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The Impact of Foreign Direct Investment on Productivity and Growth in the Southern African Development Community (SADC)

By

Nicholas Masiyandima

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Supervisor: Professor Paul J. Dunne

School of Economics

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Abstract

This thesis focuses on the impact of foreign direct investment on productivity and growth in the Southern African Development Community (SADC), which is dealt with in three related studies. The first study undertakes an investigation of the existence and nature of technology and productivity spillovers from foreign direct investment to domestic firms in the region, while the second investigates the role of the spatial density of economic activities in speeding up the productivity externalities and impact of foreign direct investment in FDI host countries. In the last study, we investigate the role of intra-regional bilateral foreign direct investment between South Africa and countries in SADC in influencing growth and income convergence in the region. The three studies are subjects of chapters 2, 3 and 4, respectively.

The first study uses firm level data from the World Bank Enterprise Surveys and employs alternative techniques to identify and estimate the within and intra-industry productivity impact of firm foreign ownership. It uses output per worker to measure firm productivity and employs sector fixed effects to identify the impact of foreign firm ownership on productivity. We find results that strongly suggest the existence of positive within firm and intra-industry FDI productivity spillover effects for the firms in the region; with both small and large firms experiencing productivity gains from more foreign firm ownership, although the productivity gains are larger for small firms than for large firms. Individual country productivity estimations suggest that relatively more developed countries have larger intra-industry spillover gains while less technologically endowed countries have lager within firm gains. In overall terms the chapter concludes that the region has productivity gains from FDI.

In the second study we employ macro time series data over 1980 to 2011 to estimate the separate and joint productivity effects of agglomeration and FDI externalities in the region. In order to achieve these objectives, we develop a theoretical framework that fuses together the roles of agglomeration and FDI productivity spillovers to be able to identify both individual and joint impacts of FDI and density on aggregate productivity growth. An instrumental variables estimation technique is employed, allowing for country fixed effects to identify the impacts of critical variables on productivity. Using an index of density constructed from the interaction of population density and urbanization to measure density of economic activities, we find results suggesting positive and complementary effects of agglomeration and FDI externalities on aggregate productivity in the region. The finding is robust to controlling for other alternative channels through which FDI and agglomeration productivity externalities can be transmitted to productivity such as human capital and human capital density. Consequently,

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we conclude that there are synergies between FDI and agglomeration that magnify productivity externalities from foreign direct investment in the region.

The third study is devoted to investigating the productivity and income convergence implications of bilateral FDI between South Africa as the leading FDI and technology source country in SADC and the rest of the countries in the region within the leader follower model of international technology diffusion and convergence suggested by Barro and Sala-i-Martin (2004). Using country per capita income data over the period from 1980 to 2011, we find evidence suggesting that countries with high levels of bilateral FDI between themselves and South Africa converge faster both on the region average income and on South Africa's per capita income than those with low bilateral FDI stocks. The finding is robust to estimating countries' income gaps to South Africa conditioned alternative potential sources of technology and productivity growth, including trade, FDI from the rest of the world and domestic capital formation. There are, therefore, prospects of technology and income convergence driven by South Africa as the major FDI country and technology leader in the region.

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My Parents, For Your Wishes!

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List of Acronyms

AERC	African Economic Research Consortium
BRICS	Brazil Russia India China and South Africa
CMA	Common Monetary Area
CSAE	Centre for Studies of African Economies
CZI	Confederation of Zimbabwe Industries
DRC	Democratic Republic of Congo
EAC	East African Community
ECOWAS	Economic Community Of West African States
ERSA	Economic Research of Southern Africa
EU	European Union
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
IBM	International Business Machines
IMF	International Monetary Fund
ISIC	International Standard Industrial Classification
MNCs	Multinational Corporations
OECD	Organization for Economic Co-operation and Development
PWT	Penn World Table
R&D	Research and Development
SACU	Southern African Customs Union
SADC	Southern Africa Development Community
SADCC	Southern African Development Coordination Conference
UCT	University of Cape Town
UNCTAD	United Nations Conference on Trade and Development
WDI	World Development Indicators
WBES	World Bank Enterprise Surveys

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Chapter 1

1.1 Introduction and Motivation

At least three features characterize the global economy at the time of writing this thesis. Firstly, foreign direct investment has been increasing both at the global level and for developing countries for at least two decades, with the stock of global inward FDI increasing by more than tenfold from US$2.1 trillion to US$25.4 trillion between 1990 and 2013 (UNCTAD, 2014). Similarly, annual flows of inward FDI increased from US$0.21 trillion to US$1.45 trillion over the same period. Secondly, the share of inward FDI flows destined for the developing countries has been increasing, with UNCTAD (2014) reporting that the share of FDI flows accruing to the developing countries reached 54% of the global FDI flows in 2013 compared to 39% for the developed countries. These developments have been occurring alongside significant improvements in developing countries' FDI absorptive capacities, including the policy environment, quality of institutions and human capital development (Spence, 2011). Lastly and tying up with the above developments, there has been relatively high growth and faster convergence of developing countries' incomes towards the developed countries for more than a decade long (Rodrik, 2011 and Spence, 2011)

These facts are unlikely to be a coincidence. The growth in FDI and increased country openness have led to significant internationalization of the benefits of R&D undertaken in advanced economies (Keller, 2004). Thus, trade, foreign direct investment and the international exchange of ideas have improved significantly over the years with attendant benefits accruing to the global economy in the form of productivity growth, especially for developing countries which host relatively limited R&D and human capital stocks. However, even though it is widely acknowledged that international sources of technology are crucial for productivity gains for the developing countries, with Keller (2004) noting that foreign sources of technology account for at least 90 percent of domestic productivity growth in developing countries, the debate about whether trade and FDI have positive impacts on recipient countries' productivity remain unsettled. Nevertheless, the increasing share of FDI accruing to developing countries is likely to imply that the countries have been accessing considerably increasing amounts of foreign technology and advanced production techniques from the developed world.

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There are several channels through which foreign direct investment can drive growth of the FDI host country and these include factor accumulation effects (Alfaro et al, 2009 and Lipsey, 2002) as well as technology externality effects (Keller and Yeaple, 2009; Javorcik, 2004 and Blomstrom and Kokko, 2003). Factor accumulation is in respect of additions to the FDI recipient countries' stocks of physical and human capital that occur directly from FDI augmentation, while technology externality effects occur through improved domestic productivity resulting from the local presence of foreign firms and investments. A number of potential channels through which FDI confers technology to the FDI host countries have been proffered and include labour turnover between the MNCs and local firms; demonstrations effects by the MNCs, imitation of the MNCs' production methods by local firms, training and backward and forward linkages between local and foreign affiliate firms. In some instances MNCs have also directly invested in R&D and human capital development in the FDI recipient countries as with IBM in Kenya and Dupont (United States) in South Africa (UNCTAD, 2014). Such technology spillovers have been suggested to be the cause of sustained productivity growth in developing countries (Liu, 2008).

Despite the potential productivity gains from FDI for developing countries, not all researchers are optimistic about gains from international productivity spillovers through FDI, with Rodrik (1999) remarking that evidence suggesting that foreign direct investment causes growth is extravagant, while Aitken and Harrison (1999) suggest a market stealing hypothesis, in which foreign firms are perceived as squeezing domestic firms in local markets. The controversy suggests that the case for FDI productivity spilllovers remains a puzzling problem that needs further evidence based research. Consequently, this thesis engages with the debate and questions whether FDI has conferred productivity and growth gains in a group of mainly developing countries in Sub-Saharan Africa in SADC[1]. The thesis also searches for circumstances through which such gains can be attained or enhanced, more specifically within possible externality effects of agglomeration and intra-regional South African bilateral FDI as a technology leading country in the region.

This thesis makes a contribution to the debate on the productivity and growth effects of FDI by considering three broad objectives, which are subjects of three chapters. These are to

[1] The Southern African Development Community (SADC) is comprised of Angola, Botswana, Mozambique, Tanzania, Zambia, Lesotho, Malawi, Swaziland, South Africa, Namibia, the Democratic Republic of Congo (DRC), Mauritius, Madagascar, Zimbabwe and Seychelles

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investigate: (1) whether firm foreign ownership in SADC has had a positive effect on firm productivity; (2) whether agglomeration externalities in the region have productivity enhancing effects on FDI at the country level; and (3) whether intra-SADC South African bilateral foreign direct investment has a positive impact on per capita income convergence in the region.

We have chosen to study countries in SADC on account of the fact that they host a significant amount of FDI stock and flows on the African continent, with South Africa and Mauritius being among the top FDI recipients in Africa. In addition, given that SADC is a regional economic community, its countries should be close in terms of geography and a number of social, economic and political attributes making them poolable to allow for a larger data set for robust estimation and analysis. Similarly, the formation of SADC dates back to the mid-1970s[2], making room for us to have a long time series dimension for our studies utilizing panel data. Lastly, the region hosts South Africa, which is a leading FDI and technology source country in the region. This specifically makes it possible for the thesis to address research question three.

The first objective of the thesis is the subject of chapter two. It is motivated by the wide acknowledgement that firm productivity is critical to the build-up of aggregate country productivity and growth. Models of within-firm inefficiency, for example, suggest that large differences in countries' aggregate total factor productivity are a result of differences with which international technology diffuses across firms in different countries (Klenow and Rodriguez-Clare, 2005) while the resource misallocation hypothesis suggest that the differences in country productivity are due to inefficiencies with which productive resources are allocated across firms (Hsieh and Klenow, 2009). To the extent that these facts are valid, it is important to have a knowledge of how FDI influences firm level productivity to have a picture of its likely impact on aggregate productivity and growth at the country level.

Suggestions that firm foreign ownership can have a positive impact on local firm productivity follow from views that increased international interface among local firms and the MNCs promote the exchange of ideas on technology and better methods of production, which boost local productivity. Despite the plausibility of this prediction, empirical studies have both

[2] SADC was formed in the 1970s as Frontline States to seek political independence from colonialism and minority white rule in the region. Its members were Angola, Botswana, Mozambique, Tanzania, and Zambia. In the 1980, the organization was transformed to Southern African Development Coordination Conference (SADCC) when Lesotho, Malawi, Swaziland, and Zimbabwe joined. SADCC sought to reduce dependence on apartheid South Africa. In 1992, SADCC was transformed to a treaty based economic bloc SADC.

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confirmed the productivity spillover hypothesis (e.g. Javorcik, 2004 and Liu, 2008) as well as refuting it (e.g. Aitken and Harrison, 1999 and Carkovic and Levine, 2005). This suggests that the question of whether FDI confers productivity gains or not to the FDI host country should be addressed by way of more evidence based research on individual countries or regions rather than being inferred from generalized conclusions on arguments that productivity externalities from FDI are likely to be country or region specific.

For SADC, we argue that it is likely that most countries in the region are in transition from factor accumulation and resource based growth to technology driven growth and that FDI could be an important source of sustainable technology and productivity growth as suggested by Keller (2004). In light of this argument, firms in SADC have the potential to benefit from FDI. To address this hypothesis, we allow for an objective assessment of whether our expectations are true or not in this chapter by employing firm level data on firm foreign ownership and productivity to statistically infer whether there are firm productivity gains from the presence of MNCs in SADC. The hypothesis is tested for: (1) the pooled firms in the region, (2) firms in individual countries, and (3) small and large firms in the region. Using the harmonized World Bank Enterprise Surveys data for firms in the region and employing sector fixed effects as well as non-parametric estimation, we have found evidence suggesting the existence of positive within firm and intra-industry FDI productivity spillover effects for the region, for both small and large firms and for most of the countries in the region. In overall terms, we suggest that on average firms in SADC have positive gains from the presence of foreign firm ownership.

Chapter three follows up on chapter two by investigating whether firm level productivity gains from FDI in the region could imply higher aggregate country level productivity gains and whether country productivity gains from FDI can be enhanced by agglomeration externalities. It employs macroeconomic time series data from 1990 to 2011. The specific objectives of the chapter are: (1) to investigate whether FDI on its own confers aggregate country level productivity gains in the region, and (2) to investigate whether there are agglomeration externalities in the region which enhance the productivity effects of FDI productivity.

The study is motivated by both the FDI productivity spillover hypothesis and theories of agglomeration externalities, which suggest that there can be complementarities between FDI and agglomeration externalities that have the potential to boost the productivity effects of FDI yet the two have largely been treated in a mutually exclusive way by most studies on technology

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externalities (e.g. Ciccone and Hall, 1996; Abel, et al, 2011; Aitken and Harrison, 1999 and Carkovic and Ldevine, 2005). By suggesting that proximity of economic activities in agglomerated areas enhances the effectiveness and efficiency of ideas cross pollination, theories of agglomeration externalities imply that FDI which is located in countries or regions with greater concentration of economic activities is likely to confer greater technology externalities than that in sparsely populated countries and regions. In a more densely populated area where workers and human capital are highly concentrated, the cost of interaction and information searching and sharing is minimal, hence the spread of new managerial skills, expertise and technology which is associated with FDI becomes faster and more efficient as long as the negative effects of congestion are minimal.

The dichotomous treatment of FDI and agglomeration externalities in most the growth literature is exemplified by Ciccone and Hall (1996) who does not pay attention to the actual source of productivity in his estimated density of economic activities economies, while studies that have assumed human capital as the source and compliment of agglomeration externalities such as Liu (2013) have assumed away possible productivity externalities from FDI. Similarly, it can be argued that studies by Aitken and Harrison (1999) and Carkovic and Levine (2005), which have failed to confirm productivity externalities from FDI may have failed on account of not accommodating the potential productivity magnifying effects of agglomeration. This view follows from Driffield and Munday (2000) who find that agglomeration and FDI actually positively impact on domestic industry comparative advantage in the UK, implying that the productivity crowding out effect of FDI suggested by Aitken and Harrison (199) may be outweighed by its positive competitiveness effect in agglomerated regions. From this, it follows that dichotomous treatment of FDI and agglomeration productivity externality effects is a problem that creates a research gap that needs more researched.

This chapter is a contribution to this research gap in an area which is thinly studied. To address the study's objectives, we have used three measures of country level agglomeration effects, which are urbanization, population density and a composite index of agglomeration effects, which combines urbanization and population density and find results suggesting that agglomeration externalities in SADC are complimentary to and enhance the productivity externalities of FDI, suggesting that FDI which lands in urban and more agglomerated areas confers more productivity gains for the region. The chapter's findings are robust to isolating out alternative sources of productivity externalities and channels that include human capital,

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human capital density and the demand and factor accumulation effects of FDI and density. In overall terms, we have suggested that FDI and agglomeration effects are synergistic in improving aggregate productivity in the region and that there may be need to jointly consider both agglomeration and FDI policies as development strategies for the region.

Turning to the subject of chapter four, we have dealt with the role of South African bilateral FDI in SADC in fostering productivity and income convergence within the context of the leader follower[3] model of international technology diffusion suggested by Barro and Sala-i-Martin (2004). According to Barro and Sala-i-Martin (2004), the international diffusion of technology between a technology leader and a technology follower occurs through a continuous process of innovation by the leader and imitation by the follower. Because it is cheaper for the follower to imitate and adopt the advanced technology from the leader than for the leader to innovate, the poor country is predicted to eventually catch up with the leader.

The leader follower theoretical framework employed to tackle chapter four's objective is inspired by the existence of South Africa as a major source country for FDI and a technology leader in the region. The country accounts for up to 90% of the inward FDI stocks in some of the SADC countries (UNCTAD, 2014). On the basis of these stylized facts, there is scope for the relatively technology poor countries in the region to catch-up with South Africa. To augment this motivation, Keller (2004) and Comin, et al (2012) have also suggested that technology diffusion negatively depends on geographic distance, implying that South African bilateral FDI is likely to confer productivity gains and income convergence opportunities in SADC than FDI from the rest of the world.

Despite the attractiveness of the leader follower convergence model for the SADC region, a study by the AfDB (2013) suggests that what matters in promoting productivity growth and convergence is the quality of FDI, with FDI in manufacturing sectors likely to confer greater technology spillovers internationally than FDI in the extractive or primary sectors. This implies that South African bilateral FDI in the region may cause or fail to cause faster income convergence depending on its quality. In addition, as argued by Durham (2004), countries' domestic FDI absorptive capacities are likely to be critical with regard to the productivity

[3] The thesis' chapter four is based on Barro and Sala-i-Martin (2004), who put forward a model of convergence between a technology leading country and a technology following country through international diffusion of technology. We hereafter refer to the model as the "Leader Follower Model."

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impact of intra-SADC South African bilateral FDI, with countries hosting better capacities likely to converge on South Africa faster than otherwise. This means that the applicability of the leader follower model of international technology diffusion and convergence in SADC should be an empirical subject that needs to be investigated on the basis of evidence on patterns of FDI and incomes prevailing in the region.

To investigate the income convergence impact of South African FDI in SADC, chapter four characterizes and compares patterns of income convergence between countries with high South African FDI and those with low South African FDI over the period 1980 to 2011. The time frame for the data has been chosen to establish a time dimension which is long enough to allow us to use unit roots tests for country pairwise income convergence on South Africa which is more informative and applicable to the few countries in our study (Bernard and Durlauf, 1994 and Greasley and Oxley, 1997). We find results suggesting that there is faster convergence of incomes in countries with high South African bilateral FDI on both average incomes and South Africa's per capita income than those with low FDI stocks. The results are robust to estimating countries' income convergence on South Africa's per capita income conditioned on a number of alternative sources of technology and productivity growth that include trade, FDI from the rest of the world and domestic capital formation, suggesting that the region enjoys technology spillovers and productivity gains from South Africa's intra-SADC bilateral FDI.

In conclusion, the thesis contributes to the debate on the developmental effects of FDI in developing countries. Its contribution is threefold. First, it investigates the impact of FDI at the micro firm level as well as at the macro level for the same countries. This is distinguished from studies which undertake investigations either at firm level or at country level without inferring effects at various levels. Second, by investigating the role of agglomeration effects on FDI productivity externalities, the study distinguishes itself from most studies that treat the two externality factors separately. To the best of our knowledge, there is no study which has investigated complementarities between FDI and agglomeration externalities for the SADC region, making our contribution potentially important. Lastly, a direct link of the income convergence impact of mutual FDI between FDI source and host countries undertaken in chapter four is a thinly researched area. The chapter is, therefore, a potential significant contribution to the literature on growth and income convergence, especially for SADC region.

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1.2 Organization of the Thesis

After outlining the major milestones of the thesis, we outline the organization of the thesis, with the study on the FDI productivity spillovers for firms in SADC being undertaken in chapter two while chapter three deals with the macro level impacts of FDI and agglomeration effects on productivity in the region and chapter four handling the study on whether bilateral FDI between South Africa and countries in the region positively impacts on income per capita convergence in the region. Chapter five concludes the thesis.

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Chapter 2

Foreign Direct Investment and Firm Productivity in the SADC Region

2.1 Introduction

The issue of cross country income differences is topical in studies on growth with various propositions being made about the source of the differences. Studies by Banerjee and Duflo (2005) and Hsieh and Klenow (2009), for example, suggest that part of the cross country differences in per capita incomes results from productivity differences at firm and industry levels, with Klenow and Rodriguez-Clare (2005) noting that differences in within-firm efficiency and productivity emanate from differences in rates of international technology diffusion across countries. Klenow and Rodriguez-Clare (2005), therefore, imply that increases in a country's aggregate growth emanate from improvements in firms' technical efficiencies. Similarly, Hsieh and Klenow (2009) arguing from the resource misallocation hypothesis, suggest that improving resource allocation efficiency among firms can raise a country's aggregate productivity and per capita income. It is clear that both models of within firm efficiency and those that are based on resource allocation efficiency across firms and industries suggest the importance of firm productivity in driving aggregate productivity.

Improvement in resource allocation can be achieved by the institution of market reforms that are inclined towards more competitive systems free of distortionary selective taxes and subsidies, for example, but a question that has been widely asked and researched on is how within firm technical efficiency can be improved (Romer, 1994). In one of their perspectives, endogenous growth theorists such as Romer (1994) and Mankiw, et al (1992) suggest that the driver of technology growth is productivity externalities emanating from R&D, innovation, human and physical capital investment. Thus countries with higher investment expenditures on research institutions, education, and infrastructure are expected to have accelerated growth, compared to those with low innovation. At firm level, the differences in country level productivity growth emanates from failure by firms to invest adequately in firm-specific capital and technical know-how, with firms that devote more resources and managerial time to accumulating more knowledge capital expected to experience higher growth that contribute to accelerated growth for the economy.

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While R&D and human capital development are plausible ways of improving firm level technical efficiency, most developing countries often have limited resources and capacity to undertake meaningful R&D and innovation. Similarly, resource reallocation is likely to be difficult for the countries given that most of the countries tend have structural and institutional rigidities such as distortionary subsidies and taxes in their product, credit and labour markets that restrict their ability to raise firm productivity through meaningful resource re-allocations (Hsieh and Klenow 2009). Consequently, the countries have relied more on foreign sources of technology such as FDI and trade as the immediate feasible options to access modern advanced technology, with Keller (2004) suggesting that foreign sources of technology account for at least 90% of the developing countries' domestic productivity growth.

In a model of international technology, Barro and Sala-i-Martin (2004) suggest that technologically poor countries can access advanced technology from countries with advanced technology through a leader follower catch-up mode involving processes of new innovations in the advanced economies and imitation by the technology poor countries, implying that poor countries that are more open to trade and capital flows should accelerate and converge towards higher income levels faster than otherwise. Similarly, Liu (2008) has a model suggesting that the presence of multinational corporations is positively related to the accumulation of firm-specific capital in the FDI host country by way of their positive effect on local innovation possibilities, while Blomstrom and Kokko (1998) suggest that firms in countries hosting more MNCs are forced to improve their productive efficiency due to stiffer competition they face from the MNCs. These models suggest that firms in the developing countries stand to benefit from the domestic presence of MNCs.

Given these propositions, the question which inspires this study is whether an increase in developing countries' exposure to foreign sources technology can effectively transmit higher technology and productivity externalities in SADC. In more specific terms, we consider how foreign firm ownership in the Southern African Development Community (SADC), which is mainly comprised of developing countries in Sub Saharan Africa, has impacted on firms' productivity in the region. We argue that technology growth is critical for the region and that FDI should be one important source of technology for the countries given their limited R&D and internal innovations. In addition to the direct transfer of technology associated with FDI, Blomstrom and Kokko (1998) add that local firms also benefit from better international markets

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exposure and access over time though associating with the MNCs. These FDI effects suggest that there can be potential benefits from the existence of MNCs in the region.

The perceived gains from FDI have led most developing countries to institute a number of diverse institutional reforms, FDI absorption capacities and fiscal incentives such as tax and tariff exemptions in order to attract and retain foreign investments. Coincidently, there has been a significant increase in the global stock of inward foreign direct investment over the years, with developing countries getting an increasing share of the flows (UNCTAD, 2014). Concurrently, the SADC region has had significant growth in inward FDI for over a decade, with the region hosting an average of about 36% of FDI flows to Africa between 2000 and 2009 and a cumulative of US$83 billion of FDI in greenfield projects in manufacturing and services between 2009 and 2013 (AfDB, 2011 and UNCTAD, 2014). The increase in FDI for developing countries is potentially a result of the incentives and support measures for FDI that these countries have been instituting. However, a question which remains debatable is whether there have been commensurate gains from the resource outlays and FDI inflows.

Skeptics of the role of FDI in development include the dependency neo-Marxist school, which sees FDI as benefiting the FDI source countries and the modern economy at the expense of the host and periphery (Wilhelms, 1998). In their criticism, MNCs are regarded as entities that suppress and distort the development process and unduly manipulate the political systems of the countries in which they invest (Findlay, 1978). Similarly, Rodrik (1999) has remarked that studies that suggest the existence of productivity spillovers from FDI to the host country are extravagant while Ajayi (2006) has hinted at the possibility of less developing countries “racing to the bottom” in excessive support measures for foreign direct investment. In addition, Aitken and Harrison (1999) puts forward a market stealing hypothesis suggesting that FDI crowds out domestic investment and productivity in the FDI host countries while UNCTAD (2013) has reported a global decline in FDI’s contribution to exports and value addition growth.

In the SADC region, however, there has been high growth during the high FDI growth period, with the region growing by up to an average of about 6.4% between 2004 and 2008 and remaining above 4% since 2009 (AfDB, 2011). Notwithstanding the high growth rate over the period, there have been heterogeneities in the pattern of growth across countries which do not seem to tally with FDI patterns, with some major FDI recipient countries in the region including South Africa, Angola and Zambia, growing by below the region average growth. These facts

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suggest a clear puzzle that requires further research for a more informed evidence based analysis of the relationship between FDI and productivity growth.

The divergent perspectives and evidence on the productivity and growth impact of FDI are a motivating puzzle which this study attempts to address for the SADC region. In more specific terms, the study investigates the benefits of foreign firm ownership to the host SADC countries in terms of its impact on within firm and intra-industry productivity in the region, with the FDI productivity gains estimated for the pooled SADC firms, for individual countries and for small and large firms in the region. To achieve these objectives, the harmonized World Bank Enterprise Surveys firm data is used. The data covers 12 out of the 15 countries in the region. To the best of our knowledge, no cross country study on the impact of FDI on firm productivity in the region has been undertaken and the study should be a novel contribution to the literature on the FDI productivity spillover hypothesis. The results that we obtain are informative with regard to both the debate on the subject and for suggesting possible policy handles for the region and developing countries at large.

The organization of the study is as follows: the next section discusses literature on the FDI technology spillover hypothesis; section 2.3 presents the theoretical framework of the study; section 2.4 presents data description; sections 2.5 and 2.6 deal with the estimation and discussion of the study results and section 2.7 concludes the study and provide some policy recommendations.

2.2 Literature Review

Productivity spillovers from foreign direct investment were formally recognized and modelled since the 1960s, with MacDougall (1960) explicitly including them among the possible general welfare effects of foreign direct investment. Other early contributions were provided by Corden (1967), who theoretically looked at the effects of FDI on optimum tariff policy, and Caves (1971), who examined the welfare effects of FDI as well as how FDI influences the industrial structure. The presence of MNCs was perceived as a competitive force, which reduces profits, while improving efficiency and productivity. Because the aim of the studies was on welfare effects of FDI, FDI productivity externalities were discussed together with other indirect effects that came into the welfare assessment function, such as those arising from the impact of FDI on government revenue, tax policies, terms of trade, and the balance of payments. Since then,

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models that systematically consider the mechanisms and effects through which FDI productivity externalities are realized have been put forwarded.

Models of FDI productivity externalities envisage foreign direct investment productivity spillovers as occurring when the domestic presence of MNCs leads to productivity or efficiency benefits to local firms, and the MNCs' are not able to fully internalize the benefits. As suggested by Blomstrom and Kokko (2003), the gains include improvements in firms X-efficiency, allocative efficiency as well as international market access spillovers realized by local firms through their interactions with the MNCs. Various channels have been suggested for FDI productivity spillovers to local firms, which include the imitation of foreign technology by local firms; informal and formal interactions of workers between the MNCs and local firms through hiring and firing; backward and forward linkages between MNCs and local firms, and demonstrations effects.

Findlay (1978) proposed one of the early models of FDI productivity spillovers emphasizing the direct contacts between the MNCs and local firms and or their workers and technology diffusion was more seen as spontaneously taking place between MNCs and local firms that are situated in proximity. Thus, Findlay (1978) suggests that the spread of technology from advanced economies to the backward economies is facilitated by the presence of international corporations in the underdeveloped countries. In his model the rate of technology advancement in the backward economy receiving FDI positively depends on the technology gap between its own level of technology and that of the advanced country, implying that FDI does not only transfer technology to the FDI host country but also result in productivity and income convergence between the FDI source and host countries.

Wang (1990) has extended Findlay (1978)'s model by suggesting that FDI and the growth of domestic human capital are complimentary and endogenously depending on each other. In his model, an increase in FDI induces more investments in human capital, which enhances the catch-up potential of the recipient country. Higher levels of human capital on the other hand also attract more FDI inflows. In the whole, the relationship creates an opportunity for the FDI recipient country to expand its productivity. The perceived complementarities between FDI and domestic investment emanate from the growth in income associated with the presence of the MNCs. The limitation with models by Findlay (1978) and Wang (1990), however, is that they seem to suggest a passive role for individual firms in terms of building firm specific

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capacities to harness technology externalities from FDI, with Findlay (1978) likening the process of technology transmission to the spread of a contagion disease just requiring the interaction of foreign corporations and domestic firms to occur. This seem to suggest that the role of creating FDI absorptive capacities is delegated to governments.

The importance of the FDI absorptive capacities in the FDI host countries is explicitly modelled by Walz (1997) and Baldwin, et al (1999) who refer to the FDI absorptive capacities as the knowledge-capital sector. In Baldwin, et al (1999)'s model, the sector's productivity in terms of new innovations and technology positively depends on the amount of foreign technology brought by foreign corporations which influences the probability of new innovation and technology discoveries. Of late, some MNCs have resorted to building up their own R&D as exemplified by cases of IBM in Kenya and Panar Seed in Southern Africa (UNCTAD, 2014), with similar productivity spillover implications as those of national R&D centers except that productivity spillovers from individual firms' R&D are likely to be narrower and more firm specific than the more public R&D centres that are more general in scope.

Other models that involve the building of firm specific capital by the MNCs include models by Fosfuri, et al (2002) and Blomstrom and Kokko (2003) which explicitly model productivity spillovers from FDI to local firms through deliberate worker training and human capital development by the MNCs. Fosfuri, et al (2002)'s model emphasizes the protective attitude of the MNCs which extend their firm-specific technical and managerial know-how to local affiliates and pay the trained workers premium remunerations in order to ensure that they do not cross over to local firms. Alternatively, Fosfuri, et al (2002) suggests that the foreign firm may resort to exporting rather than investing off shore to protect its knowledge capital. However, productivity spillovers from the MNCs to domestic firms eventually occur when local firms appropriate the MNCs' technology by hiring the trained managers or when the managers start their own businesses.

Blomstrom and Kokko (2003), propose a wider relationship between FDI and domestic capital, in which higher levels of human capital are an FDI absorptive factor, which attracts FDI while at the same time, the MNCs provide scholarship and training for locals through direct funding of tertiary institutions, direct training of their workers and through providing prestigious employment opportunities to locals who advance in schooling. Their model suggests that there is an interaction effect between domestic human capital and FDI which leads to domestic

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human capital development and growth in productivity while at the same time creating higher FDI absorptive capacities. Thus according to the model, the effect of FDI on domestic productivity should be self-perpetuating through the induced human capital development.

A much broader model of FDI productivity spillover allowing for different forms of building productivity enhancing capacities by Ehrlich et al (1994)'s firm specific model capital accumulation model. In its version as modelled and utilized by Ehrlich et al (1994), the model suggests that the amount of resources and time devoted to the accumulation of firm-specific capital by the firm is dependent on the relative returns on marginal investment on the firm-specific capital to production. The broadness of the model emanates from its flexibility to handle different forms through which firms can accumulate knowledge capital from the local presence of MNCs which include setting up R&D centers and human capital training. As such the model is favorable to this study.

Liu (2008) has suggested that the local presence of foreign technology provides local firms with greater chance of new discoveries hence improve returns from time invested in the accumulation of firm-specific capital at the margin. This implies that higher levels of FDI incentivizes domestic firms to produce more firm specific capital and in the process to improving domestic firms' productivity. An important feature of the model by Liu (2008) is its ability to separate the short term productivity impact of FDI in the host economy which is likely to be negative as firms divert resources to accumulate the firm specific capital and the positive long run productivity impact occurring as returns from the built firm specific capital start to accrue. Liu (2008), however, does not emphasize the potential differences in the productivity impacts of intra-industry, within firm and extra-industry FDI and we argue that the effect of FDI on the marginal profitability of firm-specific capital investment should depend on whether it's within the same firm or sector or not.

Models of technology spillover from FDI to local firms suggest that the transfer of technology is not without costs. Besides the implied cost of accumulating firm-specific capital, the tacit nature of technology means that there are costs associated with diffusion of technology from the MNCs to local firms that require domestic firms to spend resources to access the technology. By suggesting that MNCs have an incentive to prevent technology leakage to local competitors through the use of intellectual property rights, production and trade secrecy and paying higher wages to trained workers, Fosfuri, et al (2002) imply that local firms can not

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freely access technology from the MNCs without expending some resources. Similarly, Aitken and Harrison envisage a market stealing hypothesis in which the MNCs crowd out domestic firms in local markets while Blomstrom and Kokko (1999) note that the entry and presence of MNCs disturbs existing domestic market equilibrium and forces local firms to take costly action to protect their market shares. The existence of these costs imply that the process of international technology transfer is not spontaneous but needs deliberate efforts by host countries to learn and transfer the technology, hence the appropriateness of Liu (2008)'s firm specific capital accumulation model which combines the possibility of both costs and benefits in the process of technology transfers.

Having looked at the various models of international technology transfers, we now turn to the empirical findings on the subject, which mainly fall into three categories. First, there are case studies such as by Moran (2001), which are highly informative but lacking external validity outside the case study because they pertain to particular FDI projects or specific countries. Then, there are industry-level studies, which have mostly used cross-sectional data and most of which have confirmed the FDI productivity spillover hypothesis, with higher foreign firm ownership leading to higher average value added per worker in the sector. These have been criticised for their inability to establish cause and effect between FDI and productivity or value addition. Finally, there are studies based on firm level panel data, which have sought to identify causality between productivity and FDI. The studies largely confirm productivity spillovers in developed countries while suggesting weak or no spillovers for developing countries.

Most of the early studies on the productivity spillovers of FDI indirectly tested the spillover effects of FDI through estimating the impact of MNCs on firm profit margins under the prediction that the presence of MNCs should lower monopolistic tendencies and lower profit margins (Caves, 1974). Caves (1974) estimated productivity spillovers in manufacturing industries in Canada, Australia and the United States by way of associating the spillover gains with inter-industry differences in the share of the market occupied by foreign firms in Canadian and Australian markets and finds results that confirm the gains. Similarly, Globerman (1979) estimated the differences in Canada's manufacturing industries labour productivity against various measures of foreign ownership and finds a positive relationship between productivity differences across plants and the amount of foreign ownership in an industry and suggest that the results confirm the FDI productive Spillovers.

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Other relatively more recent studies have estimated FDI productivity spillovers by closely linking the FDI source and host countries in a pairwise manner to see if there is any productivity convergence between the source and host countries. These nclude Nadiri (1991) who confirms the spillover hypothesis for U.S. direct investment in plant and equipment in France, Germany, Japan, and the U.K's manufacturing sectors and Blomstrom and Wolff (1994) who find evidence of manufacturing sector productivity convergence between the U.S and Mexico as a result of U.S FDI in Mexico's manufacturing sector. Because these studies are at industry or individual country levels, they are informative. Their limitation, however, is that they are not easily generalizable given their confinement to a specific country or industry.

