Bilateral Foreign Direct Investment from South Africa and Income Convergence in the Southern African Development Community

Paul J Dunne
SALDRU, University of Cape Town
john.dunne@uct.ac.za

Nicholas Masiyandima[1]
School of Economics, University of Cape Town
nicholas.masiyandima@uct.ac.za / nicmas773@gmail.com

The study is devoted to investigating the productivity and income convergence implications of bilateral FDI between South Africa as the leading source country of FDI and technology in the SADC and the rest of countries in the region. 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 on alternative potential sources of technology and productivity growth, including trade, FDI from the rest of the world and domestic capital formation. This implies that there are prospects of technology and income convergence in the SADC region driven by South Africa as the regional economic leader.

Keywords: Growth; development; technology; spillovers; productivity; FDI; SADC
JEL classification: O33

[1] *Corresponding Author*

1.0 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.

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, 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[2] 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 2 reviews the literature on income convergence; 3 presents the leader follower theoretical framework of international technology diffusion and convergence while section 4 presents the study's empirical methods. Sections 5 and 6 present and discuss the estimated convergence results, respectively while section 7 concludes the study.

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

2.0 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[3]. 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[4]. 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

[3] 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.

[4] 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 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[5]:

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

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-

[5] 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.

Martin (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-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, 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) 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.

3.0 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).

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:

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

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.

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

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

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 $\left(\frac{Y_{i,t}}{Y_{sa,t}}\right)$[6]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

[6] 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.

convergence rates where, as in Ben-David (1996)[7], 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 (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:

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

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).

4.0 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

[7] 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 $z=\ln(0.5)/\ln(\varphi)$. When φ >1, z is the number of years to double the income disparity

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 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 1 and 2 summarize the variables used in the study and their correlations, respectively.

Table 1: 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 2: 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

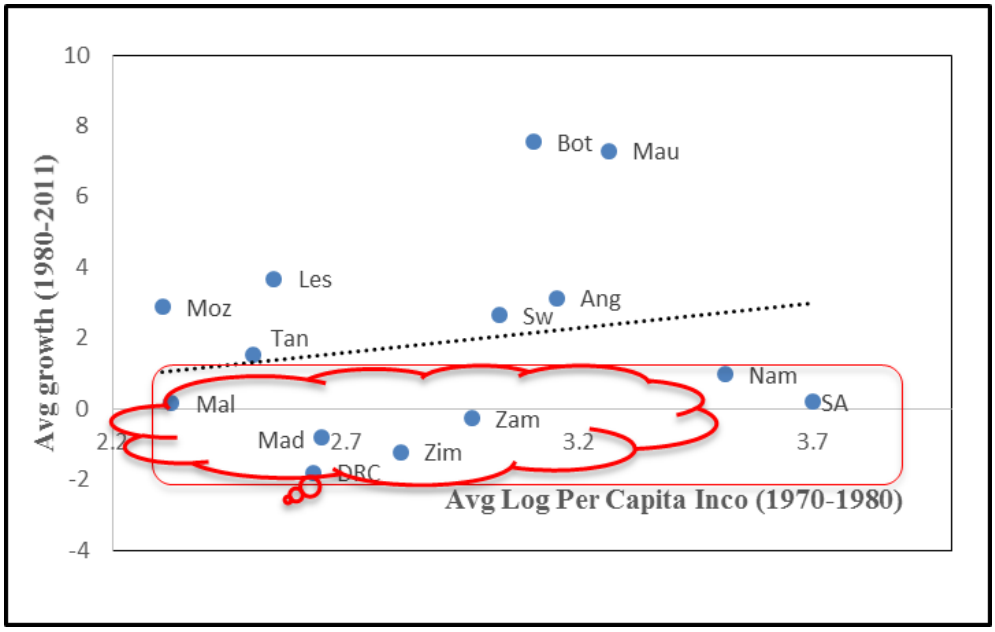
Source: UNCTAD (2014) and WDI (2014)

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.

5.0 Descriptive Estimation and Analysis of Income Convergence

A descriptive analysis of income convergence pattern in SADC is summarized by figure 1, 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.

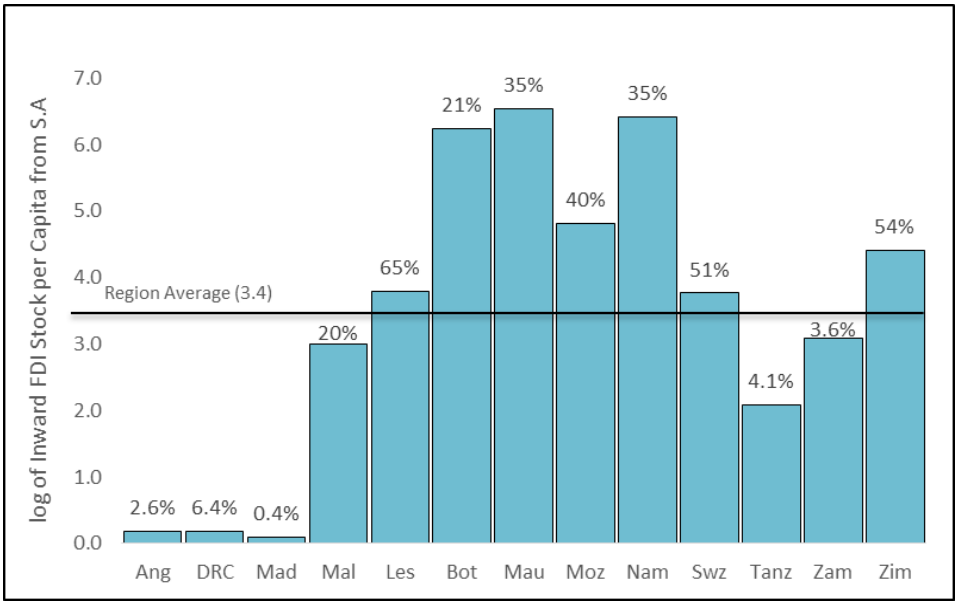
Figure 1: Income per Capita Convergence in SADC



