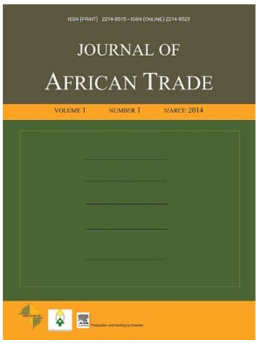

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Foreign direct investment, productivity and the technology gap in African economies

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Abstract

This paper investigates the impact of foreign direct investment on total factor productivity conditional on relative backwardness in a panel of 45 African countries over the period 1980–2012. We use two measures of relative backwardness, namely: the distance from technological frontier and the income gap. We apply the fixed-effects and two-step system GMM methods. We find a generally positive but weak effect of FDI on productivity growth. Meanwhile, the results do not support the convergence theory of Findlay (1978) and Wang and Blomstrom (1992), that relative backwardness would result in higher productivity growth via the adoption of foreign technologies.

JEL classification: E22; F21; F23; O16
Keywords: Foreign direct investment; Total factor productivity; Technology gap; Africa

1. Introduction

This paper examines the impact of foreign direct investment on productivity growth and the role of relative backwardness (the technology gap), based on a panel of 45 African countries over the period 1980–2012. FDI is often viewed as an important channel for the diffusion of technology in

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many developing countries. Endogenous growth theory postulates that FDI raises economic growth by generating technological diffusion from the developed world to the host country (Borensztein et al., 1998). This is particularly important for Africa, which has a huge technology gap. Productivity spillovers from FDI take place when the entry or presence of multinational corporations increases the productivity of domestic firms in a host country, and the multinational companies do not fully internalise the value of these benefits (Javorcik, 2004). Consequently, many policymakers in African countries have placed the attraction of FDI high on their agenda in the hope of benefitting from these technology spillovers (Woo, 2009).

A number of scholars find that differences in total factor productivity account for the huge cross-country variations in growth (Acemoglu, 2009; Caselli, 2005; Easterly and Levine, 2001). Since FDI is regarded as an important channel for technology transfer, a study of the impact of FDI on productivity growth and the role of the technology gap is of great significance to policy makers in Africa, as it provides better clarity on one of the key factors that can potentially help African countries to develop. The objectives of this study therefore include: to analyse the productivity effects of FDI in Africa and to determine the role of the technology gap on the FDI-productivity nexus. We test the 'relative backwardness' hypothesis of Findlay (1978) and Wang and Blomstrom (1992), which states that the rate of technology diffusion in a relatively backward country is higher the further the country is from the technological frontier. Thus, technology diffusion may be faster when the host country is relatively backward. Growth therefore becomes a function of the country's technological gap. Economies far from the technological frontier are expected to adopt technologies from the advanced economies to drive growth (Aghion and Howitt, 2009).

Although it has been shown that a large part of cross-country differences in income per capita can be explained by productivity growth, most of the existing literature, however, only focuses on the role of FDI on economic growth. There is a paucity of literature that examines the role of FDI on productivity growth at the cross-country level (Roy, 2008). Importantly, the role of the technology gap is often neglected. Some of the studies that attempt to address this issue include: Baltabaev (2014), Danquah and Ouattara (2014), Roy (2008) and Senbeta (2008). Baltabaev (2014) uses data for 49 countries (including both developed and developing countries) over the period 1974–2008 with a few developing countries in the sample. Danquah and Ouattara (2014) examine the contribution of human capital to productivity, innovation and adoption of technology for a sample of a panel of 83 countries, including 19 sub-Saharan African (SSA) countries over the period 1960–2003. Roy (2008) uses data for a sample of 89 countries in both Latin America and Africa. Senbeta (2008) examines the FDI-productivity growth nexus for 22 SSA countries for the period 1970–2000. However, the author does not consider the role of the technology gap. This paper uses a bigger sample consisting of 45 African countries and we incorporate two measures of relative backwardness over the period 1980–2012.