Broader FDI technology spillovers are estimated by Keller and Yeaple (2009) who investigated the presence of international productivity spillovers through imports and foreign direct investment (FDI) for the US manufacturing firms between 1987 and 1996 and confirm both spillovers on the firms. The study finds that FDI leads to substantial productivity gains for domestic firms of about 11% of total productivity growth in U.S. firms, while imports-related spillovers are also found to be significant but weaker than those from FDI, thus suggesting the superiority of FDI in transmitting internationally. In another relatively developed economy, Edwards (2002) in a case of South African firms concludes that large foreign firms in export sectors are more productive than domestic owned firms. He finds that foreign firms are more skill and capital intensive than domestic firms and concludes that technological transfers through foreign ownership and export competition increase the skill intensity of production and productivity. The wider confirmation of the FDI spillover hypothesis for developed countries, seem to be in line with the argument that FDI can only transmit productivity externalities in environments of good absorption capacities given the level of development of the capacities in the advanced economies.

The importance of FDI absorption capacities is confirmed by most of the estimations of FDI productivity spillovers in less developed or developing countries where FDI absorptive capacities are relatively low which fail to confirm the spillover hypothesis. The studies include Haddad and Harrison (1993), who fail to confirm productivity spillover effects from FDI for Moroccan firms while Aitken and Harrison (1999) in a study of Venezuelan firms find negative intra-industry productivity effect of FDI on domestic firms and put forward a "market-stealing" hypothesis in which domestic firms are squeezed out by the MNCs in domestic to explain the negative effect of FDI on firm productivity. Similarly, Chen (2007) estimates the relationship

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between FDI and regional innovation capability in China and fails to confirm FDI spillover effects towards the innovation outputs of the R&D institutions. He instead finds that higher domestic R&D expenditure strengthens the FDI spillovers for domestic innovation, suggesting that developing countries should build domestic FDI absorption capacities, especially in R&D in order to enjoy productivity spillovers from FDI.

Liu (2008) and Javorcik (2004) have, however, suggested that evidence that discard the FDI productivity spillover hypothesis are a result of wrong model specifications. Using the firm specific capital accumulation model and separating the short and long run effects of FDI for the Chinese manufacturing firms, Liu (2008) finds evidence suggesting that an increase in firm foreign ownership lowers the firms' short-term productivity but significantly raises their long-term rate of productivity growth. In overall terms, he concludes that FDI has productivity spillovers which increase and become significant in the long-run. His results suggest that it is important to look at the impact of FDI on productivity from a long term perspective than from short term perspectives only since the process of accumulating firm specific capital takes time.

Similarly, Javorcik (2004) argues that studies which fail to confirm the FDI productivity spillover hypothesis are simply looking for the spillovers in the wrong place and suggest that studies should estimates the productivity spillovers in backward and forward linkages between domestic and foreign firms. In her study on Lithuanian manufacturing firms, Jarvocik (2004) finds evidence in support of positive productivity spillovers taking place through contacts between foreign affiliates and their local suppliers in upstream sectors and for joint ventures between foreign and domestic ownerships with not spillovers associated with wholly foreign owned firms. Jarvocik (2004) suggests that technology is more easily shared when the MNCs has direct control over the local affiliates and in mixed firm ownerships since such ownership types allow for a closer cross pollination of ideas. The study suggests that there is limited technology transfers when the MNCs are wholly foreign owned, implying a narrower channel of technology diffusion. Thus the estimated productivity spillovers are narrower than those suggested by the wider channels through which MNCs can transfer technology to local firms.

2.3 Modelling Technological Spillovers

In estimating the firm productivity impact of foreign firm ownership in SADC, this study is inspired by the firm-specific capital accumulation theoretical framework. The model gives an

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explicit pro-active role to the firm in the process harnessing the FDI productivity spillovers. It envisages firm-specific capital accumulation as an input in the firm production function. The accumulation of capital endogenously depends on optimum allocation of managerial time by the firm between production of technical know-how and firm output. The model is dynamic in nature and not directly applicable to cross section data. To suit our cross section data, we assume that when the firm is observed ex post, it has gone through its value maximizing choices of firm-specific capital investment. The firm is, therefore, observed as a high productivity or low productivity entity depending on its past firm-specific capital accumulation. We extend the model by Liu (2008) to allow different impacts of firm and sector FDI on firm productivity as suggested by Aitken and Harrison (1999). Following Liu (2008), the firm's production function is specified as:

$$Y_{ijt} = A_{jt} B_{ijt} L_{ijt}^{\alpha} K_{ijt}^{\beta} [H_{ijt} M_{ijt}]^{\gamma} \quad (1)$$

Where Y_{ijt} is the log of output for firm *i* in industry *j*. A_t represents exogenous technology which is common to all firms; B_{it} is the state of technology that is embodied in FDI for the firm. This is at firm level. L_{it} and K_{it} are the logs of labour and capital employment by the firm; H_{it} is the stock of firm specific capital. H_{it} is unique to the firm and it depends on the effort, resources and time that the firm devotes to R&D, imitation and learning from observing techniques employed by the MNCs. It is positively related to the amount of technical information the firm has. M_{it} is the proportion of time the firm devotes to current output production out of its total available production time assumed to be unit. Through its optimizing decision, the firm determines proportion of production time (M_{it}) and that for production of the firm specific capital ($1-M_{it}$). The allocation of firm time between M_{it} and $1-M_{it}$ affects the firm's labour input through a positive or negative scaling factor depending on whether the firm chooses to devote less or more of its managerial time to the production of firm specific capital.

The production of H positively depends on three factors. These are the current stock of the firm specific capital the firm has; the amount of time the firm devotes to the accumulation of new stocks ($1-M$) and the amount of technical information the firm has (G) (Liu, 2008).

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$$H_{ijt} = rH_{ijt-1}[1 - M_{ijt}]^{\delta} G_{ijt}^{\varphi} \quad (2)$$

The information input in the production function (G) is either internal to the firm or is in the public domain. An inflow of FDI releases new information on advanced methods of production through channels such as demonstrations and worker turn over. G , therefore, increases with FDI in the country. The parameter r is an efficiency parameter of the firm specific capital production. The parameter 0< δ <1 indicates whether there are diminishing, constant or increasing returns to the amount of time devoted to the production of firm specific capital. φ represents the intensity of technology spillovers from FDI to local firms. The parameter is at least greater than zero. If $\varphi \geq 1$ there are increasing returns from FDI technology spillovers and if $\varphi = 0$, FDI does not confer any technology spillovers to the production of H_t.

Following Aitken and Harrison (1999), we hypothesizes that the magnitude of φ depends on the magnitudes of sector and firm level FDI. The parameter increases with FDI in the firm's sector and with respect to the firm's foreign ownership percentage. The differences in the impact of sector FDI on firm specific capital follows from the fact that sector FDI is more accessible and provides more relevant information to the firm than FDI in other sectors, while the differences in the impact of foreign firm ownership is due to the fact that firms with more foreign ownership interact and interface more with other MNCs in terms of production linkages as well as worker turnovers than those with less foreign ownership. The log of firm's productivity from equation 1 is thus defined as:

$$TFP_{ijt} = \frac{Y_{ijt}}{L_{ijt}^{\alpha} K_{ijt}^{\beta}} = A_{jt} B_{ijt} [H_{ijt} M_{ijt}]^{\gamma} \quad (3)$$

Equation 2 links firm and sector FDI to the firm productivity equation through H. Substituting equation 2 into 3 gives a firm productivity equation, which is an implicit function of firm and sector foreign ownership, the past stock of firm specific capital, exogenous technology, and the level of technology embodied in foreign capital. The choice of M has two opposing effects on firm productivity. A reduction in the amount of time allocated to output production has a negative scale effect on current firm productivity. At the same time it increases the growth of the firm specific capital, which in the long term improves productivity. The net effect on

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productivity, depends on which effect dominates. Intuitively, the firm's optimum solution of M is at the point where the marginal profitability of time allocated to producing firm specific capital is equal to the marginal profitability of time allocated to output production.

From equation 3, it follows that an increase in FDI increases the marginal return of time allocated to production of firm specific capital through the potential increase in the firm's output productivity, with the effect depending on the level of foreign firm ownership, as well as on the total level of foreign ownership in the firm's sector. Firms in sectors with higher FDI or those with more foreign ownership have greater incentives to invest more in the firm specific capital and create higher scope for improved productivity. In a cross section of firms, firms with higher foreign ownership or in sectors with more FDI stocks are likely to have higher firm specific capital and so higher productivity.

On the basis of this analytical framework, we motivate the empirical model that we estimate to establish firm level productivity spillovers for firms in SADC. An estimable presentation of the firm-specific capital model in logarithm takes the form of equation 4, for which we have dropped the time subscript on the basis that the data that we use is cross sectional. Similar versions of the same model have also been used by Aitken and Harrison (1999) and Liu (2008).

$$Q_{ij} = \pi_0 + \pi_1 FDI_{firmij} + \pi_2 FDI_{\sec j} + \pi_3 FDI_{firm*\sec ij} + \pi_4 X_{ij} + \varepsilon_c + \varepsilon_I + \varepsilon_T + \varepsilon_i + \varepsilon_{ijc} \qquad (4)$$

With Q_{ij} proxing for the FDI productivity spillovers on firm *i* in sector *j*, which are the logarithm of labour productivity and total factor productivity in our case. FDI_{firmij} is the share of foreign equity participation at the firm level. If foreign ownership in a firm increases its productivity, the coefficient on FDI_{firmij} should be positive. The coefficient reflects the within firm productivity effect of changes in foreign firm ownership. $FDI_{\sec j}$ is a measure of the presence of foreign ownership in the industry, whose computation is detailed in the data section. On the basis of the productivity spillover hypothesis, the coefficient on industry FDI is expected to be positive. $FDI_{firm*\sec ij}$, is the level of industry foreign ownership for firms with foreign ownership. It allows for inference on whether the effects of the MNCs' presence on other foreign firms differs from the effects on domestic firms.

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The matrix X_{ij} captures other determinants of firm productivity that include firm size, firm age, infrastructure obstacles, corruption, credit constraints, human capital, industry regulations, access to land, institutions and political stability measures, which are all present in our data set. Shocks to firm productivity represented by $\varepsilon_c, \varepsilon_I, \varepsilon_T and \varepsilon_i$ are in respect of country, industry, year and firm fixed effects. They are controlled for by the inclusion of their respective dummies obtainable from the data, except for the firm specific effects. The year dummy takes account of the differences in the years the country surveys were done in light of the fact that technology evolves over time. The random shocks to firms' productivity are captured by ε_{ijc} and are assumed to be exogenous to the productivity covariates in the estimated model.

2.4 Data and Variables

In undertaking the study, we use data on manufacturing firms from the World Bank Enterprise Surveys[4] which were done between 2006 and 2011 for countries in SADC. All the surveys are consistent and harmonized by the use of standardized survey instruments and a uniform sampling methodology across countries (World Bank, 2007). This enables us to pool the survey data. Countries for which the survey data is available and included in the study are Angola, Botswana, DRC, Lesotho, Malawi, Madagascar, Mauritius, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. Data problems were in respect of Malawi, Lesotho and Seychelles, with Malawi's survey done in 2005 before the global survey approach and not easily poolable with other countries while the survey for Lesotho lacks critical variables on worker education and firm capital stocks and Seychelles does not have the surveys. The three countries were, therefore, left, with the remaining 12 countries constituting about 3000 manufacturing firms. South Africa has the largest data representation of 24%, while least representations are in Swaziland and Botswana (2%) (See Annex A, table A1).

The survey data covers firms in all the major two-digit manufacturing industries classified according to the International Standard Industrial Classification (ISIC), revision 3.1. To obtain enough number of firms in each industry, some of the industries were combined on the basis of similarities in the type of their activities in table 1. The category "Other Manufacturing" is

[4] Details on the WBES are in the attached Data Analysis background paper appendix.

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a residual category that includes all firms that are outside the five major industry groups. The re-grouping process yields six industry classification as presented in table 1.

Table 1: Industry Classifications

Category	ISIC	2-Digit Industry	No. of Firms
1	28, 29, 30	Industrial equipment and Fabricated Metals	398
2	27, 26	Basic Metals and non-Metals	106
3	24, 25, 19	Chemicals, Plastics and Rubber	276
4	15, 16	Food	812
5	17, 18	Textiles and Garments	511
6	20, 21, 22, 36, 37, 31, 32, 33, 34	Other	838

Source: World Bank Enterprise Surveys

The surveys data has information on firm birth year, firm location, firm foreign ownership, firm domestic ownership, firm size, management experience, assets, output, employment, input costs, product destination, raw materials and source of inputs, production constraints and other variables affecting firm productivity. Firm foreign ownership (FDI_{firmij}) is defined as the percentage of subscribed equity owned by foreign investors in a firm, while industry foreign ownership ($FDI_{\sec j}$) is average foreign equity participation for all firms in an industry[5], weighted by each firm's share in industry employment.

Firm foreign ownership ranges from 0% for no foreign ownership to 100% for firms that are wholly foreign owned, with an average of 15% for the region while industry FDI has an average of about 16%. To compute industry foreign ownership, we follow Liu (2008) as follows:

$$FDI_{\sec ij} = \sum_i \frac{employ_i}{Employ_j} XFDI_{firmij} \tag{5}$$

With $\frac{employ_i}{Enploy_j}$ giving the relative weights applied to individual firms' foreign ownership levels.

Since foreign firms tend to be more capital intensive than domestic firms as suggested by Edwards (2002), the share of foreign firms would be significantly higher if industry FDI is

[5] The terms plant and firm; and sector and industry are used interchangeably in this study, even though for our case the terms firm and industry are more appropriate.

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calculated using weights based on physical capital, hence the use of employment based shares. In line with arguments by Aitken and Harrison (1999) that firm productivity spillovers can also be spatially influenced, the estimated spillover model also includes a measure of region FDI wherein regions are defined in terms of the geographical clusters used in the surveys. The measurement of region FDI follows the same method as used in computing sector FDI in (5), except that firm weights are computed using regional instead of sector employment levels.

To measure productivity spillovers (Q), labour productivity is preferred due to its wide use and easy of computation given our survey data. However, total factor productivity (TFP) could have been a better measure of firm productivity but its computation is likely to suffer from biases associated with reverse causality in the cross section data that we use. The TFP is, however, still estimated and used for robustness checking against results from using labour productivity given that literature has suggested that the two measures are positively correlated due to production frictions (Bartelsman, et al 2013).

Labour productivity is computed as firm's real sales divided by the number of workers employed, where real sales are firms' nominal sales deflated by individual country GDP deflator to 2005 US dollar equivalence. An accurate measure of labour could have been actual number of hours worked instead of number of workers (Bartelsman, et al 2009). However, the firm surveys data used does not have information on hours worked, hence the measure could not be corrected for the effective time factor. Foster, et al (2008) and Bartelsman (2013) have, however, suggested that the correlation between measures that control for effective time worked and using the number of workers is positive and high, implying that number of workers employed can be used in place for hours worked.

Total factor productivity is the log of firms' deflated sales minus the weighted log of labour plus capital, where the weights are estimated from the Cobb-Douglas production function:

$$Y_{ij} = A_i + \theta_i^l L_{ij} + \theta_i^k K_{ij} + \omega_i + \varepsilon_{ij} \qquad (6)$$

With Y_{ij} measuring firm real output obtained as in the computation of labour productivity above. K_{ij} is the real value of physical capital employed by the firm, measured as firms'

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reported net book values of fixed assets that include equipment and machinery and motor vehicles. Following the same deflation procedure as used for sales, real capital figures are obtained by deflating the local currency units measured values of the assets to 2005 using each country's GDP deflator before they are converted to the US dollar equivalence at 2005 exchanges. L_{ij} is labour employment adjusted for human capital, with adjustment is done using the approach by Caselli (2005) defining human capital adjusted labour as: $L_i = W_i * e^{Q(S_i)}$, with W_i representing the number of full-time workers for firm i and $Q(s_i)$ the average human capital per employee, assumed to be piecewise linear in average worker education (s_i) of the firm[6]. ω_i is firm specific effects on productivity approximated by industry specific effects on assumption that the firm effects are proportional to the industry specific effects, i.e $\omega_i \propto \omega_j$.

While deflating output using individual countries' GDP deflator is closer to using inflation which is closely related to each firm's sales than deflating using the US deflator, the approach falls short of getting actual physical output, which can only be obtained by deflating nominal sales using the firm specific price deflator or at least the industry specific deflator in each country. However, information on the two alternative deflators is not available in the surveys, hence the use of economy wide price deflators. This means that, there are still elements of idiosyncratic demand shocks that are firm specific in the measures of productivity used. We, however, use the revenue productivity measures following Bartelsman et al (2013) who have justified and used revenue productivity measures on the basis that they are highly positively correlated with their respective physical productivity measures.

In estimating equation (6), literature has warned against productivity transmission to the optimal choice of inputs, which biases the estimated factor shares (Griliches and Mairesse, 1998). Attempts to correct the bias have often used IV approaches with firm fixed effects (Arellano and Bond, 1991 and Olley and Pakes, 1996). The nature of our data, which is cross sectional, forbids us from using the dynamic structural estimation methods, which require panel data. However, to minimize the productivity transmission bias in (6) we have resorted to

[6] On the basis of the piecewise approach used by Caselli (2005), human capital is estimated as 0.134*education years if education years>=2years; 0.132+0.101*education years if education years is equal to 3 or 4 years & 0.396+0.068*education years if education years>4

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instrumenting labour and capital with their past levels and use industry dummies as proxies for firm fixed effects.

Labour employment is instrumented by the number of workers employed by the firm at business commencement on the justification that productivity is persistent (Foster, et al, 2008 and Bartelsman and Dhrymes, 1998) and that more productive firms employ more workers (Edwards, 2002). To check on this assumption, we have estimated and find a correlation coefficient between workers at business commencement and current employment 0.7, which together with the fact that there should be no theoretical link between employment levels when the firm commenced operation and current firm productivity shocks justifies the instrument. While restructurings of firms between when the firm started operation and the time of the survey, could have affected firm productivity, it is assumed that on average firms that were perceived to be more productive at commencement of business are likely to remain productive after the restructurings, hence the high positive correlation between current employment and employment and business commencement.

Unlike labour employment decisions that are more short-term in nature, capital and investment decisions are relatively sunk and mostly determined at the beginning of the production year (Olley and Pakes, 1996). The factor is, therefore, instrumented by the current net book values of fixed assets on assumption that they are dependent on the amount of capital the firm had at the beginning of the production year and that the factor is subject to more adjustment frictions than labour that limit the amount productivity transmission from optimal capital choices during the current production period. Our approach is supported by Gandhi, et al (2012) who argue that if the value of an input is determined by a decision made before the current period, its current value can be used to instrument itself.

To check on whether the instruments used have reduced the bias in the estimated capital and labour shares or not, we have estimated the factor shares using both OLS and the IV technique and find that the IV approach reduces labour and increases capital elasticity coefficients compared to OLS except for Tanzania and Angola as shown in Annex A, table A3. This suggests that the IV technique that we employed has reduced the productivity transmission bias in the estimated production function. A summary of the computed variables and other major variables as well as their correlation coefficients are presented in tables 2 and 3, respectively.

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Table 2: Summary Statistics for Selected Variables

Variable	Obs	Mean	Std.Dev.	Min	Max
Log Labour Productivity	2469	6.122	1.684	0.0437	18.4
TF Productivity	2705	15.21	33.61	0	100
FDI_{firm}	2705	26.30	15.06	0	83.5
FDI_{sec}	2693	15.74	10.72	0	75
Mgt Experience (Years)	2194	3.543	2.944	0	100
Formal Competition	2686	19.58	18.83	1	100
Firm age (Years)	2213	1.562	6.317	0	100
Corruption	2705	0.716	1.024	0	5
Telephone Obstacle	2705	1.874	1.588	0	5
Credit Obstacle	2705	0.430	0.495	0	1
Firm Size	2705	0.796	0.403	0	1

*//Firm size (Small=1; Large=0); Tel and Credit Obstacle (not obstacle=0; Severe=5); Corruption=Expend. as % of Sales

Data Source: WBES

Table 3: Correlation Coefficients Summary for Selected Variables

	LP	TFP	Firm FDI	Sector FDI	Mgt Experience	Compe-tion	Firm Age
LP	1						
TFP	0.566	1					
Firm FDI	0.087	0.109	1				
Sector FDI	0.092	0.124	0.146	1			
Mgt Exper.	0.014	-0.072	-0.020	-0.055	1		
Competition	-0.025	-0.124	-0.050	-0.043	0.046	1	
Firm Age	0.171	-0.085	0.014	-0.106	0.374	0.034	1
Corruption	-0.118	-0.010	-0.007	0.065	-0.002	-0.013	-0.043
Tel. Obstacle	-0.007	-0.053	0.023	-0.008	-0.041	0.047	-0.019
Credit Obstacle	-0.158	-0.260	-0.101	0.001	0.005	0.077	-0.020
Start Workers	0.148	0.029	0.239	0.109	0.031	0.021	0.225
	Corrup-tion	**Telephone Obstacle**	**Credit Obstacle**	**Start Workers**			
Corruption	1						
Tel. Obstacle	0.027	1					
Credit Obstacle	0.005	0.270	1				

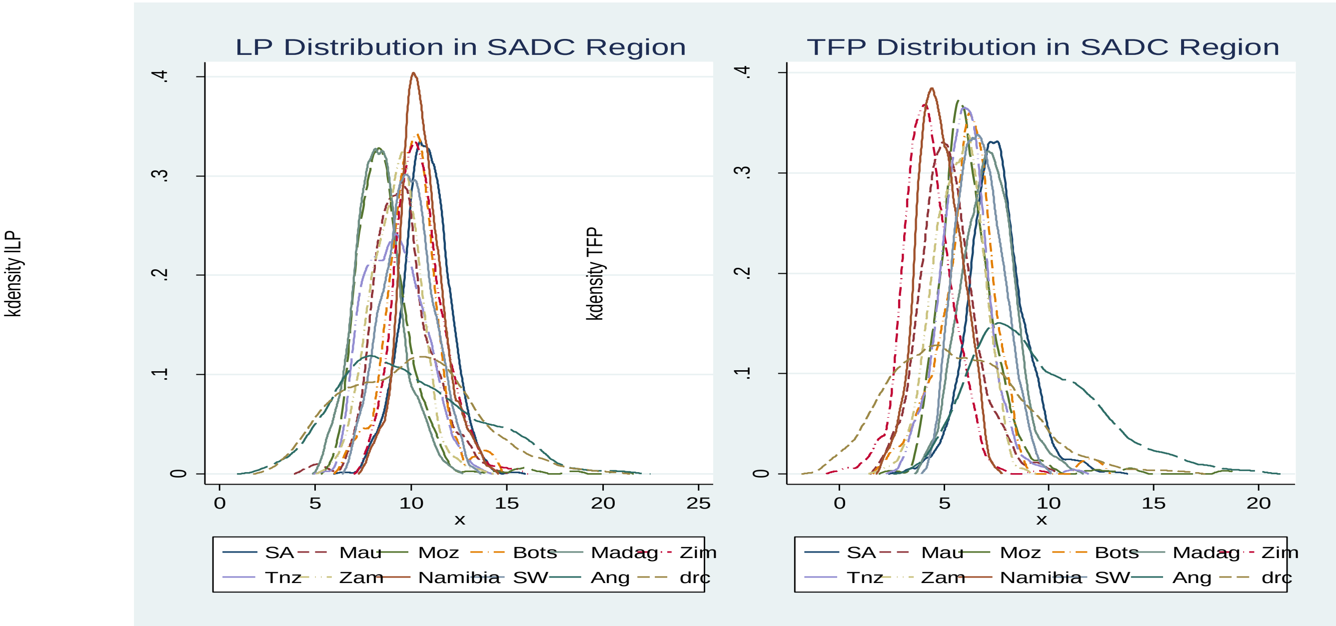
*//Firm size (Small=1; Large=0); Tel and Credit Obstacle (not obstacle=0; Severe=5); Corruption=Expenditure as % of Sales

Data Source: WBES

2.5 Non-Parametric Results Estimation and Analysis

It is important to assess the existence and nature of any heterogeneities in firm productivity across countries in the region to have an insight into how firms from the countries can be pooled. To do this, we have plotted labour and total factor productivity distributions for individual countries in SADC in figure 1, with labour productivity distributions shown first and the TFP distributions second. The figure suggests that average labour productivity is generally higher than total factor productivity in the countries. This confirms findings by Bartelsman, et al (2013) who suggest that the difference follows from the fact that when estimating labour productivity capital is fixed as opposed to varying both labour and capital when estimating TFP. In addition, there is evidence suggesting firm productivity heterogeneities, with differences in average firm productivity likely to be a result of country fixed effects as well as the effects, both of which require the use of country and time effects when estimating FDI productivity spillovers. There is also outlying productivity polarizations for DRC and Angola, which are likely to be a result of data problems.

Figure 1: Country Labour Productivity and TFP Distributions[7]



Source of Data: World Bank Enterprise Surveys

The effect of firm foreign ownership on firm productivity is assessed using the relative productivity distribution approach suggested by Morris and Handcock (1999)[8]. To be able to apply the method, we group firms into foreign and domestic owned firms and treat foreign owned firms as the referred group, while domestic owned firms are the comparison group. Firms are regarded as foreign owned if they have at least 10% foreign shareholding; otherwise they are defined as domestically owned. The cut-off point follows the International Monetary

[7] SA=South Africa; Mau=Mauritius; Moz=Mozambique; Bots=Botswana; Madag=Madagascar; Zim=Zimbabwe; Tnz=Tanzania; Sw=Swaziland; Ang=Angola; drc=The DRC

[8] The discussion of the relative distribution here is mainly based on Morris and Handcock (1999)

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Fund (IMF, 1993)'s definition of FDI which allows the foreign stakeholder a controlling share in the foreign owned firm. Even though the productivity distribution of foreign owned firms is treated as the reference distribution and that of the domestic owned firms as the comparison, similar results are obtained from switching the groups' roles.

The relative distribution analysis is used to compare the two groups' productivity on the basis of a common density function using relative productivity data between foreign owned and domestic owned firms. The relative productivity data (r) is the percentile rank that the productivity of domestic owned firms have in the productivity distribution of the foreign owned firms both ranked by the productivity cumulative density function of the foreign owned firms. The relative density function is defined by the ratio of the fraction of firms in the domestic owned firms' productivity distribution to the fraction of firms in the productivity distribution of the foreign owned firms; i.e.

$$RD = g(r) = \frac{f(Q_0(r))}{f_0(Q_0(r))} \qquad r \in [0,1] \tag{7}$$

With f defining the productivity PDF of the domestic firms and f_0 the productivity distribution of the foreign owned firms both evaluated at $Q_0(r)$ which is the rth quantile of the relative ranking of domestic owned firms' productivity to foreign owned firms' productivity on the original measurement scale and determined from the CDF of the foreign owned firms' productivity distribution. In contrast to directly comparing the groups' productivity distributions when they are overlaid on each other and requiring the computation of the differences between the two curves at each point on the scale, the relative productivity density codes this comparison directly in terms of a ratio. In general, the relative distribution is invariant to the scale of the distributions, implying that comparing productivity directly gives similar results as comparing the log of productivity (Morris and Handcock 1999).

From equation 7, if the relative productivity density greater than 1, it indicates that the frequency of domestic owned firms at the given quantile of the productivity distribution of foreign owned firms is greater than that of foreign owned firms implying greater productivity or foreign owned firms. If it is less than 1, it indicates greater frequency in the foreign owned

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firms distribution at the given quantile and greater productivity for domestic owned firms. For example, if the relative density of domestic firms' productivity at the 20th percentile of the foreign firms' productivity distribution is to 2, this means that domestic owned firms are about twice as likely as foreign owned firms to fall at this point of productivity, implying that domestic firms are less productive than foreign firms. Alternatively, this scenario means that the proportion of domestic owned firms with productivity level corresponding to the 20th percentile of the foreign owned firms' productivity distribution is twice the proportion of foreign owned firms at that point. When the two groups' distributions are identical, the relative productivity density is always equal to one and it is defined by the uniform PDF on [0, 1].

Following the relative productivity distribution analysis, the productivity distributions of the foreign and domestic owned manufacturing firms in SADC are shown in figure 2. Graphs in the first column of the figure give the firms' productivity distribution densities, with broken line graphs representing foreign owned firms and solid line graphs representing domestic owned firms; while graphs in the second column give the relative productivity distributions. In the first row, we present labour productivity distributions and the second row presents the total factor productivity (TFP) distributions.

An attempt to deduce productivity differences from overlaid productivity distributions of the foreign and domestic owned firms in the first column of figure 2 suggests that both labour and TFP are higher for foreign owned firms than for domestic owned firms, although the difference is marginal in the case of the TFP. The direct comparison of the productivity distributions, however, is limited in that it only gives a qualitative picture of the impact of firm foreign ownership on productivity. To get a more detailed analysis with quantitative interpretations using the relative distributions, we can use the relative productivity distributions in the second column with the 95% confidence bands to allow for statistical inferences on whether the difference in firm productivity is significant or not[9].

[9] For example, the top right graph shows that domestic firms have approximately between 1.25 and 2 more chance of falling at the 10th decile of the foreign owned firms' labour productivity, hence less productive than foreign owned firms.

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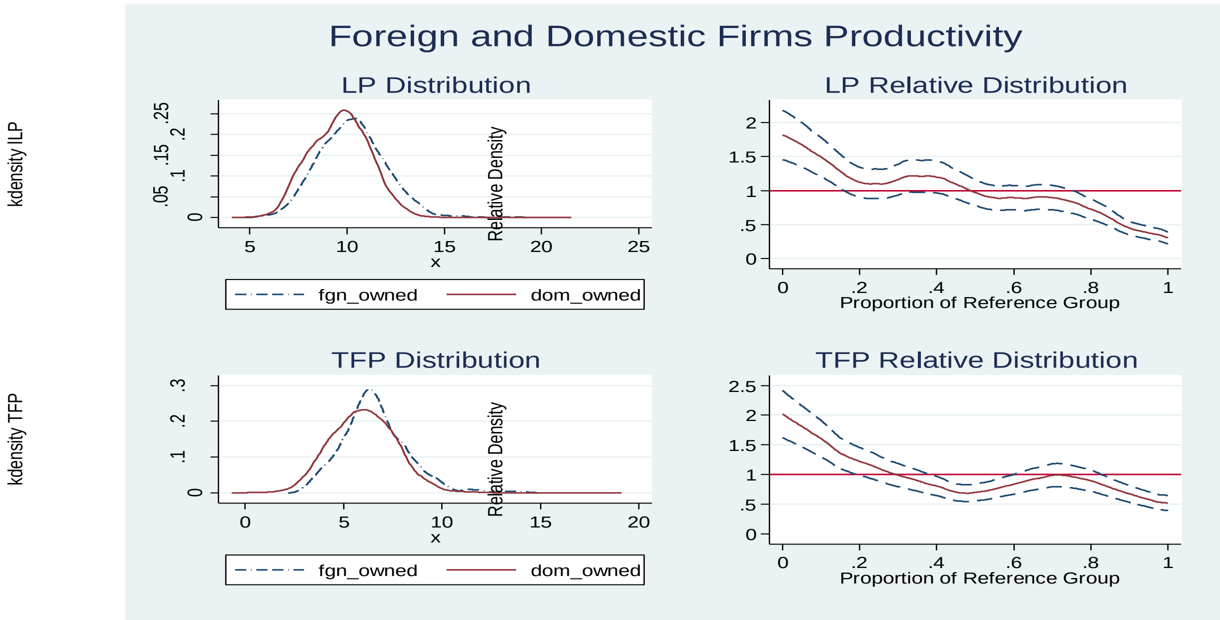
Figure 2: Firm Foreign Ownership and Firm Productivity



Source: World Bank Enterprise Surveys

Considering labour productivity in the first row of figure 2 first, the relative productivity distribution suggests that a greater proportion of domestic owned firms' productivity lies below the median labour productivity of foreign owned firms, with domestic firms' labour productivity twice more likely to fall below the median of the foreign owned firms' productivity than the foreign owned firms themselves. Similarly, there is a lesser proportion of domestic firms above foreign owned firms' median labour productivity. On the basis of the 95% interval, domestic firms' labour productivity is up to 1.5 times more likely to fall within the second decile of foreign firms' productivity distribution, implying that foreign owned firms are more productive than domestic owned firms in the region.

A qualitatively similar picture is portrayed by analyzing total factor productivity in the second row of the diagram. The TFP distribution of domestic firms is up to 2.5 times likely to fall within the lower 3nd decile of the productivity distribution of the foreign owned firms, while in the upper end of the distributions, which capture more productive firms both foreign and domestic owned firms are more or less equally productive. In overall terms, figure 2 suggests that domestic owned firms are on average less productive than foreign owned firms. The positive association between FDI and firm productivity is, however, either a result of FDI self-

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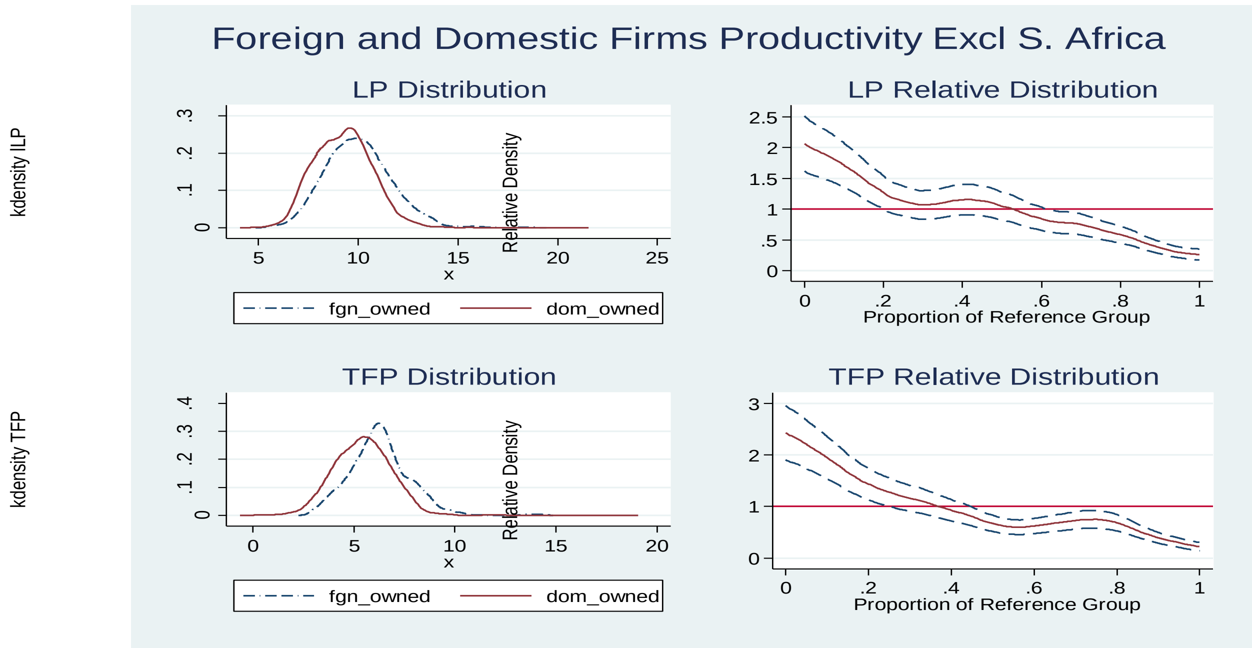
selecting into more productive firms or of FDI boosting firms' within-firm productivity, given that causality cannot be deduced from the relative distribution analysis.