Data Source: WDI (2014)

To link the convergence pattern in figure 1 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 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 2, 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 2: Countries' FDI Stocks per Capita from South Africa

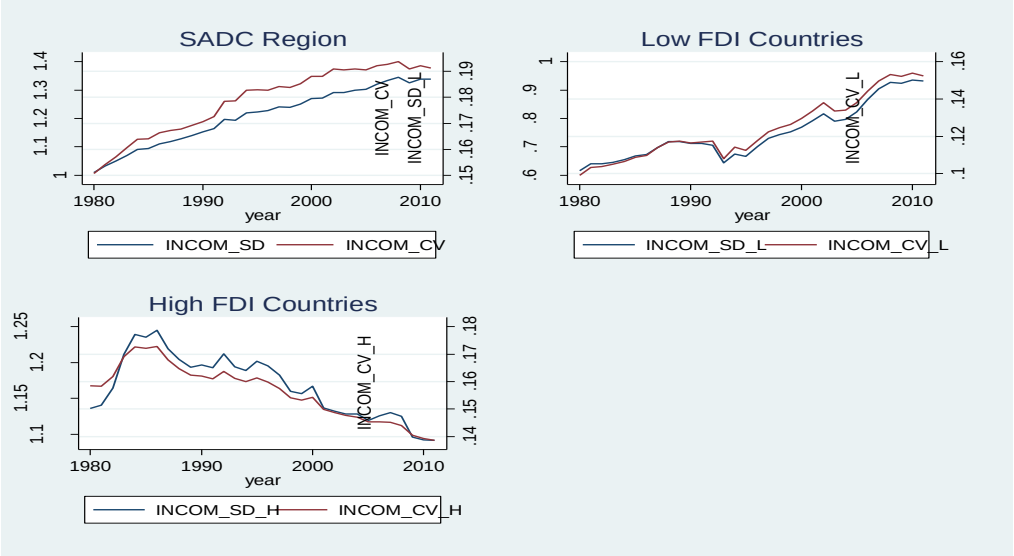


Data Source: UNCTAD (2014)

From figure 2, 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 3, 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 3: Income per Capita Dispersion in SADC



Data Source: WDI (World Bank, 2014)

As suggested by figure 2, figure 3 confirms the non-existence of income convergence for SADC suggested in figure 2, 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.

A quantitative sense of the extent of the income variability portrayed in figure 3 is obtained from table 4, 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 3: 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 3 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 faster than others. The last column of table 4 has negative percentage changes for countries that converged on South Africa and positive percent changes for countries that diverged away.

Table 4: 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 4 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.

6.0 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 5 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:

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

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 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 5: 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 5 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)[8] or an indication of entrenched 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 5 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

[8] 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.

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 5 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 6 confirm this.

Table 6: 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 instrumeted 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

A comparison of the random effects results in tables 5 and 6, 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 6 compared to 1.5% in table 5 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 6

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 5 and 6 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.

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:

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

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 7. The final model incorporating variables that are significant in the stepwise regressions only is presented in column 7.

Table 7: 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

In table 7, 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 7, 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.

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:

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

(9)

With pairwise income convergence on South Arica confirmed when individual countries' income deviations from South Africa's per capita income (χ) 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 8, with countries classified either as high or low FDI countries.

Table 8: 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 8 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 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 8, 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.

7.0 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.

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.

References

Abel J R, et al (2011) *Productivity and the Density of Human Capital*, Federal Reserve Bank of New York Staff Reports no. 440

Abramovitz M (1986), *Catching Up, Forging Ahead, and Falling Behind*, Journal of Economic History, June

African Economic Outlook (2013), http://www.africaneconomicoutlook.org

AfDB (2011), *Southern Africa Regional Integration Strategy Paper 2011-2015,*

Aghion P and Howitt P (2004), *Growth with Quality-Improving Innovations: An Integrated Framework*; in Aghion P and Durlauf S (ed), Handbook of Economic Growth; ELSEVIER

Aghion P et al (2013), *What Do We Learn From Schumpeterian Growth Theory?*. 2013

Ackerberg D A, et al (2006), *Econometric Tools for Analyzing Market Outcomes in* Handbook of Econometrics, vol. 6, ed by J J Heckman and E E. Leamer. Amsterdam: Elsevier, 4171–4276.

Aitken B. J and A.E Harrison (1999), *Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela,* American Economic Review, Vol.89, No.3

Ajayi S I (2006), *FDI and Economic Development in Africa,* ADB/AERC International Conference on Accelerating Africa's Development Five years into the Twenty-First Century, Tunis, Tunisia November 22-24

Akamatsu K (1961). *A Theory of Unbalanced Growth In The World Economy*, Review of World Economics, 86:3.25

Alfaro L, et al (2009), *FDI, Productivity and Financial Development*, The World Economy

Alfaro L, et al (2004), *FDI and Economic Growth: The Role of Local Financial Markets*, Journal of International Economics, 64, 113–34.

Alfaro L, (2006), *How Does Foreign Direct Investment Promote Economic Growth? Exploring the Effects of Financial Markets on Linkages*, NBER Working Paper 12522.