This paper contributes to the literature in many ways. Firstly, we narrow our focus to only African countries (45) to help reduce any bias that may be due to sample selection. This is important because scholars such as Kumar and Pradhan (2002) and Sylwester (2005) find that FDI has differential effects in different regions. We use two measures of relative backwardness, namely: the distance to the technology leader and the income gap. We analyse both the individual and simultaneous interactions of FDI with these 'relative backwardness' measures and their impact on productivity growth. We control for endogeneity, using the system GMM estimation. We also use the fixed effects estimation to check for the robustness of the results.

The rest of the paper is organised as follows: Section 2 reviews and discusses the related literature. Section 3 details the model specification and data description. Section 4 presents the estimation and analysis of the results, Section 5 provides robustness checks, and Section 6 is the conclusion and policy recommendations.

2. Literature review

FDI is considered an important channel for the transmission of technology in many developing countries (Jyun-Yi and Chih-Chiang, 2008). The endogenous growth theory postulates that FDI raises economic growth by generating technological diffusion from the developed world to the host country (Borensztein et al., 1998). Crespo and Fontoura (2007) summarise the five main channels of technological diffusion linked to FDI flows and these include: demonstration or imitation; labor mobility; exportation; competition; and backward and forward linkages with local firms. Hence, FDI does not only help to introduce new technologies into the host economy, but may also assist in raising the skill level, reducing prices and changing the competition structure.

Studies on the FDI-productivity growth nexus have provided mixed results. Scholars such as Bitzer and Gorg (2009), Liu et al. (2000) and Woo (2009) conclude that FDI has a positive effect on productivity growth. In contrast, some researchers find that FDI may negatively affect productivity (Azman-Saini et al., 2010; Ang, 2009; Alfaro et al., 2004; Aitken and Harrison, 1999; Haddad and Harrison, 1993). For example, Aitken and Harrison (1999) find that FDI negatively affects the productivity of domestic firms. They postulate a 'market-stealing' hypothesis to explain their results. This hypothesis states that while FDI may promote technology transfer, foreign investors 'steal' market share at the expense of domestic firms and this forces domestic firms to produce smaller output at higher average costs. As a result, the overall benefit of FDI is negligible at best or even negative.

Interestingly, some studies observe that a positive effect of FDI on productivity is dependent on the sector (Sjöholm, 2008; Buckley et al., 2008); the degree of complementarity and substitution between FDI and domestic investment (De Mello, 1999); and local conditions in the host country. For instance, Alfaro et al. (2009) find that countries with well-developed financial markets gain significantly from FDI via productivity improvements. Roy (2008) shows that the distance to the technology frontier is significant in determining the ability of the host country to take advantage of spillovers from FDI. He also finds that while there is a positive and significant effect of FDI on productivity, this effect is lower the higher the technological gap.

Using a panel of seven Mediterranean countries over 1980–2000, Cecchini and Lai-Tong (2008) examine the links between trade, FDI and total factor productivity. They find that FDI has beneficial effects on productivity growth but the spillovers are conditional on a number of host country factors, such as the degree of trade openness and the level of human capital. In contrast, Woo (2009), in a study of the effect of FDI on productivity in a large sample of countries from 1970 to 2000 finds that though FDI has a positive effect on productivity there is no evidence that this effect is dependent on host country factors. Ng (2006) analyses the relationship between FDI and productivity growth for eight Asian economies and finds no evidence to show that FDI drives technological progress in the sample countries.

A number of studies differentiate the effect of FDI by country. For instance, Johnson (2006) examines the effect of FDI on economic growth via two channels, namely: technology spillovers and physical capital accumulation. The study uses a panel dataset comprising 90 developed and developing countries over the period 1980–2002. The study finds that FDI improves economic growth in developing economies only and not in developed economies. Lee (2009) examines the long-run productivity convergence for a sample of 25 countries over 1975–2004. The study uses panel unit root procedures focusing mainly on trade and FDI links and finds that FDI helps to boost productivity growth in host countries. Holland and Pain (2000) examine the linkages between FDI and productivity growth in ten Central and East European countries. They find a positive impact of FDI on productivity in these economies, with the benefits being higher in the more-market oriented countries.

