Coelli *et al.* (2005), Aigner and Chu (1968) considered a Cobb-Douglas production frontier of the form,

$$\ln q_i = \mathbf{x}_i'\beta - u_i, \qquad i = 1, \ldots, I \qquad \text{(B.1:1)}$$

where q_i represents the output of the *i*th firm; $\mathbf{x}_i$ is a K x 1 vector containing the logarithms of inputs; β is a vector of unknown parameters; and u_i is a non-negative random variable associated with technical inefficiency. Aigner and Chu (1968) used linear programming to estimate the parameters of this model (see Coelli *et al.* 2005)[77]. Afriat (1972) assumed that the u_is were gamma distributed random variables and used the method of maximum likelihood, while Richmond (1974) used modified ordinary least squares (*ibid*).

[77] The linear programming problem was to minimise the sum of the $u_i = \ln q_i - \mathbf{x}_i'\beta$ subject to $u_i \geq 0$.

Aigner *et al.* (1977) detail some of the problems associated with this deterministic production frontier. According to Coelli *et al.* (2005), frontiers of this type take no account of measurement errors and other sources of statistical noise. Statistical noise may arise from omission of relevant variables from the vector $\mathbf{x}_i$, and measurement and approximation errors associated with the choice of functional form (*ibid*). All deviations from the frontier are thus assumed to be the result of technical inefficiency. A solution to this problem has been to introduce another random variable that represents statistical noise. The resulting frontier is what has been referred to as the stochastic production frontier. The basic formulation of the stochastic production frontier which has served as the foundation for subsequent variants is,

$$\ln q_i = \mathbf{x}_i'\beta + v_i - u_i, \qquad \text{(B.1:2)}$$

where v_i is a symmetric random error term that accounts for statistical noise (see Coelli *et al.* 2005). The model is considered stochastic because output values are bounded from above by the stochastic variable $\exp(\boldsymbol{x}_i'\beta + v_i)$. According to Coelli *et al.* (2005) the random error v_i can be positive or negative and so the stochastic frontier outputs vary about the deterministic part of the model, $\exp(\boldsymbol{x}_i'\beta)$. In the literature one can find a number of variants of the stochastic frontier model with different assumptions about the distribution of the inefficiency term u_i. Murillo-Zamorano (2004) and Kumbhakar and Lovell (2000) provide a comprehensive catalogue of variants of the SFA model (also see Fried *et al.* 2008). Worth noting for studies similar to this one where statistical analysis of the relevance of causative factors is important is that the SFA has been extended to accommodate such an analysis. Coelli *et al.* (2005) provide a description of a number of methods of how this can be achieved in SFA models.

Just like DEA which has a number of appealing attributes for researchers (see Alvarez & Crespi 2003, Murillo-Zamorano 2004, Coelli *et al*. 2005, and Wilson 2006), so does SFA. Jacobs (2000), Ondrich and Ruggiero (2001), Murillo-Zamorano (2004), Coelli *et al.* (2005), and Fried *et al.* (2008) provide a description of the advantages of SFA. Inevitably, however, SFA just like any other quantitative technique has some shortcomings. Kaparakis *et al.* (1994) provide a description of some of these shortcomings. Berger and Humphrey (1991), Kaparakis *et al.* (1994) and Fried *et al.* (2008) provide a description of how recent studies have attempted to address some of these shortcomings.

Despite their distinct approaches to estimating a production frontier against which the relative efficiency of a production frontier is estimated, these methods have been applied to studies of SMEs. As noted by Murillo-Zamorano (2004) none of these approaches is strictly preferable to the other. The choice of which approach to follow must be based on careful consideration of their main advantages and disadvantages, the data set utilised and the intrinsic characteristics of the industry under analysis (Fried *et al.* 2008). According to Fried *et al.* (2008) progress in knowledge generation has reduced the gap between the two methods. What researchers should be concerned with is whether the two approaches provide consistent results when applied to the same data (*ibid*). Fried *et al.* (2008) argue that the higher the quality of the data, the greater the concordance between the estimates from the two methods.

APPENDIX B.2: Regularity axioms of production

This Appendix outlines the axioms of production due to Fare and Primont (1995). The axioms are extracted from Fare and Primont (1995, p. 27).

i. $0_M \in P(x)$ for all x in $\mathbb{R}_+^M$ (inactivity).

ii. For all (x, y) in $\mathbb{R}_+^{N+M}$ if $y \in P(x)$ and $0 < \theta \leqq 1$ then $\theta y \in P(x)$ (weak disposability of outputs).

iii. If $y \in P(x)$ and $y' \leqq y$ then $y' \in P(x)$ (strong disposability of outputs).

iv. For all x in $\mathbb{R}_+^N$, $P(x)$ is a bounded set (scarcity).

v. For all x in $\mathbb{R}_+^N$, $P(x)$ is a closed set (output closedness).

vi. $y \notin P(0_N)$ if $y \geq 0_M$ (no free lunch).

vii. If $y \in P(x)$ and $\lambda \geqq 1$, then $y \in P(\lambda x)$ (weak disposability of inputs).

viii. If $y \in P(x)$ and $x' \geqq x$, then $y \in P(x')$ (strong disposability of inputs).

ix. $\{x: y \in P(x)\}$ is closed for all $y \in \mathbb{R}_+^M$ (input closedness).

x. The output correspondence is quasi-concave on $\mathbb{R}_+^N$ i.e. for all $x, x' \in \mathbb{R}_+^N$ if $0 \leqq \lambda \leqq 1$, then $P(x) \cap P(x') \subseteqq P(\lambda x + (1-\lambda)x')$ (input convexity).

xi. $P(x)$ is convex for all x in $\mathbb{R}_+^N$ (output convexity).

APPENDIX C: SURVEY OF THE LITERATURE ON DETERMINANTS OF TECHNICAL INEFFICIENCY OF SMES

Reading the literature on determinants of technical inefficiency of SMEs it was realised that because of the huge number of relevant papers to read, it is a vast and complex task to evaluate them. This Appendix presents a fairly comprehensive survey of this literature. Appendix C.1 presents a summary of empirical findings on estimated relationships between technical inefficiency and determinants of technical inefficiency. It is clear from this literature that empirical findings do not show consistency. This suggests that sector and country specific studies are an important task to avoid erroneous policy focus. Appendix C.2 provides more details of the papers evaluated and summarised in Appendix C.1.

APPENDIX C.1: Summary of empirical findings on determinants of technical inefficiency of SMEs

	Predicted relationship with technical inefficiency	*Empirical Findings*			
Firm specific characteristics		***Negative correlation***	***Positive correlation***	***Zero correlation***	***Varies across sectors***
Firm size	Negative	Harris 1991, Lundvall & Battese 2000, Mini & Rodriguez 2000, Hossain & Karunaratne 2004, Chapelle & Plane 2005, Oczkowski & Sharma 2005, Margono & Sharma 2006, Bhandari & Maiti 2007, Mouelhi 2009 and Romero & Rodriguez 2010	Alvarez & Crespi 2003, Badunenko *et al.* 2006 and Vixathep & Matsunaga 2012		Yang & Chen 2009
Firm age	Negative	Yang & Chen 2009, Romero & Rodriguez 2010	Burki & Terrell 1998, Bhandari & Maiti 2007	Mini & Rodriguez 2000, Soderbom & Teal 2004, Vixathep & Matsunaga 2012	Lundvall & Battese 2000, Driffield & Kambhampati 2003, Margono & Sharma 2006
Capital intensity	Negative	Wu *et al.* 2007	Hossain & Karunaratne 2004, Diaz & Sanchez 2008, Faruq & Yi 2010, Vixathep & Matsunaga 2012		
Outward orientation	Negative	Hill & Kalirajan 1993, Hossain & Karunaratne 2004, Pham *et al.* 2009, Mouelhi 2009, Romero & Rodriguez 2010, Vixathep		Alvarez & Crespi 2003, Oczkowski & Sharma 2005	Driffield & Kambhampati 2003, Kim 2003

		& Matsunaga 2012			
Subcontracting					
a. Subcontracting out work	Negative	Taymaz & Saatci 1997, Fixler & Siegel 1999, Girma & Gorg 2004			
b. Participating in production networks	Negative	Burki & Terrell 1998, Tran *et al.* 2008, Yang & Chen 2009			
R&D intensity (process innovation)	Negative	Wu *et al.* 2007, Yang & Chen 2009			Kim 2003, Driffield & Kambhampati 2003
Pattern of financing	Ambiguous			Gokcecus 1995	Kim 2003
Foreign equity participation	Negative	Harris 1991, Mouelhi 2009, Halkos & Tzeremes 2010, Romero & Rodriguez 2010, Faruq & Yi 2010	Pitt & Lee 1981, Pham *et al.* 2009	Soderbom & Teal 2004, Oczkowski & Sharma 2005	
Private sector ownership	Negative	Margono & Sharma 2006, Tran *et al.* (2008)		Pham *et al.* 2009	
Entrepreneurial attributes					
Education of the manager	Negative	Burki & Terrell 1998	Alvarez & Crespi 2003		
Experience of the manager	Negative			Alvarez & Crespi 2003	
Features of the business environment					
Trade liberalization	Negative	Goksecus 1995, Hossain & Karunaratne 2004, Oczkowski & Sharma 2005, Pham *et al.* 2009			Driffield & Kambhampati 2003
Agglomeration and urbanization	Negative	Badunenko *et al.* 2006, Tran *et al.* 2008, Vixathep & Matsunaga 2012		Taymaz & Saatci 1997, Chapelle & Plane 2005, Aggrey *et al.* 2010	Margono & Sharma 2006
Financing constraints	Positive	Sena 2006		Alvarez & Crespi 2003, Chapelle & Plane 2005	