One potential problem with results from figure 2 pertains to the dominance of South African firms in the survey data as well as its relatively high technology levels compared to the average country in the region. It can be speculated that the inclusion of South African firms in the analysis of productivity differences between foreign and domestic owned firms may have influenced the correlation results. In light of this observation, firms' productivity graphs are re-plotted with South Africa excluded in figure 3.

Figure 3: Foreign Ownership and Productivity Excluding South Africa



Source: World Bank Enterprise Surveys

Figure 3 confirm our speculation and suggest that there is greater productivity difference between domestic and foreign owned firms for the region when South African firms are excluded from the firm pool data. Productivity differences become more distinct for both labour and total factor productivity measures, with the relative distributions suggesting that domestic owned firms are now up to twice and three times more likely than foreign owned firms to fall within the median and 3rd deciles of foreign owned firms' labour and TFP distributions, respectively.

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A possible explanation for the difference in FDI productivity impact for the region when South African firms are excluded lies in the fact that the region excluding South Africa is composed of countries with relatively lower technology levels, which are likely to enjoy relatively larger productivity gains from FDI than when South Africa whose technology is relatively more advanced is included. This is in line with the model of international technology spillovers by Findlay (1978) and Baro and Sala-i-Martin (2004), which suggest that gains from technology spillovers from FDI are greater the lower the level of technology of the FDI recipient country.

Another limitation with the firm productivity comparison in figures 2 and 3 is suggested by literature which points that there are usually productivity heterogeneities on the basis of firm size (Edwards, 2002 and Bartelsman, et al, 2013). To the extent that this holds, it means that comparison of the impact of FDI on firm productivity without separating firms according to their size may conceal important information about how firms in different size categories are affected by firm foreign ownership differentials. An analysis of the impact of FDI on firm productivity by firm size also becomes compelling given that the size distribution of firms in the region is highly skewed with small firms constituting a disproportionately large percentage of the firms (World Bank Enterprise Surveys).

To facilitate the analysis of firm foreign ownership impact on firm productivity in the region according to firm size, firms are classified into small and large firms groups within the foreign and domestic owned firm categories. Small and medium enterprises employing less than 100 workers are collectively classified as small firms, while firm employing at least 100 workers are classified as large firms. The classification cut off point follows the classifications used by most countries in the region for purposes of selective intervention policies for the small and medium enterprises (Government of Zimbabwe, 1991). On the basis of this classification, figure 4 shows the productivity difference between small and large firms excluding South African firms, with the scenario including South Africa shown in Annex A, figure A3. Figure 4 has left out the impact of firm foreign ownership on the TFP for clarity purposes to avoid congestion of graphs.

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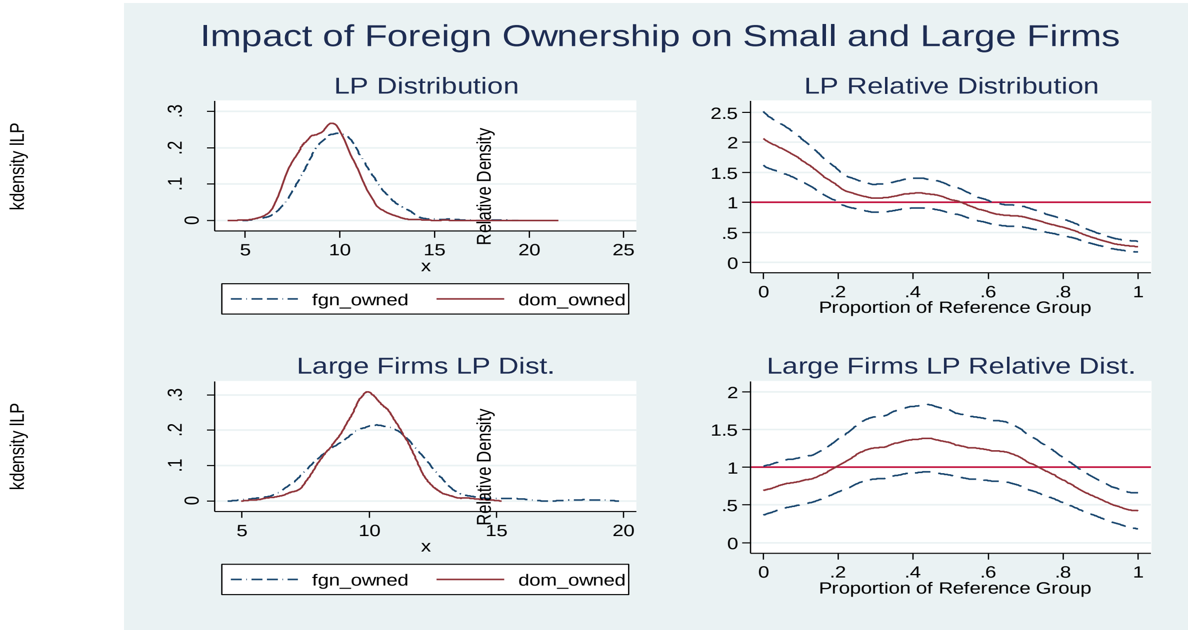
Figure 4: Firm Ownership and Firm Productivity by Firm Size (Excluding S.Africa)



Source: World Bank Enterprise Surveys

Figure 4 suggests that there is a greater positive impact of foreign firm ownership on small firms' productivity than for large firms. The productivity distribution of small domestic owned firms is up to 2.5 more times likely to fall within the 4th decile of the productivity of their foreign owned counterparts and less likely to fall beyond the 4th decile. In the case of large firms, the impact of foreign firm ownership is less distinctive, with domestic large firms being more productive than foreign large firms in the lower tail end of the productivity distribution density, while foreign large firms become more productive as productivity increases improves. Following suggestions by Findlay (1978) that the productivity gain from FDI is negatively related to the FDI recipient's state of technology, the greater productivity gain for small firms than for large firms suggest that small firms in the region are technologically less endowed than large firms. In terms of policy, this suggests the need for directed FDI policies that favour MNCs joint ventures with small to medium enterprises than with large established firms.

Another interesting feature from figure 4 is that the relative productivity distribution of large firms suggests that inefficient (low productivity) large foreign firms are less productive than inefficient (low productivity) large domestic owned firms. This could be a result of at least two factors, which are that less efficient large foreign firms in the region are employing obsolete and inefficient technologies or that large inefficient domestic firms are enjoying some selective

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assistance such as selective credit, subsidies and market access support from their governments. Either way, the growth consequences are detrimental, as the first possibility implies that any additional FDI injection that comes through the inefficient large foreign firms has little or no technology spillover gains for the region, while the second explanation suggests that if such selective assistance exists for the inefficient large domestic owned firms, the interventions may amount to growth stagnation and higher poverty in the long run through the perpetual loss in potential productivity growth.

However, when South African firms are included in annex A, figure A3, both large and small firms have more or less similar productivity gains from foreign ownership, suggesting that large foreign owned firms in South Africa are more productive than large foreign owned firms in the rest of the region. Possible reasons why large firms in South Africa are more productive than large firms in other countries in the region could be that large firms in the rest of the region upgrade their technology at slower pace than those in South Africa. Alternatively, it could be that most of the large foreign owned firms in the rest of the region outside South Africa are inefficient parastatals jointly owned by foreign investors and governments.

Another limitation with our analysis of the impact of firm foreign ownership emanates from the possibility of productivity heterogeneities within countries suggested by figure 1 above. Such heterogeneities imply that our pooled firm data analysis may fail to give us a picture of how foreign firm ownership could be impacting on firm productivity in each of the region's countries. As such the analysis of the impact of firm foreign ownership on firm productivity is extended to consider impact at country levels, with the country graphs shown in annex A, figure A6, which qualitatively confirm findings from the pooled firm data with foreign owned firms being more productive than domestic owned firms in all the countries except Angola, where data problem issues have already been raised. However, the positive correlation between firm productivity and firm foreign ownership is marginal for South Africa and Mauritius, suggesting that the two countries' technology levels are close to those in most of their FDI source countries as implied by Findlay (1978) and Barro and Sala-i-Martin (2004).

2.6 Econometric Results Estimation and Analysis

To further investigate the impact of firm foreign ownership on firm productivity in the region, the FDI productivity spillovers are estimated from productivity spillover model 4, which we

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restate below. The same model is estimated for all the pooled firms in the region, for firms in individual countries and for small and large firm categories:

$$Q_{ij} = \pi_0 + \pi_1 FDI_{firmij} + \pi_2 FDI_{\sec j} + \pi_3 FDI_{firm*\sec ij} + \pi_4 X_{ij} + \varepsilon_c + \varepsilon_I + \varepsilon_T + \varepsilon_i + \varepsilon_{ijc} \qquad 4$$

With Q_{ij}, FDI_{firmij} and $FDI_{\sec j}$ defining measures of firm productivity, within firm foreign ownership and intra-industry foreign ownership, respectively. Productivity is in log terms while measures of foreign ownership are in percentage. Estimated coefficients on the two measures of foreign firm ownership give within firm and intra-industry productivity spillovers, respectively

To estimate the productivity spillover model, we utilize the OLS technique. In light of productivity spillover identification problems associated with model 4 emanating from reverse causality between firm foreign ownership and firm productivity, we rely on two strategies. First, we control for as many firm characteristics that may affect the firm's productivity as possible. Given that some of the variables are likely to be correlated with both FDI and productivity, this minimizes the prevalence of firm fixed effects in the error term. Second, under the assumption that firm-specific productivity is proportional to industry productivity, we use the industry-specific dummy in estimating model 4 to proxy for the firm fixed effects.

Regression results from equation 4 for the pooled firm productivity are presented in table 4 below, with the baseline model presented in the first column[10]. The first column, which is our baseline model, reports productivity spillover effects from within firm FDI, intra-industry FDI and the interaction of the two measures of FDI as the basic channels though which FDI transfers productivity gains to the local firms. The only difference between columns 1 and 2 is that column 1 controls for country fixed effects while column 2 controls for time fixed effects, for which preliminary estimations suggest to be highly collinear and which cannot be jointly controlled for in the same model. In overall terms results in table 4, suggest that the model with country fixed effects has better fit than the model with time fixed effects. It jointly explains about 40% of the variation in firm productivity, with a significant F-statistic for model fit.

[10] Parallel model results using the TFP are reported in Annex A, tables A12 to A16. They suggest qualitatively similar results

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Table 4: FDI and Labour Productivity Spillover for SADC Pool

	OLS Estimation Firm Labour Productivity (Excluding Angola and DRC)				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Firm Foreign Ownership	0.012***	0.011***	0.011***	0.011***	0.012***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Sector Foreign Ownership	0.017***	0.017***	0.015***	0.014***	0.013***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Firm FDI x Sector FDI	-0.2e-4***	-0.2e-4***	-0.2e-4***	-0.2e-4***	-0.2e-4**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Management Experience	-0.005*	-0.009***	-0.006**	-0.006**	-0.007**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Formal Competition	-0.018*	-0.006	-0.018	-0.018	-0.015
	(0.010)	(0.012)	(0.011)	(0.011)	(0.012)
Informal Competition	0.005	-0.105***	0.008	0.008	-0.009
	(0.023)	(0.025)	(0.023)	(0.022)	(0.023)
Firm Age	0.010***	0.012***	0.010***	0.009***	0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Firm Avg Human Capital	0.130**	0.093*	0.136**	0.151***	0.160***
	(0.059)	(0.056)	(0.059)	(0.042)	(0.057)
Corruption	-0.008**	-0.015***	-0.006*	-0.007**	-0.006*
	(0.003)	(0.005)	(0.003)	(0.003)	(0.003)
Communication Obstacle	0.036	0.016	0.028	0.022	0.019
	(0.034)	(0.040)	(0.034)	(0.034)	(0.035)
Credit Constraint	-0.118***	-0.213***	-0.116***	-0.112***	-0.111***
	(0.022)	(0.025)	(0.022)	(0.022)	(0.022)
Rule of Law (0=yes; 1=no)	-0.152**	0.201***	-0.155**	-0.128**	-0.091
	(0.062)	(0.071)	(0.061)	(0.061)	(0.062)
Firm Size(0=large; 1=small)	-0.330***	-0.520***	-0.294***	-0.297***	-0.292***
	(0.090)	(0.094)	(0.089)	(0.088)	(0.088)
Foreign Inputs			0.005***	0.004***	0.005***
			(0.001)	(0.001)	(0.001)
Regional Foreign Ownership				-0.002	-0.002
				(0.002)	(0.002)
Regional Wage				1.349***	0.824***
				(0.169)	(0.035)
Constant	11.031***	10.551***	10.994***	-1.083	3.881***
	(0.155)	(0.198)	(0.156)	(1.511)	(0.351)
No. of Observations	1,869	1,869	1,869	1,869	1,869
R-squared	0.404	0.240	0.414	0.431	0.421
F-Stat	61.6	34.42	61.84	63.28	73.8
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes
Country FE	Yes	No	Yes	Yes	No

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

Table 4 shows that the coefficients on both within firm and intra-industry foreign ownership are positive and significant across all models, while the impact of sector foreign firm ownership

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on the productivity of firms with foreign ownership is negative and significant. Variables with theoretically expected signs are firm age, average firm human capital and firm size with positive impacts on firm productivity and corruption, rule of law, competition and credit constraint which negatively impact on firm productivity. However, firm productivity is negatively related with managers' experience, which is not consistent with theoretical predictions that more experienced managers should be more productive. This, however, could suggest that the long serving managers are not updating their skills commensurately with new technology developments, hence become less productive than the more recent graduates.

Turning to measures of firm foreign ownership, the regression results suggest that firms with 10 percentage points more foreign ownership have average labour productivity, which is 0.12% higher than otherwise. This represents the within plant impact of foreign firm ownership, which emanates from more advanced technology, managerial skills and training associated with FDI. It implies that foreign investment is both physical capital accumulation and an addition to FDI host countries' technology stocks. Similarly, the coefficient on sector foreign firm ownership is positive and significant, with a 10 percentage points increase in sector foreign ownership associated with a 0.2% increase in the productivity of firms in the same sector. This captures the intra-industry FDI productivity spillover effect, which is realized by firms within the industry receiving more FDI.

Given that the impacts of firm and industry FDI on productivity are estimated after controlling for other potential co-variates of firm productivity, including sector specific productivity effects that we have used to proxy for the firm-specific effects, the results suggest that the positive productivity effects from firm foreign ownership should be attributed to the existence of more firm and sector foreign equity holdings in the region.

Contrary to the positive impacts of firm and sector FDI on firm productivity, sector FDI has a negative productivity effect on firms with foreign ownership. The negative and significant coefficient on the interaction term between firm and sector foreign firm ownership on domestic firms' productivity suggests that local joint ventures between domestic and foreign firms are negatively affected by an increase in sector foreign ownership. Given that the interaction term is jointly controlled for together with other firm productivity determinants, this implies that already existing foreign owned firms are disadvantaged by new foreign firm entrants. As suggested by Aitken and Harrison (1999), this could be explainable by the fact that new foreign

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owned firms could be more productive and competitive than the existing foreign owned firms. This occurs if there is lack of continuous technology upgrading by local foreign owned firms such that their technology lags behind new technology coming with the increases in intra-industry foreign ownership. To the extent that this holds, it suggests that most local joint ventures are old and commanding old production methods. Another possible explanation lies in the 'market stealing' hypothesis, in which case new foreign firms could be concentrated in areas that already have more FDI concentration.

A potential problem with the estimated FDI productivity spillovers in table 4 emanates from failure to control for the use foreign inputs by firms. Literature on international technology transfers has suggested that the use of foreign inputs by domestic firms is a potential channel of transmitting foreign technology to local firms given that the inputs are usually embodied with the high technology (Keller and Yeaple, 2009 and Yasar and Paul, 2008). Thus to the extent that foreign owned firms are also likely to be users of more foreign inputs through backward and forward linkages, the observed productivity spillovers in column 1 could be emanating from the use of foreign inputs by firms instead of firm or sector FDI. In column 3, we therefore control for use of foreign inputs. The impacts of firm and sector FDI remain positive and significant. The productivity impact of foreign inputs is, however, also positive and significant, with a 10 percentage points differential in the use of foreign inputs causing a 0.05% differential in firm productivity. The results suggest that taking out the productivity impact of foreign inputs reduces the marginal productivity impact of industry FDI from 0.17% to 0.15% for a 10 percentage points increase in sector FDI, suggesting that part of FDI productivity spillovers estimated in column 1 is actually spillovers from use of foreign inputs even though it remains robust and significant.

Another question that could be asked is whether the estimated productivity spillovers are not a result of spatial productivity externalities if some regions are more productive than others and FDI favours more productive regions. In this case it means FDI would locate in spatially concentrated regions, resulting in spatial technology spillovers driving the observed productivity differentials instead of FDI productivity spillovers (Marshall, 1920). To control for the possibility of spatial productivity externalities, columns 4 and 5 isolate out the effects of regional FDI as well as average region productivity captured by average regional wage rate. However, the coefficients on firm and sector FDI remain positive and significant while that of regional FDI is insignificant. What obtains instead is a situation suggesting that productivity is

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also regional specific with the coefficient on regional wage rate being positive and significant. Thus the estimated productivity spillovers in model 4 are likely to be a result of technology externalities emanating from the presence on MNCs in the region. The findings confirm the FDI productivity spillover hypothesis for the SADC region and they suggest that the region stands to enjoy significant productivity gains from the presence of MNCs.

In light of the dominance role played by South Africa in terms of commanding relatively higher levels of technology and also constituting a greater proportion of firms in the region, both of which could put the generalization of spillover results in the region to question, we estimate the spillover model 4 without the country and infer any differences in productivity. Results of the estimated spillover model without South Africa are presented in table 5 and they qualitatively do not suggest any difference in terms of the impact of FDI in the region with the productivity effects of both within firm and sector FDI remaining positive and significant. This suggests that the SADC region at large has productivity gains emanating from hosted MNCs even if the dominant country is excluded.

Table 5: FDI and Labour Productivity Spillovers Excluding South Africa

	OLS Estimation of Labour Productivity Excluding Angola, DRC & S.A				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Firm Foreign Ownership	0.014***	0.015***	0.012***	0.012***	0.013***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Sector Foreign Ownership	0.013***	0.012***	0.011***	0.011***	0.009**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Foreign Inputs			0.005***	0.004***	0.004***
			(0.001)	(0.001)	(0.001)
Regional Foreign Ownership				0.003	0.001
				(0.003)	(0.003)
	----see Annex A, table A7 for other control variables--				
Constant	10.096***	10.257***	9.799***	-0.399	3.184***
	(0.944)	(0.216)	(0.896)	(1.666)	(0.750)
Observations	1,246	1,246	1,246	1,246	1,246
R_squared	0.304	0.265	0.316	0.340	0.327
F-Stat	28.3	26.6	28.2	30.3	32.3
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes
Country FE	Yes	No	Yes	Yes	No

//Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
//See table A7 in Annex A for full results with all variables

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The improvement in the within firm impact of FDI and a decline in the intra-industry impact of FDI when South Africa is excluded in table 5 suggest that firms in the rest of the region excluding South Africa tend to enjoy greater within firm productivity gains from the presence of FDI than South African firms while South Africa has greater intra-industry productivity spillovers than the rest of the countries in the region. From suggestions by Findlay (1978) and Aghion and Howitt (2004) that the gain in productivity from FDI is larger the lower the level of technology in the FDI recipient country, this implies than firms outside South Africa have lower technology levels than South African firms. The larger intra-industry gains for South African firms, on the other hand, should be a result of better FDI absorptive capacities in South Africa and suggest that other countries should improve their capabilities (Durham, 2004).

Lastly, we also address potential problems of the likely differences in the impact of firm foreign ownership on the productivity spillovers of small and large firms and across countries in light of the earlier non-parametric estimations, which suggest the existence of productivity heterogeneities across firm sizes and countries in the region. Deducing the FDI productivity spillovers from the pooled firms' productivity could be misleading and less informative if firm foreign ownership has different effects on firm productivity within the different firm size categories or countries.

To investigate possible heterogeneities on the impact of firm foreign ownership on firm productivity between small and large firms in the region, we estimate the spilloaver model 4 for the two firm groups separately and present the estimated results in tables 6 and 7 below, respectively.

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Table 6: Labour Productivity Spillover Effects on Small Firms

	OLS Estimation of Labour Productivity				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Firm Foreign Ownership	0.013***	0.012***	0.011***	0.011***	0.012***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Sector Foreign Ownership	0.016***	0.019***	0.014***	0.013***	0.014***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Foreign Inputs			0.006***	0.006***	0.006***
			(0.001)	(0.001)	(0.001)
Regional Foreign Ownership				0.002	0.003
				(0.002)	(0.002)
----see Annex A, table A8 for other control variables----					
Constant	10.755***	10.111***	10.740***	-0.471	3.315***
	(0.151)	(0.200)	(0.150)	(1.650)	(0.354)
Obs	1,515	1,515	1,515	1,515	1,515
Rsqrd	0.386	0.194	0.402	0.419	0.411
F-Stat	45.8	28.8	47.0	48.5	56.8
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes
Country FE	Yes	No	Yes	Yes	No

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
//See table A8 for results with all variables

Table 7: Productivity Spillover Effects on Large Firms

	OLS Estimation of Labour Productivity				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Firm Foreign Ownership	0.008**	0.009**	0.007**	0.008**	0.010***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Sector Foreign Ownership	0.013	0.011	0.013	0.011	0.010
	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)
Foreign Inputs			0.001	-0.000	0.000
			(0.002)	(0.002)	(0.002)
Regional Foreign Ownership				-0.015**	-0.021***
				(0.006)	(0.006)
----see Annex A, A9 for other control variables----					
Constant	10.700***	10.011***	10.704***	-8.281*	5.089***
	(0.365)	(0.461)	(0.366)	(4.652)	(0.949)
Observations	354	354	354	354	354
R-squared	0.311	0.170	0.311	0.349	0.298
F-Stat	10.5	8.23	10.1	10.7	11.8
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes
Country FE	Yes	No	Yes	Yes	No

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
//See Annex A table A9 for results with all variables

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The regression results in tables 5 and 6 suggest that small firms have larger productivity gains from firm foreign ownership in the region. A 10 percentage points increase in within firm foreign ownership leads to within firm increase in productivity of 0.13% for small firms and 0.08% for large firms. The within firm increases are significant for both firm categories. On the intra-industry productivity spillovers, the productivity impact of industry FDI is positive and significant for small firms and insignificant for large firms. The differences in the impact of FDI on firm productivity suggest that the region, which hosts more small firms that large firms, stands to gain significantly from the presence of MNCs. The results suggest that countries in the region should promote foreign joint ventures with local firms in this category.

Lastly, to make inferences about possible heterogeneities with respect to the impact of FDI across the different SADC countries, the productivity spillover model is estimated separately for each individual country and the results are presented in table A9 annex A. Results suggest that seven countries experience positive within firm productivity gains, while the impact is positive but insignificant in the other countries. There are larger gains for the relatively technologically backward countries in the region compared to South Africa's gains. Largest intra-industry productivity spillovers are found in Angola and South Africa, respectively. The heterogeneities with respect to individual countries' gains are an indication of differences in the countries' FDI absorption capacities and differences in country technology levels. Countries with better FDI absorption capacities or with low technology are expected to gain more from FDI productivity spillovers than otherwise. This means that countries should promote their FDI absorptive capacities in order to gain more from FDI.

In overall terms, results from the estimated FDI spillover model and our analysis clearly suggest the existence robust productivity spillovers from FDI in the region. The results, which have been confirmed for both non-parametric and parametric estimations are robust to isolating the possible productivity spillover from imported inputs and spatial proximity in production, to the excusion of South African firms in the sample and also for most countries in the region. This suggests that countries in SADC have potential significant gains from FDI presents.

2.7 Firm Productivity and FDI Causality Issues

According to the literature on FDI productivity spillovers, FDI tends to flow to higher productivity firms and sectors such that any observed positive correlation between firm

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productivity and measures of FDI may be a result of FDI self-selecting into higher productivity firms and not necessarily FDI raising productivity (Liu, 2008; Alfaro, et al, 2009 and Keller and Yeaple, 2009). This causes identification problems in the estimated FDI productivity spillovers, especially in cross section firm data where it is impossible to pin down the firm-specific productivity effects. To infer on the likely causal direction between FDI and firm productivity implied by model 4 in our estimated results, we re-estimate the FDI productivity spillover model exclusively for domestic owned firms as presented in equation 8.

$$Q^{d}{}_{ij} = \pi_0 + \pi_2 FDI_{\sec j} + \pi_4 X_{ij} + \varepsilon_c + \varepsilon_I + \varepsilon_T + \varepsilon_i + \varepsilon_{ijc} \qquad (8)$$

With Q^d representing labour productivity for domestic owned firms. Since the reverse causality between FDI and productivity occurs when FDI self-selects into high productivity sectors, it can be assumed that firms without foreign ownership are low productivity firms compared to those with foreign ownership. If this is the case, then evidence of spillovers on the coefficient of sector FDI in 8 would suggest that causality runs from FDI to firm productivity as it suggests the existence of FDI productivity externalities to non-foreign owned firms.

The estimated productivity spillover results for domestic firms presented in table 8 suggest that FDI has productivity spillovers to domestic owned firms. This finding is also robust to controlling for the impact of foreign inputs use by firms in the region. The results, therefore, suggest that the existence of MNCs in SADC confers productivity spillovers to domestic firms regardless of whether they are perceived to be high or low productivity firms. Thus, the estimated spillovers in model 4 are more likely to be a result of the impact of FDI than a reflection of FDI self-selecting into high productivity firms.

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Table 8: FDI and Labour Productivity Spillover for Domestic Firms

	OLS Estimation of Labour Productivity Large Firms				
VARIABLES	LP_1	LP_2	LP_3	LP_4	LP_5
Sector Foreign Ownership	0.015***	0.016***	0.013***	0.012***	0.011***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Foreign Inputs			0.006***	0.005***	0.006***
			(0.001)	(0.001)	(0.001)
----*see Annex A, table A10 for other control variables*----					
Constant	11.090***	10.568***	11.043***	-1.597	3.543***
	(0.170)	(0.228)	(0.170)	(1.656)	(0.366)
Obs	1,512	1,512	1,512	1,512	1,512
Rsqrd	0.409	0.211	0.424	0.444	0.432
F(23; 1491)	53.9	25.5	54.8	57.7	66.3
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes
Country FE	Yes	No	Yes	Yes	No

//Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$
See Table A10 in Annex A for full variables tables.

Alternatively, we have utilized the propensity score matching approach suggested and utilized by Yasar and Paul (2008) to infer causality between FDI and firm productivity in our data. The approach directly compares the productivity of foreign and domestic owned firms as opposed to indirectly inferring causality in equation 8. It, however, estimates the within firm effects of FDI rather than FDI productivity spillovers, which are our interest in this study, hence it could not be used as our main analytical approach.

The propensity score matching approach involves pairing foreign owned and domestic owned firms that have the same observed attributes in the observational surveys before foreign investment under the assumption that foreign investment is not guided by any unobserved firm productivity effects and infer differences in their within firm productivity (Rosenbaum and Rubin, 1993 and Yasar and Paul, 2008)[11]. It estimates treatment effects (foreign ownership) between the performance of the treated and the untreated (domestic ownership) when the two firm categories are in randomized groups to ensure that there is no selection bias in the group

[11]Rosenbaum and Rubin (1993) give an outline of the details of the propensity score matching method, which is outlined in Annex A. Because the approach is not the study's major approach, we don't dwell into greater details of the method, although the arguments we give generally follow from the authors.

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assignments (Heckman, et al (1997). In the case of observational firm surveys, randomization of subjects is impossible as firms are observed ex post. Unbiased treatment effect, instead is based on ability to match foreign and domestic owned firms on the basis of some common factor or attributes that are independent from both FDI and firm productivity.

Variables closely satisfy this requirement in our firm survey data are: the number of workers the firm started operations with, the industry or sector in which the firm operates and the age of the firm. We, however, note that these attributes are weak matching factors if firms change sectors or industries over time in response to foreign ownership or if the number of workers, firms started business with are a reflection of the productivity of the firm. The factors are, however, the closest to the characteristics that can enable us to reasonably our foreign and domestic firms, hence we use them.

To estimate the FDI productivity impact, firms have been matched using the nearest neighbour, kernel and stratification methods and impact of FDI on firm productivity is estimated as:

$$ATT = \frac{1}{n_1} \sum_{i \in (T \equiv 1)} \left[Y_{1i} - \sum w(ij) Y_{0j} \right] \qquad (9)$$

With Y_{1i} defining firm productivity for each matched foreign owned firm *i*; and Y_{0j} is the productivity of each domestic owned firm *j* matched to firm *i*. $w(ij)$ are the weights assigned to each of the *i* firm matches depending on the matching method used.

Table 9 presents the estimated impacts of foreign firm ownership over domestic owned firms, with the first 3 rows of the table giving the foreign ownership treatment effects for all the region firm pool. The second and third 3 rows are for the small firms and large firms, respectively. Considering that the firms are pooled, the table suggests that foreign owned firms are on average between 0.23 and 0.29 log points more productive than domestic owned firms across the different matching methods, which amounts to approximately 26% to 34% productivity difference between the two firm categories. For small firms, the gain in productivity by foreign firms is between 28% and 36%, while for large firms, the gain for foreign owned firms is smaller falling between 9% and 16%.

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Table 9: Within Firm FDI Impact on Labour Productivity

Match Method	#of Treated	#of Untreated	ATT	t-stat
		SADC POOL		
Nearest Neighbour	438	359	0.232	2.251**
Kernel	438	1921	0.287	4.066***
Stratification	438	1921	0.230	2.852**
		SMALL FIRMS		
Nearest Neighbour	287	261	0.244	1.850*
Kernel	287	1676	0.307	2.685**
Stratification	287	1676	0.244	2.518**
		LARGE FIRMS		
Nearest Neighbour	151	98	0.090	0.367
Kernel	151	246	0.158	0.932
Stratification	151	246	0.145	0.699

*Significant at 10%; **Significant at 5%; *** Significant at 1%

Productivity differences between foreign and domestic owned firms and their pattern qualitatively mirror those obtained in both the descriptive and econometric results estimations. They confirm the existence of FDI technology spillovers for the region and also the earlier finding that the spillovers are greater for small firms than for large firms. To the extent that the propensity score matching compares the impact of FDI on productivity for domestic and foreign owned firms that are presumed to have similar characteristics before foreign ownership, the results suggest that firm foreign ownership has some positive within firm productivity effect in the region and that the causality runs from FDI to firm productivity.

2.8 Conclusion

In this study, we have undertaken an empirical analysis of the productivity spillover effects of FDI on domestic firms in SADC. In specific terms, we have investigated whether there are any positive within firm and intra-industry productivity spillovers from FDI for SADC firms, for small and large firms in the region and for firms in individual countries in the region. The study is a valuable contribution to the literature on the FDI productivity spillover hypothesis, given that it has been undertaken for a group of mostly developing countries in where such studies are limited due to unavailability of harmonized firm level data.

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Evidence from the study suggest the existence of within firm and intra-industry productivity spillover effects for the region, with productivity gains that are stronger and larger for small firms than for large firms. At the country level, there is evidence suggesting heterogeneities with respect to the productivity impact of FDI while almost all the 12 countries investigated experience some within firm productivity gains from foreign firm ownership, the intra-industry gains are significant for South Africa, Angola, Mozambique and Tanzania and insignificant for other countries. It has been argued that the differences and weaker results with respect to individual countries are a result of small size and data problems in some countries. Similarly, adverse country fixed effects have been emphasized as alternative contributing factors.

Overall, it appears that the region enjoys considerable productivity gains from the presence of MNCs in the region. First, the large within firm productivity gains for small firms and the relatively poor countries suggests significant productivity and growth gains for the region given that most of the counties in SADC still command relatively low technology levels and that a large proportion of the firms in SADC are still in the small to medium size category. The downside risks to productivity growth are, however, in respect of large firms in the region outside South Africa, which seem to be utilizing less productive technology.

Similarly, the finding that large low productivity foreign firms are less productive than their domestic owned counterparts has been interpreted as signifying the existence of adverse idiosyncratic measures that sustain large inefficient firms such as the support by governments of inefficient public enterprises in the region. The prevalence of such selective interventions have been identified for China and India by Hsieh and Klenow (2009). To the extent that this is occurring, such policies are detrimental to growth in the long run due to lost potential growth in productivity. This suggests the need for market and policy reforms to remove or minimize any policies that tend to protect inefficiency of large corporations such as subsidies and concessionary credit.

On the policy front, the finding that firm foreign ownership results in productivity gain the region encourages countries to promote the establishment of MNCs to promote the productivity spillovers. Second, the large productivity gains for small firms than large firms, suggest that FDI policies in the region should be directed and inclined towards promoting foreign joint ventures with local small and medium enterprises in order to obtain maximum productivity spillovers. There is, however, need to ensure that large corporations in the poor countries of

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the region pro-actively upgrade their technology through, for example, removal of selective protectionist policies that seem to sustain their inefficiencies.

However, notwithstanding the study's potential contribution, its major weakness lies in the cross section data used and as such we suggest that further studies be done in future once full firm panels of the harmonized data are available.

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Chapter 3

Foreign Direct Investment and Agglomeration Effects in SADC

3.1 Introduction

Research on technological spillovers and productivity growth has tended to deal with foreign direct investment without considering the potential impact of agglomeration externalities. Proponents of the FDI productivity spillover hypothesis suggest that foreign direct investment brings forth more advanced technology through transfers of new production techniques that build on FDI recipient countries' productive capabilities (e.g. MacDougall, 1960; Blomstrom and Kokko, 2003, Javorcik, 2004 and Liu, 2008). Similarly, literature on agglomeration perceives geographic proximity as affecting productivity growth through information and knowledge spillovers across firms and individuals when economic activities are geographically concentrated (Marshall, 1920; Henerson, 1974 and Ciccone and Hall, 1999). Agglomeration externalities imply that regions or countries with higher agglomeration and density of economic activities are expected to transfer technology more quickly and effectively than otherwise.