Other researchers disaggregate TFP growth into different components to determine the impact of FDI on the various components. Such an approach is adopted by Ng (2007) who examines the linkage between FDI and productivity in 14 SSA countries using the Granger causality test. The study disaggregates TFP growth into two components, namely: technical change and efficiency change to identify if FDI has any effect on these two components. They find that FDI has not contributed to technical change in the countries in the sample. Furthermore, the study provides evidence that FDI has contributed to higher efficiency change in only three of the countries in the sample. The findings therefore do seem to suggest that FDI has limited effects on productivity growth in the countries in the sample.

Some scholars provide insights on the dynamic differential effects of spillovers from FDI on productivity growth in terms of the short run and the long run. For instance, in a study of the nexus between FDI and productivity growth in the Chinese manufacturing sector, Liu (2008) finds that an increase in FDI in the industry lowers the short-run productivity level but raises the long-run rate of productivity growth of manufacturing firms. At a macro level, Senbeta (2008) studies the nexus between FDI inflows and productivity growth in 22 SSA countries over the period 1970–2000, using fixed effects and dynamic panel models. The study includes control variables such trade openness, financial sector development, the indebtedness of the country, and the share of agriculture in GDP which is assumed to indicate the level of development of the country. The results show that the effect of FDI on productivity is negative in the short run but becomes positive in the long run.

On the other hand, Girma (2005) examines the relationship between FDI and productivity using firm level data from the UK. The study demonstrates that the effect of FDI on productivity depends on the technology gap, which is defined as the distance from the technological leader in the industry. The study also finds that there is a non-linear relationship between the technology gap and spillovers from FDI. Similarly, Girma and Gorg (2005) examine the role of the absorptive capacity in determining whether domestic firms benefit from FDI-related productivity spillovers. The study finds that there is a U-shaped relationship between productivity growth and FDI interacted with absorptive capacity. This suggests that improvements in absorptive capacity at the firm level allow the firm to enhance the spillovers from FDI. Blalock and Gertler (2009) in a study of Indonesian firms find that while FDI on its own generally has no significant effect on a firm's productivity, manufacturing firms with larger technological gaps do benefit from FDI. This finding highlights the importance of the sector and the technology gap.

Some studies use the income gap to measure relative backwardness. For instance, Li and Liu (2005) investigate the impact of FDI on economic growth using a large sample of 84 countries for the period 1970–99 conditional on relative backwardness. They define relative backwardness using the ratio of host country GDP to US GDP. They include FDI interacted with the proxy for relative backwardness in their growth regression. They find a significantly negative coefficient for this interaction term along with a positive coefficient for the FDI term. This implies that the higher the relative backwardness of the host country, the smaller the effect of FDI on growth. They calculate a threshold value for relative backwardness of 12.6, below which FDI is no longer beneficial for the host country.

Generally, literature on the impact of FDI on productivity growth in African countries is scant and in particular the role of technology gap is often neglected. Some of the papers that attempt to address this issue are: Baltabaev (2014), Roy (2008) and Senbeta (2008). Baltabaev (2014) studies the link between FDI and TFP for 49 countries (including both developed and developing countries) over the period 1974–2008. The study however only includes few developing countries and hence it is not representative enough of African countries. Roy (2008) uses data for a sample of 89 countries in both Latin America and Africa. Senbeta (2008) examines the FDI-productivity growth nexus for 22 sub-

Saharan African (SSA) countries for the period 1970–2000 but does not consider the role of the technology gap.