APPENDIX C.2: Summary of papers evaluated

Author(s) and Journal title	***Year of publication***	***Study objective, methodology, data and explanatory variables***	***Findings***
Alvarez, R and Crespi, G *Small Business Economics*	2003	• Study objective: determine the level and identify factors that affect the technical efficiency of small firms in Chilean manufacturing (all sub-sectors) • Methodological approach: Two stage DEA (Tobit regression in the second stage) • Data: survey data for the period 1998 • Explanatory variables: experience of the firm owner; education of the firm owner; variability of sales; share of qualified labour to total employment; experience of workers; age of machinery; age of equipment; age of vehicles; capital per worker; use of bank credit; participation in a technological development program; and participation in a technical assistance fund.	• Firm owner experience-efficiency: insignificant • Firm owner education-efficiency: significant • Labour quality-efficiency: experience, significant; skilled workers not significant • Age of fixed capital-efficiency: significant (negative) • Capital per worker-efficiency: significant • Access to credit-efficiency: insignificant • Outward orientation-efficiency: insignificant • Variability of sales-efficiency: insignificant • Public programs-efficiency: significant
Bhandari, AK and Maiti, P *International Journal of Business and Economics*	2007	• Study objective: investigate technical efficiency of India's textile firms • Methodological approach: translog stochastic production frontier • Data: survey data for selected years • Explanatory variables: firm size and firm age	• Firm size-efficiency: significant • Firm age-efficiency: younger firms are more efficient
Chapelle, K and Plane, P *Journal of Development Studies*	2005	• Study objective: analyse the productive performance in Ivorian manufacturing firms (textiles and garments, metal products, food processing, wood and furniture) • Methodological approach: Cobb-Douglas stochastic production frontier • Data: survey data for the period 1995-96	• Firm size-efficiency: significant • Formality-efficiency: significant in 3 of 4 sectors. • Presence of union-efficiency: firms where a trade union is present are more technically inefficient

		• Explanatory variables: official registration; firm size; presence of a trade union; public infrastructure; and difficulty in obtaining institutional credit.	• Public infrastructure-efficiency: insignificant • Difficulty in obtaining institutional credit-efficiency: insignificant
Diaz, AM and Sanchez, R *Small Business Economics*	2008	• Study objective: analyse performance of SMEs in Spanish manufacturing • Methodological approach: translog stochastic production frontier • Data: micro panel data covering the period 1995-2001 • Explanatory variables: proportion of temporary workers; market share; capital per worker; gross investment over capital; public limited company; and firm size.	• Proportion of temporary workers-efficiency: firms with a high proportion of temporary workers are inefficient. • Market share-efficiency: significant • Capital intensity-efficiency: significant (negative) • Gross investment over capital-efficiency: insignificant. • Public limited company-efficiency: significant • Firm size-efficiency: significant (negative)
Driffield, NL and Kambhampati, US *Review of Development Economics*	2003	• Study objective: analyse determinants of efficiency in Indian manufacturing (transport, textiles, metals, machine tools, food and chemicals) • Methodological approach: stochastic production frontier • Data: data on public limited companies for the period 1987-1994. • Explanatory variables: R&D; market share; market concentration; age; liberalization (deregulation of entry, expansion and exit); capital intensity; export earnings; and import expenditure	• R&D-efficiency: significant in transport equipment, metal products and chemicals. • Market share-efficiency: significant • Market concentration-efficiency: significant (negative) in machine tools, transport equipment and metal products • Firm age-efficiency: middle-aged firms more efficient • Import expenditure-efficiency: varies across sectors • Export earnings-efficiency: significant in machine tools and chemicals. • Liberalization-efficiency: varies across sectors
Faruq, HA and Yi, DT *Global Economy*	2010	• Study objective: estimate technical efficiency of firms in Ghana's manufacturing (textiles, garment, machinery and chemical, food, furniture and wood) industries.	• Firm size-efficiency: significant and non-linear across the six industries • Firm age-efficiency: significant for very

Journal		• Methodological approach: Two stage DEA (OLS in the second stage) • Data: firm level data covering the period 1991-2002. • Explanatory variables: firm size; firm age; labour-capital mix; and foreign ownership.	experienced firms • Labour-capital mix-efficiency: significant for firms that use a greater mix of labour and capital (except for garments) • Foreign ownership-efficiency: significant
Halkos, GE and Tzeremes, NG *Journal of Productivity Analysis*	2010	• Study objective: examine the effect of foreign ownership among the foreign equities trying to establish the impact of different ownership levels on Greek manufacturing SMEs' performances • Methodological approach: DEA methodology (with bootstrap) • Data: financial data for SMEs for the year 2001 • Explanatory variables: foreign ownership	• Foreign ownership-efficiency: significant
Hossain, MA and Karunaratne, ND *Journal of Development Studies*	2004	• Study objective: investigate the effects of trade liberalization on the technical efficiency of Bangladeshi manufacturing firms • Methodological approach: translog stochastic production frontier • Data: panel data for the period 1978-94. • Explanatory variables: capital deepening; export orientation; and ratio of non-productive labour to total employment; firm size	• Firm size-efficiency: significant • Capital deepening-efficiency: significant. • Export orientation-efficiency: significant. • Ratio of non-productive labour to total employment-efficiency: Firms with higher proportion of non-production labour to total employment are more inefficient
Kim, S *Contemporary Economic Policy*	2003	• Study objective: investigate technical efficiency of Korean manufacturing firms (all manufacturing firms listed on the Korean Stock Exchange) • Methodological approach: translog stochastic production frontier • Data: unbalanced panel covering the period 1980-1993. • Explanatory variables: firm size; ratio of external capital;	• Firm size-efficiency: significant. Evidence of an inverted U shaped relationship. • Ratio of external funds to total capital-efficiency: varies across sectors • R&D-efficiency: varies across sectors. • Exports-efficiency: varies across sectors.

		research and development (R&D); and exports	
Lundvall, K and Battese, GE *Journal of Development Studies*	2000	• Study objective: investigate the relationship between firm size-age and technical efficiency for Kenyan manufacturing firms (food, wood, textile and metal sectors) • Methodological approach: translog stochastic production frontier • Data: unbalanced panel covering the period 1993-1995. • Explanatory variables: firm size, firm age	• Firm size-efficiency: significant • Firm age-efficiency: insignificant (except textiles)
Margono, H and Sharma, SC *Journal of Asian Economics*	2006	• Study objective: estimate technical efficiency and total factor productivity growth of manufacturing industries in Indonesia (textile, chemical, and metal products) • Methodological approach: stochastic production frontier • Data: annual survey data covering the period 1993-2000. • Explanatory variables: firm size; ownership (public or private); firm age; and regional location	• Firm size-efficiency: significant • Ownership-efficiency: significant for private ownership for all sectors except textiles • Firm age-efficiency: varies across sectors • Regional-location efficiency: significant only in the textile sector.
Mini, F and Rodriguez, E *International Review of Applied Economics*	2000	• Study objective: investigate the relationship between firm size and technical efficiency in the Philippine manufacturing sector (textile sector). • Methodological approach: Cobb-Douglas stochastic production frontier • Data: census data for the year 1994 • Explanatory variables: firm size. In addition, the study considers the effects of age of establishment; legal organization; export activity; and government support to explain technical efficiency indicators)	• Firm size-efficiency: significant. Efficiency gap shrinks once the authors account for characteristics typically found in larger establishments. • Export activity-efficiency: significant for large firms • Government support-efficiency: significant for large firms • Age and legal organization however appear to be insignificant.
Mouelhi, RBA *Economic Modelling*	2009	• Study objective: investigate the impact of Information and Communications Technology (ICT) adoption on Tunisian manufacturing • Methodological approach: Cobb-Douglas stochastic	• ICT adoption-efficiency: significant. • Export participation-efficiency: significant • Foreign capital participation-efficiency: significant

		production frontier • Data: panel data covering the period 1998-2002 • Explanatory variables: ICT adoption; export participation; foreign capital participation; and firm size	• Firm size-efficiency: significant
Oczkowski, E and Sharma, K *Journal of Development Studies*	2005	• Study objective: estimate the technical efficiency and analyse determinants of technical efficiency in Nepalese manufacturing (food, beverages and tobacco, textiles and wearing apparels, paper and chemical products, fabricated metal products, non-metallic mineral products, radio, TV and communication equipment) • Methodological approach: translog stochastic production frontier • Data: firm level survey data for the post reform period (2000/01) • Explanatory variables: firm size; capital intensity; foreign participation; export intensity; and nominal rate of protection.	• Firm size-efficiency: significant • Capital intensity-efficiency: significant (negative) • Foreign participation-efficiency: insignificant • Export intensity-efficiency: insignificant • Nominal rate of protection-efficiency: significant (negative).
Pham *et al*. *Journal of International Development*	2009	• Study objective: investigate key determinants of technical efficiency in Vietnamese manufacturing. • Methodological approach: Cobb-Douglas stochastic production frontier • Data: census data • Explanatory variables: ownership structure; gender; proportion of permanent employees; use of personal computers; export participation; import penetration; and location.	• Ownership-efficiency: no statistical difference in the efficiency of domestic private firms and local and central level state owned enterprises. Foreign invested firms are found to be less efficient than local state owned enterprises. • Gender-efficiency: feminisation reduces efficiency • Proportion of permanent employees-efficiency: positive and significant for firms with a higher proportion of permanent employees. • Use of personal computers-efficiency

			relationship: significant • Export participation-efficiency: modest • Import penetration-efficiency: significant (negative) • Location-efficiency: significant
Romero, CQ and Rodriguez, DR *International Journal of Production Economics*	2010	• Study objective: investigate efficiency effects of using information technologies related to the Internet by Spanish manufacturing firms (all sectors) • Methodological approach: Cobb-Douglas stochastic production frontier • Data: unbalanced panel for the period 2000-2005. • Explanatory variables: use of the internet; firm size; firm age; export propensity; foreign ownership in the company's equity capital; and percentage of R&D expenditures	• Use of internet to purchase goods and services-efficiency: significant • Use of internet to sell goods to customers and other businesses-efficiency: insignificant • Firm size-efficiency: significant • Firm age-efficiency: significant • Export propensity-efficiency: significant • Foreign ownership-efficiency: significant
Roudaut, N *Journal of Productivity Analysis*	2006	• Study objectives: estimate technical and managerial efficiency of manufacturing firms in Cote d'Ivoire (agribusiness, textiles, wood and metal industries) • Methodological approach: Cobb-Douglas stochastic production frontier. • Data: unbalanced panel for the years 1994 and 1995 • Explanatory variables: market conditions (competition); entrepreneur origin; formality	• Formality-efficiency: informal firms are less efficient than formal ones. • Entrepreneur origin-efficiency: being an African (non-Ivorian) impedes performance • Competition with imports-efficiency: significant
Sena, V *European Journal of Operational Research*	2006	• Study objective: investigate the hypothesis that finance constraints can have a positive impact on the technical efficiency of manufacturing firms-Italian manufacturing firms in extraction of metals, transformation of metals, food, tobacco, textiles, leather, wood and paper. • Methodological approach: stochastic production frontier • Data: panel data covering the period 1989-1994.	• While in most sectors variations in finance constraints affect technical efficiency positively, the size of the effects varies across sectors and within the same sector according to whether the long run or short run measure of finance constraints is considered.