The channels through which technology externalities occur in the two hypothesis clearly suggest that two should be connected, with FDI productivity externalities requiring an effective labour and human capital interface, which can be facilitated by agglomeration externalities. Despite this seemingly important link, literature on FDI productivity spillovers has emphasized the role played by other FDI absorptive capabilities with little consideration for the role of agglomeration effects. For example, Borensztein et al (1998) incorporate the role of differences in country human capital in their analytical framework on the impact of FDI, Olofsdotter (1998) considers the role of institutional capability, Balasubramanayam et al., (1996) considers the role of policy environment, while the role of financial development is considered in Alfaro et al., (2004, 2009) and that of differences market structure was considered by Alfaro et al. (2006). Few studies have considered the joint productivity externality effects of agglomeration and foreign direct investment (e.g. De Propris and Driffield, 2006; and Manghinello, et al, 2010).

The fact that there should be some complementarity between FDI and agglomeration externalities is clear if one considers high growth rates in countries that are fast urbanizing such

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as China and India relative to other countries with comparable per capita FDI and human capital stocks while the stock of foreign direct investment per capita for China falls below that of Russia, Brazil and South Africa among the BRICS yet its average growth rate surpasses any of the three countries[12]. Similar facts hold for India which, despite lower FDI stocks per capita, has average growth higher than other country mates in the BRICS. A common feature about China and India, however, is their growing urbanization and agglomeration rates with the two countries constituting close to 40% of the increase in global urbanization rates by 2014 (UN, 2014). In addition, Henderson (2003) points out that China has had FDI policies that concentrate FDI in few cities with special economic zone status, which have become major agglomerations and significant sources of technology advancements for possible utilization by the whole economy. Thus the countries' high growth and fast urbanization are unlikely to be coincidental and we suggest that agglomeration economies could be playing a role.

Our view follows De Propris and Driffield (2006) and Manghinello, et al (2010) who find that agglomeration externalities play a significant role in enhancing FDI productivity externalities. To the extent that positive agglomeration externalities exist, it can be argued that the failure to confirm productivity externalities from FDI in studies such as by Aitken and Harrison (1999) and Carkovic and Levine (2005) maybe due to the failure of the studies to account for agglomeration externalities in the estimated spillovers. This point is likely to carry more weight for SADC, given increases in both urbanization and FDI over the past three decades, with urbanization increasing by more than four times between 1980 and 2011 for most of the least urbanized (WDI, 2015). Concurrently, the region has had significant increases in FDI stocks, hosting at least 36% of FDI in Africa by 2011 (UNCTAD, 2011). The question that we ask in this study following these facts, is whether there has been productivity growth in the region which is commensurate with the improved FDI and agglomeration.

The proposition that a combination of high FDI and high agglomeration effects is likely to enhance growth is, however, a contested proposition, with the theory on agglomeration externalities suggesting that excessive growth in agglomeration leads to negative congestion effects (Williamson, 1965 and Henderson, 1974). At the same time the existence of FDI productivity externalities depends on the quality of FDI (AfDB, 2011). This suggests that the

[12] China had average growth close to 10% over the decade to 2011, compared to 4% for Brazil; 5% for Russia; 4% for South Africa and 2% for the USA. Population densities in the two countries are relatively higher than in the other countries in BRICS.

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co-existence of high FDI and agglomeration may not necessarily lead us to predict higher growth. A consideration of the growth pattern in SADC also seem not to suggest an obvious relationship between urbanization rates, FDI patterns and productivity with some countries which have relatively high urbanization and FDI stocks such as Mauritius and Botswana experiencing high growth while others with relatively high urbanization and FDI such as South Africa, Angola, Namibia, Zambia, Madagascar and Zimbabwe experience low average growth rates (WDI, 2015). Clearly, the differences in countries' growth rates are not easily reconcilable with their urbanization and FDI patterns and suggest a puzzle that needs more research.

In this study, we seek to contribute towards the closure of the research gap on the FDI, agglomeration and growth linkage by estimating the joint productivity impact of FDI and agglomeration effects in SADC. In more specific terms, the study's objectives are: (1) to estimate the isolated impact of FDI on productivity growth in SADC; (2) to estimate the isolated impact of agglomeration effects on growth in SADC; and (3) to estimate the joint impact of agglomeration and FDI externalities on productivity in the region. To achieve these objectives, panel time series data from 1990 to 2011 is used, with the period of study chosen to coincide with the post-apartheid period in South Africa. The SADC region is an interesting case for this study given that the region is a major recipient of FDI in Africa and has also had significant growth in agglomeration over the study period (UNCTAD, 2011 and WDI, 2015).

The use panel data as opposed to cross section data allows the isolation of country specific fixed effects and to control for the simultaneity in the relationship between FDI and agglomeration externalities and growth. Controlling for country fixed effects allows us to deal with the criticism that has often been labelled against studies that try to identify agglomeration effects on productivity using cross country data and fail to isolate out country specific differences (Abel, et al 2011 and Chen, et al, 2011). The novelty of this study lies in its consideration of the joint growth impacts of agglomeration and FDI productivity externalities on income for which there are limited empirical studies that have been undertaken as well as in using data that allows controlling of country fixed effects in the estimated externality effects.

The rest of the chapter is organized as follows: section 3.2 deals with the theoretical and empirical literature on FDI and agglomeration economies; in section 3.3 we develop the study theoretical and empirical frameworks; sections 3.4 and 3.5 deal with results estimation and analysis and section 3.6 concludes the study.

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3.2 Literature Review

The foreign direct investment technology spillover hypothesis predicts that FDI transfers advanced technology and positive productivity externalities to the FDI host country (MacDougall, 1960 and Findlay, 1978). The mechanism through which FDI impacts on technological growth of the FDI host country falls under the endogenous growth framework. As suggested by Blomstrom and Kokko (2003), technology gains from FDI include improvements in firms X-efficiency, allocative efficiency as well as international market access spillovers realized through the interaction of MNCs and local firms. Several mechanisms have been advanced as possible channels for transmitting technology between FDI source and host countries. These include reverse engineering, imitation, labour turnovers, demonstrations, formal or informal contacts between employees of the MNCs and local firms (Blomstrom and Kokko, 2003, Javorcik, 2004 and Liu, 2008).

A number of studies have been undertaken to investigate the existence of technology spillovers in FDI recipient countries, which hypothesis largely confirmed in developed countries (Nadiri, 1991; Blomstrom and Wolff, 1994 and Keller and Yeaple, 2009) and with limited confirmation in most developing countries (Chen, 2007; and Aitken and Harrison, 1999). Consequently, literature has suggested that the failure by most developing countries to realize technology externalities from FDI is caused by their inadequate FDI absorptive capabilities (Durham, 200). Similarly, Xu (2000) finds that US MNCs tend to have productivity externalities in developed countries and not in developing countries and suggest that developing countries fail to meet the FDI absorptive capacity thresholds. Consequently, a number of studies that have estimated the growth impact of FDI conditional on various FDI absorption capacities in developing countries have confirmed the externalities.

Borensztein et al (1998) has modelled the importance of human capital in the FDI technology spillover model and suggested that countries need a minimum human capital development thresholds in order to benefit from the technology externalities of FDI, while Olofsdotter (1998) finds institutional capability with emphasis on the role of bureaucratic efficiency to be an important factor. Similarly, the importance of local financial markets and market structure are confirmed and emphasized in Alfaro et al., (2004, 2009) and Alfaro et al, (2006), respectively. However, by the nature of the FDI productivity spillovers which require interaction and interface between the MNCs and local firms it is likely that the spatial proximity

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of firms and people who are the agents of technology transfers is important. Keller (2004) and Comin, et al (2012) have emphasized this aspect of technology spillovers by suggesting that the rate of technology diffusion is inversely related to geographical distance between the source and recipient of technology. Thus the limitation of most studies on FDI productivity spillovers is failure to take this factor into account by not conditioning the impact of FDI on density of economic activities.

Theoretical models of economic geography note that spatial concentration of economic activity has productivity externalities which have a bearing on FDI technology externalities. They include knowledge externalities which accrue from the improved efficiency and effectiveness of labour and human capital interactions brought about by a higher density of economic activities in a city, region or country (Marshall, 1920; Jaffe et al, 1993; Rauch, 1991 and Ciccone and Hall, 1996). There are also decreasing returns to productivity caused by the effects of overcrowding and congestion, which tend to negate the positive productivity externalities. Williamson (1965) suggests that agglomeration boosts GDP growth during the early stages of development to make up for the scarcity of infrastructure and market access and that as development takes course, congestion externalities set in and cause growth to decline. Similarly, Rauch (1991) put forward a model in which the negative effects of agglomeration arise in the form of higher rentals, while Henderson (1974)'s model emphasizes the dampening effects of increasing transport costs for workers on the overall productivity effect of density.

The role of agglomeration effects in technology transfers among firms was formalized by Marshall (1920) and later modelled, among others, by Henderson (1974), Rauch (1991) and Ciccone and Hall (1996). These models perceive the spillovers as intra-industry in nature with exchange of information taking place among similar industries situated in close proximity. According to Jacobs (1969), however, agglomeration externalities are inter-industry realized across different industries through production complementarities and diversification. The two channels can be perceived as complimentary although the latter is broader and more applicable when agglomeration is viewed broadly in terms of urbanization. Empirical studies on agglomeration economies have, however, emphasized the Marshallian spillovers, which are directly industry specific and hence linked to industry characteristics.

Most of the models on agglomeration externalities have emphasized the role of human capital as a source and catalyst for technology externalities, with agglomeration externalities and

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human capital endogenously depending on each other, with Glaeser and Resseger (2010) suggesting that high levels of human capital and city size interact to push out the frontier of knowledge and the level of productivity while Abel, et al (2011) note that higher interaction of highly-skilled people is more likely to result in more innovation than increasing the density of low human capital people. These models suggest that in countries or regions where levels of education and skills are low, there is limited or no agglomeration economies. Without undermining the technology externalities from human capital, other sources of technology externalities such as R&D, trade and FDI are likely to interact in more or less the same way with agglomeration as human capital to enhance productivity, though not widely studied.

At least two strands of studies have been popularized with regard to estimating agglomeration effects. There are those that estimate the existence of externalities without identifying their source and those that identify with human capital as the source of technology in the agglomeration externalities. Country level studies estimating the existence of agglomeration effects on income growth have been undertaken by Brulhart and Sbergami (2009) and Henderson (2003). Brulhart and Sbergami (2009) used urbanization, population density and an index of spatial concentration to measure agglomeration for 105 countries and confirmed positive agglomeration effects for the countries when per capita income is less than US$10 000 and negative effects beyond this income per capita while Henderson (2003) finds that urban primacy, defined as urban concentration as opposed to urbanization has positive agglomeration effects also up to a given income of about US$2 300. Their studies suggest that agglomeration effects are non-linear and point to the importance of country capacity factors that improve the elasticity of productivity with respect to agglomeration such as infrastructure.

A popular study among the strand of studies that do not explicitly consider the source of technology in agglomeration economies is by Ciccone and Hall (1996) who model agglomeration externalities from local production arising from the density of economic activity and examine their impact on differentials in output per worker and wages in a cross section of the US States. Using population density to proxy for agglomeration effects, they find evidence of net increasing returns to scale due to spatial agglomeration with doubling of average state density increasing average state labour productivity by about six percent. Similarly, results by Ciccone (1999), confirm agglomeration effects in Europe, with an estimated elasticity of productivity with respect to density of 4.5 for Europe. These studies have, however, been

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criticized for failing to account for possible simultaneity biases between density and productivity, which tend overestimate the productivity impact of agglomeration.

After accounting for the simultaneity biases, Abel, et al (2011) and Yu-chin Chen, et al (2011) re-estimated agglomeration externalities for the US States and find lower density externalities on productivity than those found by Ciccone and Hall (1996). Abel, et al (2011) find evidence suggesting productivity elasticity with respect to density of between 2 to 4 percent for the US states compared to about 6 percent found by Ciccone and Hall (1996), while Yu-chin Chen, et al (2011) find robust evidence for agglomeration effects even within industries after taking into account the simultaneity bias. These result suggest the importance of employing data and estimation techniques that can allow one to control for possible reverse causality when estimating productivity spillovers from agglomeration externalities, especially the use of country panel data instead of cross section data and simultaneous estimation methods.

Studies that have explicitly considered the role of human capital in agglomeration productivity externalities include Liu (2013), Glaeser and Resseger (2010) and Rosenthal and Strange (2008). The studies mostly find that human capital and agglomeration effects complement each other in enhancing productivity, with Liu (2013) terming the interaction of human capital and density, human capital density. He finds evidence suggesting that human capital density in China positively influences productivity with the relationship getting stronger when production technology and human capital become more complex. Similarly, Rosenthal and Strange (2008) find that the productivity benefits of spatial concentration increase with proximity to college educated workers while Glaeser and Resseger (2010) suggest that there are virtually no productivity externalities from agglomeration in cities with human capital below some minimum threshold. The importance of these studies with regard to our study is that they deal with an alternative source of technology to FDI and as such close to a model that assumes FDI to be a source of technology externalities in estimated agglomeration economies.

However, despite the likely importance of human capital in agglomeration economies, the suggestion Keller (2004) that most developing countries have limited R&D and human capital capabilities and rely on external sources of technology implies that FDI is likely to be an equally or even superior source of technology to human capital to consider when estimating agglomeration productivity externalities for developing countries. The importance of FDI in agglomeration externalities is echoed in studies by De Propris and Driffield (2006) and Manghinello, et al (2010).

De Propris and Driffield (2006), estimated productivity spillovers from FDI for firms in and outside clusters for UK and find a significant difference in productivity spillovers between the two groups. The study finds evidence suggesting the existence of significant intra and inter-industry productivity spillovers from foreign to domestic firms in industries and regions that possess significant clusters and no evidence of spillovers for non-clusters in which they instead find evidence for crowding out effects. The study finds that even though firms in clusters suffer from increased competition from new foreign investment, the loss in productivity is more than offset by the beneficial effects of FDI. Similarly, Menghinello, et al (2010) support the positive joint effect of density and foreign ownership for the Italian manufacturing firms which is stronger in regions with higher FDI and in manufacturing. The two studies are directly relevant to this study, which is, however at country level. They suggest that agglomeration externalities have the potential to enhance the productivity effects of FDI and as such motivate our study theoretical framework.

3.3 Modelling FDI and Agglomeration Externalities

To develop a theoretical framework that accommodates the separate and joint impacts of FDI and agglomeration effects on productivity, we follow De Propris and Driffield (2006) and Manghinello, et al (2010) and derive an empirical framework that parallels the one developed and applied by Abel, et al (2011). Our model assumes that FDI is the main source of technology externalities in the spillover model instead of human capital as assumed by Abel, et al (2011). The framework assumes that technical know-how from FDI to domestic sectors is transferred through labour turnover and interaction whose effectiveness and quality is dependent on agglomeration effects. Thus, greater labour proximity in more agglomerated countries makes labour turnover and interaction a more effective tool of knowledge transfer from the MNCs to domestic production entities.

Even though we do not explicitly model the role of human capital, our theoretical framework assumes that higher agglomeration imply higher labour and human capital density (Ciccone and Hall, 1996 and Abel et al, 2011). Defining a production function which is Cobb-Douglas with capital split between foreign and domestic capital output is:

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$$Y_{it} = A_{it} K_{fit}^{\theta} K_{dit}^{\alpha} L_{it}^{1-\theta-\alpha} \tag{1}$$

With Y_{it} representing real output for country *i* in year *t*; A_{it} is technology assumed to depend on agglomeration effects; K_{fit} is foreign capital stock; K_{dit} is domestic capital stock and L_{it} is labour. The study's technology spillover framework assumes that agglomeration externalities complement technology spillovers from foreign capital. The production function assumes constant returns to scale in factors. Parameters on the inputs are the output elasticity values with respect to the respective factors.

Following the literature on agglomeration effects, which states that density of economic activities has externalities which increase productivity (e.g Ciccone and Hall, 1996 and Abel, et al, 2011), the state of technology is represented as follows:

$$A_{it} = \lambda_{0it} D_{it}^{\lambda_1} \tag{2}$$

In which case λ_1 is the elasticity of output productivity with respect to agglomeration effects, while λ_0 is the productivity effects of other factors other than density. Thus the first parameter captures the effect of agglomeration on a country's state of technology which is realized through enhanced spillover of technical information and ideas.

Assuming competitive capital markets and uniform interest rates in each country, the amount of domestic capital demand in the production function 1 can be established by equating the marginal product of domestic capital to the domestic cost of capital (κ) as follows:

$$r_{it} = A_{it} \alpha K_{fit}^{\theta} K_{dit}^{\alpha-1} L_{it}^{1-\theta-\alpha} \tag{3}$$

From which the demand for domestic capital (K_{dit}) in each country is solved as:

$$K_{dit} = \frac{\alpha Y_{it}}{r_{it}} \tag{4}$$

Substituting (4) and (2) into the production function yields:

$$Y_{it} = \kappa D_{it}^{\lambda_1} K_{fit}^{\theta} Y_{it}^{\alpha} L_{it}^{1-\theta-\alpha} \tag{5}$$

Where parameter κ is a constant made up of the cost of capital r and the parameter λ_0. Solving for real output in (5) gives:

$$Y_{it} = \kappa D_{it}^{\frac{\lambda_1}{1-\alpha}} K_{fit}^{\frac{\theta}{1-\alpha}} L_t^{\frac{1-\theta-\alpha}{1-\alpha}} \tag{5'}$$

After dividing (5') by total labour per capita output is obtained as follows:

$$\left(\frac{Y}{L}\right)_{it} = \kappa D_{it}^{\frac{\lambda_1}{1-\alpha}} K_{fit}^{\frac{\theta}{1-\alpha}} L_t^{\frac{-\theta}{1-\alpha}} \tag{5''}$$

Which simplifies to:

$$\left(\frac{Y}{L}\right)_{it} = \kappa D_{it}^{\frac{\lambda_1}{1-\alpha}} \left(\frac{K_{fit}}{L_{it}}\right)^{\frac{\theta}{1-\alpha}} \tag{6}$$

In logarithms, equation (6) is presented as:

$$\log\left(\frac{Y}{L}\right)_{it} = \kappa_0 + \frac{\lambda_{1it}}{1-\alpha}\log(D_{it}) + \frac{\theta}{1-\alpha}\log\left(\frac{K_{fit}}{L_{it}}\right) \tag{7}$$

Therefore, equation (7) relates output per worker to density and foreign capital stock per worker, which is a modified version of the models estimated by Ciccone and Hall (1996), Liu (2013) and Abel, et al (2011), which assumed that output per worker depends on density and human capital. Our model captures the impact of density on productivity ($\frac{\lambda_{1it}}{1-\alpha}$) which can be positive or negative depending on whether the net effect of density in equation (2) is such that the positive agglomeration externalities outweigh the negative congestion effects or vice versa.

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Estimating equation (7) enables us to address our research objectives 1 and 2. Equation (7), however, leaves out the interaction between density and foreign capital and cannot answer the question on the joint productivity impact of agglomeration and FDI. To incorporate the interaction term, we follow Abel, et al (2011) who assume that output elasticity with respect to density depends on human capital. In line with the thrust of this study, we instead assume that the elasticity depends on the amount of foreign capital per capita available in a country, i.e.

$$\lambda_{1it} = \phi_0 + \phi_1 \log\left(\frac{K_{fit}}{L_{it}}\right) \qquad \phi_1 > 0 \tag{8}$$

With ϕ_1 representing the contribution of foreign capital to the net agglomeration effect of density and ϕ_0 is the productivity contribution of other factors other than foreign capital. Assuming that the contribution of foreign capital stock to net agglomeration effect is positive implies that density and foreign capital are complementary in production. Substituting (8) into equation (7), yields the full estimable model with the interaction term between density and foreign capital. This is presented in equation (9) below:

$$\log\left(\frac{Y}{L}\right)_{it} = \kappa_0^{\,*} + \frac{\lambda_{0it}}{1-\alpha}\log(D_{it}) + \frac{\phi_1}{1-\alpha}\log\left(\frac{K_{fit}}{L_{it}}\right) * \log(D_{it}) + \frac{\theta}{1-\alpha}\log\left(\frac{K_{fit}}{L_{it}}\right) \tag{9}$$

With the parameter ($\frac{\phi_1}{1-\alpha}$) indicating the joint impact of FDI and agglomeration on productivity. Equation 9, which is the study's baseline model to which other covariates of labour productivity are added as established in the literature captures the separate impacts of FDI and agglomeration on productivity as well as their joint productivity effects.

From theoretical framework model (8) and (9), we establish estimation empirical models (10) and (11), respectively, with our empirical analysis relating productivity externalities of measures of agglomeration and foreign capital as opposed to Abel et al (2011) and Glaeser and Resseger (2010), who relate measures of agglomeration and human capital foreign capital to productivity. The estimated empirical model corresponding to theoretical model (8) is thus:

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$$\log\left(\frac{Y}{L}\right)_{it} = \beta_0 + \beta_1 \log(D_{it}) + \beta_2 \log\left(\frac{K_{fit}}{L_{it}}\right) + \eta_i + \varepsilon_{it} \tag{10}$$

With $\beta_1 = \dfrac{\lambda_{1it}}{1-\alpha}$ capturing the overall impact density on output per capita and $\beta_2 = \dfrac{\theta}{1-\alpha}$ and η_i captures country fixed effects and ε_{it} is an i.i.d error term, assumed to be orthogonal to the regressors. The estimated model with joint effects of density and FDI from (9) is as follows:

$$\log\left(\frac{Y}{L}\right)_{it} = \beta_0 + \beta_1 \log(D_{it}) + \beta_2 \log\left(\frac{K_{fit}}{L_{it}}\right) + \beta_4 \log(D_{it}) * \log\left(\frac{K_{fit}}{L_{it}}\right) + \beta_5 X_{it} + \eta_i + \varepsilon_{it} \tag{11}$$

With the coefficient on the interaction term being equal to $\dfrac{\phi_1}{1-\alpha}$ and measuring how a simultaneous increase in agglomeration and FDI impacts on output per person and X_{it} capturing the impact of other productivity co-variates outside density and foreign capital. Because the parameter on density captures both the positive external economies of agglomeration and the negative effects of congestion, it can have a positive or negative sign. However, in line with the theory of agglomeration economies, it is expected to positively impact on output per person. Similarly, the coefficient on foreign capital can be positive or negative. When it is positive, it confirms the positive FDI productivity spillover hypothesis and when it is negative, it confirms productivity crowding out for the domestic economy.

Foreign direct investment has two effects on productivity. The first is the direct technology effect, which arise due to the fact that usually FDI is embedded with higher technology stocks than local capital stocks. In the estimated model specifications, this effect is captured by the coefficient on FDI. The second effect, is the spillover effect which arises through the diffusion of the higher technology in FDI to other production processes across industry. The agent of technology diffusion from FDI is usually labour turnover, labour density, human capital and or human capital density and interaction. This chapter emphasizes the role of labour and human capital density in magnifying the technology spillover effects of FDI, although the direct impact of FDI is also captured.

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To the extent that density and foreign direct investment are hypothesized to complement each other in enhancing productivity, the coefficient on their interaction term is expected to be positive, while the impacts of the variables in X_{it} can have positive and negative signs depending on their theoretical relationship with labour productivity. Variables include, human capital, infrastructure, domestic savings, measures of democracy, which are expected to impact positively on productivity and inflation, government expenditure and conflict, which are expected to negatively impact on productivity.

3.4 Data Analysis

The critical variables needed for estimating empirical models (10) and (11) are output per capita $\left(\frac{Y}{L}\right)$, measures of agglomeration (D) and foreign capital stock per capita $\left(\frac{K}{L}\right)$. Output per capita is available from the Pen World Tables (PWT8.0). It is measured as output per person and it closely approximates labour productivity under the assumption that population and labour growth are proportional. On the basis of this assumption, the variable is also interpreted to imply labour productivity, with an increase in output per capita taken as reflecting an increase in output per worker.

Regarding measures of agglomeration, variables that have applied to country level studies include urbanization rates, urban primacy and population density. Given that the interest in this study is on information and knowledge transfers that require physical interaction of people, we prefer these measures because they are population based measures of density, which capture the proximity of people as opposed to employment-based interactions which assume that the exchange of ideas in agglomerations is confined to places of employment.

Henderson (2003) uses and defines urban primacy as the percentage of a country's population living in the large urban cities, which according to WDI (2015) in our case would be cities with one million or more people. The underlying reflection in urban primacy is on the extent to which urbanization is confined to a few major metro areas, relative to being spread more evenly across a variety of cities and as such an appropriate measure of spatial concentration of economic activities in countries. The measure is, however, only available for 6 out of 14 countries in our study, hence it is not our preferred measure of agglomeration effects.

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Measures that are available for all the 14 countries in our study are urbanization and population density. While urbanization, which is measured as the percent of a country's population living in urban areas is widely used (e.g. Brulhart and Sbergami, 2009) and available for all the 14 countries of the study in the WDI, the measure is more of an agglomeration size measure as opposed to a measure of density. Similarly, population density which is measured as the number of people per square kilometre is widely used (Ciccone and Hall, 1996) and available for all the 14 countries in the WDI, but tend to measure country-wide density which is not attached to urbanization where much of non-extractive sector FDI is located (UNCTAD, 2014).

We argue that exclusively using either population density or urbanization to measure spatial proximity that link with FDI technology externalities may be misleading. If one assumes that much of the non-extractive more productive FDI is in urban areas, for example, a country with high population density but very low urbanization rates may not necessarily imply greater effective interaction that transmit technology across economic activities than a country with low population density and high urbanization. Similarly, countries with small population sizes and low population density but high urbanization rates may also not imply greater effective interaction of people and economic activities that transmit technology from FDI than countries with low urbanization but large populations and high population density.

A measure of agglomeration effects which captures both the size and density aspects of agglomeration is, therefore, preferable. To obtain such a measure, we construct an index measure which combines within country population density and urbanization. In parallel to Ciccone and Hall (1996) who assume that agglomeration factors are multiplicative, the agglomeration index is constructed as a multiplicative interaction of urbanization and population density. Interacting urbanization and population density adjusts urbanization and population density measures up or down to obtain a proxy for agglomeration effects, which closely captures effective physical proximity of people and economic activities that is relevant for transmitting technology from foreign direct investment. To make an assessment and comparison of the individual measures of agglomeration effects, however, urbanization, population density and the computed index measure are separately used.

Another critical variable in our empirical models is foreign direct investment, which is defined as net FDI stocks per capita. The variable is sourced from UNCTAD statistics. The use of per

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capita FDI stocks as opposed to flows normalizes the variable across countries. It is also motivated by the fact that technology transfers from FDI are a long term phenomenon which cannot be adequately captured by flows as suggested by Lensink and Morrissey (2006) who find that volatility of FDI flows is associated with unobserved effects which are destabilizing. Human capital is measured as the number of average schooling years for each country. It is available from the Penny World Tables (PWT8.0). The variable, however, the variable is not available for Angola and Madagascar, hence we use the percentage of education expenditure available from the WDI (World Bank, 2015) for all the 14 countries. Unlike average schooling years which measure schooling output and which has been criticised for failing to capture the quality of education in some instances (Islam, 2010), the percentage of education expenditure measures an input into education and is likely to reflect human capital quality.

To ensure that the estimated models remain parsimonious, the number of control variables in X are kept minimal and guided by the list of variables identified in Sala-i-Martin et al (2004). Variables thought to have more cross sectional variations and little time variations such as institutions, geography and religion are subsumed under the country fixed effects. This has left us with about five additional variables in X which are: measures of financial deepening (Gross Domestic Savings), infrastructure (Telephone Lines per 100 People), a measure of democracy (Polity), trade growth (Trade Volume Index) and government expenditure percentage, all sourced mainly from WDI tables. Tables 8 and 9 below summarize the variables utilized in the study and their correlations.

Table 10: Summary of Selected Variable Indicators

Variable	Mean	Std.D	Min	Max	No of Obs.
GDP Per Capita	1757	1853	118.6	6471	308
Urbanization	32.82	11.85	11.56	62.75	308
Population Density	74.81	145.7	1.719	633.5	306
Density Index	26.20	61.87	0.475	256.2	306
FDI Stock Per Capita	409.3	504.6	2	3055	308
Gross Domestic Savings	9.628	19.44	-70.46	56.23	307
Telephone Lines	3.734	6.027	0.0058	29.84	308
Polity IV Index	4.981	8.360	-9	38	308
Government Expenditure	18.34	8.531	2.050	45.26	308
Trade Volume Index	128.7	73.29	37.36	412.5	308
Human Capital	2.044	0.429	1.132	9.611	264
Education Expenditure	5.283	6.938	0.946	68.15	307

Data Source: WDI, UNCTAD, PWT8.0

Table 11: Correlation Matrix of Selected Variables

	PCGDP	URBAN	PDNS	DNSDEX	PCFDI	GDS	TEL.
PCGDP	1						
URBAN	0.753	1					
PDNS	0.360	0.099	1				
DNSDEX	0.423	0.217	0.988	1			
PCFDI	0.708	0.518	0.089	0.139	1		
GDS	0.472	0.582	0.074	0.137	0.312	1	
TEL.	0.539	0.280	0.778	0.800	0.303	0.222	1
POLITY	0.559	0.543	0.171	0.211	0.468	0.157	0.306
GOVT	0.193	-0.014	-0.156	-0.157	0.240	-0.182	-0.061
TRADE	-0.055	-0.008	0.003	-0.029	0.094	-0.004	-0.074
EDUC	0.741	0.586	0.164	0.214	0.514	0.336	0.328
ED_EXP	0.069	0.029	-0.078	-0.073	0.024	0.003	-0.040

	POLITY	GOVT	TRADE	EDUC	ED_EXP
POLITY	1				
GOVT	0.056	1			
TRADE	-0.031	-0.045	1		
EDUC	0.400	0.346	-0.068	1	
ED_EXP	-0.111	0.167	-0.067	0.203	1

*Data Source: WDI, UNCTAD, PWT8.0 *Significant at 10%*

The correlation matrix table suggests that multicollinearity is unlikely to be a problem in our estimations as shown by the low pairwise correlations coefficients among the variables (Hove, et al, 2012). The low positive correlation between urbanization and population density suggests that the two variables do not proportionately adjust over time so that countries with fast increasing population tend to experience less than proportionate urbanization, or countries with high urbanization growth rates have population density growing less commensurately. Under this scenario, the index of agglomeration allows upward and down adjustments to population density and urbanization to account for the mismatch and get a measure that takes account of the two measures. The high correlation between PDNS and DNSDEX is explained by the fact that population density (PDNS) weighs highly in the computed density index (DNSDEX) compared to urbanization on account of its large absolute values relative to urbanization.

Another data issue that we looked at is the issue of the stationarity of the variables in equations 10 and 11 given the time series component of the panel data and the warning in literature suggesting that econometric estimation of non-stationary variables can lead to spurious results if corrective measures are not implemented (Baltagi, 2005). We, therefore, test for stationarity of all the variables in the estimated models. In undertaking the panel unit roots tests, the IPS procedure suggested by Im, et al (2003) is implemented following its attractive features. It does

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not assume a common autocorrelation coefficient across cross-sections and allows the variable to have unit roots in some countries instead of requiring it to be stationary in all the countries (Im, et al, 2003). The test procedure involves testing for unit roots for variables in individual countries using the Augmented Dickey Fuller (ADF) test and averaging out the individual tests to obtain the overall test statistic as follows:

$$tbar_{NT} = \frac{1}{N}\sum_{i=1}^{N} t_{iT}(\rho_i, \beta_i) \qquad (12)$$

With $t_{iT}(\rho_i, \beta_i)$ representing the ADF t-statistics for the individual countries. According to Im, et al (2003), $tbar_{NT}$ sequentially converges to a normal distribution under the assumption of cross-sectional independence and can be tested using two standardized test statistics which are the Z_{tbar} and the W_{tbar}, with the W_{tbar} accounting for the ADF orders in computing the mean and variance adjustment factors for the statistic. As such, it performs better than the Z_{tbar} and more popular (Im, et al 2003). We, therefore, utilize the test statistic instead of the $Z_{tbar.}$

The estimated IPS panel unit roots statistics and the corresponding W_{tbar} probability values for the variables utilized in our estimation are reported in table 12 below:

Table 12: IPS Panel Unit Root Test (1990-2011)

	PCGDP	Density Index	PCFDI	Population. Density	Education Expenditure	urban	Trade Index	GDS
W_t_bar	-1.64	-2.14	-5.93	-20.4	-2.09	2.26	-2.13	-3.36
P_Value	0.05	0.02	0.01	0.01	0.02	0.99	0.02	0.01

	Education Years	Government Expenditure
W_t_bar	-0.82	-1.66
P_Value	0.21	0.06

// Variables are in Logarithms;
// Optimal lag lengths (*m*) on each variable in the ADF is determined on the basis of the Akaike Information Criterion (AIC) to circumvent the subjectivity in setting the lags;

The panel unit root test results show that our major variables, which are per capita income, the density index, foreign direct investment stock and human capital input are stationary. Given that our preferred measure of agglomeration is the index of density, we proceed to estimate the empirical model in levels instead of using panel cointegration as the results are unlikely to be spurious. For human capital we utilize education expenditure, which is stationary instead of

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years of schooling, which has unit roots. In the preliminary estimations, when the three measures of density are used, urbanization is utilized in the regressions in its first difference before it is subsequently dropped for the density index in further estimations.

3.5 Empirical Results Estimation and Analysis

The purpose of our empirical analysis is to examine whether foreign direct investment, density and their interaction increase labour productivity in SADC. To estimate the productivity impacts of these factors, we first estimate the labour productivity equation without interaction of density and FDI as derived in equation 10, which we specify below:

$$\log\left(\frac{Y}{L}\right)_{it} = \beta_0 + \beta_1 \log(D_{it}) + \beta_2 \log\left(\frac{K_{fit}}{L_{it}}\right) + \eta_i + \varepsilon_{it} \qquad (10)$$

In estimating equations 10 and 11, a problem that arises is the endogeneity of agglomeration and foreign direct investment to the error terms. This follows from the fact that more agglomerated and high productivity countries in the region are likely to attract better skills and foreign direct investment while at the same time, greater agglomeration and foreign capital stocks are likely to foster growth in productivity. High productivity countries such as South Africa are likely to be characterized by high agglomeration and income per capita due to labour and human capital immigration while the high productivity factors are likely to cause further increases in productivity. Likewise, low productivity and low income countries are likely to experience the opposite. To address the reverse causality problem, we employ the instrumental variables estimation technique with fixed effects to obtain unbiased estimated coefficients, with agglomeration and FDI instrumented by their lagged variables as suggested by Bond et al (2010) and Roodman (2009) due to difficulties in obtaining external instruments. In all the IV models the validity of the instruments is tested for.