Alfaro L and A Charlton (2007), *Growth and the Quality of Foreign Direct Investment: Is All FDI Equal?* Harvard Business School Working Paper 07-072.

Ang J B and J B Madsen (2011), *Can Second-Generation Endogenous Growth Models Explain Productivity Trends and Knowledge Production In the Asian Miracle Economies*? Review of Economics and Statistics,

Anyanwu J C (2012), *Why Does Foreign Direct Investment Go Where It Goes?: New Evidence From African Countries*, Annals Of Economics And Finance 13-2, 425{462 (2012)

Arellano M and Bond S (1991), *Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations*, Review of Economic Studies, 58(2), Arellano M and Bover O (1995), *Another look at the instrumental variable estimation of error-component models,* Journal of Econometrics, 68(1), 29-51.

Asiedu E (2004), *The Determinants of Employment of Affiliates of US Multinational Enterprises in Africa*, Development Policy Review 22 (4): 371-379.

Azman-Saini, et al (2010), *FDI and economic growth: New evidence on the role of financial markets.* Economics Letters, 107(2), 211-213.

Azariadis C and A Drazen (1990), Threshold Externalities in Economic Development, Quarterly Journal of Economics

Aw, et al (2001), *Firm-Level Evidence on Productivity Differentials and Turnover in Taiwanese Manufacturing*, Journal of Development Economics, 66:1, pp51-86

Baily M. N, et al (1992), *The Distribution of Productivity in Manufacturing Plants*, Brookings Papers: Microeconomics, Washington, D.C

Bairoch P (1993), *Economics and World History: Myths and Paradoxes*. Chicago University Press.

Balasubramanayam V N, et al 1996), *Foreign Direct Investment and Growth in EP and IS Countries*, Economic Journal, 106, 92–105.

Baldwin R, et al (1999*), Multinationals, endogenous growth and technological spillovers: theory and evidence*, CEPR Discussion Paper, 2155.

Baldwin R E and R. Forslid (2000), *The Core-Periphery Model and Endogenous Growth*, Economica 67, pp 307-324

Baltagi B H (2005), *Econometric Analysis of Panel Data*, 3rd edition, John Wiley & Sons, New York.

Botirjan Baltabaev (2014) *Foreign Direct Investment and Total Factor Productivity Growth: New Macro-Evidence,* The World Economy, Wiley Blackwell, vol. 37(2), pages 311-334, 02.

Banerjee, et al (2005), *Growth Theory Through the Lens of Development Economics*, in Handbook of Economic Growth, Vol 1A, P Aghion and S S Durlauf, eds.

Bartelsman E J and P J Dhrymes (1998), *Productivity Dynamics: U.S. Manufacturing Plants 1972-1986*, Journal of Productivity Analysis: 9:1 pp. 5-34

Bartelsman E, et al (2009), Measuring and Analyzing Cross-Country Differences in Firm Dynamics, in Producer Dynamics: New Evidence from Micro Data, by Dunne, T et al (eds), pp 15-76; University of Chicago

Bartelsman E, et al (2013), *Cross-Country Differences in Productivity: The Role of Allocation and Selection*, AER, 103:1, pp 305-334

Barro R J (1991), *Economic Growth in a Cross Section of Countries*, Quarterly Journal of Economics, Vol 106

Barro J R (2012), *Convergence and Modernization Revisited*, NBER working Paper 18295

Barro R J and X Sala i Martin (1991), *Convergence Across Regions and States*, Brookings Papers on Economic Activity, No.1

Barro R J and X Sala i Martin (1992), *Convergence*, Journal of Political Economy, April

Barro R J and X Sala i Martin (2004), *Diffusion of Technology* in Barro R J and X Sala-i-Martin, eds., *Economic Growth*. Massachusetts Institute of Technology

Barro, Robert J and X Sala-i-Martin (1997), *Technological Diffusion, Convergence, and Growth*, Journal of Economic Growth, Springer vol. 2(1)

Barro R and Lee J W (2010), *A New Data Set of Educational Attainment in the World, 1950-2010,* NBER Working Paper No. 15902.

Baumol W J (1986), *Productivity Growth, Convergence, and Welfare: What the Long-run Data Show*, American Economic Review, 76:5

Baum F C et al (2007), *Enhanced routines for instrumental variables/generalized method of moments estimation and testing*, in Newton N J and Cox H J (ed), The Stata Journal:7:4, 465–506

Becker S. O and Ichino A. (2002), *Estimation of Average Treatment Effects Based on Propensity Scores, Stata Journal*, 2, 358–377.

Ben-David (1993), *Equalizing Exchange: Trade Liberalization and Income Convergence*, Quarterly Journal of Economics, Vol 108

Ben-David D (1996), *Trade and convergence among countries*, Journal of International Economics, May

Bende-Nabende A, et al (2003), *The interaction between FDI, output and the spillover variables: Co-integration and VAR analyses for APEC, 1965–99*, Applied Economics Letters, 10 (3) (2003), pp. 165–172

Bengoa M and B Sanchez-Robles (2003), *Foreign direct investment, economic freedom and growth: new evidence from Latin America,* European Journal of Political Economy, Elsevier, vol. 19(3), pages 529-545, September.

Bernard A B and S N Durlauf (1995); *Convergence in International Output*; Journal of Applied Econometrics Vol 10:2

Bernard A and S Durlauf (1996) Interpreting Tests of the Convergence Hypothesis, Journal of Econometrics, 71

Bernard A B and C I Jones (1996), *Productivity Across Industries and Countries: Time Series Theory and Evidence*, The Review of Economics and Statistics; 78:1

Bernard A B and C I Jones (1996), *Technology and Convergence*, The Economic Journal, (July)

Bertinelli L and D Black (2004), *Urbanization and growth*. Journal of Urban, Economics 56 (1), 80–96.

