Productivity spillovers from FDI in Sub Saharan Africa. Evidence from a dynamic framework

Sheereen Fauzel (s.fauzel@uom.ac.mu)

Boopen Seetanah (b.seetanah@uom.ac.mu)

RV Sannassee (rvsan@uom.ac.mu)

Abstract

The focus of this paper is in two fold. Firstly it attempts to investigate whether FDI inflows to Sub Saharan African countries generate productivity spillovers for the period 1980-2010. Innovatively, a dynamic vector autoregressive model (PVAR) is used in this instance which ensures that the dynamic behavior of the panel series under consideration is properly captured, while simultaneously catering for endogeneity and causality issues. Any feedback and indirect effects which might be present was also detected within the PVAR. The results show that FDI is an important element in the TFP growth model as evidenced by the positive and significant effect on TFP growth. Results from the analysis also indicated the presence of a bi-directional causality between TFP growth and foreign direct investment. Indeed, although FDI induces a positive impact on TFP growth, openness was also seen to be an important determinant of TFP growth. In addition, the results also show that human capital, openness, TFP growth as well as high technological gap are also crucial determinants of FDI for the sample of countries used. The paper then proceeded to investigate the presence of any FDI spillovers in the manufacturing sector of Mauritius. It addresses the important question of whether foreign direct investment in the manufacturing sector enhances the productivity of the sector in Mauritius over the period 1990-2010. In the presence instance, the short run and long run relationships between total factor productivity for the manufacturing sector, FDI in the sector and other control variables are estimated in the vector error correction model framework. The results show that FDI in the manufacturing sector has indeed contributed to both total factor productivity and labour productivity in the long run. Analysing the short run results, we found that FDI in the manufacturing sector continues to influence productivity albeit the impact being very small. Such a result could mainly be explained by the massive relocation of foreign firms from Mauritius to other cheaper labour destinations. Also, the results confirm the presence of bi-causality and feedback effects in the FDI-Productivity relationship. Moreover, the results show that FDI is positively related to the level of domestic investment suggesting the presence of "crowding in" effect as well.

Keywords: Total Factor Productivity Spillovers, FDI, PVAR, VECM, Causality

1.0 Introduction

Over the past decade, FDI has acquired considerable importance as a tool for the economic development of host countries and for accelerating their growth. As such, inward FDI boosts aggregate investment and the level of economic activity, thereby giving positive signals as to the soundness of the host economy. Besides, FDI has numerous benefits which include employment creation, improved productivity, enhanced exports, technological and knowledge transfers.

The significance of FDI lies in its primary difference from other forms of capital investment. In fact, empirical evidence suggests that FDI flows are relatively less volatile as compared to other capital flows (IMF, World Economic Outlook, 2007). Hence, it entails a longer duration of commitment (Barrell and Holland, 2000). The aim behind FDI is to form pan-commercial relations, while exerting significant managerial control over the foreign firm. Therefore, FDI consists of a combination of capital, technology, managerial skills, market access and entrepreneurship (Dunning, 1993). The numerous benefits derived from FDI have generated much interest among policymakers as regards the potential impact of foreign direct investment and policies which would affect FDI flows. Moreover, evidence suggests that, given specific country prerequisites, FDI indeed results in better growth outcomes (Borensztein, de Gregorio and Lee, 1995; Alfaro, 2003).

Attracting foreign direct flows also ranks high on African countries' agenda in view of the accompanying wide ranging benefits. Nevertheless, over the last few years, with the advent of the global financial crisis, such flows to Africa have been constantly on the decrease with remittances to Sub Saharan African countries also dropping unfortunately. But, FDI is and remains a crucial ingredient which facilitates the flow of capital as a result of which there is broad based growth and an upgrading of human capital and it is still perceived to be one of the most effective tools in the fight against poverty. In addition, it is extensively argued in the literature (Bosworth and Collins, 1999) that the ability to attract foreign capital can offer potentially large benefits for developing countries in terms of growth prospects, employment and technological progress. Out of all forms of capital flows to developing countries, Foreign Direct Investment (FDI) is viewed as the most stable component; owing to the nature and duration of the commitment it involves (Barrell and Holland, 2000).

Unsurprisingly Sub- Saharan African countries have also laid a lot emphasis on devising measures to attract FDI since the latter is often regarded as a source of economic prosperity above all other potential benefits. For instance, Mlachila and Takebe, (2011) highlighted that investment from the emerging powers mainly sought natural resources, but is now increasingly diversifying into agriculture, manufacturing, and service industries (e.g., telecommunications) which thus enhances the potential for technology transfers and increasing productivity, playing an important role for economic growth in non-resource-rich countries.

However, although the literature is fraught with studies analyzing the impact of FDI and technology transfer at the micro level, it could be argued that only few have so far investigated the relationship between FDI inflows and productivity growth at the macro level. In this regards the paper attempts to fill this gap.

As such the paper is in two fold. Firstly, we investigated the extent to which FDI contributes towards total factor productivity in Sub Saharan African countries. Seventeen countries have been selected. Interestingly, a dynamic vector autoregressive model (PVAR) is used. By using this particular model it ensures that the dynamic behaviour of the panel series under consideration is properly captured, while simultaneously catering for endogeneity and causality issues. Any feedback and indirect effects will also be detected within the PVAR.
The second part of the paper explores the impact of FDI on total factor productivity for the manufacturing sector in Mauritius for the period 1980-2010. Contrasting with previous empirical studies, this paper uses a dynamic vector error correction model (VECM) to carry out the analysis.

Given the above, the remaining sections of the paper are structured as follows: Section two pertains to the literature review which in section three the methodologies are being discussed. The econometric analysis and findings are presented in next section. Finally we conclude and some policy implications are also presented.

2.0 Literature Review

FDI has been considered by policy makers as an important contributor to growth through different channels. They upsurge the capital stock and employment, stimulate technological change through technological diffusion and generate technological spillovers for local firms. Since it facilitates the transfer of technology, foreign investment is expected to increase and improve the existing stock of knowledge in the recipient economy through labour training, skill acquisition and diffusion. FDI is also expected to introduce new management practices and more effective organization of the production process. Hence, FDI increases not only the productivity of firms which receive these investments, but potentially on all host-country firms (Rappaport, 2000). In the review of the literature, emphasis is laid on the impact of FDI and technology transfer and the relationship between FDI and economic growth and productivity.

2.1 FDI and technology transfer

Technology transfer by foreign affiliates has been identified as a key factor to boost the economic growth of the host country. Whilst there is a lot of focus on technology transfer in past studies, it is argued by Lall (1996), that knowledge is of paramount importance for competitiveness at both micro and macro level. Host countries, especially developing economies, aim to foster indigenous technological capabilities, that is "skills-technical, managerial and institutional- that allow productive enterprises to utilize equipment and technical information efficiently "[1].It is often argued that the more difficult task is the transfer of more complex capabilities, such as skills to assess available technologies and to select the most suitable ones, or the managerial skills to improve organizational arrangements. Such capabilities are often tacit. Transfers of such knowledge are subjected to various forms of market failure.