The present paper contributes to the existing literature in a number of ways. Firstly, it has been noted by some scholars, such as Kumar and Pradhan (2002) and Sylwester (2005), that FDI has differential effects in different regions. While existing studies provide valuable insights into productivity spillovers to the host economy, they are not able to fully capture the overall effect of FDI on productivity growth in African economies. This implies that findings based on cross-regional studies must be interpreted with caution as they may not be representative enough. The focus on African countries may therefore help to reduce any bias that may arise due to sample selection. By using a large panel of 45 African countries over a longer time period (1980–2012) we are able to clarify the relationship between productivity growth and FDI conditional on relative backwardness. We use two measures of relative backwardness (technology gap): the distance to the technology leader and the income gap.

3. Empirical model and data

Following Ashraf and Herzer (2014), we model the impact of FDI on TFP and the role of relative backwardness as follows:

$$TFP_{it} - TFP_{it-1} = (1-\alpha)TFP_{it-1} + \beta_1 DTF_{it} + \beta_2 FDI_{it} + \beta_3 FDI_{it} * DTF_{it} + \beta_4 X_{it} + \eta_i + \varepsilon_{it} \quad (1)$$

Equivalently, Eq. (1) may be rewritten as follows:

$$TFP_{it} = \alpha TFP_{it-1} + \beta_1 DTF_{it} + \beta_2 FDI_{it} + \beta_3 FDI_{it} * DTF_{it} + \beta_4 X_{it} + \eta_i + \varepsilon_{it} \quad (2)$$

where i is the home country index, t is the time index, α and the β's are the unknown parameters to be estimated, DTF_{it} is the distance to the technology frontier (which measures the technology gap or relative backwardness) in home country i and time t. X_{it} is a vector of other conditional variables that affect productivity, η_i is the unobserved country-specific effect term, and ε_{it} is the usual error term. $FDI_{it} * DTF_{it}$ is the interaction term to capture the effect of relative backwardness.

We use the system GMM estimator which controls for the unobserved country-specific factors. Since there is likely to be a two-way relationship between FDI and productivity, the system GMM estimator helps to solve that endogeneity problem by using a series of internal instrumental variables based on lagged values of the dependent and independent variables. In this case, the instruments for the regression in differences are lagged levels as in the original estimator, while those for the regression in levels are the lagged differences of the corresponding variables.

Following Ashraf et al. (2014) we calculate the TFP variable using the following formula:

$$TFP = Y / \left[K^{1-\alpha} L^{\alpha}\right] \quad (3)$$

where Y is output, K denotes the capital stock, L stands for labor input, $1 - \alpha$ is the capital share of income, and α is the labor share of income. In line with common practice in the literature we assume a constant labour share of 0.6667 (Gollin, 2002). Output is measured by real GDP at 2005 US\$ obtained from the World Development Indicators (WDI) 2014 database. Capital is measured by Gross Fixed Capital Formation (GFCF) obtained from the WDI. Labour is measured by the labor force (the number of people of working age, defined as being from 15 to 64 years old) from the WDI 2014 online database.

Data on total net FDI inflows is obtained from the United Nations Conference on Trade and Development (UNCTAD) database. In the baseline model, we control for human capital, trade, population growth and technology. Human capital (sch) is measured by the level of secondary school attainment sourced from the 2014 WDI database. Higher levels of human capital increase the capacity of host countries to absorb foreign technology (Kneller, 2005). Trade openness gives the host country better access to foreign technologies (Keller, 2004). Following Loko and Diouf (2009), we use the ratio of exports plus imports to GDP as a proxy for trade openness obtained from the 2014 WDI database. Abizadeh et al. (2007) conclude that trade openness has a positive and significant impact on labour productivity. We follow Alfaro et al. (2009) who use private credit as a share of gross domestic product (GDP) as a proxy for financial market development. This is obtained from the 2014 WDI database and the expected sign is positive.