Bijsterbosch M and M Kolasa (2009), *FDI and Productivity Convergence in Central and Eastern Europe: An Industry-level Investigation*. ECB Working Paper No.992

Bloom D E, et al (2002), *Technological Diffusion, Conditional Convergence, and Economic Growth*, NBER Working Paper No.8713.

Blomström M and E Wolff (1994), *Multinational corporations and productivity convergence in Mexico* in Baumol W, et al (eds.), *Convergence of Productivity: Cross-national Studies and Historical Evidence*. Oxford; Oxford University Press.

Borensztein E J, et al (1998), *How does Foreign Direct Investment Affect Economic Growth*, Journal of International Economics:45: 115-135

Blomström M and A Kokko (1998), *Multinational Corporations and Spillovers*, Journal of Economic Surveys, 12, 247–77.

Blomström M and A Kokko (2003), *The Economics of Foreign Direct Investment Incentives,* NBER Working Paper 9489.

Bond S, et al (2010), *Capital accumulation and growth: a new look at the empirical evidence*, Journal of Applied Econometrics, John Wiley & Sons, Ltd., vol. 25(7), pages 1073-1099,

Brülhart, M and F Sbergami(2009), *Agglomeration and growth: Cross-country evidence*, Journal of Urban Economics, 65; 48-63

Burgess R (2009), *The Southern African Development Community's Macroeconomic Convergence Program*: Initial Performance, IMF Staff Position, SPN/09/14

Chen Y. (2007), *Impact of Foreign Direct Investment on Regional Innovation Capability: A Case of China*; Journal of Data Science 5(2007), pp577-596

Canales-Kriljenko J I, et al (2013), *Inward and Outward Spillovers in the SACU Area*, IMF worling Paper, WP/13/31

Cass D (1965), *Optimum Growth in an Aggregative Model of Capital Accumulation*, Review of Economic Studies 32 (3).

Caselli, F (2005), *Accounting for Income Differences Across Countries*, in Handbook of Economic Growth, Vol 1A, P Aghion and S S Durlauf, eds.

Caves, R.E. (1971), *International Corporations: The Industrial Economics of Foreign Investment*, Economica, Vol. 38, pp. 1-27.

Caves, R.E. (1974), *Multinational Firms, Competition and Productivity in Host-Country Markets*, Economica, Vol. 41, pp. 176-193

Carkovic M. and Levine R (2005), *Does Foreign Direct Investment Accelerate Economic Growth?* in Blomström M, et al (eds.), *Does Foreign Direct Investment Promote Development?*, Washington, DC: Institute for International Economics, pp. 195-220

Caselli F (2005), *Accounting for Cross-Country Income Differences* in Handbook of Economic Growth, Volume 1A, Phillipe Aghion and Steven N. Durlauf (eds.), Amsterdam: Elsevier, 679-741.

Carlino G A, et al (2007), *Urban Density and the Rate of Invention*, Journal of Urban Economics, Vol. 61, No. 3, pp. 389-419

Carliano G A and R Voith (1992), *Accounting for Differences in Aggregate State Productivity*, Regional Science and Urban Economies, Nov, 22(4)

Carmignani F. (2006), *The road to regional integration in Africa: Macroeconomic convergence and performance in COMESA*, Journal of African Economies, 15(2), June.

Caves, R E. (1974), *Multinational Firms, Competition, and Productivity in Host-Country Markets*. *Economica*. Vol. 41. pp. 176-193.

Ciccone A and Hall R E (1996), Productivity and the Density of Economic Activity, American Economic Review, 03-1996

Citigroup Global Markets (2011), *Global Growth Generators: Moving Beyond Emerging Markets and BRIC*, Global Economics Views

Charles A et al (2009), *Does the real GDP per capita convergence hold in the Common Market for Eastern and Southern Africa*?, Laboratoire d'Economie et de Management Nantes-Atlantique Université de Nantes, Working Paper

Chinn M D and H Ito (2013), *The Chinn-Ito Index*, Chinn-Ito_Website, Downloaded 25/02/2015

Choi C (2004), *Foreign Direct Investment and Income Convergence*, Applied Economics, 36,

Chen Y et al (2011), Labor Market Density and Increasing Returns to Scale: How Strong is the Evidence?

Chen Y (2007), *Impact of Foreign Direct Investment on Regional Innovation Capability: A Case of China*; Journal of Data Science 5(2007), pp577-596

Corden, W. M. (1967), *Protection and Foreign Investment*, Economic Record, Vol. 43, pp. 209- 232.

Combes P P, et al (2011), *The identification of agglomeration economies,* Journal of Economic Geography 11 pp. 253–266

Comin D A et al (2012), *The Spatial Diffusion of Technology*, NBER Working Papers 18534, National Bureau of Economic Research, Inc.

Contessi S and A Weinberger (2009), *Foreign Direct Investment, Productivity, and Country Growth: An Overview*; Federal Reserve Bank of St. Louis Review, March/April 2009, 91(2), pp. 61-78.

CZI (2009), *Confederation of Zimbabwe Industries Manufacturing Sector Survey*, Harare
Dang D A (2013), *How foreign direct investment promote institutional quality: Evidence from Vietnam*, Journal of Comparative Economics, Elsevier, vol. 41(4), pages 1054-1072.