[1] Ibid

Also, Hummels and Stern (1994) document that the lion's share of FDI occurs among nations with similar technology and human capital levels. Depending on the economy's actual growth level, technical progress and growth can be based on the creation of entirely new knowledge, or adaptation and transfer of existing foreign technology. Since it is less costly to learn to use existing technology than to generate new technology, developing countries have the potential to grow faster than developed economies for any given level of investment or R&D spending. However, this potential for convergence is conditional upon the economy's level of human capital. More specifically, as discussed by Van den Berg (2001), it is the quality of the labour force, its accumulated experience and human capital, its education system among others that determine an economy's ability to create new ideas and adapt old ones. Consequently, improvements in education and human capital are essential ingredients for absorbing and adapting foreign technology, and to generate sustainable long run growth.

Given the above, it can be safely argued that FDI contributes to economic growth through technology transfer and this is done through various channels. For instance, there may be a direct transfer, that is, by parent companies to their foreign affiliates or indirectly to domestically owned and controlled firms in the recipient country (Blomstrom et al., 2000; UNCTAD, 2000). In this regard, spillovers of advanced technology from foreign owned enterprises to domestically owned enterprises can take various forms:

- through vertical linkages between foreign affiliates and local suppliers and consumers;
- through horizontal linkages between the foreign affiliates and firms in the same industry in the recipient country;
- through turnover of labour from affiliates to domestic firms; and
- Internationalization of R&D (Hanson, 2001; Blomstrom and Kokko, 1998).

As postulated by Carkovic and Levine (2002), the degree to which technological change will occur in the economy as a whole will depend on the innovative and social capabilities of the host country, together with the absorptive capacity of other enterprises in the country.

Another strand of the literature by Jordaan (2012) propounds that FDI firms are more involved than domestic firms in various knowledge transfer activities and activities with a direct positive impact on production processes of the local suppliers. Thus, suppliers of FDI firms are more likely to experience large positive technological improvements. More so, their analysis shows that a large technology gap between FDI and local suppliers fosters rather than hinders this positive impact among local suppliers of material inputs.

Furthermore, spillover effects can also be observed in the labour markets through learning and its impact on the productivity of domestic investment (Sjoholm, 1999). Sjoholm suggests that through technology transfer to their affiliates and technological spillovers to unaffiliated firms in host economy, transnational corporations can speed up development of new intermediate product varieties, raise the quality of the product, facilitate international collaboration on R&D, and introduce new forms of human capital. Das, 1987 and Findlay, 1978 observed that an important feature of early theories of technological diffusion is the assumption of costless transfer of technology from foreign firms to local firms. However, there might be costs associated with transferring technology from parent company to its subsidiary, and learning investment from native firms. In light with this concept, Wang and Blomstrom (1992) argues that the rate and modernity of technology transfer through multinationals is positively related to the learning investment of native firms. This has a very important implication in that unless domestic firms are devoting enough resources and efforts to learn multinational's technology, the latter will be transferring to their subsidiaries outdated technologies at a slower rate.

However, the literature is not only fraught with studies depicting a positive relationship between FDI and technology in that some studies have also commented that foreign investment can have a negative impact on the direct transfer of technology, and thus reduce the spillover from FDI in the host country in several ways. For instance, they can provide their affiliate with less technological capabilities, or even limit access to the technology of the parent company. The transfer of technology can be prevented if it is not consistent with the MNC's profit maximizing objective and if the cost of preventing the transfer is low. Consequently, the production of its affiliates could be restricted to low-level activities and the scope for technical change and technological learning within the affiliate will be reduced. This may be achieved by limiting downstream producers to low value intermediate products, and in some cases "crowding out" local producers to eliminate competition. They may also limit exports to competitors and confine production to the needs of the MNCs. These may ultimately result in a decline in the overall growth rate of the host country and worsened balance of payment situation (Blomstrom and Kokko, 1998).

2.2 FDI, economic growth and productivity

Neoclassical economists argue that FDI influences economic growth by increasing the amount of capital per person. In this regard, Abdulhamid and al (2011) studied the effect of FDI on economic growth in the Sub- Saharan Africa using a panel data 1975-1999 and they concluded that FDI positively influenced economic growth and that domestic investment, trade openness and macroeconomic policies adopted also have a positive effect on growth. In the paper by Bengos and Sanchez-Robles (2003), FDI is evidenced to positively influence economic growth, but recipient countries require minimum human capital, economic stability and liberalized markets in order to benefit from long-term FDI inflows. However, the empirical evidence provided by Bende-Nabende et al. (2002) demonstrated that the direct long-term impact of FDI on output is significant and positive for comparatively economically less advanced Philippines and Thailand, but negative in the more economically advanced Japan and Taiwan. Hence, the level of economic development may not be the main enabling factor in FDI and growth nexus. On the other hand, the endogenous school proponents supports the view that FDI also influences long-run variables such as research and development (R&D) and human capital (Romer, 1986; Lucas, 1988).

In addition, other studies have shown that foreign investment could be beneficial in the short term but that this may not necessarily be the case in the longer term. Durham (2004), for example, could not find a positive relationship between FDI and growth, but instead suggests that the effects of FDI are dependent on the absorptive capability of recipient countries. Obwona (2001) notes in his study of the determinants of FDI and their impact on growth in Uganda that macroeconomic and political stability and policy consistency are important parameters determining the flow of FDI into Uganda and that FDI affects growth positively but

insignificantly. Furthermore, political regime, real income per capita, rate of inflation, world interest rate, credit rating and debt service explain the variance of FDI in Nigeria (Ekpo, 1995).
There is consensus in the literature that FDI increases growth through productivity and efficiency gains by local firms. However, the empirical evidence tend to suggest otherwise. Several papers including Globeram (1979), and Imbriani and Reganeti (1997) have argued that developed countries seem to support the idea that the productivity of domestic firms is positively related to the presence of foreign firms. However, the results for developing countries are mixed at best, with some suggesting positive spillovers (Blomstrom, 1986; Kokko, 1994; Blomstrom and Sjoholm, 1999) whilst others such as Aitken et. al. (1997) and Saqib and al (2013) reporting limited evidence. Alternatively, some studies found no evidence of positive short-run spillover from foreign firms.

Some of the underlying motivations which could explain such mixed results have been provided by Aitken et al, (1999). They argued that the envisaged forward and backward linkages may not necessarily be there and that arguments of foreign affiliates encouraging increased productivity due to competition may not be true in practice. Other reasons also include the fact that foreign firms tend to locate in high productivity industries and, therefore, could force less productive firms to exit (Smarzynska, 2002). In addition, Cobham (2001) also discussed the crowding out of domestic firms which led to a contraction in total industry size and total employment as well. Further, the role of FDI in export promotion remains controversial which depends crucially on the motive for such investment (World Bank, 1998).