We include population growth (POPG) and this is expected to affect TFP positively. This is obtained from the 2014 WDI database. According to Jones (1995) argues, more people increase the potential pool of ideas and innovation. We also include lagged TFP as one of the explanatory variables. As pointed out by Hsiao (1986) a dynamic panel model allows dynamic effects to be introduced into the model and feedback from current or past shocks. Furthermore, as Ashraf et al. (2014) notes, the lagged dependent variable also helps to control for the effect of potentially relevant, but omitted, variables and to control for serial correlation.

We include the technology gap (absorptive capacity) to measure the relative backwardness. Kokko (1992) demonstrates that the technology gap constitutes a factor affecting spillovers from FDI. He finds that large technology gaps between foreign and local firms may sometimes be obstacles to spillovers. There are however divergent views on the role of the technological gap (TG). Some scholars (Castellani and Zanfei, 2003 and Sjoholm, 1999) argue that a larger TG results in positive spillovers while others argue that the effect is moderate (Findlay, 1978) and small (Liu et al., 2000). In this study we use two measures of relative backwardness (technological gap), namely, the distance to the technology frontier (DTF) and the income gap (GAP). The distance to technology frontier (DTF) is the ratio of the technology level in the 'leader' country (i.e. the USA) to the technology level of the country under consideration. We follow Baltabaev (2014) in using the ratio of the US labor productivity to a country's labor productivity. Using the labour productivity as opposed to TFP helps to deal with the endogeneity between the DTF and the error term. Following Li and Liu (2005), the income gap is calculated as follows:

$$GAP_{it} = \text{In}\ (Y\text{max}_{it}/Y_{it}) \tag{4}$$

where $Y\text{max}_{it}$ is the GDP per capita of the US and Y_{it} is the GDP per capita for the host country.

We use a dummy variable for the existence of Investment and Export Promotion Agencies (IPA). IPA equals one if country c has an investment promotion agency at time t and zero if country c does not have an investment promotion agency at time t. Harding and Javorcik (2011), for example, show that sector targeting by IPAs leads to more FDI inflows into the particular sector. Hence, the existence of an IPA (which is a dummy variable) can be a proxy for FDI inflows. We exploit the panel data from the World Bank Census of Investment Promotion Agencies to build this variable.

We transform Eq. (2) into first differences to eliminate any country specific effects (see Arellano and Bond, 1991) as follows:

$$\begin{aligned} TFP_{it}-TFP_{it-1} = {} & \alpha(TFP_{it-1}-TFP_{it-2}) + \beta_1(DTF_{it}-DTF_{it-1}) + \beta_2(FDI_{it}-FDI_{it-1}) \\ & + \beta_3(FDI_{it} * DTF_{it}-FDI_{it-1} * DTF_{it-1}) + \beta_4(X_{it}-X_{it-1}) + (\varepsilon_{it}-\varepsilon_{it-1}) \end{aligned} \tag{5}$$

Arellano and Bond (1991) posit that to deal with the possible simultaneity bias of the explanatory variables the lagged levels of the regressors should be used as instruments. This is however only valid assuming that the error term is not serially correlated and also that the lags of the explanatory variables are weakly exogenous. This is known as difference GMM estimation. It has been shown that though the difference GMM estimation controls for country-specific effects and simultaneity bias it has some problems. Alonso-Borrego and Arellano (1999) and Blundell and Bond (1998) prove that when the explanatory variables are persistent the lagged levels of the variables become weak instruments. This results in biased parameter estimates for small samples and larger variance asymptotically. To deal with this problem Arellano and Bover (1995) propose the system GMM which combines both the difference Eq. (5) and the level Eq. (3). The system GMM is able to reduce biases associated with difference GMM (Blundell and Bond, 1998).

The list of countries included is shown in Table 1.