		• Explanatory variables: finance constraints	
Soderbom, M and Teal, F *Journal of Development Economics*	2004	• Study objective: assess the technology, technical and allocative efficiency in Ghana's manufacturing sector (food, textiles or garments, wood and furniture) • Methodological approach: GMM for translog cost function • Data: panel data covering the period 1991-1997 • Explanatory variables: firm size, firm age and ownership	• Results show that neither firm age nor ownership is associated with significant efficiency differentials: positive and significant for firm size
Tran et al. *Asian Economic Journal*	2008	• Study objective: examine performance of non-state small and medium manufacturing firms in Vietnam • Methodological approach: translog stochastic production frontier • Data: survey data for the years 1996 and 2001 • Explanatory variables: ownership; location; government assistance; subcontracting; and firm age	• Ownership-efficiency: varies across sectors • Location-efficiency: significant • Government assistance-efficiency: varies across sectors. • Subcontracting-efficiency: varies across sectors. • Firm age-efficiency: varies across sectors.
Vixathep, S and Matsunaga, N *Journal of the Asia Pacific Economy*	2012	• Study objective: examine performance of firms in Vietnam's garment industry • Methodological approach: DEA methodology (Tobit, OLS in the second stage) • Data: firm level data for the period 2007 • Explanatory variables: firm age; capital intensity; type of ownership; firm size; product specialization; export participation; and firm location	• Firm age-efficiency: insignificant. • Capital intensity-efficiency: significant (negative) • Ownership-efficiency: joint ventures more efficient • Firm size-efficiency: SMEs more efficient • Product specialization-efficiency: significant • Export participation-efficiency: significant • Firm location-efficiency: significant
Wu *et al.* *International Journal of Production Economics*	2007	• Study objective: examine the technical efficiency of watch and clock manufacturing firms in China • Methodological approach: DEA methodology (Tobit in the second stage) • Data: firm level data for the year 2002 • Explanatory variables: capital intensity; product	• Capital intensity-efficiency: significant (positive) • Product differentiation-efficiency: insignificant • R&D-efficiency: significant

		differentiation; R&D	
Yang, CH and Chen, KH *Small Business Economics*	2009	• Study objective: investigate the size efficiency relationship in Taiwanese electronics industry • Methodological approach: stochastic frontier analysis • Data: census data for the year 2001 • Explanatory variables: firm size; firm age; welfare expenditure; export intensity; R&D intensity; subcontract intensity; industry effects	• Firm size-efficiency: ambiguous • Firm age-efficiency: significant • Welfare expenditure-efficiency: significant • R&D-efficiency: significant • Subcontractor intensity-efficiency: significant • Industry effects: significant

APPENDIX D: ESTIMATED CONFIDENCE INTERVALS FOR REGRESSION OF DETERMINANTS OF TECHNICAL INEFFICIENCY

This Appendix reports estimated coefficients and confidence intervals of the regression analysis of causative factors. The estimated coefficients and confidence intervals are obtained using the bootstrap procedures due to Simar and Wilson (2007). The calculations are done by the researcher in MATLAB using the codes of Valentin Zelenyuk which adopted earlier codes of Leopold Simar. Appendix D.1 reports estimated coefficients and confidence intervals for the regression based on the double bootstrap and variable returns to scale technology estimation, with 1000 replications for bias correction and 2000 replications for confidence interval estimation. Appendix D.2 reports estimated coefficients and confidence intervals for the regression based on the double bootstrap and constant returns to scale technology estimation, with 1000 replications for bias correction and 2000 replications for confidence interval estimation.

Appendix D.3 reports estimated coefficients for the regression based on the single bootstrap and variable returns to scale technology estimation, with 2000 replications for confidence interval estimation. Appendix D.4 reports estimated coefficients and confidence intervals for the regression based on the single bootstrap and constant returns to scale technology estimation, with 2000 replications for confidence interval estimation.

APPENDIX D.1: Estimated confidence intervals for the regression based on the double bootstrap (variable returns to scale technology)

Estimation 1

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.2263	0.0513	0.4080	-0.0243	0.4816	0.0774	0.3874
Export orientation	0.1518	-0.0422	0.3683	-0.1229	0.4413	-0.0163	0.3246
Entrepreneur's education	-0.0841	-0.2521	0.0764	-0.2962	0.1345	-0.2257	0.0498
Industry dummy	0.0960	-0.0602	0.2494	-0.1218	0.3026	-0.0358	0.2240
Size	-0.0920	-0.2699	0.0935	-0.3250	0.1320	-0.2387	0.0608
Year dummy	0.0265	-0.1634	0.2149	-0.2188	0.2632	-0.1373	0.1860
σ^2	*0.1975*	*0.1575*	*0.2505*	*0.1416*	*0.2636*	*0.1641*	*0.2452*

Estimation 2

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.2273	0.0517	0.4080	-0.0033	0.4540	0.0805	0.3793
Export orientation	0.1444	-0.0571	0.3589	-0.1184	0.4331	-0.0251	0.3304
Entrepreneur's experience	0.0042	-0.0040	0.0128	-0.0070	0.0149	-0.0027	0.0114
Industry dummy	0.0922	-0.0671	0.2497	-0.1104	0.2964	-0.0432	0.2236
Size dummy	-0.0920	-0.2699	0.0935	-0.3250	0.1320	-0.2387	0.0608
Year dummy	0.2987	0.1175	0.4798	0.0554	0.5337	0.1457	0.4498
σ^2	*0.1994*	*0.1596*	*0.2550*	*0.1347*	*0.2654*	*0.1688*	*0.2498*

Estimation 3

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.2280	0.0475	0.3964	-0.0032	0.4612	0.0792	0.3730
Firm age	0.0023	-0.0077	0.0119	-0.0110	0.0150	-0.0058	0.0102
Entrepreneur's education	-0.0585	-0.2229	0.1030	-0.2549	0.1653	-0.1899	0.0804
Industry dummy	0.0909	-0.0629	0.2505	-0.1126	0.2898	-0.0401	0.2283
Size dummy	-0.0859	-0.2607	0.0923	-0.3145	0.1459	-0.2409	0.0665
Year dummy	0.2894	0.1080	0.4682	0.0641	0.5179	0.1393	0.4431
σ^2	*0.1949*	*0.1548*	*0.2486*	*0.1340*	*0.2595*	*0.1626*	*0.2432*

Estimation 4

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.2294	0.0543	0.4039	0.0082	0.4536	0.0790	0.3752
Firm age	0.0013	-0.0093	0.0120	-0.0116	0.0150	-0.0076	0.0103
Entrepreneur's experience	0.0033	-0.0057	0.0119	-0.0080	0.0144	-0.0042	0.0105
Industry dummy	0.0879	-0.0684	0.2454	-0.1343	0.3018	-0.0391	0.2176
Size dummy	-0.0896	-0.2827	0.0843	-0.3395	0.1442	-0.2425	0.0570
Year dummy	0.3167	0.1327	0.4941	0.0573	0.5694	0.1594	0.4690
σ^2	*0.1972*	*0.1559*	*0.2530*	*0.1366*	*0.2644*	*0.1637*	*0.2469*

APPENDIX D.2: Estimated confidence intervals for the regression based on the double bootstrap (constant returns to scale technology)

Estimation 1

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.0185	-0.1518	0.2030	-0.2082	0.2450	-0.1302	0.1684
Export orientation	0.1533	-0.0656	0.3846	-0.1201	0.4532	-0.0397	0.3432
Entrepreneur's education	-0.1791	-0.0359	0.0003	-0.4109	0.0536	-0.3351	-0.0305
Industry dummy	0.0879	-0.0663	0.2531	-0.1215	0.2852	-0.0434	0.2235
Size	-0.0764	-0.1186	0.2904	-0.0671	0.2447	-0.0437	0.2188
Year dummy	0.2622	0.0882	0.4391	0.0241	0.4820	0.1168	0.4127
σ^2	0.2225	0.1790	0.2839	0.1616	0.2991	0.1877	0.2772

Estimation 2

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.0284	-0.1740	0.2162	-0.2196	0.2730	-0.1354	0.1888
Export orientation	0.1201	-0.1050	0.3577	-0.1752	0.4205	-0.0694	0.3142
Entrepreneur's experience	0.0001	-0.0085	0.0085	-0.0107	0.0105	-0.0070	0.0071
Industry dummy	0.2428	0.0701	0.4114	0.0170	0.4610	0.1015	0.3840
Size	0.0870	-0.0756	0.2547	-0.1305	0.3015	-0.0441	0.2263
Year dummy	-0.0705	-0.2615	0.1002	-0.3103	0.1541	-0.2275	0.0786
σ^2	0.2277	0.1811	0.2923	0.1528	0.3026	0.1903	0.2834