As reported by Blomstrom et al. (1994), FDI has a positive effect on economic growth, but this positive effect of FDI is conditional of the threshold level of income. In fact, FDI, to have a favourable effect on economic growth is subject to a minimum threshold level of income. The explanation was that only those countries that have reached a certain income level can absorb new technologies and benefit from technology diffusion, and thus benefit from the extra advantages that FDI can offer. Another strand of the literature specifies human capital as one of the reasons for the mixed evidence of FDI at different levels of income. This is because it takes a well-educated population to understand and spread the benefits of new innovations to the whole economy. Borensztein et al. (1998) also found that the interaction of FDI and human capital had important effect on economic growth, and suggest that the differences in the technological absorptive ability may explain the variation in growth effects of FDI across countries. Their paper also suggests that countries may need a minimum threshold stock of human capital in order to experience positive effects of FDI.

We further observe that, the relationship between FDI and growth is conditional on the macroeconomic dispensation the country in question is passing through. In fact, Zhang (2001) asserts that “the extent to which FDI contributes to growth depends on the economic and social condition or in short, the quality of the environment of the recipient country”. This argument was also put forward by Mustapha et al (2008). In essence, the impact of FDI has on the growth of any economy may be country and period specific, and as such there is the need for country specific studies

Hence, the growth effect of FDI does not win unanimous support. Several problems were identified in previous studies. The problems were mainly in the face of a crowding out effect on domestic investment, external vulnerability and dependence, a possible deterioration of the balance of payments as profits are repatriated, destructive competition of foreign affiliates with domestic firms and "market-stealing effect".

It is thus noted that the review of the literature on the impact of FDI on economic growth is far from being conclusive. As argued by previous studies, the role of FDI is more country specific, and can be positive, negative or insignificant, depending on the economic, institutional and technological conditions in the recipient countries.

3.0 Methodology:

The first part of the study mostly strives towards investigating whether foreign investment contributes in augmenting total factor productivity of the host countries. Referring to earlier studies on FDI and spillovers theory such as Findlay, 1978 and Wang & Blomstrom, 1992, we presume FDI increases the efficiency of firms in host countries. However, the present study is dealing with FDI and spillovers efficiency at the macro level, and therefore we will postulate that increased efficiency will lead to TFP growth.

The Sub Saharan African countries considered in our study are as follows: Angola, Benin, Botswana, Chad, Congo, Ghana, Madagascar, Mozambique, Malawi, Mauritius, Senegal, Nigeria, Seychelles, Togo, Uganda, Zambia, Zimbabwe, and the time period considered is 1980-2010.

PROBLEM DEFINITION

In light of the endogenous growth theories, FDI can affect growth of GDP per capita in the framework of both the neoclassical and endogenous growth theories. The main difference is whether the effect is temporary (as in the transition dynamics of neoclassical models) or permanent (as in the endogenous growth models). The latter can happen if FDI increases TFP through the various spillover effects associated with it.

Therefore, estimating the effect of FDI on total factor productivity (TFP) seems preferable to test whether or not FDI can serve as source of endogenous growth.

MODEL SPECIFICATIONS

Based on the principles of some earlier studies, the following functional form applies to the "productivity spillover model" used in this research:

$$\mathbf{TFP} = \alpha_0 + \beta_1 \mathbf{FDI/GDPxt} + \beta_2 \mathbf{TGxt} + \beta_3 \mathbf{OPNSxt} + \beta_4 \mathbf{HCxt} + \beta_5 \mathbf{INFxt} + \mu_{xt} \text{ ------------(1)}$$

However, because of the variance stabilizing properties of log transformation, the log values of the variables are used. In fact, logged variables yield a more clear-cut interpretation of the coefficients in terms of percentage change.

Converting all the variables in logarithmic terms yields:

$$\mathbf{L\ TFP} = \alpha_0 + \beta_1 \mathbf{LFDI/GDPxt} + \beta_2 \mathbf{L\ TGxt} + \beta_3 \mathbf{LOPNSxt} + \beta_4 \mathbf{LHCxt} + \beta_5 \mathbf{LINFxt}\ \ \mu_{xt\ldots\ldots} \mathbf{(2)}$$

Where LTFP, LFDI/GDP, LTG, LOPNS, LHC, LINF are the logs of total factor productivity growth, foreign direct investment to GDP, human capital, technology gap, openness and inflation respectively. $\beta_1 \ldots \beta_5$ represent the parameter estimates and μ_{xt} is the random disturbance term.

Dependent Variable: TFP Growth

This study employs the new dataset for TFP developed by United Nations Industrial Development Organization (UNIDO)-UNIDO World Productivity dataset. It is noted that most studies use the growth accounting methodology whereby the observed growth rate in GDP is decomposed into the growth of factor inputs and changes in production technologies. This method is used mainly because of the difficulty of measuring the productivity at aggregate country level. The measure of productivity obtained in this manner is what is commonly referred to as Solow-residual (Solow, 1957) since it is the residual after the growth rates of inputs are deducted from the observed growth rate of GDP. However, this exercise suffers from various drawbacks such as problems in measuring labour and capital inputs and the assumption employed with respect to their prices, among others, Barro and Sala-i-Martin (2004).

The World Productivity database of UNIDO developed by Isaksson is developed in a way that overcomes the problems associated with the simple growth accounting methodology (for a complete technical description of the database see Isaksson, 2007). For the purpose of this study, the growth in TFP has been considered.

Independent Variables

1. **Foreign Presence (FDI)**

The degree of foreign presence is measured by the amount of inward FDI for each country in the sample. FDI is calculated by World Bank as the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. Caves (1974) suggest that FDI increases productivity via competition and technology transfer.

Blomstrom (1986) confirms this suggestion using a sample of Mexican manufacturing industries. Thus, the larger the share of foreign ownership, the greater is the potential for spillovers. Consequently, the coefficient of FDI is expected to be positive and significant. The ratio of FDI to GDP is used as a proxy of foreign presence and accounts for country size.

2. Human Capital (HC)

Reasonably, the educational level and skills of workers affect their productivity. Indeed, a higher level of human capital increases the ability of workers to learn and adopt new technologies faster and more efficiently. Schultz (1961), Becker (1964), and Mincer (1974) put forward that human capital has a direct relationship with workers' productivity. Literacy rate, mean year of schooling, school enrolment rate, government expenditure on education, training and health often represent human capital. Conversely, Blomstrom and Sjoholm (1979) used the ratio of white to blue collar workers as proxy for skill level. This study uses secondary school enrollment ratio as a proxy for human capital in this study and a positive coefficient is expected.

3. Technology Gap (TG)

In 1992, Kokko showed that technology gap between the local firms and MNCs constitutes a factor affecting FDI spillovers. Nevertheless, opinions as to the impact of TG are divergent. Some authors (Sjoholm, 1999; and Castellani and Zanfei, 2003) argue that larger TG results in positive spillovers while others stipulate that it should be moderate (Findlay, 1978) or small (Liu et al, 2000) so as to affect productivity positively. The relationship between the dependent variable and technology gap may be non-linear as seen in the empirical review. Also, the sign of the gap coefficient may change depending on the local firm's existing level of technological competence. As seen in Perez (1997) and in Kokko(1996), this relationship is captured by including the technological gap as another explanatory variable. The present study measures TG as the difference between the GDP of a particular country and the average GDP of all remaining countries in the sample.