Davidson R and J G MacKinnon (1993), *Estimation and Inference in Econometrics*. 2d ed. New York: Oxford University Press

De Gregorio J and P E Guidotti (1995), *Financial Development and Economic Growth*, World Development, 23:3, 433–448

De Long J B and L H Summers (1992), *Equipment Investment and Economic Growth: How Strong is the Nexus?,* Brookings Papers on Economic Activity, 2

De Long J B (1988), *Productivity Growth, Convergence and Welfare: Comment*, American Economic Review 78

De Mello LR Jr (1999), *Foreign Direct Investment-led Growth: Evidence from Time Series and Panel Data*, Oxford Economic Papers, 51

De Propris L and Driffield N (2006), *The importance of clusters for spillovers from foreign direct investment and technology sourcing*, Cambridge Journal of Economics, Oxford University Press, vol. 30(2), pages 277-291, March.

Dunning J H (2000), *The eclectic paradigm as an envelope for economic and business theories of MNE activity,* International Business Review 9 (2000) 163–190

Durham K B (2004), *Absorptive Capacity and the Effects of Foreign Direct Investment and Equity Foreign Portfolio Investment on Economic Growth*, European Economic Review: 48

Driffield N et al (2010), *The multinational enterprise as a source of international knowledge flows: direct evidence from Italy*. Journal of International Business Studies, 41: 350–359.

Driffield N L and Munday M C (2000), *Industrial Performance, Agglomeration, and Foreign Manufacturing Investment in the UK*. Journal of International Business Studies, 31: 21–37

Durlauf S N and D T Quah (1998), *The New Empirics of Economic Growth*, NBER, working paper No. 6422, 1998

Durlauf S N, et al (2008), *Are Any Growth Theories Robust*, The Economic Journal, 118:527

Durlauf S N (2003), *The Convergence Hypothesis After 10 Years*, University of Wisconsin at Madison

Durlauf S and P Johnson (1995), *Multiple Regimes and Cross-Country Growth Behaviour*, Journal of Apllied Econometrics, 10

Eaton J and S Kortum (1997), *Engines of Growth: Domestic and Foreign Sources of Innovation*, Japan and the World Economy, 9

Eaton J and S Kortum (1999), *International Technology Diffusion: Theory and Measuremen*t, International Economic Review, 40, 537-570.

Ellyne M and E Letete (2012), *Study on exchange control liberalisation in SADC and its implication on the Free Trade Area in the SADC region,* SADC Study paper

Edwards L (2002), *A Firm Level Analysis of Trade, Technology and Employment in South Africa,* TIPS

Ehrlich I, et al (1994), *Productivity Growth and Firm Ownership: An Analytical and Empirical Investigation*, Journal of Political Economy, Vol. 102, No. 5 (Oct., 1994), pp. 1006-1038

Ellison G. et al (2010), *What Causes Industry Agglomeration? Evidence from Coagglomeration Patterns*, American Economic Review 100(3), 1195-1213.

World Bank Enterprise Surveys (http://www.enterprisesurveys.org), The World Bank.

Fedderke, J W and A T Romm (2006), Growth Impact of Foreign Direct Investment into South Africa, 1956-2003, Economic Modelling, 23 (5), pp. 738-60

Findly R (1978), *Relative backwardness, direct foreign investment, and the transfer of technology: a simple dynamic model*, Quarterly Journal of Economics 92, 1–16.

Fosfuri A, et al (2002), *Foreign Direct Investment and Spillovers Through Workers' Mobility*, Journal of International Economics 53, 205–222.

Foster L, et al (2008), *Reallocation, Firm Turnover, and Efficiency: Selection on Productivity or Profitability*? AER, 98:1 pp 394-425

Friedman J (1986), *The World City Hypothesis*, Development and Change, Vol 17

Fujita M P, et al (1999), *The spatial economy: cities, regions, and international trade*, Cambridge, MA: MIT Press

Gandhi A, et al (2012), *On the Identification of Production Functions: How Heterogeneous is Productivity?* Carlo Alberto NoteBooks, working Paper No. 288 December 2012

Germidis D (1977), *Transfer of Technology by Multinational Corporations*, Development Center of the OECD, Paris.

Gerschenkron A (1952), *Economic Backwardness in Historical Perspective*, in Hoselitz B. F (ed), *The Progress of Underdeveloped areas*, University of Chicago

Glaeser E and J Gottlieb (2009), *The wealth of cities: agglomeration economies and spatial equilibrium in the United States*, Journal of Economic Literature 47(4), 983-1028.

Glaeser E L(1999), *Learning in Cities*, Journal of Urban Economics, 46(2)

Glaeser E L. et al (2010), *The Complementarity Between Cities and Skills*, Journal of Regional Science, Vol. 50, No.1, pp. 221-244.

Glass A and K Saggi (1998), *International Technology Transfer and Technology Gap*, Journal of Development Economics 55, 369–398.

Globerman S (1979), *Foreign Direct Investment and 'Spillover' Efficiency Benefits in Canadian Manufacturing Industries*, Canadian Journal of Economics, February 1979, 12(1), pp. 42–56.

Government of Zimbabwe, *National Budget Statement*, March 2009

Greasley D and L Oxley (1997), Time *Series Based Tests of the Convergence Hypothesis: Some Positive Results*, Economics Letters,

Griliches Z and J Mairesse (1998), *Production Functions: The Search for Identification*, in *Econometrics and Economic Theory in the Twentieth Century*: The Ragnar Frisch Centennial Symposium. New York: Cambridge University Press, 169–203

Grossman, G.M., and E. Helpman (1991). *Innovation and Growth in the Global Economy*, Cambridge MA: MIT Press

Grossman G M and E Helpman (1994), *Endogenous Innovation in the Theory of Growth*, Journal of Economic Perspectives, 8

Haddad, M and Harrison, A E (1993), *Are There Positive Spillovers from Direct Foreign Investment? Evidence from Panel Data for Morocco*, Journal of Development Economics, October 1993, 42(1), pp. 51–74

Hall R E and C I Jones (1999), *Why Do Some Countries Produce So Much More Output Per Worker Than Others*? Quarterly Journal of Economics, Vol. 114, No. 1, pp. 83-116

Handcock, M S and M Morris (1999), *Relative Distribution Methods in the Social Sciences*. New York: Springer.