Table 14 presents the results of our regression estimation of model (10) above, using urbanization, population density and the index of density to measure agglomeration effects. We have also included the square of density to equation 10 to capture possible non-linear relationships between output per worker and measures of density. Columns (1), (2) and (3) show OLS results using the three measures of density, respectively while columns (4), (5) and

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(6) are for the IV results. In overall terms, the models explain about 25% of the variation in the natural logarithm of output per worker in SADC. The F-Statistic for model fit shows good fit for the models and the Hansen J (Roodman, 2009) and the Kleibergen-Paap (Baum, 2007) tests for model identification and instruments validity suggest that the models are correctly identified and that the instruments used are valid for the models. A comparison of the OLS and IV results shows that OLS underestimates the impacts of density and FDI on productivity due to the simultaneity between the variables and productivity. Theoretically expected relationships hold for FDI stock per capita and the measures of agglomeration, except for urbanization which is negatively related to output per person. On account of this, we resort to interpreting the IV results for the density index.

From the regression results, we find that per capita FDI stock has a positive effect on output per person, with a 1% increase in FDI stock per capita leading to 0.2% increase in output per capita. This implies that FDI and labour productivity are positively related. Results also show that agglomeration effects have a positive effect on labour productivity, with a 1% increase in the density index increasing output per capita by 1.33%. There are strong non-linear relationships between per capita income and density, with congestion effects of agglomeration reducing output per person by 0.24% for a 1% increase in the density index. This may be reflective of inadequate infrastructure for the average country in the SADC region. To the extent that this holds, the poor infrastructure implies that countries in the region do not have enough capacity to exploit the benefits of agglomeration externalities. Consequently, the total effect of agglomeration at the mean value of the density index is negative. The total agglomeration effect on productivity only becomes positive and significant with a 0.27% increase in labour productivity corresponding to a 1% increase in the density index when density is one standard deviation below its mean value[13], suggesting that at lower than the regional agglomeration average density has a positive effect on labour productivity.

[13] The mean value of the log of the density index is 6.06, while its standard deviation is 1.64

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Table 13: Agglomeration Effects, FDI and Labour Productivity

	OLS			*IV*		
VARIABLES	Urban	Density	Index	Urban	Density	Index
Agglomeration	-1.15***	0.25*	1.01***	-0.96**	0.37***	1.33***
	(0.31)	(0.13)	(0.17)	(0.48)	(0.14)	(0.21)
Agglomeration Squared	0.21***	-0.06***	-0.09***	0.19***	-0.10***	-0.12***
	(0.05)	(0.02)	(0.02)	(0.07)	(0.03)	(0.02)
Per Capita FDI Stock	0.08***	0.14***	0.14***	0.10***	0.18***	0.19***
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
Constant	7.78***	6.12***	3.36***	7.32***	5.96***	2.34***
	(0.48)	(0.20)	(0.49)	(0.79)	(0.22)	(0.60)
Observations	439	437	437	412	410	410
Number of Countries	14	14	14	14	14	14
R-squared	0.23	0.20	0.25	0.23	0.21	0.24
F-Stat	0.00	0.00	0.00	0.00	0.00	0.00
Hansen J Test (P-Value)				0.10	0.26	0.49
Kleibergen-Paap (χ)				10	35	44
Endogeneity (P-Value)				0.02	0.00	0.00

//Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
//The instrumeted variables are Density, FDI and Density Square
//For Hansen J Test of Overidentifying Restrictions: H_0: Model instruments are valid
//For Kleibergen-Paap Underidentification Test: H_0: Equation is Underidentified
//Endogeneity Test: H_0: The specified endogenous regressors are exogenous

We have argued that when FDI is hosted in an agglomerated country with higher density of economic activities, its productivity effect should be enhanced to the extent that FDI and agglomeration effects are complementary in production. The results in table 14, however, do not include the joint productivity externalities between agglomeration and FDI and cannot allow us to make this assessment.

To capture the joint effects of agglomeration and FDI productivity externalities, empirical model 11 is estimated with the estimated results presented in table 14 below. The estimated model for table 14 is re-stated below:

$$\log\left(\frac{Y}{L}\right)_{it} = \beta_0 + \beta_1 \log(D_{it}) + \beta_2 \log\left(\frac{K_{fit}}{L_{it}}\right) + \beta_4 \log(D_{it}) * \log\left(\frac{K_{fit}}{L_{it}}\right) + \eta_i + \varepsilon_{it} \qquad 11$$

With the coefficient β_4 giving the joint impact of FDI and agglomeration externalities on labour productivity. Table 15 presents results from 11 using the density index measure of

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agglomeration effects and for the IV estimation approach. The first column of table 15 presents results for the baseline model quation 11 and from columns (2) to (7), we present results from 11 augmented with additional variables to check on the robustness of the baseline model results to controlling for various scenarios under which labour productivity can be enhanced. Our baseline model is similar to the one presented by Abel et al (2011) and Glaeser and Resseger (2010), except that instead of controlling for human capital as the source of productivity, we control for foreign capital. Overall, the models have F-tests, which indicate good fit, with the baseline model explaining 42% of variation in labour productivity, while the augmented models explain between 60% and 70% of variation in productivity. Tests for model identification and instruments validity shows that the models are properly identified and the instruments used are valid for the models.

The baseline model results in column 1 suggest that the density index has a positive impact on productivity, with a 1% increase in the density index leading to 0.95% increase in output per person. The non-linearity of productivity with respect to agglomeration effects is also strongly suggested in the baseline model, with a 1% increase in the density index reducing the growth in productivity attributable to agglomeration effects by 0.2%. When both the congestion effect of density and the externality effect of FDI are considered, a 1% increase in the density index reduces output per worker by 0.072% evaluated at the mean values of density and FDI[14], while it increases output per worker by 0.26% at density which is one standard deviation below its regional mean value. Again, this emphasizes the inadequacy of infrastructure in the region to harness maximum benefits from agglomeration economies and suggesting that density has a positive effect on productivity for levels of agglomeration below its sample average.

[14] The mean value of log of per capita FDI stock is 4.76 and its standard deviation is 1.79

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Table 14: Agglomeration Effects, FDI and Labour Productivity (Augmented Model)

	Baseline	*Augmented Models*				
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Density Index	0.95***	1.061***	1.097***	1.248***	1.045***	1.729***
	(0.19)	(0.178)	(0.180)	(0.190)	(0.198)	(0.285)
Density Index Squared	-0.10***	-0.128***	-0.130***	-0.142***	-0.127***	-0.215***
	(0.02)	(0.016)	(0.016)	(0.017)	(0.018)	(0.032)
FDI Stock Per Capita	-0.08**	-0.010	-0.016	0.029	0.001	-0.060
	(0.04)	(0.032)	(0.032)	(0.034)	(0.035)	(0.041)
FDI Stock Per Capita*Density Index	0.04***	0.023***	0.024***	0.021***	0.025***	0.031***
	(0.00)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Financial Sector Credit		0.144***	0.154***	0.161***	0.138***	0.137***
		(0.024)	(0.025)	(0.024)	(0.024)	(0.027)
Telephone Lines		0.197***	0.188***	0.182***	0.194***	0.227***
		(0.021)	(0.022)	(0.022)	(0.022)	(0.026)
Domestic Expenditure			0.073			
			(0.054)			
Trade Index		0.112***	0.115***	0.093***	0.110***	0.094***
		(0.029)	(0.029)	(0.030)	(0.030)	(0.033)
Human Capital		0.123***	0.121***	0.127***	0.163***	-1.344***
		(0.021)	(0.021)	(0.021)	(0.062)	(0.451)
Domestic Investment				-0.642***		
				(0.213)		
FDI Stock Per Capita*Human Capital					-0.016	
					(0.026)	
Density Index*Human Capital						0.459***
						(0.140)
Constant	4.14***	3.832***	3.296***	3.284***	3.824***	3.467***
	(0.57)	(0.546)	(0.677)	(0.587)	(0.580)	(0.647)
Observations	410	392	392	376	384	386
No. of Countries	14	14	14	14	14	14
R_Squared	0.42	0.67	0.67	0.69	0.67	0.59
Hansen J Test (P-Value)	0.11	0.45	0.24	0.84	0.51	0.37
Kleibergen-Paap (χ)	77	59.3	100	58.9	40.2	18.3

//Instrumeted variables: Density, FDI and Density Square; Hansen Test: H_0: Model instruments are valid; Kleibergen-Paap Test: H_0: Equation is Under-identified

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The baseline model shows that, before we take the impact of agglomeration externalities into account, FDI has a crowding out effect on labour productivity, with a 1% increase in the stock of FDI stock per capita leading to 0.08% reduction in output per person, which could partly be caused by multicollinearity of separately and jointly controlling for FDI and agglomeration. However, when we take the externality effects of agglomeration in account, the impact of FDI on productivity is positive and significant, evaluated at the mean values of density and FDI stock. In this case a 1% increase in the stock of FDI stock per capita leads to 0.16% increase in output per person. Our results confirm the positive productivity externality effect of agglomeration on the impact of foreign direct investment on productivity suggested by De Propris and Driffield (2006) and Manghinello, et al (2010). On the basis of the proposed transmission mechanism between FDI, density and productivity, this suggests that agglomeration externalities play a significant role in enhancing the productivity externalities of FDI. It means that when both agglomeration and FDI effects are considered separately without including their joint productivity externality effects, their impact on productivity tends to be underestimated. Their effects are correctly estimated and become significant when the joint productivity externality effects are taken into account. Thus FDI which is directed in countries with more agglomeration has more productivity externalities than when directed in less dense countries.

A limitation with the baseline model results in table 15 is that it does not control for other circumstances through which productivity can be increased outside foreign capital, density and their interaction. To check on the robustness of the baseline model results, we control for a number of such possible productivity effects in column (2). Additional variables controlled for are: financial sector development, measured by financial sector credit, infrastructure measured by number of telephone lines per 100 people, trade, and human capital measured by investment expenditure on education. As suggested by Alfaro el al (2009), a more developed financial sector is likely to promote the positive externality effects of FDI. Similarly, Li and Liu (2005) suggest that infrastructure has positive externalities of productivity, while the issue of positive human capital productivity externalities through FDI and agglomeration is emphasized by both the theory of economic geography (e.g. Abel, et al, 2011 and Rauch, 1991) and the FDI productivity spillover hypothesis (e.g. Liu, 2008 and Javorcik, 2004).

Results in column (2) show that all the included productivity co-variates have theoretically expected signs, with the impacts of trade, human capital, financial development and

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infrastructure having positive and significant effects on labour productivity. The impact of density at the mean values of the density index and per capita FDI stock remains negative and only becomes positive at agglomeration level which one standard deviation below the mean value, while the productivity impact FDI is insignificant. However when the joint externalities of density and FDI are considered, the impact of FDI on productivity becomes positive. This shows that the productivity complementarities between FDI and agglomeration are robust to controlling for the productivity effects of trade, infrastructure, human capital and financial sector development as alternative channels through which the impact of FDI can be enhanced.

Another channel through which density and FDI can impact on output per person is the market effect. This follows from the fact that greater agglomeration means more people who present opportunities for greater markets that can boost production. At the same time FDI creates income which can be used by the FDI host countries to augment domestic expenditure. To control for these demand effects, we include total domestic expenditure inclusive of private and government expenditure in column (3) on assumption that the two market effects should be reflected in higher domestic expenditure. Column (3) suggests that the joint positive productivity externality effects of FDI and density remain robust, implying that the observed increase in productivity associated with the joint interaction of density and FDI is not a result of the market or demand effects of FDI and density.

Similarly, literature has also indicated that FDI adds to the countries' domestic capital stocks, both human and physical (Alfaro et al, 2009). To the extent that this occurs, it means that part of the estimated increase in labour productivity when FDI increases could be capturing this capital accumulation effect. To control for the capital accumulation effect of FDI, we control for domestic investment in column (4). Again, the joint productivity externality from density and FDI remain positive and robust to controlling for the capital accumulation effects of FDI on productivity. Hence, the gain in productivity is not accounted for by factor accumulation.

In addition, in columns (5) and (6), we control for the effects of human capital development on productivity that is associated with FDI and density, respectively. The effect of FDI on human capital has been suggested and modelled by Kokko and Blomstrom (2003), wherein an increase in FDI interacts with domestic human capital to improve the FDI host country's stock of human capital, which in turn improves its productivity, while the positive effect of density on human capital stock has been emphasized by studies on agglomeration externalities (e.g. Rauch, 1991

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and Glaeser and Resseger, 2010). To control for these two possible human capital effects, we include interactions of human capital and FDI in column (5) and human capital and density in column (6). In both columns (5) and (6) the joint effect of FDI and agglomeration effects remain positive and significant, which means that the estimated gain in productivity from FDI and density is not occurring through the human capital effects. However, the interaction between density and human capital also positively influences labour productivity in column (6). The result supports of Liu (2013) and Glaeser and Resseger (2010)'s findings that human capital density enhances productivity. It suggests the importance of human capital in agglomeration externalities and points to the fact that human capital, density and FDI are synergistic and complementary in enhancing labour productivity in the region.

Lastly, the robustness of results in table 15 are checked against different sample compositions, especially with regard to outlier countries in the region. If the exclusion of such countries drastically changes the results, this could put to question the external validity of the results even within SADC itself. Outlier countries that we control for are South Africa and Angola on the basis that South Africa is a dominant player in the region in terms of agglomeration factors, intra-region FDI and technological advancement while Angola is excluded due to its undiversified economy that heavily depends on mineral resources or mineral resources based industries. Consequently, it could be questioned as to whether the results in table 15 are not necessarily driven by the dominance of South Africa or whether the inclusion of Angola is not down playing the productivity effect of FDI if it is assumed that resource based FDI is less productive than manufacturing sector FDI.

To check on the robustness of our results against sample composition, we re-estimate results of table 15 without the outlier countries and present the re-estimated results in table 16 below. Interestingly, the joint impact of density and FDI on labour productivity remains positive and significant at 1%. The coefficients on the interaction of density and FDI are, however, marginally higher than those in table 15, except for column 5 when the interaction between FDI and human capital is controlled for. In addition, the impact of the interaction between human capital and density remains significant but higher in magnitude when South Africa and Angola are excluded.

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Table 15: Agglomeration and FDI Productivity Externalities Excluding South Africa and Angola

	Urban	Density Index				
VARIABLES		(1)	(2)	(3)	(4)	(5)
Density Index	1.08***	0.970***	1.023***	1.135***	1.075***	2.234***
	(0.19)	(0.184)	(0.184)	(0.191)	(0.215)	(0.414)
Density Index Squared	-0.11***	-0.119***	-0.121***	-0.132***	-0.129***	-0.261***
	(0.02)	(0.016)	(0.016)	(0.017)	(0.019)	(0.043)
FDI Stock Per Capita	-0.05	-0.019	-0.029	0.017	-0.025	-0.043
	(0.04)	(0.031)	(0.031)	(0.032)	(0.035)	(0.043)
Per Capita FDI Stock *Density Index	0.04***	0.024***	0.025***	0.022***	0.022***	0.034***
	(0.00)	(0.004)	(0.004)	(0.004)	(0.005)	(0.006)
Financial Sector Credit		0.120***	0.142***	0.136***	0.124***	0.150***
		(0.025)	(0.027)	(0.025)	(0.027)	(0.034)
Telephone Lines		0.201***	0.186***	0.189***	0.204***	0.187***
		(0.023)	(0.023)	(0.023)	(0.025)	(0.030)
Domestic Expenditure			0.134**			
			(0.058)			
Trade Index		0.079***	0.082***	0.067**	0.080**	0.033
		(0.030)	(0.029)	(0.030)	(0.031)	(0.041)
Human Capital		0.147***	0.142***	0.144***	0.086	-1.773***
		(0.021)	(0.021)	(0.021)	(0.065)	(0.530)
Domestic Investment				-0.466**		
				(0.205)		
Per Capita FDI Stock *Human Capital					0.029	
					(0.028)	
Density Index*Human Capital						0.589***
						(0.162)
Constant	3.61***	4.071***	3.127***	3.573***	3.894***	2.107**
	(0.58)	(0.573)	(0.705)	(0.592)	(0.639)	(0.923)
Observations	351	337	337	328	331	333
R_Squared	0.46	0.70	0.71	0.72	0.68	0.51
Hansen J Test (P-Value)	0.13	0.58	0.49	0.75	0.58	0.92
Kleibergen-Paap (χ)	38	49	99	59	33	19

//Instrumeted variables: Density, FDI and Density Square; Hansen Test: H_0: Model instruments are valid; Kleibergen-Paap Test: H_0: Equation is Under-identified

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The differences in the impacts of FDI and density on productivity could be explicable by the fact that other countries in the region outside South Africa are relatively technologically poor and any technology spillovers including human capital density for them is likely to have a greater productivity impact than it would impact on South Africa as suggested by Findlay (1978) and Barro and Sala-i-Martin (2004).

Overall, the results suggest strong evidence that agglomeration externalities and foreign direct investment in the SADC region are complimentary in boosting productivity. The region, therefore, stands to benefit from FDI with optimum agglomeration.

3.1 The Source of Agglomeration Externalities

We have argued that a more plausible source of technology relevant for agglomeration externalities in SADC and many developing countries is foreign direct investment. This argument is based on suggestions that human capital and R&D levels are relatively low in most developing countries and that foreign sources of technology constitute a large component of the countries' technology stocks (Keller, 2004). It is critical to empirically estimate and analyse the implications of both human capital and FDI technology externalities in the region agglomeration externalities. In support of most studies in economic geography (e.g. Liu, 2013, Abel, et al 2011 and Rauch, 1991), the significance of human capital density in explaining labour productivity in column 6 of tables 14 and 15 suggests that human capital is an equally important source of agglomeration externalities as FDI in the region.

To analyse the relative importance of FDI and human capital in agglomeration externalities, we follow Abel, et al (2011) and Glaeser and Resseger (2010) and assume that both human capital and FDI are explanatory variables in the labour productivity equation as follows:

$$\log\left(\frac{Y}{L}\right)_{it} = \beta_0 + \beta_1 \log(D_{it}) + \beta_2 \log\left(\frac{K_{fit}}{L_{it}}\right) + \beta_3 \log\left(\frac{H}{L}\right)_{it} + \eta_i + \varepsilon_{it} \qquad (12)$$

With $\frac{H}{L}$ measuring human capital per capita. To estimate the relative importance of foreign capital and human capital in agglomeration externalities on productivity, we follow the procedure used by Glaeser and Ressenger (2009) who analysed the contribution of human capital density externalities by estimating a model similar to 12 with human capital only and assess how controlling for human capital impacts on the coefficient of density and deduce its implied effects from observed changes in the estimated coefficient on density coefficient. In our case, however, the objective is to assess how alternatively controlling for human capital and foreign capital in model 12 differently affects the coefficient on density. Our analysis is first simplified by excluding interaction terms between density and human capital and human capital and FDI, which we later incorporate.

Estimated results from equation are presented in table 16 below:

Table 16: Estimating Sources of Agglomeration Externalities

	Using Density Index					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Density Index	0.296***	0.524***	0.467***	0.331***	0.953***	1.235***
	(0.099)	(0.055)	(0.088)	(0.078)	(0.358)	(0.337)
Human Capital	0.192		0.284		0.555	
	(0.327)		(0.341)		(0.390)	
FDI Stock Per Capita	0.070***			0.071***		0.102***
	(0.022)			(0.022)		(0.024)
Density Index Squared					-0.042	-0.076***
					(0.030)	(0.028)
Constant	4.317***	3.251***	3.449***	4.200***	1.964*	1.558
	(0.496)	(0.374)	(0.440)	(0.455)	(1.146)	(1.060)
Observations	238	238	238	238	238	238
Number of Countries	12	12	12	12	12	12
R-squared	0.31	0.22	0.24	0.31	0.26	0.34
F-Stat	330	1600	624	430	373	368
Hansen J (P-Value)	0.79	0.67	0.62	0.75	0.36	0.99
Kleibergen-Paap (χ)	37	77	44	44	52	47
Income Turning Point					2330	1230

//Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
//The instrumeted variables are Density, FDI and Density Square
//For Hansen J Test of Overidentifying Restrictions: H_0: Model instruments are valid
//For Kleibergen-Paap Underidentification Test: H_0: Equation is Underidentified
//Endogeneity Test: H_0: The specified endogenous regressors are exogenous

The first column of table 16 gives results for the complete model in equation while the second column gives results when density index is the only variable controlled for. In columns 3 and 4, we alternatively control for human capital and per capita FDI stock, respectively together with the density index. In the last two columns, we include the squares of density to capture

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the possibility of agglomeration diseconomies as suggested by results above.

The positive coefficient on the density index in the complete model suggests that on average the positive agglomeration effects on productivity outweigh the negative congestion effects. When we control for density alone in column (2), the effect of density on labour productivity increases from 0.3% in column (1) to 0.52% in column (2). Given that human capital and FDI are hypothesized to influence productivity through agglomeration externalities, the improved coefficient of 0.52% on density in column 2 should compositely incorporate human capital and FDI externality effects, which we alternatively isolate in columns 3 and 4 and assess the resultant declines in the coefficients on density index.

When we control for human capital externality effect in column 3, the coefficient on density falls from 0.52% to 0.47%, which is a 10% decline. On the basis of our assumption of no interaction between density and human capital, this implies that human capital constitutes about 10% of density externalities on productivity in the region. Alternatively, when the effect of per capita FDI stock is controlled for in column 4, the coefficient on density falls from 0.52% to 0.33%, which constitutes a 37% decline in the impact of density on productivity. These results suggest that FDI has a greater complimenting effect in density externalities than human capital in SADC implying that a greater proportion of the estimated productivity externalities are emanating from FDI than from human capital.

The results could easily be invalidated if the joint productivity spillovers of human capital and density are larger than the joint productivity spillover effects of FDI and density. To clear this suspicion, we have estimated the equivalence of columns 2, 3 and 4 controlling for the interaction terms and other determinants of labour productivity (see Table B1, Annex B) and find results that qualitatively confirm the same pattern of relative importance for FDI and human capital, with the contributions of human capital and FDI in the coefficient on density estimated at 25% and 56%, respectively evaluated at means of density, human capital and FDI.

Alternatively, we have also assessed the relative importance of FDI and human capital on agglomeration externalities by computing the implied differences in the turning point incomes at which diseconomies to agglomeration set in when the two factors are alternatively controlled for in columns 5 and 6. This analysis follows suggestions by Henderson (2003) and Williamson (1965) that the relationship between density and productivity is concave. If FDI is relatively

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more important than human capital in agglomeration economies, its presence should prolong the turning point income more than the presence of human capital does. Alternatively put, when the effect of FDI is taken out of the impact of density, diseconomies of agglomeration should be realized much quicker than when human capital is taken out.

The inclusion of the square of the density index in columns 5 and 6 in table 13 enables us to compute the productivity turning point incomes when human capita and FDI are alternatively controlled for in the estimated models. It turns out that agglomeration diseconomies set in at incomes of US$2 300 and US$1 200 (base 2005) when human capital and FDI stock are, respectively controlled for. This means that without FDI, diseconomies from density set in more quickly than without human capital externality effects implying greater contribution of FDI technology externalities than human capital in the region's agglomeration externalities. On the basis of this analysis, therefore, it can be suggested that the region tends to derive more technology externalities from the presence of MNCs than from human capital, which according to Borensztein et al (1998) should be above some minimum threshold for FDI to be beneficial.

3.2 Conclusion

In this study we explored the separate and joint impacts of agglomeration effects and foreign direct investment on productivity growth in SADC. We have been motivated by the theoretical propositions suggesting that productivity externalities emanating from FDI and spatial proximity of economic activity are likely to be complimentary. The study is a critical contribution to economic geography literature to the debate on FDI productivity spillover hypothesis. Its novelty is derived from undertaking an investigation of how FDI and agglomeration externalities can interact to enhance productivity, which is different from most past studies which emphasize the role of human capital density in agglomeration externalities. More importantly, the study is done for a group of developing countries, which on average hosts low human capital and rely more on FDI as a major source of technology and for which no study on joint FDI and agglomeration externalities has been undertaken.

Results of the study suggest that both density and foreign capital have positive and significant effects on productivity, although the isolated impact of density tends to be dampened by the negative congestion effects. More importantly, the interaction between density and foreign direct investment has magnifying effect on the impact of FDI on productivity, suggesting a

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synergistic relationship between FDI and density productivity externalities. The positive joint externalities from density and FDI are robust to country sample composition and to controlling for domestic demand effects, domestic capital formation and a number of other knowledge capital channels through which agglomeration and FDI can influence growth that include human capital and human capital density. We have, therefore, interpreted the study's findings as confirming the complementarity between FDI and agglomeration externality effects in boosting technology transfers and enhancing productivity in the SADC region.

The policy handles suggested by the study point to the importance of policies and measures that promote both agglomerations and FDI in the region. In addition, to the extent that density enhances the productivity impact of FDI, the study suggests that countries in the region and in the developing world at large should prioritize directed FDI policies that promote FDI into more agglomerated areas and regions such as urban areas. This, however, requires the need to balance to balance between equitable regional development and agglomerated development.

Without downplaying the potential importance of the study we, however, acknowledge the limitation of undertaking the study at country level given that agglomeration economies are more closely identified at firm cluster or regional levels. We, therefore, recommend further study at firm or industry level to answer the same questions that we have considered.

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Chapter 4

Bilateral Foreign Direct Investment from South Africa and Income Convergence in SADC

4.1 Introduction

Intra-Africa foreign direct investment has been increasing, led by South African, Mauritian, Kenyan and Nigerian transnational corporations (TNCs), with UNCTAD (2014) reporting that between 2009 and 2013, the share of intra-Africa greenfield investment projects rose to 18% of the cumulative FDI for Africa compared to an increase of only 5% over the period 2003 to 2010. The advantage of the intra-African investments is their increasing concentration in manufacturing and services compared to investments from the rest of the world, with 49% of the intra-African investments in manufacturing over the cumulative period 2009 to 2013, compared to 44% of FDI from the rest of the world (UNCTAD, 2014). This potentially gives the continent enhanced growth opportunities in intra-regional trade, value chains and technology convergence. The importance of intra-regional technology transfers and income convergence becomes even more pronounced when technology leading countries on the continent such as South Africa are among the leading sources of intra-Africa FDI as this potentially allows other countries to access their advanced technology.

From a regional perspective, SADC has had significant increases in both FDI stocks from the rest of the world as well as intra-regional investments, with South Africa constituting up to 80% of some individual countries' inward foreign direct investment stocks (UNCTAD, 2014). The country had collective investments amounting to USD 980 million in Botswana, Mauritius, Mozambique and Zambia among its major regional FDI destinations in 2010 and the investments are principally in the private sectors (AfDB, 2013). The fact that much of South Africa's intra-SADC investments are in the private sectors gives the country greater leverage to transfer technology and foster income convergence across the region. As a regional economic community, SADC's macroeconomic convergence framework requires countries to attain some convergence with respect to a number of benchmarks, which include income growth. In this regard the existence of South Africa as a leader in terms of technology and intra-regional FDI should present an opportunity for the region to converge to achieve the target.

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Given these stylized facts about SADC, the empirical questions we ask in this study are whether there has been technology diffusion and income convergence in the region from South Africa; or whether there can be such prospects of income convergence over time. Literature suggests that the answers to both questions can be negative or positive. The Solow-Swan neoclassical growth models, for example, would predict income convergence for the region through cross border capital movements driven by differentials in returns (Solow, 1956), while from the perspective of increasing returns to investment and localized technology externalities suggested by Romer (1994) and Lucas (1988), the opportunity for income convergence is either absent or limited with countries that have more R&D and human capital such as South Africa and Mauritius accelerating and diverging from those with low R&D and human capital investments. In this case, there can only be some club convergence suggested by Quah (1996) with countries with harmonized social capabilities such R&D, human capital, markets and institutions converging into their own club while those that lag behind continue to diverge.

In more optimistic views, the leader follower technology spillover and catch-up hypothesis suggested by Barro and Sala-i-Martin (2004) would predict convergence possibility for the region on South Africa as a regional source of technology through trade and FDI. In this case, South Africa is perceived as driving and leading in regional innovation while other countries follow and converge on it through technology imitation. Such convergence pattern is empirically suggested by the flying geese convergence paradigm of countries in Asia on Japan through channels of product development and regional industry integration (Akamatsu, 1961 and Ozawa, 1995). This study is motivated by the predictions of the international technology diffusion and convergence model on SADC by the existence of a scenario which more or less resembles conditions of the leader follower framework.

The possibility for income convergence in SADC is, however, not an obvious expectation in light of diverse empirical evidence on the subject matter. Factors favouring convergence follow from evidence by Barro (2011) and Spence (2010) who have suggested that there has been significant improvements in developing countries' social capabilities and income convergence rates towards the advanced economies. Similarly, studies on countries that are harmonized through trade, FDI or regional integration initiatives have produced evidence confirming convergence (Abbramovitz, 1986 Oz, 2014 and Ben-David, 1996). Contrary to these optimistic factors, evidence of income convergence across heterogeneous countries have mostly suggested income divergence or at best club convergence (Romer, 1994, Quah, 1993, Quah,

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1996). It could be that there are still country heterogeneities even within regional integrations, especially in developing countries which may deter income convergence as suggested by Kumo (2011) and Jones (2002) for SADC and ECOWAS, respectively. To the extent of the existence of these two possible likelihoods, it means that the debate on income convergence remains an unsettled puzzle, with Durlauf (2003) suggesting that the amount of controversy in the subject matter shows that the literature on convergence still needs more contributions.

This study is motivated to contribute to the puzzle on cross country income convergence by characterizing growth and convergence in SADC with regard to how it is linked or influenced by the nature and forms of South African intra-region bilateral FDI. To achieve this objective, we estimate average regional income convergence which is free from patterns of FDI and average income and country pairwise convergence on South Africa's income per capita which is linked to South Africa bilateral intra-SADC FDI and make an assessment of the impact of South African FDI differentials on regional income convergence. We employ time series data on countries' per capita incomes over the 1980 to 2011 period, with the period of the study chosen to ensure that it is long enough to enable robust time series convergence analysis and also to coincide with the post SADCC[15] formation period.

Besides having characteristics which are close to conditions resembling the leader follower technology diffusion framework, the SADC region has been chosen on the basis that countries in the regional economic community are likely to be close in terms of geography and social capabilities that have been argued to be necessary for convergence (Abbramovitz, 1986). The study contributes to the literature of income convergence, especially in terms of estimating income convergence among countries which is directly linked through a specific source of technology, which is FDI as opposed to the usual estimation of cross country income convergence which is not linked to the source of convergence. Important policy handles with regard to intra-regional FDI in relation to FDI from the rest of the world for region are suggested from the results of the study.

The rest of the study is organized as follows: section 4.2 reviews the literature on income convergence; 4.3 presents the leader follower theoretical framework of international technology diffusion and convergence while section 4.4 presents the study's empirical

[15] The Southern African Development Coordination Conference (SADCC) is the predecessor to SADC

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methods. Sections 4.5 and 4.6 present and discuss the estimated convergence results, respectively while section 4.7 concludes the study.

4.2 Literature Review

The neoclassical notion of income convergence perceives that per capita incomes of countries with similar preferences and access to similar technology converges over time irrespective of their initial conditions (Solow, 1956). Technology is assumed to be exogenously determined and there is no explicit role for FDI or other technology sources such as trade which bring fourth possible technology externalities. A typical aggregate production function on which the Solow-Swan neoclassical growth model is based on equation 1 below:

$$Y_{it} = A(t)F(K_{it}, L_{it}) \tag{1}$$

With *A, K* and *L* representing the state of technology, capital and labour inputs for country *i* in period *t*, respectively. Peculiar in the specification is the assumption that technology, savings and labour evolve exogenously over time and that the function $F(K, L)$ has constant returns to scale and portrays diminishing marginal returns to capital[16]. When presented in per capita form, with the savings rate assumed to be equal to the investment rate in a closed economy, equilibrium output is obtained when the change in per capita capital is zero as follows:

$$\dot{k} = sF(k,1) - nk \tag{2}$$

The steady state equilibrium which requires that $\dot{k}$ is equal to zero implies equal growth rates for capital and labour (*n*) and also, on the basis of the constant returns to scale in production, equal output growth rate[17]. This model suggests that poor countries with higher marginal productivity of capital grow more rapidly in the transition to the long-run steady state as they

[16] Even the more generalized neoclassical growth models by Ramsey (1928), Cass (1965) and Koopmans (1965) with endogenously determined savings behaviour have similar convergence predictions as those of the Solow-Swan model.

[17] From equation 2, the assumption of diminishing marginal productivity of capital implies that a capital labour ratio, which is below the steady state, for example, implies high marginal productivity of capital than in steady state which results in capital accumulation while a higher capital ratio, implies lower marginal capital productivity than in steady state and a reduction in the capital ratio.

accumulate capital while rich countries with low marginal capital productivity experience capital reduction and low growth. Thus given that there are no technology externalities in the model, the movement of capital across countries in response to differences in capital productivity leads to convergence. The neoclassical convergence models perceive FDI as an addition to domestic capital stock the same way as domestic investment with no potential for knowledge and productivity externalities. This means that its implied convergence should be underestimated if it is assumed that FDI has the potential to transfer better and more productive techniques to the FDI receiving countries. To the extent that developing countries are usually net receivers of FDI from the developed countries with advanced technology, FDI is likely to accelerate their per capita income growth towards the FDI source countries.

The importance of technology externalities from investment is suggested by the literature on cross country technology and income convergence which argue that capital accumulation from sources within or outside the economy is associated with productivity spillovers that accelerate income convergence or divergence (Barro and Sala-i-Martin, 2004 and Romer, 1994). Unlike the assumption of perfect competition under the neoclassical model which makes it difficult for firms to enjoy profits from R&D investments, imperfect market environments in the real world have rewarded investments in firm-specific knowledge capital and incentivizes firms to participate in R&D and innovation activities with positive productivity externalities. Scholars such as Romer (1986) and Lucas (1988) has suggested such externalities are localized in ways that cause income divergence countries with conducive environments for R&D and knowledge production and those with poor institutions and other adverse environments that discourage R&D. Thus even in a regional integration, this assertion would lead to predictions in favour of club convergence, with those countries hosting good institutions, markets and macroeconomic policies converging into their own club while the rest lag behind.

Barro and Sala-i-Martin (2004), on the other hand suggests that with international diffusion of technology, countries with low R&D would converge on the rich on the rich countries with high R&D and advanced technology. These views, which are based on the globalization of technology externalities from R&D through channels that include trade, FDI, licensing, subcontracting and technical assistance contracts are also echoed by the flying geese convergence paradigm theorists such as Akamatsu (1961), Kojima (2000) and Kasahara (2004), who have modelled income convergence in Asia as being led Japan as the dominant economy, with other countries evolving through processes and stages of being net importers of

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goods from the leader through import substitution to export production when they become competitive. The model envisages a catching-up process through a hierarchy of development with countries such as China and Singapore converging on Japan through imports imitation and industry and country integration facilitated by the MNCs between the regional growth centre and the rest of the countries. These models suggest that countries in SADC would have technology gains from the regional existence of a growth centre such South Africa.