4. Openness (OPNS)

Trade openness is known as another control variable in growth regression. Openness to trade can give a country better access to technologies developed elsewhere and enhance their catching-up process through adaptation of advanced foreign technologies (Keller, 2004). Using panel data and fixed effect approach for a group of 36 developing countries, Abizadeh et al. (2007) conclude that trade openness has a positive and significant impact on labour productivity. Common proxies for trade openness include ratio of exports plus imports to GDP, ratio of exports to GDP and ratio of imports to GDP. Following Loko et al. (2009), the ratio of exports plus imports to GDP is used as proxy. The sign of the variable is expected to be positive.

5. Inflation (INF)

Inflation is seen to decrease total factor productivity. Bitros and Panas (2001) found that inflation reduces total factor productivity growth in two digit Greek manufacturing sector industries in a way which is both statistically and economically significant. Inflation can reduce the return on capital, and hence decrease investments on capital which would eventually reduce growth.

Hence, there is an inverse relationship between inflation and TFP growth. We included inflation as measured by consumer price index as another independent variable in the study.

Estimation Issues

Before estimating our equation, it is important to test whether the variables are stationary or not and thus verify the time series properties of the data. Testing the stationarity of the variables, we used Im, Pesaran, and Shin (2003) panel unit root test, which is commonly known as IPS.

The null hypothesis of a unit root is accepted or rejected based on the p-values of the LLC, IPS and ADF-Fisher. The result shows that the series are non-stationary at their level and stationary at their first difference at 5 per cent level of significance. This means that the series follow an I (1) process. (Refer to table 5 in Appendix)

Endogeniety issues and the Panel Vector Autoregressive Model

There might still be the possibility of the loss of dynamic information even in panel data framework as the dependent variable may have something to do in explaining itself as well (Levine et al, 2000). It is likely that there exists dynamic feedbacks and indirect effects among the variables in the TFP growth function. Including these feedbacks are essential to the modelling of our hypotheses. Where FDI can directly affect TFP growth, it may also have indirect positive impacts on the country's productivity growth as it may affect other inputs in the productivity growth function. Furthermore we also come across the fact that the productivity level of a country may also result in more inflow of FDI, thus resulting in reverse causation.

Given the possibility of endogeneity and causality issues we use vector auto regressions (VAR) on panel data to enable us to consider the complex relationship that might exist between FDI and TFP growth. Moreover, Panel VAR also allows for a firm specific unobserved heterogeneity in the levels of the variables. Panel data vector auto regression combines the traditional VAR approach, which treats all the variables in the system as endogenous, with the panel data approach, which allows for unobserved individual heterogeneity. We specify a first order VAR model as follows:

$$Z_{it} = \Gamma_0 + \Gamma_1 Z_{it-1} + \mu_i + \varepsilon_t$$

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Where zt is a SIX variable vector (tfp, fdi/gdp, tg, hc, opns, inf) and the variables are as defined previously. We use i to index countries and t to index time, τ are the parameters and ε is the error term. The lowercase variables are the natural log of the respective uppercase variables

Estimation and Analysis

We estimate the coefficients of the system given in (3) and Table 1 report the results of the model.

Table 1: Results from the VAR model

Response to / *Response of*	*Constant*	*tfpt-1*	*fdit-1*	*hct-1*	*openst-1*	*inft-1*	*tg t-1*
Tfp	*0.51*	*0.98****	*0.12***	*-0.39*	*0.17**	*-0.02***	*0.008**
Fdi	*-1.82*	*0.25**	*0.60****	*0.51**	*0.29**	*-0.02**	*1.35**
Hc	*0.21**	*0.06***	*0.01*	*0.91****	*-0.06*	*0.004*	*0.12*
Opens	*0.42**	*0.12**	*0.01**	*0.014*	*0.87****	*-0.01*	*-0.11*
Inf	*4.16*	*4.64****	*0.04*	*-3.82***	*0.68*	*0.45****	*-1.14*
Tg	*0.13*	*0.07*	*-0.01*	*0.11*	*0.19**	*0.03*	*1.06****
No of Obs	*424*	*424*	*424*	*424*	*424*	*424*	*424*
No of Countries	*17*	*17*	*17*	*17*	*17*	*17*	*17*

*significant at 10%, ** significant at 5%, ***significant at 1%

Table 1 is a composite table where each equation can be viewed and analysed as an independent function. For instance, of interest to us primarily is row 1 which is in fact TFP growth equation.

It is observed that the coefficient of FDI is positive (+0.12) and significant. This suggests that FDI inflow has had a positive and significant effect on total factor productivity growth for our sample of sub Saharan African countries over the years of studies. In fact, it implies that a 1 per cent increase in FDI contributed to 0.12 per cent increase in total factor productivity growth. Our results support empirical findings of Li and Liu (2005) and Woo (2009) which reveal positive and significant effects from FDI on income and TFP growth respectively. Channels through which such productivity spillovers occur include the demonstration effect, the competition effect and through vertical linkages. However, the results are in contrast with the findings of Alfaro et al. (2004), Durham (2004), and Azman-Saini et al. (2010) who do not find any direct positive effect from FDI on growth.

Though the main objective of the paper is to investigate the link between FDI and TFP, we have also tried to see the effect of other macroeconomic variables on TFP growth. The variable technology gap is also of interest to us. The relationship between the dependent variable and the technology gap may be non-linear as seen in previous studies. Also, the sign of the gap coefficient may change depending on the local firm's existing level of technological competence. For instance, we note that the coefficient technology gap is positive and significant. This implies that apart from direct TFP enhancing effect of FDI, it is observed that TFP growth can further increase if the countries have larger technological gap. This finding is in line with Kokko (1994) who was the first to study the influence of technology gap between local firms and MNCs. Thus the coefficient in the table above supports the proposition that countries lagging far behind the technology frontier of MNCs benefit relatively much from FDI in terms of spillovers. This supports Findlay (1978) who posits that assuming a minimum level of financial development, countries with a large initial technology gap experience a higher labour productivity through FDI.

Theory postulates that the degree of openness of the economy will have positive effect on productivity. Referring to the openness variable, we observed a significant and positive relationship of the coefficient with TFP growth. It therefore implies that the more the countries have liberal policies to trade, and thus by being more open it will result in an increase in total factor productivity. This result supports Lai et al (2006), who argued that more open economies will have higher chance of accessing and benefiting from the know-how developed in the rest of the world. We can also argue that the penetration of foreign products in local markets foster competition in the host country. As such, inefficient domestic firms may be forced to become efficient, or scale down their operations or simply exit the market. Foreign competition further encourages the use of better quality and more technologically advanced inputs in producing goods for exports; hence resulting in increased productivity. According to Nordas et al. (2006), if FDI is accompanied by international trade, then knowledge transfer and the learning-by-exporting process is strengthened.