Haskel J E et al (2002), *Does Inward Foreign Direct Investment Boost the Productivity of Domestic Firms?* National Bureau of Economic Research (Cambridge, MA) Working Paper No. 8724,

Heckman J. J. (1997), *Instrumental Variables: A Study of Implicit Behavioural Assumptions Used in Making Program Evaluations*, Journal of Human Resources, 32, 441–462.

Heckman J. J et al (1997), *Matching as an Econometric Evaluation Estimator: Evidence From Evaluating a Job Training Programme*, Review of Economic Studies, 64, 605–654.

Heckman J. J (1998), *Characterizing Selection Bias Using Experimental Data, Econometrica*, Volume 66, 1017–1098.

Holland P. (1986), *Statistics and Causal Reasoning*, Journal of the American Statistical Association, Vol 81, 945–960.

Helpman E et al (2004), *Export versus FDI with heterogeneous firms*, The American Economic Review 94, 300-16

Helpman E (1995), *International R&D Spillovers*, European Economic Review, 39

Helpman E, et al (1997), *North-South R&D Spillovers*, The Economic Journal, 107

Henderson, V J (1986), *Urbanization in a developing country: City size and population composition*, Journal of Development Economics, Elsevier, vol. 22(2), pages 269-293.

Henderson J V(2003), *Urbanization and Economic Development*, ANNALS of Economics and Finance 4: 275-341

Henderson J V (2000). *The Effects of Urban Concentration on Economic Growth*, NBER Working Papers 7503, National Bureau of Economic Research, Inc

Hohenberg P M. (2004) *The historical geography of European cities: An interpretative essay*. in: Henderson, J. Vernon, Thisse, Jacques-François (Eds.), Handbook of Regional and Urban Economics, vol. 4: Cities and Geography. Elsevier, North-Holland.

Hove S, et al (2011). *Do Monetary, Fiscal and Financial Institutions Really Matter for Inflation Targeting in Emerging Market Economies*, ERSA Working Paper Series: 247

Hsieh C T and P J Klenov (2009) *Misallocation and Manufacturing TFP in China and India*, Quarterly Journal of Economics, CXXIV:4

Hurwicz L (1950), *Least Squares in Time Series*, in Koopmans T C (ed), *Statistical Inference in Dynamic Economic Models*, Wiley, NY

IMF (1993), *Balance of Payments Manual*. 5th Edition, Washington D.C.: IMF

Im K S, et al (2003), *Testing for unit roots in heterogeneous panels*. Journal of Econometrics, 115(1-2), 53-74

Inklaar R and M P Timmer (2013), *Capital and TFP in PWT8.0*, www.ggdc.net/pwt.

Islam N (1995), *Growth Empirics: A Panel Data Approach*, Quarterly Journal of Economics, 110:4, 127-1170

Jacobs J (1969), *The Economy of Cities*, Vintage Books, New York

Javorcik B S (2004), Does Foreign Direct Investment Increase the Productivity of Domestic Firms? American Economic Review

Jaffe A. B, et al (1993), *Geographic Localization of Knowledge Spillovers As Evidenced by Patent Citations*, Quarterly Journal of Economics 108: 577-598

Jones, B. (2002), Economic *Integration and Convergence of Per Capita Income in West Africa*, African Development Review, 14

Jones and Romer (2010) *The New Kaldor Facts: Ideas, Institutions, Population, and Human Capital*, American Economic Journal: Macroeconomics, 2:1, 224–245

Kasahara S (2004), *The Flying Geese Paradigm: A Critical Study of Its Application To East Asian Regional Development*, UNCTAD, No. 169

Keller W and S R Yeaple (2009), *Multinational Enterprises, International Trade and Productivity Growth: Firm Level Evidence from the United States*, The Review of Economics and Statistics 91 (4):821–831

Keller W (2002), *Geographic Localization of International Technology Diffusion*, American Economic Review, Vol 92:1

Keller W (2004), *International Technology Diffusion*, Journal of Economic Literature, Vol XLII (September)

Kemeny T (2009), *Are International Technology Gaps Growing or Shrinking in the age of Globalization*, Journal of Economic Geography, 11

Klenow P J and A Rodriguez-Clare (2005), *Externalities and Economic Growth*, in Aghion A P and S Durlauf (eds), *Handbook of Economic Growth*, Vol. 1. Amsterdam: Elsevier,

Kojima K (2000), *The Flying Geese Model Of Asian Economic Development: Origin, Theoretical Extensions, And Regional Policy Implication*, Journal of Asian Economics, 11(4):375.401, Autumn.

Kokko A. (1994), *Technology, Market Characteristics, and Spillovers*, Journal of Development Economics, Vol.43, No.2, pp.279-93

Koopmans T. C. (1965), *On the Concept of Optimal Economic Growth*, The Economic Approach to Development Planning. Chicago: Rand McNally. pp. 225–287

Krugman P (1991), *Increasing Returns and Economic Geography*, Journal of Political conomy 99, 483-499.