Estimation 3

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.0379	-0.1363	0.2166	-0.1850	0.2791	-0.1151	0.1937
Firm age	0.0031	-0.0128	0.0072	-0.0156	0.0110	-0.0113	0.0056
Entrepreneur's education	-0.1664	-0.3451	0.0070	-0.4027	0.0555	-0.3160	-0.0235
Industry dummy	0.0841	-0.0843	0.2475	-0.1278	0.2890	-0.0550	0.2217
Size	-0.0794	-0.2336	0.0840	-0.3026	0.1410	-0.2054	0.0544
Year dummy	0.2365	0.0743	0.4007	0.0008	0.4591	0.1037	0.3745
σ^2	0.2165	0.1717	0.2794	0.1549	0.2901	0.1806	0.2714

Estimation 4

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.0415	-0.1414	0.2179	-0.1958	0.2763	-0.1138	0.1887
Firm age	0.0021	-0.0131	0.0091	-0.0167	0.0116	-0.0113	0.0073
Entrepreneur's experience	0.0005	-0.0086	0.0102	-0.0109	0.0133	-0.0072	0.0085
Industry dummy	0.0861	-0.0723	0.2409	-0.1254	0.2812	-0.0438	0.2159
Size	-0.0745	-0.2333	0.0854	-0.2759	0.1472	-0.2033	0.0529
Year dummy	0.2192	0.0467	0.3962	-0.0039	0.4456	0.0802	0.3644
σ^2	0.2199	0.1747	0.2802	0.1586	0.2922	0.1862	0.2735

APPENDIX D.3: Estimated confidence intervals for the regression based on the single bootstrap (variable returns to scale technology)

Estimation 1

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.0717	-0.2310	0.0911	-0.2991	0.1462	-0.2040	0.0648
Export orientation	0.0742	-0.1241	0.2808	-0.1833	0.3575	-0.0888	0.2441
Entrepreneur's education	-0.2011	-0.3488	-0.0561	-0.3920	-0.0056	-0.3259	-0.0800
Industry dummy	0.0878	-0.2586	0.0956	-0.3109	0.1585	-0.2276	0.0669
Size dummy	-0.0764	-0.0671	0.2447	-0.1186	0.2904	-0.0437	0.2188
Year dummy	0.2621	0.0761	0.4482	0.0240	0.5076	0.1094	0.4154
σ^2	0.1614	0.1202	0.2110	0.0980	0.2190	0.1284	0.2049

Estimation 2

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.0732	-0.2329	0.0835	-0.2813	0.1336	-0.2076	0.0629
Export orientation	0.0251	-0.1713	0.2377	-0.2374	0.3272	-0.1416	0.1963
Entrepreneur's experience	0.0013	-0.0071	0.0099	-0.0099	0.0121	-0.0055	0.0083
Industry dummy	0.0793	-0.0744	0.2368	-0.1240	0.2813	-0.0524	0.2122
Size dummy	-0.0686	-0.2596	0.1097	-0.3247	0.1891	-0.2297	0.0781
Year dummy	0.2655	0.0887	0.4468	0.0434	0.5084	0.1189	0.4178
σ^2	0.1711	0.1274	0.2239	0.0987	0.2352	0.1379	0.2182

Estimation 3

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.0546	-0.2064	0.1110	-0.2620	0.1505	-0.1846	0.0778
Firm age	0.0032	-0.0127	0.0064	-0.0161	0.0101	-0.0112	0.0049
Entrepreneur's education	-0.1968	-0.3474	-0.0510	-0.3858	0.0034	-0.3216	-0.0722
Industry dummy	0.0861	-0.0723	0.2409	-0.1254	0.2812	-0.0438	0.2159
Size dummy	-0.0856	-0.2636	0.1016	-0.3165	0.1559	-0.2389	0.0732
Year dummy	0.2563	0.0790	0.4443	-0.0197	0.5173	0.1065	0.4200
σ^2	0.1616	0.1199	0.2100	0.1040	0.2220	0.1306	0.2053

Estimation 4

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.0637	-0.2390	0.0995	-0.2960	0.1573	-0.2099	0.0722
Firm age	0.0024	-0.0124	0.0090	-0.0153	0.0113	-0.0110	0.0071
Entrepreneur's experience	0.0019	-0.0069	0.0104	-0.0092	0.0135	-0.0058	0.0089
Industry dummy	0.0770	-0.0786	0.2284	-0.1248	0.2794	-0.0458	0.2067
Size dummy	-0.0705	-0.2615	0.1002	-0.3103	0.1541	-0.2275	0.0786
Year dummy	0.2601	0.0777	0.4347	0.0134	0.4907	0.1049	0.4062
σ^2	0.1709	-0.1245	0.2236	0.1037	0.2353	0.1363	0.2179

APPENDIX D.4: Estimated confidence intervals for the regression based on the single bootstrap (constant returns to scale technology)

Estimation 1

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.0181	-0.1195	0.1591	-0.1837	0.2127	-0.0999	0.1392
Export orientation	0.1222	-0.0526	0.3018	-0.1100	0.3582	-0.0218	0.2710
Entrepreneur's education	-0.1528	-0.2875	-0.0204	-0.3279	0.0136	-0.2717	-0.0412
Industry dummy	0.0793	-0.0744	0.2368	-0.1240	0.2813	-0.0524	0.2122
Size	-0.0994	-0.2389	0.0283	-0.2806	0.0764	-0.2153	0.0076
Year dummy	0.1510	0.0153	0.2902	-0.0357	0.3290	0.0360	0.2680
σ^2	0.1319	0.1042	0.1688	0.9090	0.1779	0.1089	0.1642

Estimation 2

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.0272	-0.1124	0.1662	-0.1516	0.2086	-0.0898	0.1459
Export orientation	0.0949	-0.0790	0.2726	-0.1221	0.3525	-0.0563	0.2458
Entrepreneur's experience	0.0003	-0.0063	0.0068	-0.0086	0.0092	-0.0051	0.0057
Industry dummy	0.0777	-0.0575	0.2138	-0.0972	0.2501	-0.0386	0.1908
Size	-0.0958	-0.2278	0.0379	-0.2825	0.0801	-0.2068	0.0183
Year dummy	0.1373	0.0038	0.2735	-0.0383	0.3129	0.0251	0.2520
σ^2	0.1368	0.1081	0.1758	0.0937	0.1848	0.1142	0.1707

Estimation 3

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.0329	-0.0998	0.1790	-0.1494	0.2114	-0.0832	0.1520
Firm age	0.0023	-0.0103	0.0057	-0.0128	0.0086	-0.0089	0.0043
Entrepreneur's education	-0.1444	-0.2841	-0.0056	-0.3199	0.0304	-0.2594	-0.0314
Industry dummy	0.0764	-0.0698	0.2181	-0.1113	0.2588	-0.0449	0.1978
Size	-0.0953	-0.2705	0.0863	-0.3223	0.1373	-0.2408	0.0503
Year dummy	0.1512	0.0149	0.2892	-0.0370	0.3231	0.0370	0.2680
σ^2	0.1334	0.1058	0.1712	0.0954	0.1801	0.1117	0.1669

Estimation 4

Variable	Estimated coefficient	Lower 5%	Upper 5%	Lower 1%	Upper 1%	Lower 10%	Upper 10%
Financing constraints	0.0376	-0.1185	0.1830	-0.1631	0.2291	-0.0934	0.1618
Firm age	0.0015	-0.0102	0.0081	-0.0129	0.0104	-0.0088	0.0065
Entrepreneur's experience	0.0006	-0.0070	0.0076	-0.0099	0.0100	-0.0059	0.0063
Industry dummy	0.0691	-0.0663	0.2531	-0.1215	0.2852	-0.0434	0.2235
Size	-0.0992	-0.2411	0.0287	-0.2771	0.0669	-0.2183	0.0097
Year dummy	0.1383	0.0064	0.2695	-0.0328	0.3145	0.0280	0.2488
σ^2	0.1379	0.1081	0.1773	0.0939	0.1863	0.1143	0.1722

APPENDIX E: CITATIONS

Sekwati, L 2014, 'Investigating the technical efficiency of SMEs in non-resource sectors in a resource dependent and developing economy: application of the DEA bootstrap, *10th Asia-Pacific Productivity Conference*, 8 - 11 July 2014, Centre for Efficiency and Productivity Analysis, University of Queensland, Brisbane, Australia.

Sekwati, L & Harvie, C 2014, 'Investigating determinants of the technical inefficiency of SMEs in Botswana: application of Simar and Wilson (2007) methodology, *Australian Conference of Economists*, 1 - 4 July 2014, Hobart, Tasmania, Australia.

REFERENCES

Acemoglu, D, Johnson, S & Robinson, JA 2001, 'An African success story: Botswana', Working Paper 01-37, Massachusetts Institute of Technology, Cambridge.

Acs, Z & Armington, C 2003, 'Employment growth and entrepreneurial activity in cities', *Regional Studies*, 38, pp. 911-927.

Acs, Z 2006, 'How is entrepreneurship good for economic growth?', *Innovations*, 1, 1, pp. 97-107.

Acs, ZJ & Varga, A 2005, 'Entrepreneurship, agglomeration and technical change', *Small Business Economics*, 24, pp. 323-334.

Acs, ZJ 1992, 'Small business economics: a global perspective', *Challenge*, November-December, pp. 38-44.

Acs, ZJ 1999, *Are small firms important?*, Kluwer Academic Publishers, Boston MA.

Acs, ZJ & Szerb, L 2010, *Global entrepreneurship and the United States*, SBA Office of Advocacy.

Acs, ZJ, Audretsch, DB, Braunerhjelm, P & Carlsson, B 2004, 'The missing link: the knowledge filter and entrepreneurship in endogenous growth', *Discussion Papers on Entrepreneurship, Growth and Public Policy*, Discussion Paper 0805, Max Planck Institute for Research into Economic Systems, Germany.