Barro and Sala-i-Martin (2004) have put forward a leader-follower model of growth which formalizes the importance of international technology diffusion in cross country income convergence. The model has clear cross country productivity externalities and convergence implications and as such relevant to this study. It accommodates possibilities of heterogeneous R&D and technologies across countries as determined by the quality of their institutions but also allows poor countries to converge on the rich countries with advanced technology. The follower countries, which are usually the resource poor countries draw advanced technologies from the leader countries with high R&D through international channels that include FDI while the dominant country leads the innovation process.

Growth in the technology poor countries is directly linked to growth of the regional technology leader as follows[18]:

$$\frac{\dot{Y}_{i,t}}{Y_{i,t}} = \gamma_{l,t} + H\left[\frac{Y_{i,t}}{Y_{l,t}}, \left(\frac{Y_{i,t}}{Y_{l,t}}\right)^{*}\right] \qquad (3)$$

With $\frac{\dot{Y}_{i,t}}{Y_{i,t}}$ representing the growth in income per capita (Y) in the follower country (*i)* and $\gamma_{l,t}$ the growth rate of income per capita in the leader country (*l*). The function H increases with the difference between the ratio of the follower's per capita income to the leader's $\left(\frac{Y_{i,t}}{Y_{l,t}}\right)$ and the ratio of their steady state incomes defined by $\left(\frac{y_{i,t}}{y_{l,t}}\right)^{*}$. According to Barro and Sala-i-Martin

[18] Details of the derivation of the model are in Barro and Sala-i-Martin (1997; 2004). The characteristics of the study theoretical model as discussed borrow from the same source.

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(2004), H$(\cdot,\cdot)$ is such that $H_i > 0$, $H_l < 0$ and H$(\cdot,\ \cdot) = 0$ at $\frac{y_{i,t}}{y_{l,t}} = \left(\frac{y_{i,t}}{y_{l,t}}\right)^*$ implying that when the follower's income is increasing relative to the leader, its growth is higher than that of the leader so that convergence takes place and when that of the leader is increasing relative to that of the follower, the growth of the follower is slower resulting in divergence.

Therefore, growth of income in the follower country is linked to the average growth rate of the leader and the ratios of its current and steady state incomes to that of the leader. Convergence in the model occurs because the growth rate of the follower's income declines as its relative income increases for a given steady state ratio suggesting that the productivity externalities from imitation are not unlimited. Similarly, for a given income ratio, growth increases as the steady state increases, implying that a country's growth rate increases with distance to its steady state and the income of the leader. Barro and Sala-i-Martin (2004) indicates that convergence results from the fact that the leader spends more resources on new innovation than what the follower spends on imitation. Alternatively, it may be a reflection of the existence of diminishing returns in the production of innovation and new ideas for the leader.

The model suggests that the follower country has the responsibility of instituting good policies, institutions and sound social capital to attract and absorb FDI to raise its productivity. This implies that even in a regional integration such as SADC, there is a possibility of some countries growing and converging faster towards the source of FDI and technology leader than others depending on country specific environments. This implies that estimation of country pairwise convergence on the regional leader would be more informative than estimation of average convergence on the leader.

Cross country income convergence has been estimated either using cross country or country pairwise income convergence estimations, with cross country convergence modelled as:

$$g_{iT} = F(Y_{it-T} \mid S_{it}, X_{it}) \tag{4}$$

With g_{iT} representing a country' average growth rate over a long time period (T) and Y_{it-T} the country's initial per capita income in period *t-T*. The coefficient on Y_{it-T} gives absolute β-

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convergence rate when (4) is not conditioned on other variables and conditional β-convergence rate when other variables are conditioned. The major criticism on model 4 is that it has the problem of regressing to the mean, which leads to over-estimation of the likelihood of income convergence in cross section data (Quah, 1996). Similarly, the model fails to uniquely identify convergence when there are multiple steady state incomes (Azariadis and Drazen, 1990).

The second approach to estimating income convergence, especially pairwise country convergence or with few countries is the unit roots test. It defines income convergence as existing when countries' long term per capita incomes are equal, i.e:

$$\lim_{k \to \infty} E(Y_{i,t+k} - Y_{j,t+k} \mid I_t) = 0 \qquad (5)$$

$Y_{i,t+k}$ and $Y_{j,t+k}$ are per capita incomes of countries *i* and *j* in period *t+k* and I_t is the information set for the two countries available at period *t*. Income convergence exists when countries' incomes are cointegrated with cointegrating vector (1,-1) (Bernard and Durlauf, 1996).

The estimation of (4) and (5) have produced mixed results with regard to the existence of cross country income convergence. Studies that have considered countries that are harmonized by some common factors such as countries in a regional integration or states of a country have generally suggested evidence in support of convergence. These studies include studies by Barro and Sala-i-Martin (1992) who have investigated income convergence across the US states and among the OECD countries and find an absolute convergence rate of 2 % per year for the U.S. states. Similarly, Barro and Sala-i-Martin (1991) estimate an absolute convergence rate of 2% per year for seven European countries, while Baumol (1986) and Abramovitz (1986) relying on evidence from historical income evolutions support the existence of income convergence among the industrialized countries. In Sub-Saharan Africa, however, there is no wide evidence supporting convergence in regional integration, with Kumo (2011) failing to find convergence for SADC, while Jones (2002) obtains club convergence in ECOWAS. These studies imply that there is greater scope for convergence for countries that are already harmonized by some common factor provided heterogeneities among the countries in the group are minimal.

Contrary to harmonized countries studies, studies that have been undertaken for country cross sections characterized by heterogeneous attributes have largely failed to confirm convergence,

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with countries tending to be characterized by club convergence. Jones and Bernard (1986) and Quah (1996) have failed to find convergence for a cross section of developed and developing countries and instead find club convergence characterized by twin peaks of advanced and developing countries converging separately while poor countries diverge and lag behind. Similarly, McCkoskey (2002) failed to confirm income convergence in Sub-Saharan Africa and also find smaller convergence clubs within the continent. The significance of these findings as suggested by Abramovitz (1986) is that the issue of income convergence cannot be isolated from harmonization and upgrading of country capabilities.

The importance of harmonization of countries' social capabilities is supported and confirmed by recent studies that have confirmed increasing convergence rates for developing countries on the developed countries on account of advancements in their human capital, R&D and institutions (Spence, 2010; Rodrik, 2011 and Barro, 2012). Barro (2012) has linked the modernization hypothesis to convergence and finds results suggesting that growth and convergence of incomes can be self-perpetuating through their positive effect on the quality of institutions. Rodrik (2011), however, hints that the sustainability of the convergence drive depends on rapid structural change in favour of tradables, manufactures and modern services by developing countries. Thus, in addition to developing and harmonizing their social capabilities, developing countries need to restructure their economies and encourage the reallocation of resources towards more productive sectors as opposed to reliance on the less productive traditional sectors. This view has been supported by Rodrik (2012) who has estimated convergence rates of about 3% across a cross section of manufacturing sectors in 118 countries, which is more than the 2% by Barro and Sala-i-Martin (1991), implying that technology is more sector or industry specific than country specific and that the issue of convergence is more informing when analysed at disaggregated than at country levels.

An important category of income convergence studies are those that have linked convergence to a specific source of technology. The studies have generally produced evidence supporting income convergence or higher convergence rates among countries. They include the study by Oz (2014) who finds per capita income convergence between FDI host and source countries in the OECD over 1950 to 2010. Oz (2014)'s results fundamentally suggest the existence of technology spillovers between the FDI host and home countries. His results are supported by Choi (2004) who also finds convergence between per capita incomes of FDI host and source countries among the OECD countries over the period 1982 to 1997. In addition, Choi (2004)

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finds geographical closeness and common language to be critical factors for convergence and bring into light the importance of country harmonization factors. Outside the OECD, Bijsterbosch and Kolasa (2009) find evidence suggesting that bilateral FDI among countries in Central and Eastern Europe fosters pairwise country income convergence. Thus from these studies, FDI is not only an addition to capital but an agent for international technology diffusion and convergence as suggested by Barro and Sala-i-Martin (2004).

In a related study, Ben-David (1996) has considered convergence of incomes in groups of countries drawn from 25 countries, with country groups constituted by countries that are mutually linked through trade and based on a leading country's major trading partners and other groups which are randomly constituted. The study has evidence suggesting faster convergence in groups characterized by mutual trade than in groups which were randomly formed, meaning that trade is responsible for income convergence among countries involved in mutual trade. The results confirm and have similar convergence implications to the results by Ben-David (1993) in which trade liberalization in the European Economic Community countries led to faster convergence of countries' income in that they emphasize the role of international technology diffusion in promoting income convergence the same way as the results suggesting the importance of FDI in fostering income convergence between FDI source and host countries. These studies motivate our theoretical model framework in this study.

4.3 Modelling International Diffusion of Technology

Inspired by the leader follower technology diffusion framework proposed by Barro and Sala-i-Martin (2004), we developed an income convergence framework for SADC with South Africa as the technology leader and bilateral FDI from South Africa as the vehicle for technology diffusion in the region. The framework is an endogenous growth framework premised on the possibility of poor countries catching up with the rich countries through a process of technology innovation by the developed countries and imitation by the developing countries. Underlying the model is the assumption that most of the technological advancements occur in the relatively more developed South Africa which hosts much of the R&D investments while the relatively poor countries in SADC with limited R&D mostly get involved in imitating and adopting advanced technologies from South Africa with convergence occurring on the basis that it is cheaper to imitate for the follower than to invent for the leader (Barro and Sala-i-Martin, 2004).

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Restating the leader follower model from Barro and Sala-i-Martin (2004) with South Africa replacing the leader in the earlier general model presentation, we the convergence model as:

$$\frac{\dot{Y}_{i,t}}{Y_{i,t}} = \gamma_{sa,t} + H\left[\frac{Y_{i,t}}{Y_{sa,t}}, \left(\frac{Y_{i,t}}{Y_{sa,t}}\right)^{*}\right] \tag{6}$$

Where $\frac{\dot{Y}_{i,t}}{Y_{i,t}}$ is growth in income per capita (Y) in the follower country (*i*); $\gamma_{sa,t}$ is the growth rate of income in South Africa. According to Barro and Sala-i-Martin, the function H positively depends on the ratios of the individual countries' actual and steady state per capita incomes to those of South Africa $\left(\frac{Y_{i,t}}{Y_{sa,t}}\right)$ and $\left(\frac{Y_{i,t}}{Y_{sa,t}}\right)^{*}$, respectively, implying that it increases in individual countries' incomes and falls as South Africa's income increases.

In overall terms, model (6) suggests that growth in technology poor countries is directly positively related to growth in South Africa and that the larger is the difference between the two countries' relative incomes and their relative steady state incomes, the faster is the growth rate of the follower country. Thus relatively poorer countries such as Mozambique, Malawi and Tanzania in SADC are expected to grow faster than the relatively more affluent economies such as Mauritius and Botswana. This implies convergence of incomes over time conditioned on similar exposure to the technology source country. To the extent that countries have different bilateral trade or FDI between themselves and South Africa, they are expected to diverge from each other and converge differently on South Africa.

The appealing feature of the model is that it enables us to tie the process of growth and income convergence to the FDI source country and uphold income convergence among countries that are mutually related as opposed to studies that assume convergence in cross sections of heterogeneous countries. Our empirical model from (6) is adopted from Oz (2014) as follows:

$$\log\left(\frac{Y_{i,t}}{Y_{i,t-1}}\right) = \log\left(\frac{Y_{sa,t}}{Y_{sa,t-1}}\right) - \theta\left[\log\left(\frac{Y_{i,t}}{Y_{sa,t}}\right) - \log\left(\frac{Y_{i}}{Y_{sa}}\right)^{*}\right] \tag{7}$$

With parameter θ defining the average speed of convergence between the followers and the leader and the remaining variables representing their corresponding definitions in the theoretical model 6.

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After re-arrangements, equation 7 gives our estimation equation 8 (see C1; Annex C):

$$\log\left(\frac{Y_{i,t}}{Y_{sa,t}}\right) = a + b\log\left(\frac{Y_{i,t-1}}{Y_{sa,t-1}}\right) + \varepsilon_{i,t} \qquad (8)$$

Where $a = \log\left(\frac{Y_i}{Y_{sa}}\right)^*$ and $\theta = 1/b - 1$. Therefore, 8 estimates countries' current income gaps to South Africa $\left(\frac{Y_{i,t}}{Y_{sa,t}}\right)$[19]as a function of the previous period income gaps $\left(\frac{Y_{i,t-1}}{Y_{sa,t-1}}\right)$ with an increase in the income ratio reflecting a fall in the income gap. This means that a value of one on the left hand side of (8), reflects complete closure of a country's income gap to South Africa. The way model (8) is presented implies that a positive value of *b* which is less than 1 signifies income convergence towards South Africa while a negative value signifies divergence.

We emphasize the θ-convergence rate which is calculated as $\theta = 1/b - 1$, because it directly links individual countries' per capita incomes to the technology source country compared to the popularly used β-convergence which does not link convergence to the technology source country's per capita income. If South African FDI is a pulling factor driving convergence, then there should be higher convergence rates towards South Africa than towards the average income for the region. The concept of the half-life to convergence is also utilized to compare convergence rates where, as in Ben-David (1996)[20], the half-life is defined as the average number of years for existing income disparity among countries to be reduced by half.

The convergence rate estimated from model (8) gives average region income convergence on South Africa. It does not inform how individual countries' income evolve with respect to South Africa's income. To estimate individual country pairwise income convergence on South Africa, the unit roots tests for convergence in model (5) suggested and utilized by Bernard and Durlauf

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[19] The actual gap is the inverse of the ratio or 1-$\left(\frac{Y_{i,t}}{Y_{sa,t}}\right)$. We choose this presentation because it is direct and easier to deal with. An increase in the ratio reflects income convergence while a reduction reflects divergence.

[20] The procedure for estimating the half-life years as derived in Ben-David (1993) proceeds as follows: Let X=Income Gap & z = half-life; then $X_{t+1} = \varphi X_t$ and $X_{t+z} = \varphi^z X_t$. By definition $X_{t+z} = 0.5X_t$ (ie at half life years) implying $0.5X_t = \varphi^z X_t$ or $0.5 = \varphi^z$. This gives z=ln(0.5)/ln(φ). When φ >1, z is the number of years to double the income disparity

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(1995) and Greasley and Oxley (1997) are employed. To overcome the dimensional limitations of the cointegration approach used by Bernard and Durlauf (1995) in establishing convergence from equation (5) when there are many countries, Pesaran (2006) shows that country pairwise income convergence can be obtained from the pair-wise differences between countries' logarithms of per capita incomes. Thus countries' pairwise income convergence on South Africa is established from the following ADF model specified with intercept and trend:

$$x_{i,t} = \beta_0 + \beta_1 t + \varphi x_{i,t-1} + \sum_{m=1}^{M} c_j \Delta x_{i,t-m} + \varepsilon_{it} \qquad (9)$$

With $x_{i,t} = y_{it} - y_{sa,t}$ defining the difference between country (i)'s log of per capita income and that of South Africa and $\Delta x_{i,t} = x_{i,t} - x_{i,t-1}$. From (9), country pairwise income convergence on South Africa is obtained when there are no unit roots in the ADF and both the intercept and trend are insignificant. The statistical significance of the intercept and or trend in (9) suggests that the country's income and that of South Africa have a common deterministic trend and are driven by similar underlying factors (Greasley and Oxley, 1997).

4.4 Data and Definition of Variables

Variables that we need are countries' per capita incomes including that of South Africa and bilateral FDI stocks between South Africa and other SADC countries. Other variables needed to augment our estimations are SADC intra-regional trade, FDI from the rest of the world and countries' domestic investment. The overall period of analysis has been stretched from 1980 to 2012 in order to have long time series data for each country to enable individual country time series analysis that are robust. However, sample periods for estimation equations that include bilateral FDI as an augment are constrained to start from 2001 by the period for which the UNCTAD bilateral FDI statistics are available.

Turning to the major variables of interest, bilateral FDI between South Africa and the SADC countries is measured in three ways, with all of the three sourced from UNCTAD bilateral FDI statistics (UNCTAD, 2014). First, we investigate the separate impact of per capita inward FDI stock from South Africa, then second the separate impact of outward FDI stock and lastly, the impact of total bilateral FDI stock per capita between individual countries and South Africa. This allows us to assess the impact of each of the measures of bilateral FDI variable on the

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countries' income gaps to South Africa. Inward bilateral FDI stock is defined as FDI stock per capita from South Africa and hosted in individual SADC countries, while outward FDI stock per capita is each country's per capita FDI stock hosted in South Africa. Total bilateral FDI is the total of the two FDI stocks. FDI from the rest of the world is the difference between each country's total per capita inward FDI stock and per capita inward FDI stock from South Africa.

Countries' per capita income statistics are sourced from WDI (World Bank, 2014), with the variable reflecting output per person as well as a proximate for labour productivity. This definition implies that per capita income convergence or divergence implications are also interpreted to reflect the same on countries' productivity. Intra-regional trade, which is sourced from the SADC website (SADC, 2014) is defined as the percentage of intra-SADC trade to GDP. Lastly, domestic investment is measured as gross fixed capital formation as a percentage of GDP. It is sourced from WDI statistics (World Bank, 2014).

Tables 17 and 18 summarize the variables used in the study and their correlations, respectively.

Table 17: Summary of Selected Variables

Variable	Mean	S.Dev.	Min	Max	No.of Obs
GDP Per Capita	1656	1739	118.6	6471	440
S. Africa GDP Per Capita	5010	401.0	4472	5810	448
Income Gap To S. Africa	0.330	0.343	0.0251	1.114	440
Intra-SADC Trade Percent	7.124	6.310	0.0155	28.94	168
S.Africa FDI Stock/Capita	363.1	1328	0	8130	118
Inward S. Africa FDI Stock	291.3	1097	0	7589	132
Outward S. Africa FDI Stock	85.92	146.4	0	1072	132
Gross Domestic Investment	20.51	10.46	1.434	74.82	427

Source: UNCTAD (2014) and WDI (2014)

Table 18: Correlation Matrix for Selected Variables

	PCGDP	SAGDP	TRADE	SAFDI	In.SAFDI	OSAFDI	GDPGAP
PCGDP	1						
SAGDP	0.093	1					
Intra-Trade	-0.027	-0.031	1				
PCSAFDI	0.484	0.191	-0.186	1			
In.SAFDI	0.496	0.190	-0.156	0.994	1		
O.SAFDI	0.653	0.165	0.228	0.615	0.642	1	
GDPGAP	0.993	0.012	-0.022	0.448	0.461	0.632	1
GFCF	0.121	0.039	0.001	0.115	0.106	-0.066	0.117

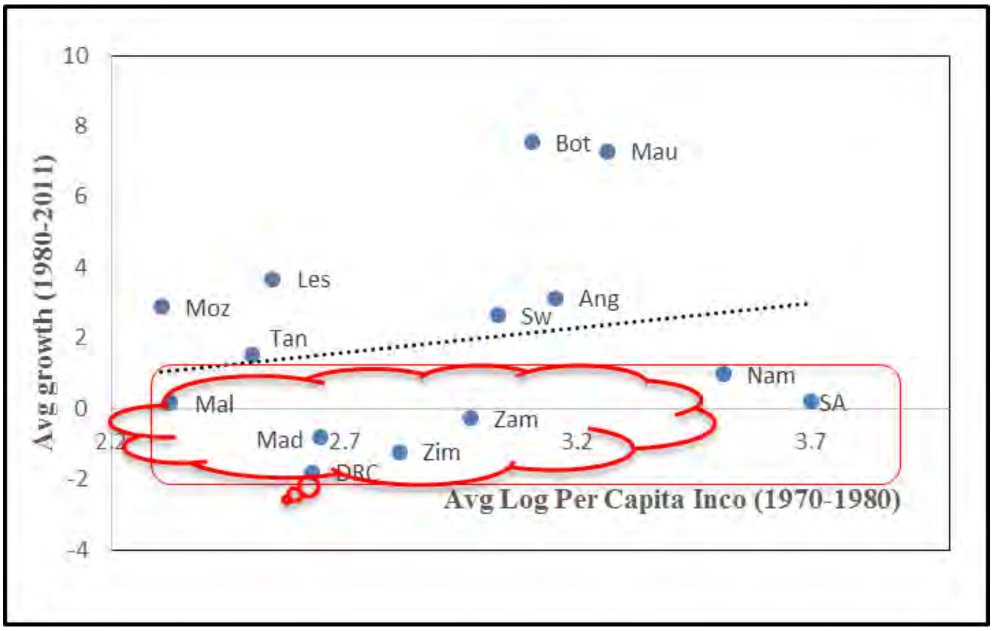
Source: UNCTAD (2014) and WDI (2014)

The high correlation between inward FDI stock per capita from South Africa and total FDI stock per capita shows that much of the bilateral FDI stock is composed of inward FDI. The two variables are, however, not used jointly in any of the estimated equations, hence they don't pose any multicollinearity problems.

4.5 Descriptive Estimation and Analysis of Income Convergence

A descriptive analysis of income convergence pattern in SADC is summarized by figure 5, which plots countries' average growth rates over the 1980 to 2011 period against countries' initial incomes in 1980. When there is per capita income convergence among the SADC countries, there should be a negative correlation between initial incomes and growth suggesting that initially poor countries are growing faster than initially richer countries. Overall, the figure suggests income divergence for the region, with countries encircled in red, namely Malawi (Mal), Madagascar (Mad), the DRC, Zimbabwe (Zim) and Zambia (Zam) stagnating in low per capita income and low growth over the 1980 to 2011 period, while Botswana (Bot) and Mauritius (Mau) had relatively high initial incomes, which they sustained over the period.

Figure 5: Income per Capita Convergence in SADC



Data Source: WDI (2014)

To link the convergence pattern in figure 5 to the pattern of South African bilateral FDI in the region, we have classified countries in the region into two groups, which we name high FDI

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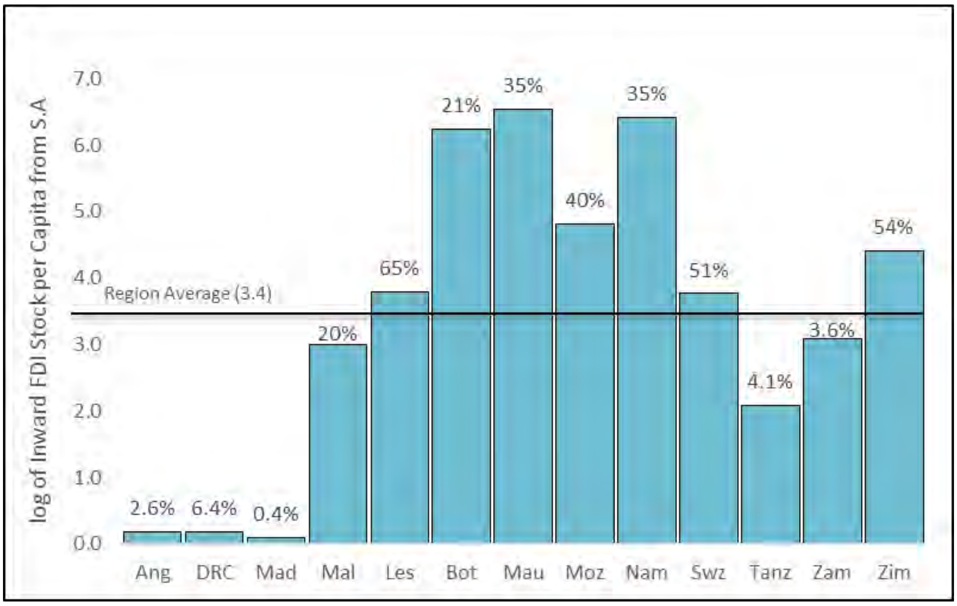
countries for countries with high South African bilateral FDI and low FDI countries for countries with low South African bilateral FDI and analyse patterns of income convergence in the two groups. The cut-off point between high and low FDI countries is set at the average regional South African bilateral FDI stocks per capita, with high FDI countries defined as those above the average and low FDI countries as those below the average, using figure 6, which plots the logs of countries' average per capita FDI stocks from South Africa over the 2001 to 2012 period. The figures on top of each bar are countries' percentages of South African FDI to total FDI stocks, which also show the relative amounts of South African FDI stocks each country hosts. We have used per capita South African FDI stocks instead of total South African FDI stocks to classify countries on account of the fact that per capita FDI stocks indicate approximate amounts of FDI each person in each of the countries potentially has to work with. The horizontal line cutting across the FDI stock bars for each country gives the average South African FDI for the region over 2001 to 2012.

Figure 6: Countries' FDI Stocks per Capita from South Africa

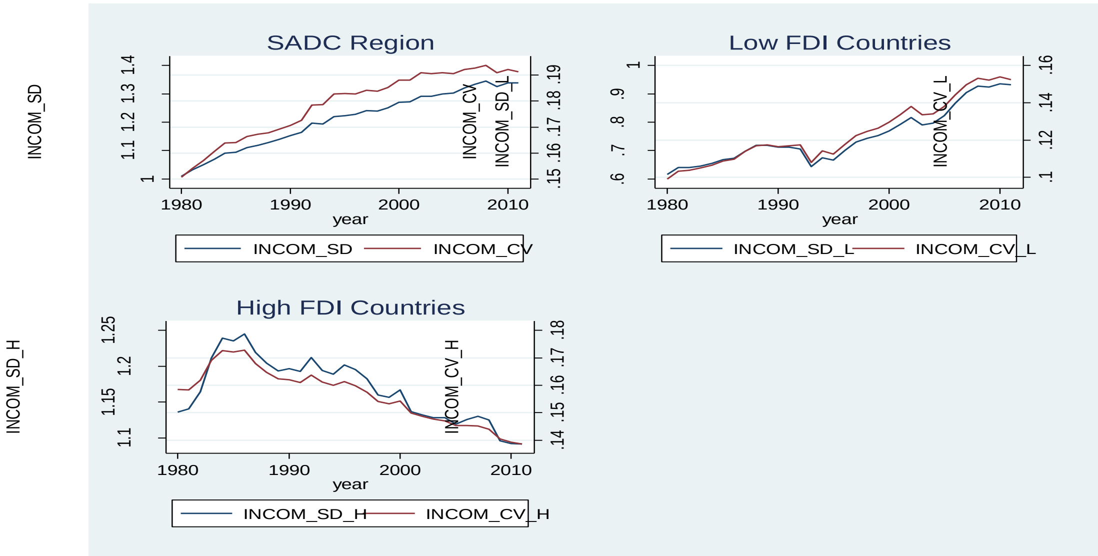


Data Source: UNCTAD (2014)

From figure 6, high FDI countries are: Botswana, Lesotho, Namibia, Mauritius, Mozambique, Zimbabwe and Swaziland while Angola, the DRC, Madagascar, Malawi, Tanzania and Zambia are classified as low FDI countries. Zimbabwe has been classified under the low FDI category on account of the low industrial capacity utilization in the country during the 2001-2011 period, which the CZI (2009) estimates at about 10% in 2008 at the peak of the crisis. This implies that an assessment of the marginal productivity impact of foreign capital for the country over the period is difficult as much of it was unutilized, implying low effective foreign capital stocks for the country than portrayed by the statistics.

Variability of incomes in the two country groups is analysed using the standard deviation and the coefficient of income variation, with declining variability interpreted to imply income convergence within the groups while increasing variability is interpreted as representing income divergence (Quah, 1996 and Kemeny, 2009). The coefficient of variation is the income standard deviation normalized by the countries' average incomes. The two measures are plotted in figure 7, with the first graph representing income variability for all the countries in the region and the second graph representing income variability for the low bilateral FDI countries while the last plots income variability for the high bilateral FDI countries. The left y-axis gives values for the standard deviation while the right y-axis give the coefficient of variation.

Figure 7: Income per Capita Dispersion in SADC



Data Source: WDI (World Bank, 2014)

As suggested by figure 6, figure 7 confirms the non-existence of income convergence for SADC suggested in figure 6, with the standard deviation and coefficient of variation for income per capita in the region rising over the 1980 to 2011 period. A characterization of the income variances within the low and high FDI countries in graphs 2 and 3, respectively, however, clearly shows that the increased variability in the region's income is being driven by the low FDI countries while for the high FDI countries income variability diminished over the period.

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A quantitative sense of the extent of the income variability portrayed in figure 7 is obtained from table 19, which gives the mean and median incomes for the SADC panel, the low and high bilateral FDI countries over 1970-1979 and subsequently over five year intervals starting from 1980 to 2011. Relating the mean and median for the whole region, the table shows that the median income for the region increased less proportionately than the average income. This scenario is consistent with a case where a few countries are persistently growing faster than the rest of the countries in the region, thus implying income divergence. When income dispersion is dissected within each FDI country groups, the table shows that average income within the high FDI countries increased by 83% compared to 43% for the low FDI countries. This means than the high FDI countries' per capita income increased by about 1.4 times more than the low FDI countries' income.

The fact that there is income growth and convergence for the high FDI countries and low income growth and divergence for the low FDI countries can be interpreted as a confirmation of the leader follower model of international technology diffusion and income convergence suggested by Barro and Sala-i-Martin (2004). However, at this point it is hard to attach the observed patterns of income variability exclusively to the role of South African bilateral FDI in the region other than to suggest that the pattern is linked to underlying factors that are positively associated with our country classifications.

Table 19: Dynamics of Per Capita Incomes in SADC (US Dollar)

	1970-1979	1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2011	% Change
Region Average	1233	1320	1395	1491	1586	1729	2089	69.4
Region Median	717	706	675	659	632	661	739	3.0
High FDI Average	1389	1537	1633	1802	1948	2135	2538	82.8
Low FDI Average	1233	1320	1395	1491	1536	1590	1754	42.3
High:Low Ratio	1.1	1.2	1.2	1.2	1.3	1.3	1.4	

//Monetary figures are in USD terms (Base=2005)

Given than table 19 is based on country groups, it conceals information about how each individual country's income evolved against that of South Africa. To investigate the dynamics of each individual country's income dynamics relative to South Africa's income, ratios of South Africa's income to individual countries' incomes are presented in 20. This information is critical given that it is likely that there were shifts in country income positions across the region and within the high and low FDI country categories, with some countries accelerating

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faster than others. The last column of table 20 has negative percentage changes for countries that converged on South Africa and positive percent changes for countries that diverged away.

Table 20: Ratio of South Africa's Per Capita Income to Individual Countries' Incomes

	1970-1979	1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2011	% Change
Angola	3.5	3.9	3.2	3.7	3.9	3.4	2.3	-34.3
Botswana	4.1	2.5	1.7	1.2	1.1	1.0	0.9	-77.4
DRC	11.5	15.0	14.3	20.1	30.1	39.1	38.6	235.9
Lesotho	14.5	12.4	10.8	8.5	7.6	7.2	6.9	-52.4
Madagascar	11.2	14.7	15.1	15.5	16.6	17.7	19.9	78.2
Malawi	23.7	24.3	24.7	24.1	21.0	23.0	24.9	4.8
Mauritius	2.7	2.7	1.9	1.4	1.2	1.0	1.0	-64.2
Mozambique	24.7	29.0	30.4	24.9	21.7	17.6	15.7	-36.3
Namibia	1.5	1.7	1.7	1.6	1.6	1.5	1.4	-7.9
Swaziland	4.7	4.1	3.3	2.3	2.1	2.2	2.3	-50.6
Tanzania	15.8	17.4	17.3	15.9	16.0	14.4	13.2	-16.3
Zambia	5.3	6.7	7.0	7.2	8.1	8.2	8.0	52.0
Zimbabwe	7.5	8.1	7.8	7.1	6.6	8.5	14.2	88.8

//Figures reflect ratios of period simple averages of per capita incomes

Table 20 shows that in 1980 South Africa was up to 30 times richer than the poorest country in the region, which was Mozambique with the closest country being Namibia while by 2011 the country's income was 39 times higher than the poorest country, the DRC. This suggests that there was both increased income dispersion and shits in countries' relative income positions for the region. Considering the last column of the table, it follows that most of the countries in the high FDI country category converged towards South Africa while most of the low FDI countries diverged, with Angola and Tanzania being the exceptional cases. Thus, the table supports earlier findings suggesting higher growth and faster convergence for the high FDI countries than for the low FDI countries.

Certainly, the descriptive analysis of the dynamics of incomes in SADC in relation to our country classifications raises interesting questions on whether the observed pattern of income convergence in the region is actually being driven by South Africa bilateral FDI in the region or other factors that are positively correlated with South African bilateral in the region. Another interesting issue emerging from the analysis is about the magnitude and statistical significance of income convergence rates within the low and high FDI country categories.

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4.6 Econometric Estimation of Convergence

To estimate income convergence rates, equation (8) is utilized. The equation regresses the difference in current income and either average income for the region or South Africa's income per capita against its lag. The estimated equation gives the average convergence rate and the average half-life years to convergence for each country group. The equations are separately estimated for the whole region; and for the low and high FDI country categories so that an assessment of the convergence impact of South African FDI can be made through comparisons of differences in convergence rates across the different country groups.

One concern in estimating equation (8) using annual data is that the data may be influenced by short term transitory shocks and noise that create high volatility in the series resulting in distorted and inefficient convergence parameter estimates. To eliminate the effects of the noise, we follow Barro (2012) and use 5 year income averages instead of the annual income figures in all the estimated convergence models. Results based on annual income data are, however, presented in Annex C for purposes of comparisons with those from the averaged data. Another potential problem in model specification (8) emanates from the lagged dependent variable bias problem in models that have the lag of the dependent variable as an explanatory variable (Roodman, 2009). To deal with this potential bias, we follow Roodman (2009) and use the IV estimation approach, with the previous period income gaps instrumented by their second lags. The maximum lag for the instrument was set in order to keep the time dimension of the series as long as possible while at the same time satisfying conditions for good model identification.

Table 21 gives estimated convergence results for income deviations from the average income in each country group. The results in the table are estimated from equation (8) but with income gaps to South Africa replaced by income gaps to average incomes in each group as follows:

$$\log\left(\frac{Y_{i,t}}{\bar{Y}_{i,t}}\right) = a + b\log\left(\frac{Y_{i,t-1}}{\bar{Y}_{i,t-1}}\right) + \varepsilon_{i,t} \qquad (8)$$

The estimated rates of convergence, therefore, are the equivalence of absolute β -convergence rates within each FDI country category. In overall terms, the estimated results qualitatively confirm the results from the descriptive convergence analysis above. There is higher

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convergence rates for high FDI countries than for countries hosting low FDI stocks from South Africa. There is good fit for the estimated model specifications across country groups.