Krugman P (2014), *The Unresolved Crisis*, Finance and Development, IMF Publication

Kumo W L (2011), Growth and macroeconomic convergence in Southern Africa, African Development Bank, Series 130,

Lall S V and S Yilmaz (2001), *Regional Economic Convergence: Do Policy Instruments Make a Difference*?, The Annals of Regional Science, 35

Larrain F and J Tavares (2004), *Does foreign direct investment decrease corruption?* Cuadernos de Economica, 41 (Agosto) (2004), pp. 217–230

Lensink R and O Morrissey (2006), *Foreign Direct Investment: Flows, Volatility, and the Impact on Growth*, Review of International Economics, Vol 14

Li X and Liu X (2005), *Foreign Direct Investment and Economic Growth: An Increasingly Endogenous Relationship*, World Development, Vol 33

Robert E L (2002), *Home and Host Country Effects of FDI*, NBER Working Papers 9293, National Bureau of Economic Research, Inc.

Liu Z (2008), *Foreign direct investment and technology spillovers: Theory and evidence*, Journal of Development Economics 85 (2008) 176–193

Liu Z (2013), Human Capital Externalities in Cities: Evidence from Chinese Manufacturing Firms, Journal of Economic Geography, August 2013
Lucas R (1988), *The mechanics of economic development*, Journal of Monetary Economics 22, 3-42.

Lucas R Jr. (1988), *On the Mechanics of Economic Development*, Journal of Monetary Economics, Vol. 22: 1, July.

Maddala G and S Wu (1999), *A comparative study of unit root tests with panel data and a new simple test*, Oxford Bulletin of Economics and Statistics, 61(Suppl. 4), 631-652.

Mankiw N G, et al (1992), *A Contribution to the Empirics of Economic Growth*, NBER Working Paper No.3541.

Markusen J R and Venables A J (1999), *Foreign direct investment as a catalyst for industrial development*, European Economic Review, Elsevier, vol. 43(2), pages 335-356, February.

Mansfield E. M (1961), *Technical Change and the Rate of Imitation*, Econometrica, XXIX (Oct. 1961), 741-66.

McCoskey S.K. (2002), *Convergence in Sub-Saharan Africa: A nonstationary panel data approach*, Applied Economics, 34, 819-829.

Marshall A (1920), Principles of Economics, New York: Macmillan.

Macdougall, G.D.A. (1960), *The Benefits and Costs of Private Investment from Abroad: A Theoretical Approach*, Economic Record, Vol. 36, pp. 13-35.

Martin P and G I P Ottaviano (2001), *Growth and Agglomeration*, International Economic Review, Department of Economics, University of Pennsylvania and Osaka University Institute of Social and Economic Research Association, vol. 42(4), pages 947-68, November

Manghinello S, et al (2010), *Industrial districts, inward foreign investment and regional development*, Journal of Economic Geography, 10 (2010) pp. 539–558

Moran T (2001), *Parental Supervision: The New Paradigm for Foreign Direct Investment and Development*, Washington DC: Institute for International Economics

Nadiri M I and S Kim (1996), *International R&D Spillovers, Trade and Productivity in Major OECD Countries*, NBER Working Paper No.5801.

Nelson R R and E S Phelps (1966), *Investment in Humans, Technological Diffusion, and Economic Growth*, American Economic Review, 56

Neto D G and F J Veiga (2013), *Financial globalization, convergence and growth: The role of foreign direct investment*, Journal of International Money and Finance, 37

Olley S. and Pakes A (1996), *The Dynamics of Productivity in the Telecommunications Equipment Industry*, Econometrica 64: 1263-1297

Ospina S and M Schiffbauer (2010), *Competition and Firm Productivity: Evidence from Firm-Level Data*, IMF Worling Paper, WP/10/67

Olofsdotter K, (1998), *Foreign Direct Investment, Country Capabilities and Economic Growth* Weltwitschaftliches Archive, 134 (3) (1998), pp. 534‑547

Overman H and D Puga (2010), *Labor pooling as a source of agglomeration: an empirical investigation*, in E. Glaeser (ed.), *Agglomeration Economics*. Chicago, IL: University of Chicago Press, 133-150.

Overman H G, et al (2001), *The Economic Geography of Trade, Production, and Income: A Survey of Empirics*, Centre for Economic Performance, LSE&PS

Ozawa T (1995), *The Flying Geese Paradigm Of FDI, Economic Development And Shifts In Competitiveness*, UNCTAD

Öz S (2014), *Diffusion of Technology: Convergence Implications of FDI*, Koç University-Tüsiad Economic Research Forum, Working Paper Series, WP1407

Persaran M H (2007), *A pair-wise approach to testing for output and growth convergence*, Journal of Econometrics, Volume 138, Issue 1, May 2007

Potterie B P and F Lichtenberg (2000), *Does Foreign Direct Investment Transfer Technology Across Borders*, Review of Economics and Statistics

Psacharopoulos G (1994), *Returns to Investment in Education: A Global Update*, World development vol. 22 no. 9 pp 1325-43

Quah D T (1993), *Galton's Fallacy and Tests of the Convergence Hypothesis*, Scandinavian Journal of Economics, vol. 95(4), December

Quah D T (1993), *Empirical cross-section dynamics in economic growth*, European Economic Review, Vol. 37(2-3), April

Quah D T (1996), *Twin Peaks: Growth and Convergence in Models of Distribution Dynamics*, Economic Journal, Royal Economic Society, vol. 106(437), July.

Ramsey F P (1928), *A Mathematical Theory of Saving*, Economic Journal 38 (152).

Rauch, J E (1991), *Productivity Gains From Geographic Concentration of Human Capital: Evidence from the Cities*. Mimeo, University of California, San Diego, 1991

Redding S and A J Venables (2004), *Economic geography and international inequality* Journal of International Economics, Elsevier, vol. 62(1), pages 53-82, January.