Afriat, SN 1972, 'Efficiency estimation of production functions', *International Economic Review*, 13, pp. 568-598.

Aggrey, N, Eliab, L & Joseph, S 2010, 'Firm size and technical efficiency in East African manufacturing firms', *Current Research Journal of Economic Theory*, 2, 2, pp. 69-75.

Aghion, P & Howitt, P 1992, 'A model of growth through creative destruction', *Econometrica*, 60, pp. 323-351.

Aigner DJ, Lovell, KAC & Schmidt, P. 1977, 'Formulation and estimation of stochastic production function models', *Journal of Econometrics*, 6, pp. 21-37.

Aigner, DJ & Chu, SF 1968, 'On estimating the industry production function', *American Economic Review*, 58, pp. 826-839.

Alexander, RJW, Haug, AA & Jaforrulah, M 2010, 'A two stage double bootstrap data envelopment analysis of efficiency differences of New Zealand secondary schools' *Journal of Productivity Analysis*, 34, pp. 99-110.

Alvarez, R & Crespi, G 2003, 'Determinants of technical efficiency in small firms', *Small Business Economics*, 20, pp. 233-244.

Ameyiya, T 1973, 'Regression analysis when the dependent variable is truncated normal', *Econometrica*, 41, 6, pp. 997-1016.

Amoros, JE, Bosma, N & Levie, J 2011, '*Ten years of global entrepreneurship monitor: accomplishments and prospects*', Babson College, Babson Park, United States.

Amoros, JE, Bosma, N & the Global Entrepreneurship Research Association 2014, *Global entrepreneurship monitor: 2013 global report*', Babson College, Babson Park, United States.

Arocena, P & Aliveros, D 2012, 'The efficiency of state owned and privatised enterprises: does ownership make a difference?', *International Journal of Production Economics*, 140, pp. 457-465.

Assaf, GA & Agbola, FW 2011, 'Modelling the performance of Australian hotels: a DEA double bootstrap approach', *Tourism Economics*, 17, pp. 73-89.

Audretsch, DB & Fritsch, M 2002, 'Growth regimes over time and space', *Regional Studies*, 36, 2, pp. 113-124.

Audretsch, DB & Keilbach, M 2004, 'Entrepreneurship capital and economic performance, *Regional Studies*, 38, pp. 949-959.

Audretsch, DB & Thurik, AR 2000, 'Capitalism and democracy in the 21st century: from the managed to the entrepreneurial economy', *Journal of Evolutionary Economics*, 10, 1, pp. 17-34.

Audretsch, DB 1995, 'Innovation, growth and survival', *International Journal of Industrial Organization*, 13, pp. 441-457.

Audretsch, DB 2005, 'The knowledge spillover theory of entrepreneurship and economic growth', in GT Vinig, RCW Van Der Voort, (eds..), *The emergence of entrepreneurial economics: research on technological innovation, management and policy*, Emerald Group Publishing Limited, pp. 37-54.

Audretsch, DB, Keilbach, M & Lehmann, EE 2006, *Entrepreneurship and economic growth*, Oxford University Press, New York.

Auty, RM 2000, 'How natural resources affect economic development', *Development Policy Review*, 18, pp. 347-364.

Ayyagari, M, Beck, T & Dermiguc-Kunt, A 2007, 'Small and medium enterprises across the globe', *Small Business Economics*, 29, pp. 415-43.

Badunenko, O, Fritsch, M & Stephan, A 2006, 'What determines the technical efficiency of a firm: the importance of industry, location and size', Faculty Discussion Paper 33/2006, Friedrich-Schiller-University of Jena.

Bank of Botswana 2007, *Annual Report*, Bank of Botswana, Gaborone.

Bank of Botswana 2011, *Annual Report*, Bank of Botswana, Gaborone.

Bank of Botswana 2013a, *Annual Report*, Bank of Botswana, Gaborone.

Bank of Botswana 2013b, *Botswana Financial Statistics*, Bank of Botswana, Gaborone.

Bank of Botswana 2014a, *Botswana Financial Statistics*, Bank of Botswana, Gaborone.

Bank of Botswana 2014b, *Monetary Policy Statement*, Bank of Botswana, Gaborone.

Barro, RJ 2001, 'Human capital and growth', *American Economic Review*, 91, 2, pp. 12-17.

Barros, CP & Garcia-del-Barrio, P 2011, 'Productivity drivers and market dynamics in the Spanish first division football league', *Journal of Productivity Analysis*, 35, pp. 5-13.

Basdevant, O 2008, 'Are diamonds forever? Using the permanent income hypothesis to analyse Botswana's reliance on diamond revenue', IMF Working Paper 08/80, International Monetary Fund.

Battese, GE & Corra GS 1977, 'Estimation of a production frontier model: with application to the pastoral zone of Eastern Australia", *Australian Journal of Agricultural Economics*, 21, pp. 169-179.

Beck, T & Demirguc-Kunt, A 2006, 'Small and medium size enterprises: access to finance as a growth constraint', *Journal of Banking and Finance*, 30, pp. 2931-2943.

Beck, T, Dermiguc-Kunt, A & Levine, R 2005, 'SMEs, growth and poverty: cross country evidence', *Journal of Economic Growth*, 10, pp. 199-229.

Beck, T, Demirguc-Kunt, A & Maksimovic, V 2008, 'Financing patterns around the world: are small firms different?' *Journal of Financial Economics*, 89, 3, pp. 467-487.

Berger, AN & Humphrey, DB 1991, 'The dominance of inefficiency over scale and product mix in banking', *Journal of Monetary Economics*, 28, pp. 117-48.

Beulier, SA 2003, 'Explaining Botswana's success the critical role of post-colonial policy', *Cato Journal*, 23, 2, pp. 227-240.

Bhandari, AK & Maiti, P 2007, 'Efficiency of Indian manufacturing firms: textile industry as a case study', *International Journal of Business and Economics*, 6, 1, pp. 71-88.

Biggs, T, Shah, M & Srivastava, P 1996, '*Technological capabilities and learning in African enterprises*', Regional Program of Enterprise Development (RPED) case study series, World Bank, Washington, DC.

Bosma, N & Harding, R 2007, *Global entrepreneurship monitor: 2006 summary results*, Babson College, Babson Park, United States.

Bosma, N, Acs, ZJ, Autio, E, Coduras, A & Levie, J 2009, *Global entrepreneurship monitor: 2008 Executive Report*, Babson College, Babson Park, United States.

Bosma, N, Jones, K, Autio, E & Levie, J 2008, *Global entrepreneurship monitor: 2007 executive report*, Babson College, Babson Park, United States.

Bosma, N, Wennekers, S & Amoros, JE 2012, *Global entrepreneurship monitor: 2011 extended report*, Babson College, Babson Park, United States.

Branchflower, D 2000, Self-employment in OECD countries, *Labour Economics*, 7, 5, pp. 471-505.

Braunerhjelm, P & Borgman, B 2004, 'Geographical concentration, entrepreneurship and regional growth: evidence from regional data in Sweden', *Regional Studies*, 38, pp. 929-947.

Braunerhjelm, P, Acs, ZJ, Audretsch, DB & Carlsson, B 2010, 'The missing link: the knowledge filter and entrepreneurship in endogenous growth', *Small Business Economics*, 34, pp. 105-125.

Brock, WA & Evans, DS 1989, 'Small business economics', *Small Business Economics*, 1, pp. 7-20.

Brummer, B 2001, 'Estimating confidence intervals for technical efficiency: the case of private firms in Romania', *European Review of Agricultural Economics*, 28, 3, pp. 285-306.

Burki, AA & Terrell, D 1998, 'Measuring production efficiency of small firms in Pakistan', *World Development*, 26, 1, pp. 155-169.

Carlsson, B 1992, 'The rise of small businesses: causes and consequences', in WJ Adams (ed.), *Singular Europe, economy and policy of the European Community after 1992*, University of Michigan Press, Ann Arbor MI, pp. 145-169.

Carlsson, B 1999, 'Small business, entrepreneurship and industrial dynamics', in Z Acs (ed.), *Are small firms important*? Kluwer Academic Publishers, Boston MA, pp. 99-110.

Carree, M, van Stel, A, Thurik, R & Wennekers, S 2002, 'Economic development and business ownership: an analysis using data of 23 OECD countries in the period 1976-1996', *Small Business Economics*, 19, pp. 271-290.

Carree, MA & Thurik, RA 2005, 'The impact of entrepreneurship on economic growth', *Handbook of Entrepreneurship Research*, Springer, US, pp. 437-471.

Central Statistics Office 2010, *2006/7 Census of enterprises and establishments report*, February 2010, Central Statistics Office, Gaborone.

Chapelle, K & Plane, P 2005, 'Technical efficiency measurement within the manufacturing sector in Cote d'Ivore: A stochastic frontier approach', *The Journal of Development Studies*, 41, 7, pp. 1303-1304.

Charnes, A & Cooper, WW 1961, *Management models and industrial applications of linear programming*, Wiley, New York.

Charnes, A, Cooper, WW & Rhodes, E 1978, 'Measuring the efficiency of decision making units', *European Journal of Operational Research*, 2, pp. 429-444.

Chawla, SK, Pulling, C & Alexander, FD 1997, 'Critical success factors from an organizational life cycle perspective: perceptions of small business owners from different business environment', *Journal of Business Entrepreneurship*, 9, 1, pp. 47-58.

Cheng, L & Dinopoulos, E 1992, 'Schumpeterian growth and international business cycles', *American Economic Review*, 82, pp. 409-414.

Cihak, M, Dermiguc-Kunt, A, Feyen, E & Levine, R 2012, 'Benchmarking financial systems around the world', World Bank Research Working Paper 6175, World Bank, Washington.

Coelli, TJ, Rao, PDS, O'Donell CJ & Battese GE 2005, *An Introduction to efficiency and productivity analysis*, Springer, New York.

Collier, P 2007, *The bottom billion: why the poorest countries are falling behind and what can be done about it*, Oxford University Press, Oxford.