Table 21: Income Convergence on the Region Average Income

	SADC		*High FDI Countries*		*Low FDI Countries*	
VARIABLES	RE	FE	RE	FE	RE	FE
Log of Income Gap	0.995***	0.962***	0.985***	0.953***	0.998***	0.981***
	(0.004)	(0.007)	(0.004)	(0.009)	(0.008)	(0.011)
Constant	0.000	0.000	0.026***	0.055***	-0.015*	-0.03***
	(0.005)	(0.001)	(0.006)	(0.005)	(0.009)	(0.008)
Observations	364	364	156	156	182	182
No. of Countries	14	14	6	6	7	7
R-squared	0.96	0.96	0.91	0.91	0.94	0.94
P>F-Stat	0.00	0.00	0.00	0.00	0.00	0.00
Convergence Rate (%)	0.5	3.8	1.5	4.7	0.2	1.9
Half Life Years	140	18	46	10	340	36

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1;

Table 21 results suggest absolute convergence rates of 0.5% and 3.8% per year on the SADC regional average income using the random and fixed effects models, respectively. The respective average half-life years to convergence for the region are 140 and 18 years. There is similarly low convergence rates for the low FDI countries of 0.2% and 1.9% corresponding to the random and fixed effects models. The random effects model results, therefore, suggest that with the current adverse country specific effects, there is almost no income convergence for the region and low FDI countries while convergence can only be attained after controlling for country fixed effects. On the contrary, high FDI countries have higher convergence rates of 1.5% and 4.7% under random and fixed effects, respectively and corresponding half-life years to convergence of 46 and 10 years. This suggests that there is a positive correlation between South African bilateral FDI stocks in the region and average income convergence rates, which could be evidence in support of the leader follower convergence model.

The large differences in the estimated fixed and random effects convergence rates are either a result of the 'fixed effects bias' suggested by Barro (2012)[21] or an indication of entrenched

[21] Barro (2012) suggests that country fixed effects in cross-country income convergence estimations involve a trade-off between the downward bias on the estimated convergence rate if the country fixed effects are omitted and an upward Hurwicz (1950) bias arising from the inclusion of the fixed effects. When the time dimension of the data used is short, the upward Hurwicz bias is significantly large. We note that this could partly explain the high convergence rates estimated from the fixed effects models.

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adverse country fixed factors which frustrate income convergence in the region. To the extent that the differences are a result of adverse country fixed effects, the results suggest that countries in the region should improve and harmonize their specific adverse effects in order to speed up the process of income convergence.

One problem with results in table 21 is that they represent average income convergence on average income per capita, which is not the same as the leader's income as modelled under the leader follower convergence framework. The estimated results allow countries to converge above or below their current incomes depending on the current levels of those incomes relative to average income per capita in their groups. To link convergence rates to South Africa's income, we estimate θ-convergence rate rates in equation (8) as follows:

$$\log\left(\frac{Y_{i,t}}{Y_{sa,t}}\right) = a + b\log\left(\frac{Y_{i,t-1}}{Y_{sa,t-1}}\right) + \varepsilon_{i,t} \qquad (8)$$

South Africa has an income convergence effect in the region if countries converge faster towards South Africa's income than they do towards the regional average income in table 21 and also if high FDI countries convergence faster towards South Africa's income per capita than low FDI countries. Regression results from equation (8) presented in table 22 confirm this.

Table 22: Convergence of Incomes on South Africa's Income

	SADC		*High FDI Countries*		*Low FDI Countries*	
VARIABLES	RE	FE	RE	FE	RE	FE
Log of Lag Income Gap	0.993***	0.952***	0.976***	0.948***	1.004***	0.992***
	(0.004)	(0.007)	(0.005)	(0.007)	(0.008)	(0.013)
Constant	-0.005	-0.076***	-0.003	-0.068***	0.004	-0.027
	(0.009)	(0.013)	(0.008)	(0.009)	(0.021)	(0.032)
Observations	364	364	156	156	182	182
No. of Countries	14	14	6	6	7	7
R-squared	0.98	0.98	0.99	0.99	0.97	0.97
P>F-Stat	0.00	0.00	0.00	0.00	0.00	0.00
Convergence Rate (%)	0.7	5.0	2.5	5.5	diverge	0.8
Half Life Years	99	14	29	13	diverge	87

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1;
//The instrumented variables are lag of income gap and Gross Domestic Investment
//The number of countries correspond to the number in each category as classified under the descriptive analysis

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A comparison of the random effects results in tables 21 and 22, suggests that the region converges at a rate of 0.7% towards South Africa's income compared to the convergence rate of 0.5% towards the regional average. Similarly, countries hosting high bilateral FDI from South Africa have an average convergence rate of 2.5% in table 22 compared to 1.5% in table 21 while per capita incomes in low FDI countries diverge. The faster convergence rates for countries hosting higher South African bilateral FDI than those hosting low FDI in table 22 should be attributable to factors that are linked to the FDI country classification effect. In overall terms, South Africa's per capita income has a greater income convergence effect in the region than would be attained on average income without the country's convergence effect. This seem to confirm the leader follower model of international technology diffusion and income convergence model is one assumes that there are no other factors that positively correlate with South Africa's intra-regional bilateral FDI and also driving convergence.

However, while results in tables 21 and 22 seem to confirm our hypothesized leader follower country convergence framework suggested by Barro and Sala-i-Martin (2004), it is still possible that there are other technology transmitting factors which jointly affect productivity growth and convergence in the region other than the intra-regional bilateral FDI effect. If the alternative convergence factors are positively correlated with South Africa's bilateral FDI stocks in the region, then the study's argument that the estimated convergence pattern is driven by the bilateral FDI factor may be open to question.

One possibility is that bilateral trade between a technology leader and a technology follower may also lead to international diffusion of technology as suggested by Ben-David (1996). Given that South Africa is both a major source of FDI and a leader in SADC intra-regional trade, it is possible that the observed convergence pattern could be driven by trade rather than by FDI differences. Other factors, such as country membership in the Southern African Customs Union (SACU), high domestic investment and high FDI stocks from the rest of the world in the high FDI countries, which are likely to be positively correlated with South African bilateral FDI and at the same time positively influencing income growth may also put to question our convergence conclusions to question. For example, the same countries favoured by South African FDI are likely to be favoured by FDI from the rest of the world due to favourable market conditions or higher rates of returns in the destination countries, making it difficult to separate the effect of South African FDI from that of FDI from the rest of the world.

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To account for the income convergence effects of other possible technology transmitters, which could be driving the convergence pattern in the region other than South African FDI, we estimate an augmented convergence model controlling for the other convergence factors from:

$$\log\left(\frac{Y_{i,t}}{Y_{sa,t}}\right) = a + b_o \log\left(\frac{Y_{i,t-1}}{Y_{sa,t-1}}\right) + b_1 X_{i,t} + \varepsilon_{i,t} \tag{11}$$

With X controlling for South African bilateral FDI, trade growth, FDI from the rest of the world, the SACU membership effect and domestic investment. These are controlled for in a stepwise manner. Results from (11) are presented in table 23. The final model incorporating variables that are significant in the stepwise regressions only is presented in column 7.

Table 23: The Impact of FDI on Country Income Gap Convergence

	IV Estimation Results for Income Gap						
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lag Income Gap	0.82***	0.85***	0.85***	0.81***	0.95***	0.95***	0.85***
	(0.03)	(0.04)	(0.03)	(0.04)	(0.01)	(0.01)	(0.04)
In. FDI from S.Africa	0.01*						
	(0.00)						
Out. FDI to S.Africa		0.01					
		(0.01)					
Total Bilateral FDI			0.01**				0.02**
			(0.01)				(0.01)
Total FDI from ROW				-0.01			
				(0.00)			
Trade Growth					0.05***		0.09***
					(0.02)		(0.03)
Gross Dom. Investment						0.19***	-0.02
						(0.07)	(0.19)
Constant	-0.3***	-0.3***	-0.3***	-0.3***	-0.1***	-0.1***	-0.3***
	(0.06)	(0.07)	(0.06)	(0.06)	(0.02)	(0.02)	(0.06)
Observations	119	121	132	119	390	367	127
No. of Countries	12	11	12	12	13	13	12
R-squared	0.86	0.86	0.86	0.86	0.96	0.96	087
P>F-Stat	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hansen J (P-Value)	0.42	0.76	0.19	0.73	0.70	0.87	0.24
Kleibergen-Paap (χ)	93	13	14	69	102	56	17
Exogeneity (P-Value)	0.05	0.03	0.13	0.10	0.00	0.01	0.02

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1;
//The instrumeted variables are lag of income gap and Gross Domestic Investment
//For Hansen J Test of Overidentifying Restrictions: H_0: Model instruments are valid
//For Kleibergen-Paap Underidentification Test: H_0: Equation is Underidentified

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In table 23, we have controlled for countries' membership in SACU membership by way of estimating fixed effects models of equation (11), while following Lichtenberg and de la Potterie (1996), we have treated countries' inward and outward FDI stocks from and to South Africa and total bilateral FDI stock separately in the estimated models under the expectation that the FDI measures may differently impact on countries' income gaps to South Africa's income.

The regression results suggests that inward bilateral FDI from South Africa has a positive and significant impact on countries' income convergence on South Africa in column (1) while column (2) suggests that the convergence impact of outward FDI to South Africa is insignificant. This suggests that inward bilateral FDI from South Africa transmits more technology into the region than outward FDI stocks. The impact of total bilateral FDI stock per capita is positive and significant while FDI from the rest of the world insignificantly impacts on countries' income convergence, suggesting that South African bilateral FDI has greater income convergence effect in the region than FDI from the rest of the region.

Table 23, however, suggests that trade and domestic investment also positively impact on income convergence as South African FDI. Nevertheless, the only factors that turn out to be significant and positively influencing income convergence in the last column are trade growth and total South African bilateral FDI, suggesting that the effect of bilateral FDI from South Africa in SADC as a factor driving the estimated convergence patterns observed in earlier results cannot be ruled out, hence the estimated convergence patterns in the region support the leader follower model of international technology diffusion and income convergence.

Having characterized the pattern of income convergence in SADC according to the pattern of intra-regional South African bilateral FDI, we also estimate how each individual country's income converges on South Africa's income and relate the estimated country pairwise convergence patterns to levels of bilateral FDI between the countries and South Africa. In light of our earlier argument that countries are likely to converge at different rates towards the regional technology leader depending on the quality of their institutions, economic policy environments and other country specifics, the estimation of pairwise country income convergence on South Africa should be more informative than the estimated convergence models so far which give average convergence rates.

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To obtain country pairwise income convergence on South Africa, we estimate the ADF model 9 restated below with countries grouped according the amounts of South African FDI they host:

$$x_{i,t} = \beta_0 + \beta_1 t + \varphi x_{i,t-1} + \sum_{m=1}^{M} c_j \Delta x_{i,t-m} + \varepsilon_{it} \quad (9)$$

With pairwise income convergence on South Arica confirmed when individual countries' income deviations from South Africa's per capita income (x) are stationary and both the intercept and trend in (9) are insignificant (Bernard and Durlauf, 1996). Results on pairwise country income convergence using (9) are presented in table 24, with countries classified either as high or low FDI countries.

Table 24: Country Pairwise Income Convergence on South Africa

Country	Intercept (P-Value)	Trend (P-Value)	ADF (P-Value)	Stationarity S/TS/NS	Convergence C/NC
			----HIGH FDI COUNTRIES---		
Botswana	0.722	0.985	0.031	S	C
Lesotho	0.231	0.452	0.002	S	C
Mauritius	0.903	0.902	0.001	S	C
Mozambique	0.000	0.000	0.000	TS	NC
Namibia	0.005	0.004	0.005	TS	NC
Swaziland	0.701	0.212	0.128	NS	NC
			----LOW FDI COUNTRIES---		
Angola	0.119	0.290	0.237	NS	NC
DRC	0.052	0.117	0.065	TS	NC
Madagascar	0.039	0.022	0.038	TS	NC
Malawi	0.120	0.452	0.111	NS	NC
Tanzania	0.024	0.11	0.024	TS	NC
Zambia	0.185	0.605	0.208	NS	NC
Zimbabwe	0.249	0.109	0.184	NS	NC

S=Stationary; NS=Not Stationary; TS=Stationary with Trend;
C=Convergence; NC=No Convergence

The first column of results table 24 gives the probability values of the intercept from the ADF equation under the null hypothesis that the intercept is equal to zero while the second column gives the probability values of the trend under the null hypothesis that it is equal to zero. The final estimated model of the ADF is estimated with or without trend depending on whether they are found to be significant or insignificant. Column 3 gives the p-values for ADF test

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statistic for the null hypothesis that the income gap has unit roots. The last two columns indicate the conclusions on stationarity and convergence, respectively. The cut-off point for the lag on the ADF equation is set at 1 for all the countries based on the general-to-specific approach.

The estimated ADF unit roots test results from (9) suggest that all countries in the high FDI category either have incomes which convergence on South Africa's income per capita or at least have their incomes driven by common trends with South Africa's income. Swaziland is the only exceptional case which fails to convergence with a marginally insignificant p-value of 0.128%. A consideration of the low FDI country category suggests the opposite picture, with no evidence of any country converging on South Africa. At best there are three out of seven countries with incomes having a common trend with South Africa's income, namely Tanzania, Angola and Madagascar.

Results in table 24, therefore, support the earlier finding that countries with higher bilateral FDI stocks between themselves and South Africa converge faster on South Africa while those hosting low South Africa FDI on average tend to diverge away from South Africa. In support of our earlier findings, we interpret these results as confirming the income convergence effect of the South African bilateral FDI in SADC within the leader follower international technology diffusion and income convergence framework.

4.7 Conclusion

In this study, we sought to investigate whether bilateral foreign direct investment between a technology leader and a group of technology follower countries improves technology upgrading, productivity and per capita income catch-up for the followers. South Africa has been defined as both the major source of FDI and technology spillovers in the SADC region. The scenario investigated resembles the leader follower endogenous growth framework in which the growth of the follower countries and their convergence towards the leader is dependent on the diffusion of technology between the two countries (Barro and Sala-i-Martin, 2004). The study is a contribution to the literature on the role of FDI in transmitting technology across countries, with emphasis on the effects of country bilateral FDI on income convergence as opposed to the conventional estimations of income convergence in country cross sections, which is not linked to any specific source of technology or productivity.

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We find evidence suggesting weak income convergence in the region when the role of bilateral FDI from South Africa is not taken into account or when it is low. What we obtain is a situation of countries hosting high South African bilateral FDI converging faster towards both the region average income and on South Africa's per capita income than countries hosting low South African bilateral FDI stocks. Consequently, we have suggested that the difference in the convergence rates is a result of the country FDI classifications. In probing further whether FDI is the relevant factor driving convergence differentials in the region by conditioning the estimated convergence rates on other potential sources of technology including bilateral South African FDI, we find results suggesting that total bilateral FDI to and from South Africa plays a significant role in the region's income convergence. We have also found evidence suggesting that there are significant differences in the convergence rates from the fixed and random effects models and suggest that this largely reflects the existence of entrenched adverse country specific effects that retard income the convergence effect of bilateral FDI in the region.

A number of policy handles emerge from the study results, which suggest that countries should consider more targeted FDI policies, especially through Bilateral Investment Agreements (BIPAs) that selectively incentivize and prioritize FDI coming from technology leading countries or intra-regional FDI as long as the source country hosts higher levels of technology. The observed adverse country fixed effects that limit income convergence in the region suggest that countries in the region should harmonize their FDI absorptive capacities.

However, given that the issue of income convergence is a long term phenomenon, we acknowledge the weakness in the short time period over which data on bilateral FDI is currently available and recommend for future research agenda further studies that encompass long time periods on account of data availability.

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Chapter 5

Conclusion

5.1 Summary of findings

In this thesis we looked at the productivity and growth effects of foreign direct investment in the Southern African Development Community. The topic has been tackled in three studies, which are subjects of chapters 2, 3 and 4. The first study has dealt with the analysis of the impact of foreign firm ownership on firm productivity in the region. The chapter considered within firm and intra-industry productivity spillovers from FDI with the objective of obtaining the micro level impact of foreign direct investment on productivity. The second study has dealt with the joint productivity effects of FDI and agglomeration on country level aggregate productivity in the region, while the last chapter has considered the output productivity and income convergence implications of South Africa's intra-regional bilateral FDI in the region.

The thesis contributes to the debate on the growth effects of FDI, with particular interest on the SADC countries. Its contribution is threefold. First, it builds a case of the impact of FDI from a micro level study to the macro level and distinguishes from studies which undertake investigations either at firm level or at country level without inferring effects at various levels. Second, by investigating the role of agglomeration effects on FDI productivity externalities, the study distinguishes itself from most studies that treat the two externality factors separately. Lastly, a direct link of the productivity impact of FDI to the productivity of the FDI source country is also a thinly researched area that we explore utilizing the bilateral FDI statistics recently published by UNCTAD. This has enabled us to link income convergence patterns in the region to FDI patterns and technology growth in the FDI source country.

The firm level study has exploited the opportunity presented by the existence of the World Bank Enterprise Surveys firm data, which are harmonized and poolable across countries. Using labour productivity to measure productivity and sector fixed effects to identify the productivity impact of firm foreign ownership, the chapter finds evidence suggesting the existence of positive within firm and intra-industry productivity gains associated with more foreign ownership in the region. However, within firm productivity externalities are larger for small firms than for large firms implying that in overall terms, the region which has a greater

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proportion of small to large firms is likely to experience growth gains from the existence of more MNCs in the region. At individual country levels, the chapter has evidence suggesting that the relatively poor countries tend to gain more through within firm productivity gains while the relatively richer countries gain more through intra-industry productivity gains, implying that technologically poorer countries in SADC should improve their FDI absorptive capacities in order to yield more intra-industry productivity gains.

The third chapter has dealt with the question of whether the observed productivity gains at firm level for the region imply productivity gains at the country level. In more specific terms, it considers possible joint complementarities between the productivity externality effects of agglomeration and FDI in enhancing aggregate country productivity effects of FDI in the region. The study has been motivated by studies on FDI productivity spillovers and those in economic geography that seem to treat the two growth externality factors in a mutually exclusive manner when effectively their transmission channels suggest that they should be synergistic. We have, therefore, hypothesized that there are positive synergies between the agglomeration and FDI productivity externalities in SADC and used time series data over the period 1990 to 2011 and a theoretical framework that fuses FDI and agglomeration externalities together to test the hypothesis.

Using an index of agglomeration effects, which is a blend of country population density and urbanization, the chapter finds evidence suggesting that both FDI and agglomeration factors have positive effects on output per worker in the region and that their positive effects are enhanced by the joint interaction of the factors. These results are robust to controlling for alternative channels through which density and FDI can cause productivity growth such as human capital density and to excluding outlying countries from the study. Thus, the chapter suggests that FDI and agglomeration technology externalities are complementary and pro-growth in the region, suggesting combined policies on the two factors for growth purposes.

Chapter four has addressed the empirical question of the income convergence role of the intra-SADC bilateral South African FDI in the region as motivated by the leader follower model of international technology diffusion and income convergence suggested by Barro and Sala-i-Martin (2004). The utilized theoretical framework has been inspired by the fact that South Africa is both a major source of FDI and a technology leader in the region, which create scope for the relatively technology poor countries in the region to catch-up with South Africa through

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technology imitation and adoption. In addition, the study is also motivated by Keller (2004) and Comin, et al (2012) who have suggested that technology diffusion negatively depends on geographic distance, implying that South African FDI is likely to confer greater productivity gains and income convergence opportunities in the region than FDI from the rest of the world.

Through characterizing the pattern of income convergence in the region and linking it to patterns of intra-regional South African bilateral FDI using countries' income per capita data and FDI over the period 1980 to 2011, we find results suggesting that South African bilateral FDI has a positive income convergence effect on per capita incomes in SADC, with countries hosting high South African bilateral FDI converging faster both on the region average income and on South Africa's income while those with low FDI exhibit low convergence rates. The findings are robust to controlling for alternative sources of technology growth that include trade and FDI from the rest of the world. They imply that countries in SADC have significant productivity gains from South African intra-regional FDI and suggest the policies that favour bilateral FDI than general FDI blanket policies.

5.2 Implications of findings for policy

A number of important policy implications emerge from the thesis. In more specific terms, the second chapter's findings, which confirm the existence of FDI productivity spillovers for the region suggest that countries in the region should encourage the establishment of multinational corporations in order to enhance international diffusion of technology to local firms. The finding that small firms have larger productivity gains than large firms suggests that targeted FDI policies should seek to promote joint ventures between the MNCs and firms in the small to medium enterprises categories than joint ventures with local blue chip corporations. Lastly, the low intra-industry productivity gains by the relatively poor countries in the region suggests that the countries need to upgrade their FDI absorption capacities in order improve intra-industry productivity gains from FDI.

Turning to the chapter three, two major policy implications can be noted. First, the importance agglomeration externalities on productivity suggest that the region should encourage FDI in more agglomerated areas and regions if greater productivity externalities are to be realized. While this conflicts with the strategy of equitable regional development in most countries, the result suggests that on average the marginal benefits associated with more agglomeration

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outweighs the costs and that there is still more room for geographically centralized development before congestion diseconomies set in. Other than the re-direction of FDI into urban areas and more agglomerated areas, the chapter also suggests that countries in the region should consider policies that encourage more urbanization and agglomeration in order to promote interface of people and economic activities and the exchange of ideas.

Lastly, evidence suggesting the positive impact of bilateral FDI from South Africa on the region's income per capita convergence, suggests that countries in the region should favour FDI policies along lines of Bilateral Investment Treaties (BIT), that are earmarked at promoting bilateral FDI from high technology countries within the region in order to have maximum gains from the potential FDI productivity externalities. The strategy contrasts the conventional blanket FDI policies, incentives and support measures that are instituted by most countries in the developing world, which may not be optimal given the limited resources most of the countries have to expend to attract and sustain FDI. In this regard, the selective targeted FDI policies do not only promote growth in the region but they also take off some burden from the developing countries' fiscus and free some budgetary space for other developmental priorities.

5.3 Suggestions for future research

The thesis suggests a number of future research areas. The first suggestion is on the extension of the study on the impact of foreign firm ownership on technology spillovers using firm panel data to allow more distinct identification of cause and effect between FDI and firm productivity both in the short and long run periods. Regarding the productivity externality impact of density, the thesis suggests an investigation at more micro regional and industry levels in order to tackle the research's questions at levels that proximate the definition of agglomeration by most of the studies in the literature. Lastly, the convergence impact of bilateral FDI on productivity and income convergence in the region also needs to be extended to the sector level to give more detailed insights into how productivity in the countries' different sectors such as manufacturing is linked to and driven by sector specific bilateral FDI from South Africa. In addition, studies involving longer time dimensions for the series may be more informative given that the issue of income convergence should be looked at more accurately from a long term perspective.

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Annex A

Table 25: List and Definition of Variables

Variable	Definition	Source
Chapter Two Variables		
Firm Foreign Ownership (FDI_{firm})	Percentage of firm equity holding owned by foreign investors.	WBES
Sector Foreign Ownership (FDI_{sector})	Weighted percentage of sector equity holding owned by foreign investors	“
Management Experience (Mgt Exper)	The number of years of magerail experience of the firm managing director	“
Formal Competition	Categorical variable indicating the threat of competition from other formal firms	“
Informal Competition	Categorical variable indicating the threat of competition from other the informal firms	“
Firm Age	The number of years the firm has been in existence since established	“
Corruption	Categorical variable indicating the threat of government corruption for the firm’s	“
Firm Avg Human Capital	operation The average years of schooling education for	“
Communication Obstacle	the firm’s workers Categorical variable indicating the threat of inefficient communication infrastructure to	“
Credit Constraint	the firm’s operation Categorical variable indicating the threat of	“
Rule of Law	lack of credit on the firm’s operation Dummy variable showing the existence or	“
Firm Size	non-existence of the rule of law as rated by the firm	“
Foreign Inputs	Dummy variable indicating whether the firm is small (D=1) or large (D=0)	“
Regional Foreign Ownership	The percentage of foreign inputs in total inputs used by the firm	“
Regional Wage	Weighted percentage of foreign firm ownership in specific regions Average wage rate in the region	“
Chapter Three Variables		
Per Capita GDP (PCGDP)	Output per person or GDP divided by total population.	WDI
Per Capita FDI Stock (PCFDI)	The stock of net FDI per person or total net FDI divided by total population	UNCTAD
Urbanization (Urban)	Percentage of a country’s population living in urban areas	WDI
Density (PDNS)	Average number of people per square kilometre in individual countries	WDI
Density Index (DNSDEX)		WDI

Gross Domestic Savings (GDS)	An index of agglomeration computed from the multiplicative interaction of urbanization and density.	WDI
Financial Sector Credit	The percentage of gross savings to income in a country.	WDI
Telephone Lines (TEL)	Total private sector credit made by the financial sector as percentage of GDP	WDI
Polity (POL)	The number of telephone lines per 100 people in a country. Used to proxy for infrastructure.	Polity IV
Government Expenditure (GOVT)	Measure of the quality of institutions, defined by the Polity IV Index	PWT8.0
Trade Index (TRADE)	Total government expenditure as percentage of GDP	WDI
Domestic Expenditure	Simple average of a country's imports and exports as percentage of GDP	PWT8.0
Human Capital (EDUC)	Total private sector domestic expenditure as percentage of GDP	PWT8.0
Education Expenditure (ED_Exp)	Average number of schooling years for a country Total expenditure on education by a country as a percentage of its GDP. Variable used alternatively for human capital	WDI
Chapter Four Variables		
Income Gap (GDP GAP)	The ratio of South Africa's per capita income to individual countries' per capita income	WDI
In.FDI From S.Africa (In.SAFDI)	Inward FDI stock Per Capita from South Africa	UNCTAD
Out.FDI to S. Africa (O.SAFDI)	Outward FDI stock Per Capita to South Africa	UNCTAD
Total Bilateral FDI (S.Africa FDI Stock)	Total of Inward and Outward FDI stocks per capita between S. Africa and individual countries	UNCTAD
Total FDI from ROW	Net FDI stock per capita from the rest of the world excluding South Africa	UNCTAD
Trade Growth	Annual growth of the average of exports and imports	WDI
Gross Domestic Investment (GFCF)	Gross Fixed Capital Formation as percentage of GDP	PWT8.0

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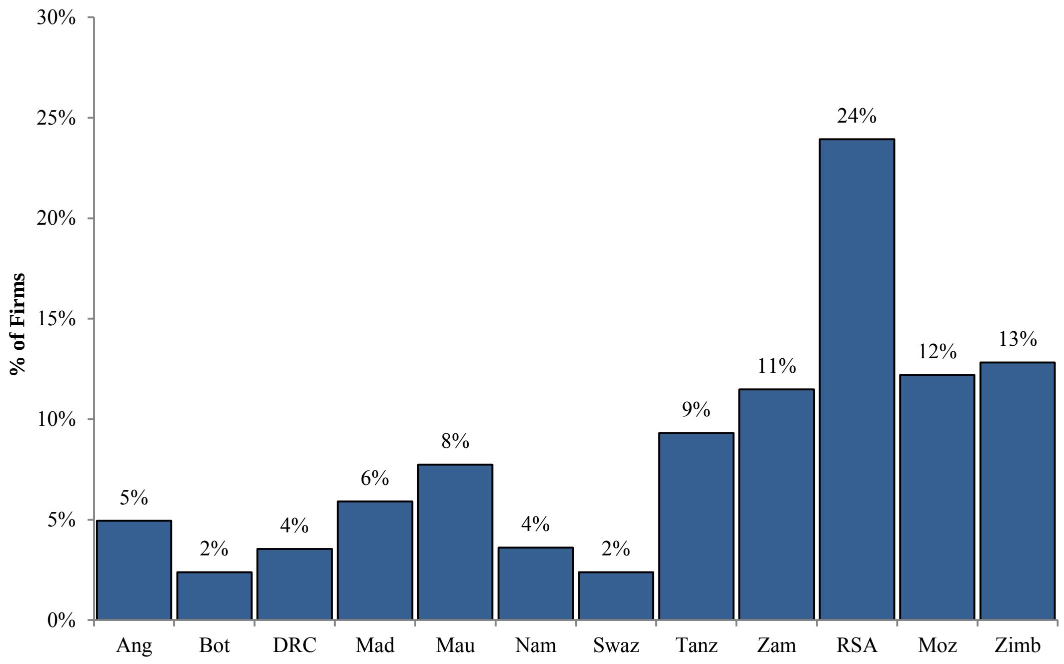
Insert 1: The World Bank Enterprise Surveys Data

Figure A1: Firm Representation by Country



Source of Data: World Bank Enterprise Surveys (various)

Table A1: Firm Representation by Country and Industry (% of total No. in Each Industry)

	Ind-1	***Ind-2***	***Ind-3***	***Ind-4***	***Ind-5***	***Ind-6***
Angola	*3.0*	*6.6*	*2.9*	*9.1*	*1.8*	*4.2*
Botswana	*2.0*	*7.5*	*2.5*	*0.9*	*3.1*	*2.9*
DRC	*2.3*	*2.8*	*4.7*	*3.7*	*0.8*	*5.4*
Madagascar	*1.5*	*2.8*	*4.0*	*4.7*	*11.2*	*6.9*
Mauritius	*2.0*	*5.7*	*3.3*	*13.2*	*10.2*	*5.4*
Namibia	*5.0*	*9.4*	*4.0*	*2.3*	*1.0*	*4.9*
Swaziland	*1.8*	*4.7*	*2.5*	*2.0*	*1.0*	*3.6*
Tanzania	*5.5*	*12.3*	*9.1*	*8.6*	*0.6*	*16.7*
Zambia	*10.1*	*8.5*	*8.3*	*14.4*	*15.7*	*8.1*
S. Africa	*36.2*	*9.4*	*38.0*	*15.0*	*24.1*	*23.6*
Mozambique	*21.1*	*9.4*	*6.2*	*11.8*	*11.2*	*11.2*
Zimbabwe	*9.5*	*20.8*	*14.5*	*14.3*	*19.6*	*7.2*

Source: World Bank Enterprise Surveys

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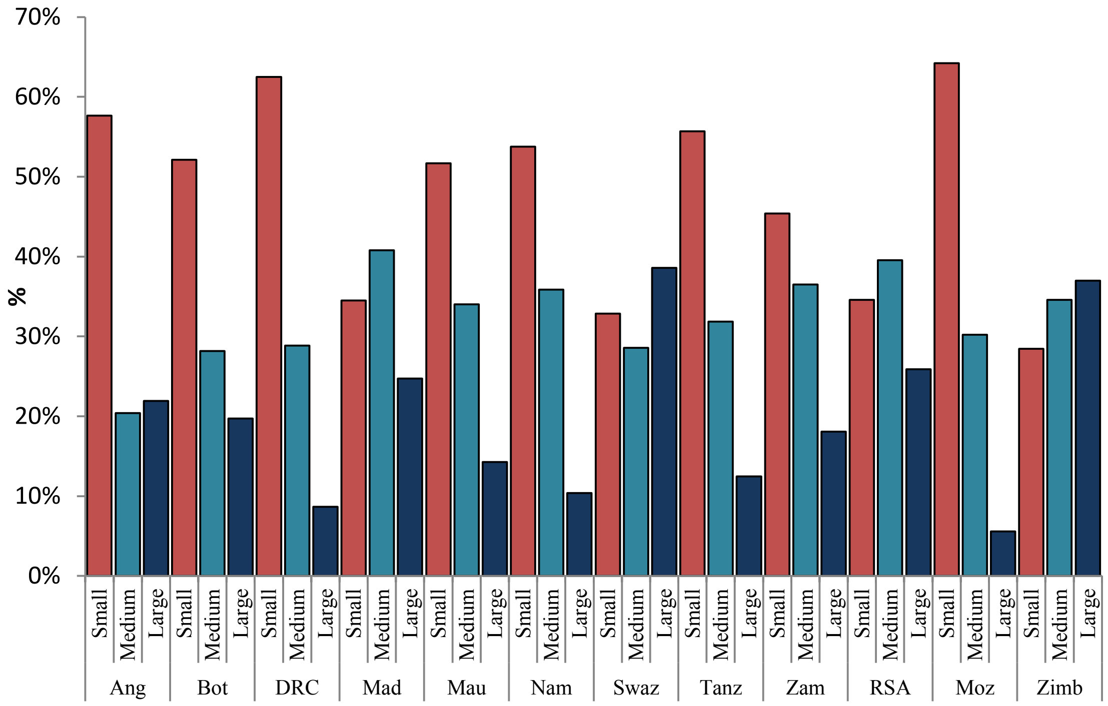
Figure A2: Within Country Firm Representation by Firm Size (% of Total Firms in each Country)



Data Source: World Bank Enterprise Surveys.