Also, we note that inflation has a negative impact on total factor productivity growth. Many of the countries analysed in the study has high rates of inflation. Our results thus support economic theory in various ways. For instance, inflation may affect adversely productivity by causing an inefficient mix of input resources. Inflation causes misperception of the relative price levels and leads to inefficient investment plans and therefore affects productivity inversely (Clark 1982). The price mechanism plays an important role in allocating resources efficiently in a market economy. Inflation disrupts the proper functioning of this mechanism, resulting in distortions and misallocation of resources.

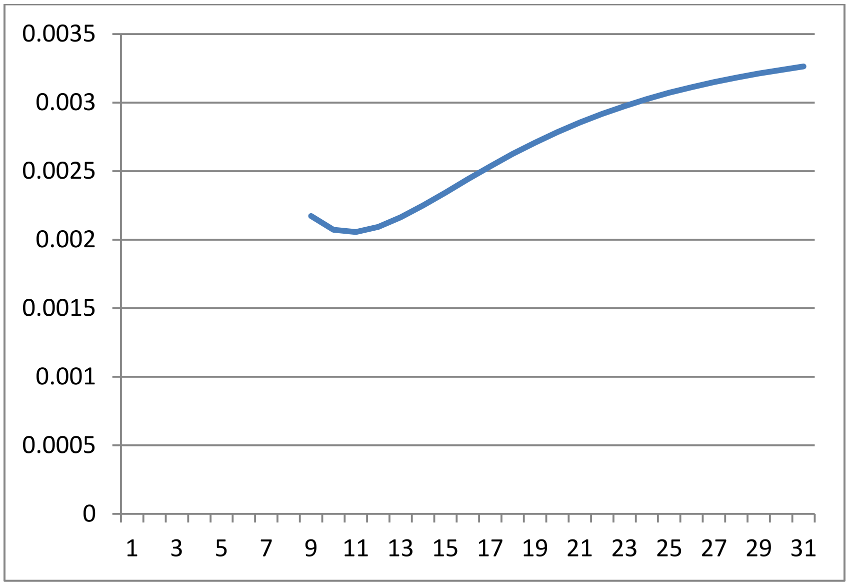
Higher levels of human capital can help countries to develop their technologies as well as increase countries' ability to absorb technologies developed elsewhere (Kneller, 2005; Nelson & Phelps, 1966). Greater human capital obtained from education, training and accumulated through learning by doing process can increase the efficiency of labour and also enhance TFP. In the present study, we obtain negative but yet insignificant results for human capital.

The VAR framework, as discussed before, enables us to gauge more interesting insights on endogeneity issues and indirect effects as well. Referring to the 'FDI' equation, it is observed that a reverse causation exists as well as TFP growth appears to be also a determinant of FDI. We found that a 1% increase in productivity results in 0.24% increase in FDI inflow. It therefore implies that productivity level of the countries play an important role in attracting FDI thus supporting a bi-causal and reinforcing relationship between TFP growth and FDI. As observed, the most interesting economic scenario suggests a two-way causal link between FDI and Host Country's Economic Growth. Countries with fast growth generate more demand for FDI and offer opportunities for making profits. On the other hand, inward FDI flows may enhance growth through positive direct and indirect effects on variables that affect growth. Also, FDI as a dependent variable is highly influenced by all the other control variables. Consequently, it is observed, in terms of magnitude, that past values of FDI, human capital, openness and technology gap are all important determinants of FDI. Such results provide insights as to the policies that a country should have in order to attract FDI in the long run. For instance, the coefficient of human capital suggests that for each percentage increase in HC, FDI increases by 0.51%. This serves as an incentive for governments to increase their investment in human capital in order to enhance labour productivity.

Impulse response Function

Impulse response analysis has also been used to investigate the effect of a one percent point shock in productivity growth rate to foreign direct investment. The figure below depicts the Generalised Impulse Response Function for the list of sub Saharan African countries.

Figure 1 Generalised Impulse Response Function.
Response of total factor productivity to one S.D FDI innovation



We observed that the effect of the shock keeps on increasing over the years. In other words, a shock in FDI keeps affecting productivity over time. The analysis confirms that FDI has a positive effect on the productivity level of the countries, thus consolidating the previous results.

4.0 Emphasizing on the manufacturing sector, the second part of this study aim at investigating the extent to which FDI flowing in the manufacturing sector in Mauritius contribute towards increasing total factor productivity of the sector. The following functional form applies to the "productivity spillover models in the manufacturing sector" used in this research:

Also, we incorporated a second model by using labour productivity instead of total factor productivity as a robustness check. The time period considered is 1980-2010.

Model 1:

$$\mathbf{TFPm = \alpha_0 + \beta_1 FDIm_t + \beta_2 DInvtm_t + \beta_3 HCt + \beta_4 INFt + \beta_5 INSTt + \mu_{xt}} \text{------------}\mathbf{(4)}$$

Model 2:

$$\mathbf{LPm = \alpha_0 + \beta_1 FDIm_t + \beta_2 DInvtm_t + \beta_3 HCt + \beta_4 INFt + \beta_5 INSTt + \mu_{xt}} \text{--------------}\mathbf{(5)}$$

Because of the variance stabilizing properties of log transformation, the log values of the variables are used. In fact, logged variables yield a more clear-cut interpretation of the coefficients in terms of percentage change.

Converting all the variables in logarithmic terms yields:

Model 1:

$$tfp_m = \alpha_0 + \beta_1 fdimt + \beta_2 Dinvtmt + \beta_3 phct + \beta_4 inft + \beta_5 inst + \mu_{xt} \ldots (6)$$

Model 2:

$$lp_m = \alpha_0 + \beta_1 fdimt + \beta_2 Dinvtmt + \beta_3 phct + \beta 4inft + \beta_5 inst + \mu_{xt} \ldots (7)$$

Where tfpm, lpm, fdim, phc, inf and tariff are the logs of total factor productivity, labour productivity in the manufacturing sector, foreign direct investment flowing in the manufacturing sector, domestic investment in the manufacturing sector, human capital (primary education), inflation and tariff(institutional variable) respectively. $\beta_1 \ldots \beta_5$ represent the parameter estimates and μ_t is the random disturbance term.