Competition Act of 2009, Government Printing and Publishing Services, Gaborone.

Cooper, WW, Seiford, LM & Zhu, J 2004, 'Data envelopment analysis: history, models and interpretations', in WW Cooper, LM Seiford & J Zhu (eds.), *Handbook on data envelopment analysis*, Kluwer Publishers, Boston, pp. 1-39.

Corden, MW & Neary, PJ 1982, 'Booming sector and de-industrialization in a small open economy', *The Economic Journal*, 92, pp. 825-848.

Corden, WM 1984, 'Booming sector and Dutch Disease economics: survey and consolidation', *Oxford Economic Papers*, 36, pp. 359-380.

Cox, GM & Harvie, C 2010, 'Resource price turbulence and macroeconomic adjustment for a resource exporter: a conceptual framework for policy analysis', *Energy Economics*, 32, 2, pp. 468-489.

Dahl, H-E 1981, 'Economic and social development in Botswana 1966-78', in C. Harvey, ed., *Papers on the Botswana Economy*, Heinemann, London, pp. 1-13.

Dale, R 1995, *Botswana's search for autonomy in Southern Africa*, Westport, Conn: Greenwood Press.

Dantzig, G.B 1963, *Linear programming and extensions*, Princeton University Press, Princeton.

Debreu, G 1951, 'The coefficient of resource utilization' *Econometrica*, 19, pp. 273-292.

Demchuk, P & Zelenyuk, V 2009, 'Testing differences in efficiency of regions within a country: the case of Ukraine', *Journal of Productivity Analysis*, 32, pp. 81-102.

Deprins, D, Simar, L & Tulkens, H 1984, 'Measuring labour-efficiency in post offices', in M Marchand, P Pestieau, & H Tulkens (eds.), *The performance of public enterprises: concepts and measurements*, Amsterdam, North-Holland.

Desai, A, Ratick, SJ & Schinnar, A 1994, 'DEA with stochastic variations data', Working Paper 94-51, Max. M. Fisher College of Business, Ohio State University.

Diaz AM & Sanchez, R 2008, 'Firm size and productivity in Spain: a stochastic frontier analysis', *Small Business Economics*, 30, pp. 315-323.

Driffield, NL & Kambhampati, US 2003, 'Trade liberalization and the efficiency of firms in Indian manufacturing', *Review of Development Economics*, 7, 3, pp. 419-430.

Du Rietz, A & Henrekson, M 2000, 'Testing the female underperformance hypothesis', *Small Business Economics*, 14, pp. 1-10.

Dugger, RR III 1974, An application of bounded non-parametric estimating functions to the analysis of bank cost and production functions, PhD dissertation, Department of Economics, University of North Carolina, Chapel Hill, North Carolina.

Efron, B & Tibshirani, R.J 1993, *An introduction to the bootstrap*, Chapman and Hall, London.

Fare, R & Primont, D 1995, *Multi-output production and duality: theory and applications*, Kluwer Publishers, Boston.

Fare, R, Grosskopf, S & Lovell KAC 1994, *Production frontiers*, Cambridge University Press, Cambridge.

Farrell, MJ 1957, 'The measurement of productive efficiency', *Journal of the Royal Statistical Society*, Series A, CXX, Part 3, pp. 253-290.

Faruq, HA & Yi, DT 2010, 'The determinants of technical efficiency of manufacturing firms in Ghana', *Global Economy Journal*, 10, 3, pp. 1-21.

Ferrier, GD & Hirschberg, JG 1997, 'Bootstrapping confidence intervals for linear programming efficiency scores: with an illustration using Italian bank data', *Journal of Productivity Analysis*, 8, pp. 19-33.

Ferrier, GD & Trivitt, JS 2012, 'Incorporating quality into the measurement of hospital efficiency: a double bootstrap approach' *Journal of Productivity Analysis*, pp. 1-19.

Fischer, E 1992, 'Sex differences and small business performance among Canadian retailers and service providers', *Journal of Small Business and Entrepreneurship*, 9, 4, pp. 2-13.

Fischer, EM, Reuber, RA & Dyke, LS 1993, 'A theoretical overview and extension of research on sex, gender and entrepreneurship', *Journal of Business Venturing*, 8, pp. 151-168.

Fixler, D & Siegel, D 1999, 'Outsourcing and productivity growth in services', *Structural Change and Economic Dynamic*, 10, pp. 177-194.

Frankel, JA 2010, 'The natural resource curse: a survey', HKS Faculty Research Working Paper RWP10-005, John F. Kennedy School of Government, Harvard University.

Fried, HO, Lovell, KAC & Schmidt, SS 2008, *The measurement of productive efficiency and productivity change*, Oxford Scholarship online.

Fried, HO, Schmidt, SS & Yaisawarng, S 1999, 'Incorporating the operating environment into a non-parametric measure of technical efficiency', *Journal of Productivity Analysis*, 12, pp. 249-267.

Girma, S & Gorg, H 2004, 'Outsourcing, foreign ownership, and productivity: evidence from UK establishment level data', *Review of International Economics*, 12, 5, pp. 817-832.

Gokcekus, O 1995, 'The effects of trade exposure on technical efficiency: new evidence from the Turkish rubber industry', *Journal of Productivity Analysis*, 6, pp. 77-85.

Grosskopf, S 1996, 'Statistical inference and non-parametric efficiency: a selective survey', *Journal of Productivity Analysis*, 7, pp. 161-176.

Halkos, GE & Tzeremes, N 2010, 'The effect of foreign ownership on SMEs performance: an efficiency analysis perspective', *Journal of Productivity Analysis*, 34, pp. 167-180.

Harris, RID 1991, 'Measuring efficiency in Northern Ireland manufacturing using a frontier production function approach', *Scottish Journal of Political economy*, 38, 4, pp. 386-397.

Hebert, R & Link, A 1989, In search of the meaning of entrepreneurship, *Small Business Economics*, 1, pp. 39-49.

Heshmati, A 2003, 'Productivity growth, efficiency and outsourcing in manufacturing and service industries', *Journal of Economic Surveys*, 17, 1, pp. 0079-34.

Hessels, J, van Gelderen, M & Thurik, R 2008, 'Entrepreneurial aspirations, motivations, and their drivers', *Small Business Economics*, 31: pp. 323-339.

Hill, CB 1991, 'Managing commodity booms in Botswana', *World Development*, 19, 9, pp. 1185-1196.

Hill, H & Kalirajan, KP 1993, 'Small enterprise and firm level technical efficiency in the Indonesian garment industry', *Applied Economics*, 25, 9, pp. 1137-1144.

Holtz-Eakin, D & Kao, C 2003, 'Entrepreneurship and economic growth: the proof is in the productivity', Centre for Policy Research Working Paper 50, Syracuse University, New York.

Horne, M, Lloyd, P, Pay, J & Roe, P 1992, 'Understanding the competitive process: a guide to effective intervention in the small firms sector', *European Journal of Operation Research*, 56, 1, pp. 54-66.

Hossain, MA & Karunaratne, ND 2004, 'Trade liberalization and technical efficiency: Evidence from Bangladesh manufacturing industries', *Journal of Development Studies*, 40, 3, pp. 87-114.

Human Resource Development Bill of 2013, Ministry of Education and Skills Development, Gaborone.

Humphreys, M, Sachs, JD & Stiglitz, JE 2007, 'What is the problem with natural resource wealth' in M Humphreys, JD Sachs & JE Stiglitz (eds.), *Escaping the resource curse*, Columbia University Press, pp. 1-20.

Iimi, A 2007, 'Escaping from the resource curse: evidence from Botswana and the rest of the world', *IMF Staff Papers*, 24, 54, International Monetary Fund.

Im, FG & Rosenblatt, D 2013, 'Middle-income traps: a conceptual and empirical survey', *World Bank Policy Research Working Paper 6954*, The World Bank, Operations and Strategy Unit, Development Economics.

International Bank for Reconstruction and Development/World Bank 2012, *Doing Business 2013: smarter regulations for small and medium sized enterprises*, The World Bank Group.

International Monetary Fund (IMF) 2012, *Macroeconomic Policy Frameworks for Resource-Rich Developing Countries Background Paper 1*, International Monetary Fund.

International Monetary Fund (IMF) 2014a, Sustaining long run growth and macroeconomic stability in low income countries - the role of structural transformation and diversification, IMF Policy Paper March/2014, International Monetary Fund.

International Monetary Fund (IMF) 2014b, Botswana: 2014 article IV consultation, *Country Report 14/204*, International Monetary Fund.

Jo, H & Lee, J 1996, 'The relationship between and entrepreneur's background and performance in a new venture', *Technovation*, 16, 4, pp. 161-171.

Johnson, S & Storey, D 1993, Male and female entrepreneurs and their businesses: a comparative study in S Allen & C Truman (eds.), *Women entrepreneurs*, Routledge, London.

Kalirajan, KP & Shand, RT 1999, 'Frontier production functions and technical efficiency measures', *Journal of Economic Surveys*, 13, 2, pp. 149-172.

Kalleberg, AL & Leicht, KT 1991, 'Gender and organizational performance: determinants of small business survival and success', *Academy of Management Journal*, 34, 1, pp. 136-161.

Kaparakis, EI, Miller, SM & Noulas, AG 1994, 'Short-run cost inefficiency of commercial banks: a flexible stochastic production frontier approach', *Journal of Money, Credit and Banking*, 26, 4, pp. 875-893.

Kelley, DJ, Singer, S & Herrington, M & the Global Entrepreneurship Research Association 2012, *Global Entrepreneurship Monitor: 2011 Global Report*', Babson College, Babson Park, United States.

Kharas, H & Kolhi, H 2011, 'What is the middle-income trap, why do countries fall into it, and how can it be avoided?', *Global Journal of Emerging Market Economies*, 3, 3, pp. 281-289.