Restuccia, et al (2008), *Policy Distortions and Aggregate Productivity with Heterogeneous Plants*, Review of Economic Dynamics, 11, pp 707-720

Rivera-Batiz, et al (1991), *The Effects of Direct Foreign Investment in the Presence of Increasing Returns Due to Specialization*, Journal of Development Economics, November 1991, 34(1-2), pp. 287-307.

Rhee J and T Belot (1989), *Export Catalysts in Low-Income Countries*, World Bank Working Paper

Rodrik D (1999), *The New Global Economy and Developing Countries: Making Openness Work,* Overseas Development Council (Baltimore, MD) Policy Essay No. 24, 1999

Rodrik D (2011), *The Future of Economic Convergence*, NBER Working Paper No. 17400
Rodrik D (2012), *Unconditional Convergence in Manufacturing*, Harvard University

Romer P M (1986), *Increasing Returns and Long-Run Growth*, Journal of Political Economy, Vol. 94, No. 5

Romer P M (1987), *Growth Based on Increasing Returns Due to Specialization*, American Economic Review, 77:2

Romer P M (1990), *Endogenous Technological Change*, Journal of Political Econ, 1990, 98

Romer P M (1994), *The Origins of Endogenous Growth*, Journal of Economic Perspectives, Vol 8: 1, Winter

Romer (2010) *Which Parts Of Globalization Matter For Catch-Up Growth*? NBER, Working Paper 15755

Roodman D (2009) *How to do xtabond2: An introduction to difference and system GMM in Stata,* Stata Journal, StataCorp LP, vol. 9(1), pages 86-136, March

Rosenbaum P and D B Rubin (1983), *The Central Role of the Propensity Score in Observational Studies for Causal Effects*, Biometrika, 70, 41–55

SADC (2002), *Macroeconomic Convergence in SADC – A Policy Perspective for the Central Banks of the Integration Arrangement*, CCBG, January 2002

SADC (2003), *Regional Indicative Strategic Development Plan (RISDP),* SADC Secretariat

SADC (2007), *The Achievement of SADC Macroeconomic Convergence Targets: Assessment of Performance Reviews and Implementation Plans* (SADC Secretariat). http://www.sadc.int/tifi/macroeconomic_policies_convergence

SADC Statistics (2014), www.sadc.org

Samuelson P A (1948), *International Trade and the Equalization of Factor Prices*, Economic Journal 58

Schoors, K and T Bartoldus (2001), *The Productivity Effect of Foreign Ownership on Domestic Firms in Hungary,* Paper presented at the International Atlantic Economic Conference in Philadelphia, PA, October 11–14, 2001

Sghaier I M and Abida Z, (2013), *Foreign Direct Investment, Financial Development and Economic Growth: Empirical Evidence from North African Countries*, Journal of International and Global Economic Studies, 6(1), June 2013, 1-13 1

Smith, J. (2000), *A Critical Survey of Empirical Methods for Evaluating Active Labour Market Policies*, Swiss Journal of Economics and Statistics, 136, 247–268.

Smith J and P Todd (2005), *Does Matching Address Lalonde's Critique of Nonexperimental Estimators*, Journal of Econometrics, 125, 305–353.

Solow R(1988), *Growth Theory and After*, American Economic Review, 78:3

Solow R (2014), *Affluent Economies Stuck in Neutral*, Finance and Development, IMF

Solow R. (1956), *A Contribution to the Theory of Economic Growth,* Quarterly Journal of Economics, Vol 70. No.1

Spence, M (2011), *The Next Convergence: The Future of Economic Growth in a Multispeed World*. New York, NY: Farrar, Straus and Giroux

Storper M and A J Venables (2004), *Buzz: face-to-face contact and the urban economy*. Journal of Economic Geography, 4: 351-70.

Sveikauskas L A (1975), *The Productivity of Cities*, Quarterly Journal of Economics, 89(3)

Swan T W (1956), *Economic Growth and Capital Accumulation*, Economic Record, Vol 32: 2, November

Te Velde D W (2011), *Regional Integration, Growth and Convergence*, Journal of Economic Integration, 26(1), March

UNCTD (2011), *Foreign Direct Investment, the Transfer and Diffusion of Technology, and Sustainable Development*, United Nations Conference on Trade and Development, Feb 2011, Geneva

UNCTAD (2013), http://unctadstat.unctad.org

UNCTAD (2014), http://unctadstat.unctad.org

Walz U (1997), *Innovation, Foreign Direct Investment and Growth*, Economica 64: 63-79

Wang J (1990), *Growth, Technology Transfer and the Long-Run Theory of International Capital Movements,* Journal of International Economics 29, 255–271

Wilhelms S K S (1998), Foreign Direct Investment and Its Determinants in Emerging Economies, African Economic Policy Paper, Discussion Paper Number 9, July 1998

Williamson J G (1965), *Regional Inequality and the Process of National Development*, Economic Development and Cultural Change 13 (4), 3–45

Westerlund J and D Persyn (2008), Error-Correction-Based Cointegration Tests for Panel Data, The Stata Journal, Vol 8 (2)

Woo J (2009), *Productivity Growth And Technological Diffusion Through Foreign Direct Investment*. Economic Inquiry, 47(2), 226-248.

Yasar M and Paul C J M (2008), *Foreign Technology Transfer and Productivity: Evidence from a Matched Sample,* American Statistical Association, JBE Statistics, Vol 26:1

Young A (1992), *A Tale of Two Cities: Factor Accumulation and Technical Change in Hong Kong and Singapore,* NBER Macroeconomics

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