Dependent Variable: TFPm

This study uses the total factor productivity index for the manufacturing sector as produced by the digest of productivity and competitiveness statistics by statistics Mauritius. TFP index shows the rate of change in "productive efficiency" and is obtained as the ratio of output to total factor input that is a weighted combination of labour and capital inputs. TFP index is chosen over labour productivity index and capital productivity index. This is so, as these partial productivity attribute to one factor of production changes in efficiency that are attributable to other factors. However, TFP reflects many influences including qualitative factors such as better management and improved quality of inputs through training and technology.
The methodology used to calculate TFP is as follows,

$$\text{TFP index} = \frac{\text{Output index}}{\text{Total factor input index}} \times 100$$

Where Total factor input index is calculated as follows;

$$A(t) = \frac{Q(t)}{\{WL(t) \times L(t)\} + \{WK(t) \times K(t)\}} \times 100$$

Where,

A (t) = Total factor productivity index in time t

Q (t) = Output index in time t

WL(t) = Labour's input share in time t (ratio of compensation of employees to value added)

$$L(t) = \text{Labour input index at time t} = \frac{\text{Output index} \times 100}{\text{Labour input index}}$$

WK(t) = 1 - WL(t)

$$K(t) = \text{Capital input index at time t} = \frac{\text{Output index} \times 100}{\text{Capital input index}}$$

Independent Variables

1. **Foreign Presence in the manufacturing sector (FDIm)**

The degree of foreign presence in the manufacturing sector is measured by FDIm and the proxy used is FDI in the manufacturing sector as a percentage of real GDP. FDI flowing in the manufacturing sector for Mauritius is extracted from Balance of Payments reports as provided by the Bank of Mauritius. As argued by previous studies, the more foreign investment in a country the greater will be the transfer of know- how and technology. Thus, the larger the share of foreign ownership in a sector, the greater is the potential for spillovers.

2. **Tariff (Institutional Variable)**

Analysing sectoral productivity of FDI in Latin America, Tondl and Fornero (2010) found that tariffs are an important determinant in the manufacturing sector. It is seen that the lower the degree of protection by import tariff the more productive the sector is. Hence, we incorporated an institutional variable in the form of tariff in our model.

3. **Domestic investment**

Dimmerman (2003) identified two internal channels basically educational attainment and domestic investment, to account for any productive activity that may be present within the set of countries investigated. The author argued that productive activity within the domestic economy will also lead to increases in a country's TFP. The present study included domestic investment in the manufacturing sector and the data is extracted from the national accounts as obtained from statistics Mauritius.

The other control variables follow the first part of the study.

Estimation Issues

Before proceeding with the estimation of the model, it is important to investigate the univariate properties of all the individual data series. We first investigated the unit roots properties of the time series, and once the order of integration has been determined, the possibility of a long run relationship among the variables of interest is investigated. The stationarity tests suggest that all our variables are integrated of order 1 and stationary in first difference. The Johansen Maximum Likelihood approach is then used to test the presence of cointegration in a vector error correction model. The results show the presence of co-integrating vector and we thus conclude that a long run relationship exists between foreign investment in the manufacturing sector, local investment in the manufacturing sector, human capital, inflation, openness and total factor productivity. (Refer to table 6, 7 & 8 in Appendix)

For our investigation, we used a Vector Autoregressive (VAR) model. In fact the VAR model has proven to be useful for describing the dynamic behavior of economic time series and for forecasting. Moreover, it often provides better forecasts compared to those from uni variate time series models and elaborate theory-based simultaneous equations models. Forecasts from VAR models are also quite flexible because they can be made conditional on the potential future paths of specified variables in the model. Thus, given the endogeneity and causality issues, using a VAR model can prove to be highly advantageous. More so, by adopting a VAR Model, we can also correctly analyze the potential effect of foreign direct investment on total factor productivity in the manufacturing sector, any causality which might exist between them, and also investigate other feedback and indirect effects in the hypothesized link between FDI and TFP. In fact the VAR resembles a series of equation where each determinant comes as the explained variable in a system which is then solved simultaneously. However, since the variables are stationary only in first difference and are co integrated, we estimated a VAR in an error correction model (VECM).

EMPIRICAL RESULTS

VECTOR ERROR CORRECTION MODEL, VECM

Since there is the presence of co integration, and hence a long run equilibrium relationship among the variables has been established, the next step is to specify and estimate a VECM including the error correction term to investigate the dynamic nature of the model. The VECM specification forces the long run behavior of the endogenous variables to converge to their co integrated relationships, which accommodates short run dynamics. In this study, the VECM is estimated using an optimum lag length of 1. The tables below report the results of the model.

Table 2: Estimates of long run parameters

Dependent Var :		**ln TFPm**	**t-ratios**	**ln LPm**	**t-ratios**
FDIm		0.105650***	1.702310	0.090065***	1.02331
Dinvtm		0.182167*	6.003050	0.129348*	1.77231
Phc		6.918044	13.5539	5.25681	6.57461
Inf		-0.151613**	-4.23056	-0.101267*	-4.28213
Tariff		-0.140991*	-0.67882	-0.10225*	3.599000

Constant	-35.58135		-27.43292	

*significant at 10%, ** significant at 5%, ***significant at 1%

The table above illustrates the long run relationship between productivity in the manufacturing sector and the main variable of interest that is foreign investment in the manufacturing sector. Two models are used where in Model 1, productivity is measured by total factor productivity in the sector and model 2 uses labour productivity in the sector as a productivity measure. The control variables are domestic investment in the manufacturing sector, inflation, human capital and tariff.

Analysing the results of model 1, we found that FDI in the manufacturing sector does have a positive and significant impact on total factor productivity in the sector in the long run. In fact a 1% increase in FDI in the manufacturing sector raises total factor productivity by 0.10%. Our results are in line with Woo (2009), who finds that the share of FDI flow in GDP increases TFP growth of the countries under study. Relating this result to the Mauritian framework, we observed that FDI in the manufacturing sector was crucial in the early stages of export development in Mauritius. The export-oriented manufacturing sector has been the backbone of the Mauritian economy for the past three decades. It contributed much to the take-off of the Export Processing Zone (EPZ). This sector has been a major constituent of the Mauritian economy and foreign investment in the sector ultimately led to various spillovers such as export growth, foreign exchange earnings, technological transfer and job creation.

Also, interestingly we observed that domestic investment in the manufacturing sector has a positive and significant influence on the total factor productivity of the industry. Although FDI has been determinant to the takeoff of the EPZ, the success of the manufacturing would not have been possible without the substantial amount of investment provided by the local business community. However, while domestic investment allocated to the manufacturing sector has been slow-moving over the period 1992-2003, its contribution in 2007 and 2008 has been higher compared to the preceding years. (MCCI, 2009) Regarding the results of the other control variables, we observed that primary education does not influence total factor productivity in the manufacturing sector. The results are insignificant. This can be explained by the fact that education is not really important for the workers to work in the manufacturing sector. The coefficient of inflation is negative and significant suggesting that the higher the rate of inflation in the country, this would negatively affect the productivity level.
Looking at the result of the institutional variable used in this study, that is tariff, we found that it negatively affect productivity in the manufacturing sector. This result is in line with Tondl and Fornero (2010), who found that lower tariff can lead to particularly large productivity gains in manufacturing firms.

Model 2 has been incorporated in the study as a robustness check in order to verify the validity of the findings. For instance, we used the labour productivity in the manufacturing sector (initially we have used total factor productivity) as an alternative measure of productivity.

Qualitatively, the main results did not change and the positive spillovers are still found in the manufacturing sector.

Hence, we note that in this study the productivity is determined by a number of factors including the presence of foreign firms. The evidence suggests that foreign enterprises do generate spillovers to the manufacturing sector but that such spillovers are not automatic. There are other factors which are important as well.