Kilby, P 1983, 'The role of alien entrepreneurs in economic development', *American Economic Review*, 73, pp. 107-11.

Kim, S 2003, 'Identifying and estimating sources of technical inefficiency in Korean manufacturing industries', *Contemporary Economic Policy*, 21, pp. 132-144.

Kirk, R & Stern, M 2005, 'The new Southern African Customs Union agreement', *The World Economy*, 28, 2, pp. 169-190.

Kneip, A, Park, BU & Simar, L 1998, 'A note on the convergence of non-parametric DEA estimators for production efficiency scores', *Econometric Theory*, 14, pp. 783-793.

Kneip, A, Simar, L & Wilson, PW 2008, 'Asymptotics and consistent bootstraps for DEA estimators in non-parametric frontier models, *Econometric Theory*, 24, pp. 1663-1697.

Koopmans, TC 1951, 'An analysis of production as an efficient combination of activities', in TC Koopmans (ed.), *Activity analysis of production and allocation*, Cowles Commission for Research in Economics, Wiley, New York.

Koopmans, TC 1957, *Three essays on the state of economic science*, McGraw Hill, New York.

Kumbhakar, SC & Lovell, KAC 2000, *Stochastic frontier analysis*, Cambridge University Press, United Kingdom.

Land, KC, Lovell, KAC & Thore, S 1988, 'Chance-constrained efficiency analysis', Department of Economics Working Paper, University of North Carolina, Chapel Hill.

Land, KC, Lovell, KAC & Thore, S 1993, 'Chance constrained data envelopment analysis', *Managerial and Decision Economics*, 14, 6, pp. 541-554.

Latruffe, L, Davidova, S & Balcombe, K 2008, 'Application of a double bootstrap to investigation of determinants of technical efficiency of farms in Central Europe', *Journal of Productivity Analysis*, 29, pp. 183-191.

Lee, DY & Tsang, EWK 2001, 'The effects of entrepreneurial personality, background and network activities on venture growth', *Journal of Management Studies*, 38, pp. 583-602.

Leff, N 1979, 'Entrepreneurship and economic development: the problem revisited', *Journal of Economic Literature*, XVII, pp. 46-64.

Leontief WW 1953, *Studies in the structure of the American economy*, Oxford University Press, New York.

Leontief, WW 1941, *The structure of the American economy 1919-1939*, Oxford University Press, New York.

Loveman, G & Sengenberger, W 1991, 'The re-emergence of small scale production: an international comparison', *Small Business Economics*, 3, pp. 1-37.

Lucas, R 1988, 'On the mechanics of economic development', *Journal of Monetary Economics*, 22, pp. 3-39.

Lundvall, K & Battese, G.E 2000, 'Firm size, age and efficiency: evidence from Kenyan manufacturing firms', *The Journal of Development Studies*, 36, 3, pp. 146-163.

Man, TWY, Lau, T & Snape, E 2008, 'Entrepreneurial competencies and the performance of small and medium enterprises: an investigation through a framework of competitiveness', *Journal of Small Business and Entrepreneurship*, 21, 3, pp. 257-276.

Manzano, O & Rigobon, R 2001, 'Resource curse or debt overhang?', *National Bureau of Economic Research Working Paper 8390*, Cambridge.

Margono, H & Sharma, SC 2006, 'Efficiency and productivity analyses of Indonesian manufacturing industries', *Journal of Asian Economics*, 17, pp. 979-995.

McDonald, J 2009, 'Using least squares and Tobit in the second stage DEA efficiency analyses', *European Journal of Operational Research*, 197, pp. 792-798.

Meeusen, W & van den Broek, J 1977, 'Efficiency estimation from Cobb-Douglas production functions with composed error', *International Economic Review*, 18, pp. 435-444.

Mini, F & Rodriguez, E 2000, 'Technical efficiency indicators in a Philippine manufacturing sector', *International Review of Applied Economics*, 14, 4, pp. 461-473.

Ministry of Commerce and Industry 1998, *Industrial Development Policy*, Government Printers, Gaborone.

Ministry of Commerce and Industry 1999, *Policy on Small, Medium and Micro Enterprises*, Government Printers, Gaborone.

Ministry of Finance and Development Planning 1973, *National Development Plan 1973 - 1978*, Government Printers, Gaborone.

Ministry of Finance and Development Planning 1991, *National Development Plan 1991 - 1997*, Government Printers, Gaborone.

Ministry of Finance and Development Planning 1997, *National Development Plan 1997 - 2003*, Government Printers, Gaborone.

Ministry of Finance and Development Planning 2003, *National Development Plan 2003 - 2009*, Government Printers, Gaborone.

Ministry of Finance and Development Planning 2009, *National Development Plan 2009 - 2016*, Government Printing and Publishing Services, Gaborone.

Ministry of Finance and Development Planning 2010, *Budget Speech*, Government Printing and Publishing Services, Gaborone.

Ministry of Trade and Industry 2010, *Economic diversification drive guidelines*, Ministry of Trade and Industry.

Minniti, M, Bygrave, WD & Autio, E 2006, *Global entrepreneurship monitor: 2005 executive report*, Babson College, Babson Park, United States.

Mooney CZ & Duval, RD 1993, '*Bootstrapping: a non-parametric approach to statistical inference*', SAGE publications.

Mouelhi, RBA 2009, 'Impact of the adoption of information and communication technologies on firm efficiency in the Tunisian manufacturing sector, *Economic Modelling*, 26, pp. 961-967.

Mueller, P 2006, 'Exploring the knowledge filter: how entrepreneurship and university-industry relationships drive economic growth', *Research Policy*, 35, pp. 1499-1508.

Murillo-Zamorano, LR 2004, 'Economic efficiency and frontier techniques', *Journal of Economic Surveys*, 18, 1, pp. 0033-45.

Norberg, H & Blomstrom, M 1993, 'Dutch Disease and management of windfall gains in Botswana', in M Blomstrom & M Lundahl (eds.), *Economic crisis in Africa: perspectives on policy responses*, Routledge, London.

North, DC 1991, 'Institutions', *Journal of Economic Perspectives*, 5, 1, pp. 97-112.

Oczkowski, E & Sharma, K 2005, 'Determinants of efficiency in least developed countries: further evidence from Nepalese manufacturing firms', *The Journal of Development Studies*, 41, 4, pp. 617-630.

Olesen, OB & Petersen, NC 1995, 'Chance-constrained efficiency evaluation', *Management Science*, 41, 3, pp. 442-457.

Ondrich, J & Ruggiero, J 2001, 'Efficiency measurement in the stochastic frontier model: theory and methodology', *European Journal of Operational Research*, 129, pp. 434-442.

Organisation for Economic Cooperation and Development (OECD) 2014, Financing SMEs and entrepreneurs 2014: an OECD scoreboard, OECD Publishing.

Organisation for Economic Cooperation and Development (OECD)/United Nations 2011, *Economic diversification in Africa: a review of selected countries*, OECD Publishing.

Organization for Economic Cooperation and Development (OECD) 2004, *Promoting Entrepreneurship and Innovative SMEs in a Global Economy: towards a more responsible and inclusive globalization*, OECD publications, Paris.

Organization for Economic Cooperation and Development (OECD) 2005, *Entrepreneurship and Small and Medium Enterprise Outlook*, OECD Publications.

Park, B, Simar, L & Weiner, C 2000, 'The FDH estimator for productivity efficiency scores: asymptotic properties', *Econometric Theory*, 16, pp. 855-877.

Pegg, S 2010, 'Is there a Dutch disease in Botswana?', *Resources Policy*, 35, pp. 14-19.

Pham, HT, Dao, TL & Reilly, B 2009, 'Technical efficiency in the Vietnamese manufacturing sector', *Journal of International Development*, DOI: 10.1002/jid. 1588.

Piore, M & Sable, C 1984, *The second industrial divide: possibilities for prosperity*, Basic Book, New York.

Pitt, MM & Lee LF 1981, 'Measurement and sources of technical inefficiency in the Indonesian weaving industry', *Journal of Development Economics*, 9, 43-64.

Porter, ME & Schwab, K 2008, *The Global Competitiveness Report 2008-2009*, World Economic Forum, Geneva, Switzerland.

Porter, ME, Sachs, JD & McArthur, JW 2002, 'Executive summary: competitiveness and stages of economic development', in K Schwab, ME Porter & JD Sachs (eds.), *The Global Competitiveness Report 2001-2002*, World Economic Forum, Geneva, Switzerland, pp. 16-25.

Ramachandran, V & Shah, MK 1999, 'Minority entrepreneurs and firm performance in Sub-Saharan Africa', *Journal of Development Studies*, 36, 2, pp. 71-87.

Reynolds, PD, Bygrave, WD, Autio, E, Hay, M & Ewing Kauffman Foundation 2002, *Global entrepreneurship monitor: 2002 executive report*, Babson College, Babson Park, United States.

Reynolds, PD, Hay, M & Camp, MS 1999, *Global entrepreneurship monitor: 1999 executive report*, Kauffman Centre for Entrepreneurial Leadership at the Ewing Marion Kauffman Foundation, Kansas City.

Richmond, J 1974, 'Estimating the efficiency of production', *International Economic Review*, 15, pp. 515-521.

Robb, AM & Watson, J 2012, 'Gender differences in firm performance: evidence from new ventures in the United States', *Journal of Business Venturing*, 27, pp. 544-558.

Romer, P 1986, 'Increasing returns and long run growth', *Journal of Political Economy*, 94, pp. 1002-1037.

Romer, PM 1994, 'The origins of endogenous growth', *Journal of Economic Perspectives*, 8, 1, pp. 3-22.

Romero, CQ & Rodriguez, DR 2010, 'E-commerce and efficiency at the firm level', *International Journal of Production Economics*, 126, pp. 299-305.

Rosa, P, Carter, S & Hamilton, D 1996, 'Gender as a determinant of small business performance: insights from a British study', *Small Business Economics*, 8, pp. 463-478.