In Table 2 we report the summary statistics for the countries in our analysis. The mean value of TFP growth is 0.16 with a minimum value of 0.01 and 0.48. The average share of the FDI inflows in GDP is 2.74% with a standard deviation of 5.75. The mean value for first FDI-based absorptive capacity (FDIDTF) is 1.86 and it has a high variance as suggested by the standard deviation. The average value for the second FDI-based absorptive capacity (FDIGAP) is 9.83 with a very high standard deviation of 22.31. The average distance to the technology leader in our sample is 0.68 which implies that the productivity for countries on average was 0.68 times lower than that of the US.

Table 3 shows the correlation among the variables. There is a preliminary positive relationship between TFP growth and FDI though not significant. There is a negative and significant relationship between TFP growth and both measures of the FDI-based absorptive capacity i.e. FDIDTF and FDIGAP. On the other hand, sch, open, credit and IPA have positive and significant effects on TFP growth, while POPG, FDIDTF and FDIGAP have negative and significant effects on TFP growth.

4. Estimation and results

The results are summarised and presented in Tables 4 and 5. The variables of our interest are FDI, the technology gap (DTF) and FDIDTF (the interaction of the FDI with the distance to the technological frontier). We first determine whether FDI has any effect on TFP growth without conditioning on the absorptive capacity (relative backwardness). Table 4 presents the results from the fixed effects estimation method. Columns 1, 2 and 4 present the results with no interaction term (FDIDTF). In columns 3 and 5 we present the results with the interaction term. We find that there is a positive effect of FDI on TFP growth in all the columns. The coefficients are positive and generally highly significant but very small, which suggests that the effect of FDI on TFP growth is not large.

Table 1
List of countries.

Algeria	Congo	Malawi	South Africa
Angola	Egypt	Mali	Sudan
Benin	Ethiopia	Mauritania	Swaziland
Botswana	Gabon	Mauritius	Tanzania
Burkina Faso	Gambia	Morocco	Togo
Burundi	Ghana	Mozambique	Tunisia
Cameroon	Guinea	Niger	Uganda
Cape Verde	Guinea-Bissau	Nigeria	Zambia
Central Africa Republic	Kenya	Rwanda	Zimbabwe
Chad	Lesotho	Senegal	
Cote d'Ivore	Liberia	Seychelles	
Comoros	Madagascar	Sierra Leone	

Table 2
Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
TFP growth	1485	0.16	0.11	0.01	0.48
FDI	1485	2.74	5.75	−14.68	90.46
Distance to technology frontier (DTF)	1485	0.68	0.14	0.02	0.66
Income gap (GAP)	1485	3.71	1.1	−0.43	6.13
Human capital (Sch)[a]	1485	3.22	0.79	0.85	4.83
Trade openness (Open)[a]	1485	4.16	0.48	1.84	5.62
Credit[a]	1485	2.65	0.95	−4.53	5.12
Population growth (POPG)	1485	2.46	1.08	−7.53	9.77
Investment promotion agency (IPA)	1485	0.35	0.48	0	1
FDI ∗ DTF (FDIDTF)	1485	1.86	4.28	−8.24	45.36
FDI ∗ GAP (FDIGAP)	1485	9.83	22.31	−72.11	353.49

[a] This variable is included as ln (variable).

This is consistent with the findings of Li and Liu (2005), Woo (2009) and Baltabaev (2014). However, this contrasts with the findings from Durham (2004) and Azman-Saini et al. (2010).

We also analyse the role of technology gap or relative backwardness (DTF) as well as the interaction term of FDI with the DTF (FDIDTF). As shown in Table 4, both the interaction variable (FDIDTF) and technology gap (relative backwardness) variable (DTF) have generally negative and significant effects in all columns. This is inconsistent with the findings of Findlay (1978) and Wang and Blomstrom (1992). Thus both relative backwardness (DTF) and the FDI-based absorptive capacity (FDIDTF) have a negative effect on TFP growth. This implies that the lower the level of technological development in the host country the smaller the impact of FDI on TFP growth (Baltabaev, 2014). There is therefore no catching up by the relatively backward countries. However,

Table 3
Correlation matrix: 1980–2012.