To sum up, the results presented in Table 3 above suggest that on the whole, FDI in the manufacturing sector is favorable to productivity in the sector in the long run, irrespective of whether the latter is proxied by total factor productivity or labour productivity. This result is in line with various empirical studies done in the past. Also, domestic investment in the sector proves to be of paramount importance towards the contribution of productivity in the sector. Local investment proves to be crucial for both total factor productivity and labour productivity in the long run. In addition to that the result shows that both inflation and tariff negatively affect overall productivity.

THE SHORT RUN EQUATIONS

As observed from the preliminary tests, the variables are co integrated, in the short run; deviations from the long run equilibrium will feed back on the changes in the dependent variables so as to force their movements towards the long run equilibrium state. The deviation from the long-run equilibrium is corrected gradually through a series of partial short term adjustments, the co-integration term or the error correction term. It indicates the speed of adjustment of any disequilibrium towards the long-run equilibrium. The empirical results of the short run estimates of the VECM are displayed in the table below.

Table 3: Short run Dynamics: Dependent variable: ΔLn TFPt

	Δ tfp$_m$	**Δ fdi$_m$**	**Δ dinvt**	**Δ phc**	**Δ inf**	**Δ tariff**

Error correction Model						
Constant	0.02	-9.53	-0.73	-0.13	-0.23	-0.23
Δ tfpm $_{t-1}$	0.38*	0.013*	1.24*	0.17*	-14.50	0.78
Δ fdim $_{t-1}$	0.005*	0.19*	0.16*	0.01	-0.07	0.01*
Δ dinvt $_{t-1}$	0.13**	0.31*	0.28*	0.018**	2.24	-0.17*
Δ phc $_{t-1}$	-0.60	-17.60	-1.70	0.55*	-4.92	1.31
Δ inf $_{t-1}$	-0.01**	-1.50*	-0.15**	-0.01	-0.34*	0.02*
Δ tariff $_{t-1}$	-0.06*	-0.02*	-0.04*	0.04	1.80	1.50
√ $_{t-1}$	-0.12***	-0.98*	-0.05***	-0.06***	-0.09***	-0.50
R^2	0.53	0.64	0.55	0.85	0.49	0.67
DW stats	1.98	1.88	1.99	1.75	1.40	2.02

*significant at 10%, ** significant at 5%, ***significant at 1%

The regressions perform rather well with the R^2 ranging from 0.53 to 0.85. Ericsson et al., (1998) argued that weak exogeneity is a sufficient condition for the efficient inference on the parameters of interest in a conditional model. Weak exogeneity tests on each of the equations were performed and the Wald-test enables us to reject the null hypothesis of weak exogeneity at 5% significance level in all cases. The variables in the system are all endogenous, given that the lagged error-correction terms in the equations of the VECM are significant.

The table is a composite table, where each column can be viewed and analyzed as an independent function, that is, each column in the table corresponds to an equation in the VAR/VECM. The variable named in the first cell of each column is viewed as the dependent variable. The estimated coefficient of the explanatory variables is reported in the cells. Results of the short run estimates turn out to be different from the long run ones. For instance, we observed that FDI in the manufacturing does influence productivity in the sector but the coefficient is very small (0.005). The lower coefficient in the short run might indicate that such capital might take some time to have its full effect on the economy.

This result can also be explained by the winding obstacle course faced by the Mauritian manufacturing industry. As mentioned earlier, FDI in the manufacturing sector was crucial in the early stages of export development, contributing much to the take-off of the EPZ. Yet these foreign inflows which ultimately led to various spillovers became more sluggish in 2000 compared to the total FDI brought in the country. This drop in FDI levels was associated to the delocalization of foreign investors after the expiry of the multi-fibre agreement. The industry was ultimately faced with major downturns that have severely shaken the bases on which it has initially built its development path. The rise in labour cost which has eroded its competitiveness in the textile industry and the phasing out of its preferential market access, that were critical for the development of the garment industry were among others challenging developments for the sector. (MCCI, 2009)

Domestic investment is also significant in explaining the short-run variation in productivity. Moreover the coefficient of the lagged error correction term is -0.12, which indicated that about 12% of the disequilibrium is corrected in the next period. Further analysis from the third column of the table suggests significant links between productivity and FDI in the manufacturing sector. FDI is also attracted by the level of domestic investment ultimately contributing to the favorable investment climate in the country.

Further analysis from column 4 (domestic investment equation) shows that FDI has a “crowding in” effect on domestic investment and has, in fact, played an important role in promoting domestic capital accumulation confirming the existence of indirect effect. This is consistent with De Mello (1999). A 1 percentage-point increase in the growth rate of FDI leads to a 0.16 percentage-point increase in the growth rate of domestic capital after one year. Also a 1 percentage-point increase in the growth rate of domestic capital leads to a 0.13 percentage-point increase in the growth rate of productivity after one year. The latter two pieces of information taken together imply that a 1 percentage-point increase in the growth rate of FDI leads to a 0.02 percentage-point increase in the growth rate of output after two years. This might be interpreted as an estimate of the indirect effect of FDI on productivity in the short run via the domestic investment channel.

STRUCTURAL ANALYSIS

It is also possible from our framework to analyse the Granger-causal relation between a series of variables pairs. Granger-Causality is adopted to examine the direction of causality between FDI and TFP. The Granger-Causality test allows for the test of the null hypothesis: variable X does not Granger-Cause variable Y, against the alternative that variable X does Granger-Cause variable Y. The results are given below where X → Y implies X Granger-Causes Y and ↔ indicates bi-directional causality.

Table 4: Pairwise Granger-Causality tests

Null Hypothesis	F Statistics	Probability	Direction of causality

FDIm does not granger cause TFPm TFPm does not granger cause FDIm	4.05122 4.96399	0.067 0.015	FDIm ↔ TFP
Dinvt does not granger cause TFPm TFPm does not granger cause Dinvt	2.39678 2.31025	0.096 0.097	Dinvt ↔ TFP
INF(Price stability) does not granger cause TFPm	1.1450	0.081	Inf →TFP
Dinvt does not granger cause FDIm	2.64730	0.075	Dinvt →FDIm

Analyzing the Granger-Causality results of the Model 1, which uses TFP as the dependent variable, we observe that the Pairwise Granger-Causality tests confirm the results obtained previously. For instance, the Granger-Causality test reveals that there is a bi-directional relationship between FDI in the manufacturing sector and total factor productivity. Another interesting result obtained is the bi-directional relationship between local investment and total factor productivity in the sector. Moreover, we also observe that local investment and price stability influences the flow of FDI.