Ross, ML 1999, 'The political economy of the resource curse', *World Politics*, 51, pp. 297-322.

Roudaut, N 2006, 'Influences of the business environment on manufacturing firms technical efficiencies: the Cote d'Ivoire case', *Journal of Productivity Analysis*, 25, pp. 93-109.

Russell, RR 1990, 'Continuity of measures of technical efficiency', *Journal of Economic Theory*, 52, pp. 255-267.

Russell, RR 1997, 'Distance functions in consumer and producer theory in index number theory: essays in honour of Sten Malmquist, *Kluwer Academic Publishers*, pp. 7-90.

Sachs, JD & Warner AM 1995, 'Natural resource abundance and economic growth', National Bureau of Economic Research Working Paper 5398, Cambridge.

Sarasvaty, SD, Dew, N, Velamuri, SR & Venkataraman, S 2003, 'Three views of entrepreneurial opportunity', in ZJ Acs & DB Audretsch (eds.), *Handbook of Entrepreneurship research*, Kluwer Academic Publishers, Boston, pp. 141-160.

Sathye, M 2001, 'X-efficiency in Australian Banking: an empirical investigation', *Journal of Banking and Finance*, 25, 3, pp. 613-630.

Schmitz, JA 1989, 'Imitation, entrepreneurship, and long run growth', *Journal of Political Economy*, 97, pp. 721-739.

Schwab, K 2009, *The Global competitiveness report 2009-2010*, World Economic Forum, Geneva, Switzerland.

Schwab, K 2010, *The Global competitiveness report 2010-2011*, World Economic Forum, Geneva, Switzerland.

Schwab, K 2011, *The Global competitiveness report 2011-2012*, World Economic Forum, Geneva, Switzerland.

Schwab, K 2012, *The Global competitiveness report 2012-2013*, World Economic Forum, Geneva, Switzerland.

Schwab, K 2013, *The Global competitiveness report 2013-2014*, World Economic Forum, Geneva, Switzerland.

Schwab, K 2014, *The Global competitiveness report 2014-2015*, World Economic Forum, Geneva, Switzerland.

Seaver, BL & Triantis, KP 1992, 'A fuzzy clustering approach used in evaluating technical efficiency measures in manufacturing', *Journal of Productivity Analysis*, 3, 4, pp. 337-363.

Segerstrom, P 1991, 'Innovation, imitation and economic growth', *Journal of Political Economy*, 99, pp. 190-207.

Segerstrom, P, Anant, TC & Dinopoulos, E 1990, 'A Schumpeterian model of the product life cycle', *American Economic Review*, 80, pp. 1077-1091.

Seidler, V 2010, 'Why did Botswana end up with good institutions: the role of culture and colonial rule', 14th Annual Conference of the International Society for New Institutional Economics, University of Sterling, Scotland.

Seiford, LM & Thrall, RM 1990, 'Recent developments in DEA: a mathematical approach to frontier analysis', *Journal of Econometrics*, 46, pp. 7-38.

Sena, V 2006, 'The determinants of firms' performance: can finance constraints improve technical efficiency?', *European Journal of Operational Research*, 172, pp. 311-325.

Sengupta, J 1987, 'Production frontier estimation to measure efficiency: a critical evaluation in light of data envelopment analysis', *Managerial and Decision Economics*, 8, pp. 93-99.

Shephard RW 1970, *Theory of cost and production functions*, Princeton University Press, Princeton.

Shephard RW 1974, *Indirect production functions*, Hain.

Shephard, RW 1953, '*Cost and production functions*', Princeton University Press, Princeton.

Shiu, A & Zelenyuk, V 2011, 'Production efficiency versus ownership: the case of China', in I. van Keilegom & P.W Wilson, eds., *Exploring research frontiers in contemporary statistics and economics*, Springer-Verlag Berlin Heidelberg, pp. 23-44.

Simar, L & Wilson, P.W 1998, 'Sensitivity analysis of efficiency scores: how to bootstrap in non-parametric frontier models', *Management Science*, 44, 1, pp. 49-61.

Simar, L & Wilson, PW 1999a, 'Some problems with the Ferrier/Hirschberg bootstrap idea', *Journal of Productivity Analysis*, 11, pp. 67-80.

Simar, L & Wilson, PW 1999b, 'Of course we can bootstrap DEA scores! But does it mean anything?'Logic trumps wishful thinking', *Journal of Productivity Analysis*, 11, 1, pp. 93-97.

Simar, L & Wilson, PW 2000, 'A general methodology for bootstrapping in non-parametric frontier models', *Journal of Applied Statistics*, 27, 6, pp. 779-802.

Simar, L & Wilson, PW 2007, 'Estimation and inference in two-stage, semi-parametric models of production processes', *Journal of Econometrics*, 136, pp. 31-64.

Soderbom, M & Teal, F 2004, 'Size and efficiency in African manufacturing firms: evidence from firm level panel data', *Journal of Development Economics*, 73, pp. 369-394.

Solow, RM 1956, 'A contribution to the theory of economic growth', *Quarterly Journal of Economics*, 70, 1, pp. 65-94.

Statistics Botswana 2011, *External Trade Statistics 2010*, Statistics Botswana, Gaborone.

Statistics Botswana 2013a, *Botswana Core Welfare Indicators Survey 2009/10*, Statistics Botswana, Gaborone.

Statistics Botswana 2013b, *Preliminary Results: Botswana AIDS Impact Survey*, Statistics Botswana.

Statistics Botswana 2014, *Botswana International Merchandise Trade Statistics*, Statistics Botswana.

Taymaz, E & Saatci, G 1997, 'Technical change and efficiency in Turkish manufacturing industries', *Journal of Productivity Analysis*, 8, pp. 461-475.

The Economist 1977, 'The Dutch disease', *The Economist*, November 26, pp. 82-83.

Thurik, AR, Carree MA, van Stel, A & Audretsch, D.B 2008, 'Does self-employment reduce unemployment?', *Journal of Business Venturing*, 23, pp. 673-686.

Thurik, R & Wennekers, S 2001, 'A note on entrepreneurship, small business and economic growth', *Erasmus Research Institute of Management Report Series, ERS-200-60-STR*, Rotterdam School of Management.

Thurik, R & Wennekers, S 2004, 'Entrepreneruship, small business and economic growth', *Journal of Small Business and Enterprise Development*, 11, 1, pp. 140-149.

Timmer, CP 1971, 'Using a probabilistic frontier production function to measure technical efficiency', *Journal of Political Economy*, 79, 4, pp. 776-94.

Tran, TB, Grafton, QR & Kompas, T 2008, 'Firm efficiency in a transitional economy: evidence from Vietnam', *Asian Economic Journal*, 22, 1, 47-66.

Transparency International 2013, *Corruption Perceptions Index 2013*, Transparency International.

United Nations Conference on Trade and Development (UNCTAD) 2003, *Botswana Investment Policy Review*, United Nations.

United Nations Development Programme (UNDP) 2013, *The Rise of the South: Human Progress in a Diverse World*, United Nations Development Programme.

Valdmanis, V 1992, 'Sensitivity analysis for DEA models: an empirical example using public vs NFP hospitals', *Journal of Public Economics*, 48, pp. 185-205.

van Stel, A, Carree, M & Thurik, R 2005, 'The effect of entrepreneurial growth on national economic activity', *Small Business Economics*, 24, pp. 311-321.

Vixathep, S & Matsunaga, N 2012, 'Firm performance in a transitional economy: a case study of Vietnam's garment industry', *Journal of Asia Pacific Economy*, 17, 1, pp. 74-93.

Wennekers, ARM, Uhlaner, L & Thurik, AR 2002, 'Entrepreneurship and its conditions: a macro perspective', *International Journal of Entrepreneurship Education*, 1, 1, pp. 25-64.

Wennekers, S & Thurik, R 1999, 'Linking entrepreneurship and economic growth', *Small Business Economics*, 13, pp. 27-55.

Wennekers, S, van Stel, A, Thurik, R & Reynolds, P 2005, 'Nascent entrepreneurship and the level of economic development', *Small Business Economics*, 24, pp. 293-309.

Wilson, PW 1993, 'Detecting outliers in deterministic nonparametric frontier models with multiple outputs', *Journal of Business and Economic Statistics*, 11, 3, pp. 319-323.

Wilson, PW 1995, 'Detecting influential observations in data envelopment analysis', *Journal of Productivity Analysis*, 6, 1, pp. 27-46.

Wilson, PW 2006, *FEAR: a software package for frontier efficiency analysis with R*, Clemson University, South Carolina.

Wolszaczak-Derlacz, J & Parteka, A 2011, 'Efficiency of European public higher education institutions: a two stage multi country approach', *Scientometrics*, 89, pp. 887-917.

Woo, WT 2009, 'Getting Malaysia out of the middle-income trap', Mimeo, Davis: University of California Davis, August 13, 2009.

Wu, ZB, Yeung, G, Mok, V & Han, Z 2007, 'Firm-specific knowledge and technical efficiency of watch and clock manufacturing firms in China', *International Journal of Production Economics*, 107, pp. 317-332.

Xavier, SR, Kelley, D, Kew, J, Herrington, M, Vorderwulbecke, A & the Global Entrepreneurship Research Association 2013, *Global Entrepreneurship Monitor: 2012 Global Report*', Babson College, Babson Park, United States.

Yang, CH & Chen, KH 2009, 'Are small firms less efficient?', *Small Business Economics*, 32, pp. 375-395.

Zelenyuk, V & Zheka, V 2006, 'Corporate governance and firm's efficiency: the case of a transitional country, Ukraine', *Journal of Productivity Analysis*, 25, pp. 143-168.

Zelenyuk, V 2009, 'Power of significance test in Simar-Wilson two-stage efficiency analysis model', *Applied Economics Letters*, 16, 15, pp. 1493-1497.

Zizhou F 2009, *Linkages between trade and industrial policies in Botswana*, Trade and Industry Policy Strategies, Southern African Development Research Network.