Table A2: Comparison of Within Country Sample and Population Proportions of Small Firms

Country	Proportion in Population	Proportion in Sample
South Africa	0.81	0.78
Angola	0.75	0.72
Botswana	0.83	0.79
DRC	0.91	0.90
Madagascar	0.83	0.76
Mauritius	0.85	0.89
Namibia	0.90	0.91
Swaziland	0.61	0.62
Tanzania	0.88	0.87
Mozambique	0.94	0.95
Zambia	0.87	0.82
Zimbabwe	0.75	0.62

Source: Computed from World Bank Enterprise Surveys

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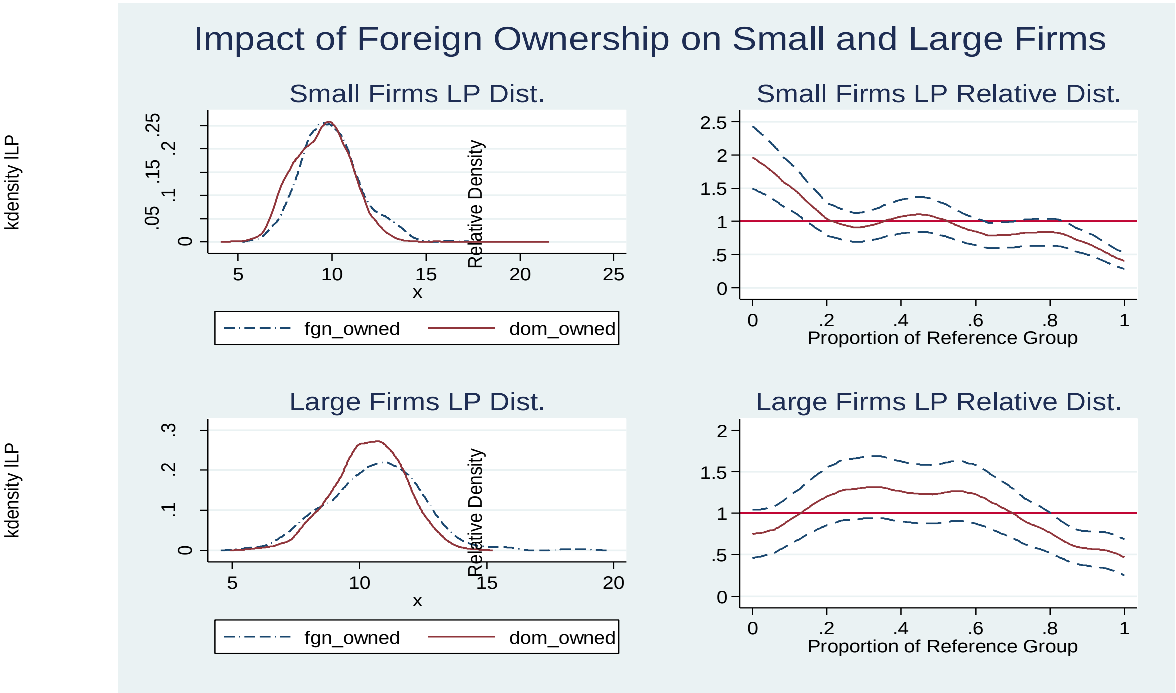
Table A3**:** Factor Shares Using Three Estimation Specifications

	OLS		OLS With Sector Effects		IV With Sector Effects	
	Capital	Labour	Capital	Labour	Capital	Labour
Angola	-	-	-	-	0.43	0.63
Botswana	0.11	0.90	0.11	0.91	0.48	0.37
DR. Congo	0.40	0.69	0.39	0.61	0.59	0.38
Madagascar	0.09	0.92	0.10	0.90	0.25	0.50
Mauritius	0.33	0.90	0.30	0.90	0.54	0.32
Namibia	0.32	0.86	0.31	0.87	0.61	0.33
Swaziland	0.27	0.68	0.27	0.70	0.38	0.61
Tanzania	0.21	0.78	0.21	0.80	0.31	0.89
Zambia	0.25	0.75	0.24	0.76	0.40	0.59
R S A	0.20	0.80	0.19	0.81	0.43	0.63
Mozambique	0.16	0.84	0.17	0.84	0.27	0.81
Zimbabwe	0.37	0.72	0.37	0.72	0.62	0.31

Estimated from the WBES

Figure A3: Foreign Ownership and Firm Productivity by Firm Size (All Countries)



Source: World Bank Enterprise Surveys

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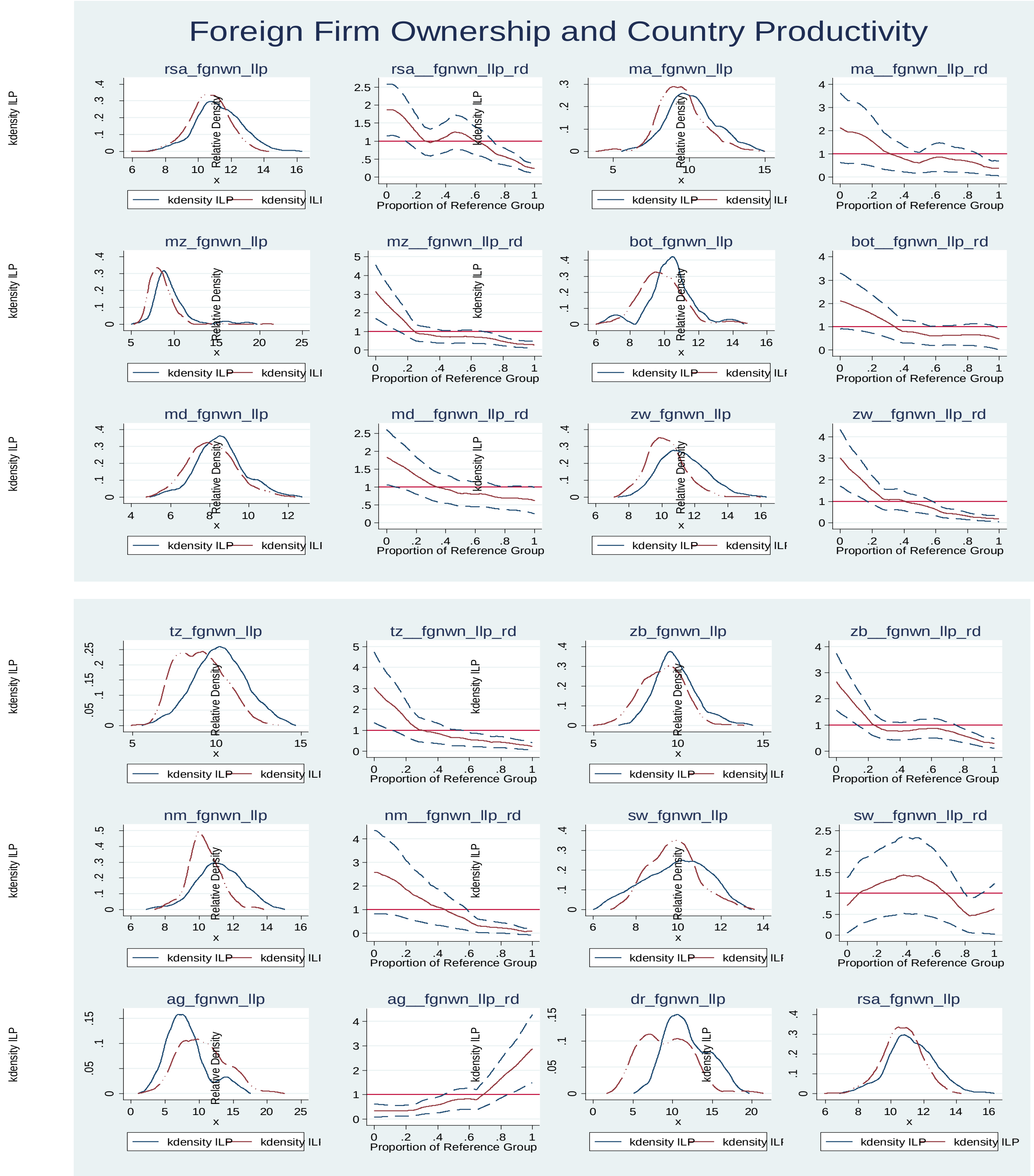
Figure A6: Impact of Foreign Firm Ownership At Country Level



///Solid line=foreign ownership; & broken line=domestic ownership

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Table A7: FDI and Labour Productivity Spillovers Excluding South Africa

	OLS Estimation of Labour Productivity Excluding Angola, DRC & S.A				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Firm Foreign Ownership	0.014***	0.015***	0.012***	0.012***	0.013***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Sector Foreign Ownership	0.013***	0.012***	0.011***	0.011***	0.009**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Firm FDI x Sector FDI	-0.000***	-0.000***	-0.000**	-0.000**	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Management Experience	-0.009**	-0.012***	-0.011***	-0.011***	-0.011***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Formal Competition	-0.021**	-0.019*	-0.023**	-0.023**	-0.020*
	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)
Informal Competition	0.011	-0.020	0.013	0.011	-0.011
	(0.028)	(0.028)	(0.027)	(0.027)	(0.027)
Firm Age	0.010***	0.009***	0.009***	0.008***	0.009***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Firm Avg Human Capital	0.140**	0.121**	0.144**	0.159***	0.170***
	(0.062)	(0.060)	(0.061)	(0.042)	(0.057)
Corruption	-0.009**	-0.011***	-0.008**	-0.007**	-0.006*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Communication Obstacle	0.036	0.023	0.027	0.018	0.015
	(0.042)	(0.044)	(0.041)	(0.041)	(0.042)
Credit Constraint	-0.113***	-0.130***	-0.114***	-0.107***	-0.107***
	(0.026)	(0.027)	(0.026)	(0.025)	(0.025)
Rule of Law (0=no; 1=yes)	-0.117	0.067	-0.137*	-0.073	-0.016
	(0.083)	(0.086)	(0.083)	(0.083)	(0.084)
Firm Size(0=large; 1=small)	-0.241*	-0.292**	-0.179	-0.167	-0.172
	(0.129)	(0.125)	(0.128)	(0.129)	(0.128)
Foreign Inputs			0.005***	0.004***	0.004***
			(0.001)	(0.001)	(0.001)
Regional Foreign Ownership				0.003	0.001
				(0.003)	(0.003)
Regional Wage				1.321***	0.912***
				(0.179)	(0.092)
Constant	10.096***	10.257***	9.799***	-0.399	3.184***
	(0.944)	(0.216)	(0.896)	(1.666)	(0.750)
Obs	1,246	1,246	1,246	1,246	1,246
Rsqrd	0.304	0.265	0.316	0.340	0.327
F-Stat	28.3	26.6	28.2	30.3	32.3
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes
Country FE	Yes	No	Yes	Yes	No

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

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Table A8: Labour Productivity Spillover Effects on Small Firms

	OLS Estimation of Labour Productivity Excluding Angola and DRC				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Firm Foreign Ownership	0.013***	0.012***	0.011***	0.011***	0.012***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Sector Foreign Ownership	0.016***	0.019***	0.014***	0.013***	0.014***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Firm FDI x Sector FDI	-0.000***	-0.000**	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Management Experience	-0.003	-0.008**	-0.005	-0.004	-0.006*
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
Formal Competition	-0.028***	-0.013	-0.030***	-0.030***	-0.028***
	(0.009)	(0.013)	(0.010)	(0.010)	(0.011)
Informal Competition	-0.002	-0.115***	0.003	0.004	-0.011
	(0.025)	(0.026)	(0.024)	(0.023)	(0.023)
Firm Age	0.009***	0.009***	0.008***	0.008***	0.008***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Firm Avg Human Capital	0.117**	0.089*	0.124**	0.138***	0.151***
	(0.054)	(0.054)	(0.054)	(0.037)	(0.049)
Corruption	-0.007**	-0.014***	-0.006*	-0.006*	-0.005*
	(0.003)	(0.005)	(0.003)	(0.003)	(0.003)
Communication Obstacle	0.044	0.013	0.030	0.024	0.028
	(0.036)	(0.044)	(0.036)	(0.036)	(0.036)
Credit Constraint	-0.117***	-0.211***	-0.112***	-0.108***	-0.108***
	(0.023)	(0.026)	(0.023)	(0.023)	(0.023)
Rule of Law (0=no; 1=yes)	-0.179***	0.192**	-0.183***	-0.146**	-0.091
	(0.067)	(0.077)	(0.066)	(0.066)	(0.066)
Foreign Inputs			0.006***	0.006***	0.006***
			(0.001)	(0.001)	(0.001)
Regional Foreign Ownership				0.002	0.003
				(0.002)	(0.002)
Regional Wage				1.239***	0.839***
				(0.184)	(0.037)
Constant	10.755***	10.111***	10.740***	-0.471	3.315***
	(0.151)	(0.200)	(0.150)	(1.650)	(0.354)
Obs	1,515	1,515	1,515	1,515	1,515
Rsqrd	0.386	0.194	0.402	0.419	0.411
F-Stat	45.8	28.8	47.0	48.5	56.8
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes
Country FE	Yes	No	Yes	Yes	No

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

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Table A9: Productivity Spillover Effects on Large Firms

	OLS Estimation of Labour Productivity Excluding Angola and DRC				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Firm Foreign Ownership	0.008**	0.009**	0.007**	0.008**	0.010***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Sector Foreign Ownership	0.013	0.011	0.013	0.011	0.010
	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)
Firm FDI x Sector FDI	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Management Experience	-0.012	-0.005	-0.012*	-0.011	-0.010
	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)
Formal Competition	0.007	0.011	0.008	0.005	0.009
	(0.028)	(0.028)	(0.028)	(0.029)	(0.029)
Informal Competition	0.062	-0.017	0.062	0.049	0.037
	(0.065)	(0.073)	(0.065)	(0.062)	(0.068)
Firm Age	0.013***	0.016***	0.013***	0.012***	0.011***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
Firm Avg Human Capital	0.805*	0.184	0.796*	0.848**	0.606
	(0.434)	(0.515)	(0.437)	(0.415)	(0.437)
Corruption	-0.012	-0.001	-0.011	-0.017	0.000
	(0.031)	(0.032)	(0.031)	(0.023)	(0.031)
Communication Obstacle	0.044	0.059	0.044	0.038	0.017
	(0.099)	(0.104)	(0.099)	(0.094)	(0.096)
Credit Constraint	-0.139**	-0.184**	-0.140**	-0.135**	-0.087
	(0.069)	(0.076)	(0.069)	(0.068)	(0.070)
Rule of Law (0=no; 1=yes)	-0.010	0.152	-0.012	-0.020	-0.120
	(0.166)	(0.196)	(0.166)	(0.168)	(0.179)
Foreign Inputs			0.001	-0.000	0.000
			(0.002)	(0.002)	(0.002)
Regional Foreign Ownership				-0.015**	-0.021***
				(0.006)	(0.006)
Regional Wage				2.159***	0.728***
				(0.521)	(0.110)
Constant	10.700***	10.011***	10.704***	-8.281*	5.089***
	(0.365)	(0.461)	(0.366)	(4.652)	(0.949)
Obs	354	354	354	354	354
Rsqrd	0.311	0.170	0.311	0.349	0.298
F(23; 1491)	10.5	8.23	10.1	10.7	11.8
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes
Country FE	Yes	No	Yes	Yes	No

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

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Table A10: FDI and Labour Productivity Spillover for Domestic Firms

	OLS Estimation of Labour Productivity for Domestic Firms				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Sector Foreign Ownership	0.015***	0.016***	0.013***	0.012***	0.011***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Management Experience	-0.006*	-0.009***	-0.008**	-0.007**	-0.008***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
Formal Competition	-0.016*	-0.001	-0.016	-0.016	-0.013
	(0.010)	(0.013)	(0.011)	(0.011)	(0.012)
Informal Competition	0.017	-0.102***	0.023	0.021	0.008
	(0.024)	(0.027)	(0.024)	(0.023)	(0.023)
Firm Age	0.009***	0.010***	0.008***	0.007***	0.008***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Firm Avg Human Capital	0.223*	0.228	0.228**	0.193**	0.263**
	(0.129)	(0.180)	(0.112)	(0.091)	(0.130)
Corruption	-0.010***	-0.016***	-0.008**	-0.008***	-0.008**
	(0.003)	(0.005)	(0.003)	(0.003)	(0.003)
Communication Obstacle	0.020	-0.028	0.006	0.005	0.005
	(0.038)	(0.045)	(0.038)	(0.037)	(0.038)
Credit Constraint	-0.116***	-0.216***	-0.113***	-0.109***	-0.110***
	(0.024)	(0.026)	(0.023)	(0.023)	(0.023)
Rule of Law (0=no; 1=yes)	-0.164**	0.202***	-0.162**	-0.125*	-0.079
	(0.066)	(0.076)	(0.065)	(0.064)	(0.065)
Firm Size	-0.315***	-0.521***	-0.268***	-0.259***	-0.272***
	(0.091)	(0.101)	(0.090)	(0.089)	(0.090)
Foreign Inputs			0.006***	0.005***	0.006***
			(0.001)	(0.001)	(0.001)
Regional Foreign Ownership				-0.001	-0.000
				(0.002)	(0.002)
Regional Wage				1.408***	0.857***
				(0.184)	(0.037)
Constant	11.090***	10.568***	11.043***	-1.597	3.543***
	(0.170)	(0.228)	(0.170)	(1.656)	(0.366)
Obs	1,512	1,512	1,512	1,512	1,512
Rsqrd	0.409	0.211	0.424	0.444	0.432
F(23; 1491)	53.9	25.5	54.8	57.7	66.3
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes
Country FE	Yes	No	Yes	Yes	No

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

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Table A11: FDI SPILLOVER EFFECTS BY COUNTRY LEVEL- USING THE LPR

	LPR RSA	LPR Mauritius	LPR Mozambiq	LPR Botswana	LPR Madagascar	LPR Zimbabwe	LPR Tanzania	LPR Zambia	LPR Namibia	LPR Swaziland	LPR Angola	LPR DRC
FDI_firm	0.005***	0.001	0.006*	-0.001	0.007**	0.015***	0.009***	0.008***	0.004	0.004	0.002	0.021*
	(0.001)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)	(0.002)	(0.002)	(0.004)	(0.004)	(0.017)	(0.011)
FDI_sec	0.040***	-0.040***	0.033***	-0.033***	-0.011**	0.012	0.038***	-0.013	-0.005	-0.006	0.102**	-0.007
	(0.009)	(0.010)	(0.011)	(0.009)	(0.005)	(0.008)	(0.008)	(0.008)	(0.010)	(0.005)	(0.043)	(0.020)
Reg_wge	1.603***	0.412	1.807***	-0.203	0.615	-0.294	1.465***	0.751	-3.952**	1.572	1.58***	0.980**
	(0.494)	(0.370)	(0.274)	(1.785)	(1.176)	(0.586)	(0.361)	(0.464)	(1.828)	(1.175)	(0.562)	(0.463)
Fgn_inp	0.005***	0.004*	0.004	0.005	0.005*	-0.005**	0.012***	0.003**	0.000	-0.003	-0.006	0.010
	(0.002)	(0.003)	(0.003)	(0.005)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.014)	(0.011)
Constant	-4.743	8.211***	-2.324	12.023	4.247	11.745**	-2.060	3.747	42.468***	-2.942	7.354**	7.952*
	(4.471)	(2.821)	(1.938)	(14.221)	(7.565)	(4.652)	(2.690)	(3.229)	(14.914)	(9.055)	(3.008)	(4.043)
……..												
Obs	623	124	321	46	106	340	251	330	76	61	61	72
R-sqd	0.219	0.270	0.271	0.379	0.245	0.166	0.424	0.188	0.473	0.293	0.502	0.365

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

//All regressions are done with same variables as in those in table 1, except in some instances were variable(s) were dropped either because there is not enough variation in the variable at country level, eg firm size; or the variable had too many missing observations. A case of the later was corruption, which is inadequately reported in some countries

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Table A12: FDI and Total Factor Productivity Spillover for SADC Pool

	OLS Estimation Firm Total Factor Productivity (Excl Angola and DRC)				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Firm Foreign Ownership	0.008***	0.004*	0.007***	0.007***	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Sector Foreign Ownership	0.011***	0.015***	0.009**	0.009**	0.011***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Firm FDI x Sector FDI	-0.000*	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Management Experience	-0.001	-0.001	-0.002	-0.002	0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Formal Competition	-0.012	-0.008	-0.013	-0.013	-0.014
	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
Informal Competition	-0.056**	-0.099***	-0.054**	-0.054**	-0.036
	(0.022)	(0.024)	(0.022)	(0.022)	(0.023)
Firm Age	0.008***	0.010***	0.007***	0.007***	0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Firm Avg Human Capital	0.062	0.061	0.069	0.075	0.104
	(0.059)	(0.080)	(0.061)	(0.058)	(0.080)
Corruption	-0.012***	-0.015***	-0.010***	-0.010***	-0.009**
	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)
Communication Obstacle	-0.008	-0.005	-0.017	-0.019	0.003
	(0.032)	(0.036)	(0.032)	(0.032)	(0.033)
Credit Constraint	-0.087***	-0.151***	-0.085***	-0.083***	-0.082***
	(0.021)	(0.024)	(0.021)	(0.021)	(0.023)
Rule of Law (0=no; 1=yes)	-0.091	-0.011	-0.092	-0.076	-0.190***
	(0.064)	(0.071)	(0.063)	(0.064)	(0.068)
Firm Size(1=large; 2=small)	-0.330***	-0.456***	-0.296***	-0.295***	-0.310***
	(0.089)	(0.099)	(0.088)	(0.089)	(0.093)
Foreign Inputs			0.005***	0.004***	0.002
			(0.001)	(0.001)	(0.001)
Regional Foreign Ownership				0.001	0.004
				(0.003)	(0.003)
Regional Wage				0.560***	0.575***
				(0.169)	(0.037)
Constant	7.754***	6.583***	7.721***	2.668*	1.809***
	(0.164)	(0.213)	(0.166)	(1.512)	(0.373)
Obs	1,803	1,803	1,803	1,803	1,803
Rsqrd	0.453	0.312	0.461	0.464	0.391
F-stat	74.3	57.8	70.8	66	67.7
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes
Country FE	Yes	No	Yes	Yes	No

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

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Table A13: FDI and Total Factor Productivity Spillovers For SADC Excluding South Africa

	OLS Estimation of TFP Productivity Excluding S.A				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Firm Foreign Ownership	0.009***	0.007***	0.008***	0.008***	0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Sector Foreign Ownership	0.008**	0.011***	0.007*	0.007*	0.010***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Firm FDI x Sector FDI	-0.000*	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Management Experience	-0.005	-0.004	-0.007**	-0.007**	-0.005
	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)
Formal Competition	-0.014	-0.018**	-0.015	-0.016	-0.020**
	(0.009)	(0.009)	(0.010)	(0.010)	(0.009)
Informal Competition	-0.019	0.021	-0.018	-0.019	0.019
	(0.025)	(0.026)	(0.025)	(0.025)	(0.025)
Firm Age	0.004	0.004*	0.003	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Firm Avg Human Capital	0.081	0.107	0.085	0.092	0.083
	(0.060)	(0.074)	(0.061)	(0.056)	(0.065)
Corruption	-0.011***	-0.010**	-0.010***	-0.010***	-0.009**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Communication Obstacle	-0.007	0.013	-0.017	-0.020	0.006
	(0.035)	(0.035)	(0.034)	(0.034)	(0.035)
Credit Constraint	-0.080***	-0.068***	-0.080***	-0.078***	-0.079***
	(0.024)	(0.025)	(0.024)	(0.024)	(0.025)
Rule of Law (0=no; 1=yes)	-0.109	-0.320***	-0.127*	-0.094	-0.277***
	(0.077)	(0.079)	(0.077)	(0.078)	(0.081)
Firm Size(1=large; 2=small)	-0.110	-0.096	-0.056	-0.047	-0.015
	(0.105)	(0.105)	(0.106)	(0.108)	(0.111)
Foreign Inputs			0.004***	0.004***	0.004***
			(0.001)	(0.001)	(0.001)
Regional Foreign Ownership				0.003	0.010***
				(0.004)	(0.003)
Regional Wage				0.581***	-0.509***
				(0.179)	(0.096)
Constant	6.094***	6.253***	5.834***	1.333	9.615***
	(0.936)	(0.218)	(0.895)	(1.623)	(0.748)
Obs	1,225	1,225	1,225	1,225	1,225
Rsqrd	0.323	0.263	0.334	0.339	0.288
F-stat	32.8	30	31.1	29.1	27
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes
Country FE	Yes	No	Yes	Yes	No

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

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Table A14: Total Factor Productivity Spillover Effects on Small Firms

	OLS Estimation of TFP Productivity Small Firms				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Firm Foreign Ownership	0.010***	0.006**	0.009***	0.009***	0.007**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Sector Foreign Ownership	0.010**	0.014***	0.009**	0.009**	0.012***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Firm FDI x Sector FDI	-0.000**	-0.000	-0.000*	-0.000**	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Management Experience	-0.001	-0.001	-0.003	-0.002	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Formal Competition	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Informal Competition	-0.021**	-0.015	-0.022**	-0.023**	-0.024**
	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)
Firm Age	-0.056**	-0.098***	-0.052**	-0.052**	-0.038
	(0.024)	(0.025)	(0.023)	(0.023)	(0.024)
Firm Avg Human Capital	0.005**	0.006**	0.004*	0.004*	0.006**
	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Corruption	0.074	0.089	0.079	0.085	0.122
	(0.054)	(0.077)	(0.056)	(0.052)	(0.075)
Communication Obstacle	-0.012***	-0.015***	-0.010***	-0.010***	-0.009**
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
Credit Constraint	0.020	0.010	0.008	0.007	0.030
	(0.037)	(0.042)	(0.037)	(0.037)	(0.039)
Rule of Law (0=no; 1=yes)	-0.085***	-0.143***	-0.081***	-0.078***	-0.081***
	(0.023)	(0.025)	(0.023)	(0.023)	(0.024)
Foreign Inputs	-0.086	-0.023	-0.087	-0.059	-0.173**
	(0.067)	(0.076)	(0.066)	(0.067)	(0.072)
Regional Foreign Ownership			0.005***	0.005***	0.001
			(0.001)	(0.001)	(0.001)
Regional Wage				0.004	0.008***
				(0.003)	(0.003)
Constant				0.525***	0.524***
				(0.187)	(0.039)
Obs	1,479	1,479	1,479	1,479	1,479
Rsqrd	0.405	0.253	0.416	0.420	0.333
F(23; 1491)	61.3	45.8	58.6	54.8	55.4
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes
Country FE	Yes	No	Yes	Yes	No

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

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Table A15: Total Factor Productivity Spillover Effects on Large Firms

	OLS Estimation of TFP Productivity Large Firms				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Firm Foreign Ownership	0.001	0.000	0.001	0.001	0.001
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
Sector Foreign Ownership	0.008	0.021**	0.007	0.006	0.015*
	(0.007)	(0.008)	(0.007)	(0.007)	(0.008)
Firm FDI x Sector FDI	-0.000	-0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Management Experience	0.004	0.005	0.003	0.002	0.001
	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)
Formal Competition	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Informal Competition	0.003	0.003	0.005	0.003	0.004
	(0.026)	(0.027)	(0.028)	(0.029)	(0.030)
Firm Age	-0.027	-0.066	-0.026	-0.032	0.007
	(0.061)	(0.068)	(0.061)	(0.060)	(0.064)
Firm Avg Human Capital	0.012***	0.017***	0.011***	0.010***	0.011***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Corruption	-0.142	-1.542**	-0.130	-0.143	-0.679
	(0.535)	(0.622)	(0.530)	(0.524)	(0.546)
Communication Obstacle	-0.012	-0.007	-0.005	-0.006	0.001
	(0.042)	(0.044)	(0.040)	(0.037)	(0.038)
Credit Constraint	-0.100	-0.016	-0.100	-0.106	-0.080
	(0.070)	(0.072)	(0.070)	(0.070)	(0.068)
Rule of Law (0=no; 1=yes)	-0.095	-0.177**	-0.104*	-0.099	-0.078
	(0.062)	(0.069)	(0.062)	(0.063)	(0.068)
Foreign Inputs	-0.218	-0.082	-0.224	-0.257	-0.378**
	(0.178)	(0.209)	(0.177)	(0.182)	(0.190)
Regional Foreign Ownership			0.004*	0.004	0.004*
			(0.002)	(0.002)	(0.002)
Regional Wage				-0.016**	-0.011
				(0.008)	(0.007)
Constant				1.101**	0.898***
				(0.458)	(0.118)
Obs	324	324	324	324	324
Rsqrd	0.620	0.501	0.625	0.634	0.591
F(25; 298)	28.3	24.9	29.1	26.8	26.9
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes
Country FE	Yes	No	Yes	Yes	No

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

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Table A16: FDI and TFP Spillover for Domestic Firms

	OLS Estimation of Total Factor Productivity				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Sector Foreign Ownership	0.009**	0.013***	0.007*	0.007*	0.010***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Management Experience	-0.002	-0.001	-0.003	-0.003	0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Formal Competition	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Informal Competition	-0.008	-0.002	-0.008	-0.008	-0.010
	(0.009)	(0.011)	(0.010)	(0.011)	(0.010)
Firm Age	-0.047*	-0.101***	-0.043*	-0.044*	-0.032
	(0.024)	(0.025)	(0.023)	(0.023)	(0.025)
Firm Avg Human Capital	0.006***	0.007***	0.005**	0.005**	0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Corruption	0.215***	0.248***	0.222***	0.206***	0.263***
	(0.070)	(0.080)	(0.064)	(0.059)	(0.089)
Communication Obstacle	-0.014***	-0.018***	-0.013***	-0.013***	-0.012***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)
Credit Constraint	-0.001	-0.005	-0.011	-0.011	0.024
	(0.038)	(0.043)	(0.038)	(0.038)	(0.039)
Rule of Law (0=no; 1=yes)	-0.084***	-0.150***	-0.082***	-0.080***	-0.080***
	(0.023)	(0.026)	(0.023)	(0.023)	(0.025)
Firm Size	-0.071	0.009	-0.069	-0.047	-0.162**
	(0.067)	(0.075)	(0.067)	(0.067)	(0.071)
Foreign Inputs	-0.395***	-0.490***	-0.358***	-0.352***	-0.350***
	(0.096)	(0.113)	(0.096)	(0.096)	(0.102)
Regional Foreign Ownership			0.004***	0.004***	0.001
			(0.001)	(0.001)	(0.001)
Regional Wage				0.002	0.005*
				(0.003)	(0.003)
Constant				0.569***	0.579***
				(0.195)	(0.040)
Obs	1,465	1,465	1,465	1,465	1,465
Rsqrd	0.475	0.326	0.482	0.486	0.411
F(23; 1491)	78.3	59.7	74.8	69.1	71.1
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes
Country FE	Yes	No	Yes	Yes	No

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

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Annex B

Table B1: The Relative Importance of Human Capital and FDI in Productivity

VARIABLES	(1)	(2)	(3)
Density Index	0.821**	1.310***	1.162***
	(0.319)	(0.311)	(0.329)
Density Index Square	-0.046*	-0.077***	-0.091***
	(0.025)	(0.026)	(0.029)
Gross Domestic Savings	0.503***	0.548***	0.502***
	(0.096)	(0.093)	(0.090)
Telephone Lines	0.157***	0.133***	0.115***
	(0.027)	(0.025)	(0.026)
Government Expenditure	0.051*	0.167***	0.070**
	(0.030)	(0.031)	(0.030)
Trade Volume Index	0.068**	-0.046	0.159***
	(0.034)	(0.033)	(0.034)
Human Capital		2.509**	
		(1.136)	
Density*Human Capital		-0.175	
		(0.151)	
Density*Per Capita FDI Stock			0.031***
			(0.004)
Per Capita FDI Stock			-0.071*
			(0.041)
Constant	2.872***	0.416	2.934***
	(1.072)	(1.157)	(1.041)
Observations	277	237	277
Number of Countries	14	12	14

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

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Annex C

C1: Derivation of the Estimation Equation for the Leader- Follower Model

Restating Equation 7:

$$\log\left(\frac{y_{i,t}}{y_{i,t-1}}\right)=\log\left(\frac{y_{sa,t}}{y_{sa,t-1}}\right)-\theta\left[\log\left(\frac{y_{i,t}}{y_{sa,t}}\right)-\log\left(\frac{y_i}{y_{sa}}\right)^*\right] \qquad (7)$$

Re-stated and given that $\log\left(\frac{y_i}{y_{sa}}\right)^*$ is a constant since it is a proportion of constants

$$\log(y_{i,t})-\log(y_{i,t-1})=\log(y_{sa,t})-\log(y_{sa,t-1})-\theta\log(y_{i,t})+\theta\log(y_{sa,t})+a$$

$$(1+\theta)\log(y_{i,t})-\log(y_{i,t-1})=(1-\theta)\log(y_{sa,t})-\log(y_{sa,t-1})+a$$

$$(1+\theta)\log(y_{sa,t})-(1+\theta)\log(y_{i,t})=\log(y_{sa,t-1})-\log(y_{i,t-1})-a$$

$$(1+\theta)\log\left(\frac{y_{sa,t}}{y_{i,t}}\right)=\log\left(\frac{y_{sa,t-1}}{y_{i,t-1}}\right)-a$$

$\log\left(\frac{y_{sa,t}}{y_{i,t}}\right)=c+b\log\left(\frac{y_{sa,t-1}}{y_{i,t-1}}\right)$: Which is the estimated equation in equation 8.

Where parameter $c=-a=\theta\log\left(\frac{y_{sa,t}}{y_{i,t}}\right)^*$ and

The convergence rate is defined as follows:

$$b=\frac{1}{1+\theta}\Rightarrow 1+\theta=\frac{1}{b}$$

$$\Rightarrow\theta=\frac{1}{b}-1$$

`

Table C1: Income Convergence on the Region Average Income (Annual Data)

	SADC		*High FDI Countries*		*Low FDI Countries*	
VARIABLES	RE	FE	RE	FE	RE	FE
Lag Mean Incom. Deviation	1.001***	0.953***	0.994***	0.932***	1.001***	0.967***
	(0.004)	(0.010)	(0.005)	(0.013)	(0.008)	(0.015)
Constant	0.000	0.000	0.019***	0.053***	-0.011	-0.04***
	(0.005)	(0.002)	(0.006)	(0.008)	(0.008)	(0.012)
Observations	420	420	180	180	210	210
No. of Countries	14	14	6	6	7	7
R-squared	0.96	0.96	0.91	0.91	0.94	0.94
P>F-Stat	0.00	0.00	0.00	0.00	0.00	0.00
Hansen J (P-Value)	na	0.47	na	0.29	na	0.72
Kleibergen-Paap (χ)	na	93	na	54	na	46
Endogeneity (P-Value)	na	0.000	na	0.003	na	0.004
Convergence Rate (%)	diverge	4.7	0.6	6.8	diverge	3.3
Half Life Years	diverge	15	115	10	diverge	21

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1;
//The instrumeted variables are lag of income gap and Gross Domestic Investment
//For Hansen J Test of Overidentifying Restrictions: H_0: Model instruments are valid
//For Kleibergen-Paap Underidentification Test: H_0: Equation is Underidentified
//Endogeneity Test: H_0: The specified endogenous regressors are exogenous
//na not reported by the xtivreg2 command from which diagnostics are obtained
//The number of countries correspond to the number in each category as classified under the descriptive analysis

Table C2: Convergence of Incomes on South Africa's Income (Annual Data)

	SADC		*High FDI Countries*		*Low FDI Countries*	
VARIABLES	RE	FE	RE	FE	RE	FE
Lag Income Gap to S.A	1.000***	0.946***	0.991***	0.932***	1.004***	0.965***
	(0.004)	(0.010)	(0.005)	(0.011)	(0.008)	(0.019)
Constant	0.008	-0.086***	0.013	-0.057***	0.005	-0.092**
	(0.008)	(0.018)	(0.008)	(0.014)	(0.021)	(0.046)
Observations	420	420	180	180	210	210
No. of Countries	14	14	6	6	7	7
R-squared	0.96	0.96	0.98	0.98	0.94	0.94
P>F-Stat	0.00	0.00	0.00	0.00	0.00	0.00
Hansen J (P-Value)	na	0.85	na	0.93	na	0.71
Kleibergen-Paap (χ)	na	100	na	56	na	44
Endogeneity (P-Value)	na	0.001	na	0.01	na	0.01
Convergence Rate (%)	diverge	5.7	1.0	7.3	diverge	3.6
Half Life Years	diverge	12	76	10	diverge	19

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1;
//The instrumeted variables are lag of income gap and Gross Domestic Investment
//For Hansen J Test of Overidentifying Restrictions: H_0: Model instruments are valid
//For Kleibergen-Paap Underidentification Test: H_0: Equation is Underidentified
//Endogeneity Test: H_0: The specified endogenous regressors are exogenous
//na not reported by the xtivreg2 command from which diagnostics are obtained