Conclusion

The first part of the study focused on a panel set of Sub Saharan African countries to simultaneously explore interaction among foreign direct investment and TFP growth in a unified framework. Most studies on FDI spillovers use firm-level data. But this study uses macro-level data in trying to capture the spillover effects outside the industry Rigorous panel VAR procedures were employed mainly to examine this complex linkage between FDI and TFP over the years 1980-2010. The panel VAR enables the identification of some determinants of TFP growth. A survey of the Literature on spillovers point out several reasons explaining why and how host countries benefit from inward FDI. However, empirical evidence from such studies provides mixed results and is inconclusive. By measuring FDI as the stock of FDI in real GDP and the dependent variable as TFP growth we find support that FDI is an important factor in the TFP growth model as evidenced by the positive and significant effect on TFP growth. This result is as well confirmed by the impulse response function analysis. The other control variables used in the study such as openness and technological gap also positively contribute to TFP growth in the sample of economies under study. As expected, inflation is seen to negatively influence TFP growth. Results from the analysis indicated the presence of a bi-directional causality between TFP growth and foreign direct investment. Indeed, although FDI induced a positive impact on TFP growth, openness was also seen to be an important determinant of TFP growth. The PVAR approach has also enable us to conclude that human capital, openness, TFP growth as well as high technological gap all together are important determinants of FDI for the sample of countries used.

The paper then proceeded to investigate the dynamic relationship between FDI flowing in the manufacturing sector and productivity of the sector for the case of Mauritius over the period 1980 to 2010. A VECM approach was used. The results show that FDI in the manufacturing sector has eventually contributed to both total factor productivity and labour productivity in the long run. Relating this result to various case studies on Mauritian manufacturing sector, we indeed observe that foreign investment has contributed to various productivity spillovers such as transfer of technology and job creation. However, analysing the short run results, we found that FDI in the manufacturing sector continues to influence productivity but the impact is very small. This result was mainly explained by the massive relocation of foreign firms from Mauritius to cheap labour destinations. Also, the results confirm the presence of bi-causality and feedback effects in the FDI-Productivity relationship. Moreover, we analyzed that FDI is positively related to the level of domestic investment suggesting the presence of "crowding in" effect as well. Interestingly, domestic investment was found to be crucial for the country to attract FDI in the manufacturing sector. Results also suggest bi-causal relationship between productivity and domestic investment implying another important feedback and dynamic effect. Also, the error correction framework confirmed the existence of a stable long-run relationship. Hence, the above results highlight the importance of FDI in generating productivity spillovers in the manufacturing sector and provide new evidences for the case of Mauritius using recent cointegration approach in a dynamic framework.

POLICY RECOMMENDATIONS

Since FDI is viewed as an important determinant of TFP growth, appropriate policies to attract FDI should be adopted by governments. In the short run a policy of (aggressively) attracting foreign direct investors in industries heavily populated by domestic firms, may have a significant negative impact on the domestic entrepreneurship. Within a longer term structural perspective FDI and domestic entrepreneurship may become complements because of many possible positive linkages. Some active measures to help long term benefits from FDI, particularly those that will help the development of backward and forward linkages viewed by policy makers are mainly improving the functioning of the banking system and capital markets, educational reforms to increase the supply of appropriate skills and the provision of new infrastructure. For the development of new industries such policies may prove fruitful.

Moreover, an improvement in institutional capacity and easier administrative procedures would surely favour the entrance of foreign firms in the host countries. Thus, policies to promote FDI should ensure capacity development, innovation and better knowledge transfer. Strategies like educational and training policies to improve skills and competency; public investment policies to enhance the local infrastructure in terms of communication and transport networks; incentives to encourage local firms to invest in technological development so as to improve their absorptive capacity; and trade policies conducive to international trade would all together help in attracting FDI.

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Appendix

Table 5: Unit Root Test

Variable	Levin, Lin &Chu P-value	Im, Pesaran &Shi P-value	ADF -Fisher Chi square P-value
ln-tfp	0.999	0.961	0.428
Δ ln-tfp	0.000	0.000	0.000
ln-FDI	0.121	0.157	0.113
Δ ln-FDI	0.000	0.000	0.000
ln-TG	0.001	0.163	0.134
Δ ln-TG	0.001	0.001	0.002
ln-hc	0.937	0.999	0.704
Δ ln-hc	0.000	0.000	0.000
ln-open	0.277	0.667	0.695
Δ ln-open	0.000	0.000	0.000
ln-inf	0.330	0.142	0.130
Δ ln-inf	0.000	0.000	0.000

Table 6: Summary results of Unit Root Tests in level form: Dickey-Fuller and Phillips/ Perron Test

variables (in log)	Aug Dickey Fuller	Phillips Perron	critical value	variable type	Aug Dickey Fuller Time trend (t)	critical value	variable type
Tfp	-0.44	-0.40	-2.96	I (1)	-3.24	-3.56	I (1)
Fdi	-2.51	-2.43	-2.96	I (1)	-3.21	-3.56	I (1)
Dinvt	-2.00	-2.01	-2.96	I (1)	-1.66	-3.56	I (1)
Phc	-2.41	-1.04	-2.96	I (1)	-3.5	-3.56	I (1)

Inf	-2.62	-2.80	-2.96	I (1)	-3.22	-3.56	I (1)
Tar	-0.39	-1.53	-2.96	I (1)	-1.63	-3.56	I (1)

Table 7: Summary results of Unit Root Tests in first difference: D/F and Phillips/ Perron Test

variables (in log)	ADF	PP	CV	variable type	ADF with time trend (t)	CV	variable type
Δ tfp	-6.35	-6.27	-2.96	I (0)	-6.22	-3.57	I (0)
Δ fdi	-5.87	-10.74	-2.96	I (0)	-5.74	-3.57	I (0)
Δ dinvt	-4.95	-4.92	-2.96	I (0)	-5.21	-3.57	I (0)
Δ phc	-5.75	-4.47	-2.96	I (0)	-5.82	-3.57	I (0)
Δ inf	-5.80	-11.22	-2.96	I (0)	-5.68	-3.57	I (0)
Δ tariff	-5.70	-5.80	-2.96	I (0)	-4.58	-3.57	I (0)

Table 8: Test result from Johansen procedure
Johansen Maximum Likelihood procedure of the cointegrating regression tfpm= (fdim,dinvt, hc, inf, openness) : number of cointegrating vectors(s) using the cointegration likelihood ratio.

	Null Hypothesis	Alternative Hypothesis	Test Statistics	5% Critical values
Trace of the stochastic matrix	*r=0*	*0.94*	*172.44*	*95.75*
	r < = 1	*0.81*	*95.33*	*69.82*
	r < = 2	*0.68*	*48.56*	*47.85*
	r < = 3	*0.33*	*16.23*	*29.79*
	r < = 4	*0.15*	*5.01*	*15.49*
	r < = 5	*0.02*	*0.47*	*3.84*
Maximal eigenvalue of the stochastic matrix	*r=0*	*0.94*	*77.10*	*40.07*
	r < = 1	*0.81*	*46.77*	*33.87*
	r < = 2	*0.68*	*32.33*	*27.58*
	r < = 3	*0.33*	*11.21*	*21.13*
	r < = 4	*0.15*	*4.54*	*14.26*
	r < = 5	*0.02*	*0.47*	*3.84*