	TFP growth	FDI	DTF	GAP	Sch	Open
TFP growth	1					
FDI	0.03	1				
DTF	−0.78***	−0.006	1			
GAP	−0.74***	−0.05**	0.79***	1		
Sch	0.61***	0.17***	−0.62***	−0.6***	1	
Open	0.32***	0.37***	−0.32***	−0.41***	0.44***	1
Credit	0.44***	−0.10***	−0.47***	−0.43***	0.44***	0.20***
POPG	−0.30***	−0.009	0.28***	0.22***	−0.33***	−0.15***
IPA	0.08**	0.14***	−0.03	0.04*	0.28***	0.18***
FDIDTF	−0.02***	0.84***	0.06***	0.01	0.09***	0.30***
FDIGAP	−0.07***	0.94***	0.1***	0.11***	0.07***	0.3***

	Credit	POPG	IPA	FDIDTF	FDIGAP
Credit	1				
POPG	−0.20***	1			
IPA	0.12***	−0.18***	1		
FDIDTF	−0.12***	0.03	0.12***	1	
FDIGAP	−0.13***	0.04*	0.16***	0.97***	1

Notes: *, **, and *** indicate statistical significance at 10%, 5% and 1% levels, respectively.

Table 4
Fixed effects model estimation results, with TFP growth as the dependent variable.

Independent variables	1	2	3	4	5
Lagged TFP growth	0.44*** (0.00)	0.38*** (0.00)	0.40*** (0.00)	0.35*** (0.00)	0.32*** (0.00)
FDI	0.002*** (0.00)	0.0004* (0.08)	0.01*** (0.00)	0.0004 (0.26)	0.01*** (0.00)
DTF	−0.16*** (0.00)	−0.15*** (0.00)	−0.20*** (0.00)	−0.22*** (0.00)	−0.14*** (0.00)
IPA		0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01* (0.00)
Sch.				0.01*** (0.00)	0.01*** (0.00)
Open				0.003 (0.33)	0.004 (0.43)
Credit				0.001 (0.18)	0.001 (0.22)
POPG				0.002 (0.18)	0.002* (0.07)
FDI ∗ DTF			−0.04*** (0.00)		−0.06*** (0.00)
Constant	0.19*** (0.00)	0.22*** (0.00)	0.24*** (0.00)	0.18*** (0.00)	0.20*** (0.00)
No. of obs.	1484	1484	1484	1484	1484
No. of groups	45	45	45	45	45
F test (p-value)	0.00	0.00	0.00	0.00	0.00
R squared	72.33	66.42	68.76	68.10	70.24

Notes: p-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% levels, respectively.

this finding is consistent with Sjöholm (1997) who argues that huge technology gaps may present an impediment to the absorption of any potential spillovers from FDI. Similarly, Glass and Saggi (1998) posit that relative backwardness is a deterrent to productivity growth because it limits the kind of technology that can be transferred to the host country. Additionally, Falvey et al. (2005) show that a huge technology gap is unlikely to automatically translate to greater knowledge diffusion and catch-up, unless certain preconditions exist that allow countries to absorb the inflow of foreign ideas and knowledge. Furthermore, Danquah and Ouattara (2014) show that proximity to the frontier is a significant determinant of productivity growth in SSA. This then supports the view that a

Table 5
Two step system GMM model estimation results, with TFP growth as the dependent variable.

Independent variables	1	2	3	4	5
Lagged TFP growth	0.38*** (0.00)	0.35*** (0.00)	0.32*** (0.00)	0.40*** (0.00)	0.41*** (0.00)
FDI	0.004*** (0.00)	0.002*** (0.00)	0.001*** (0.00)	0.006*** (0.00)	0.001*** (0.00)
DTF	−0.40*** (0.00)	−0.36*** (0.00)	−0.38*** (0.00)	−0.40*** (0.00)	−0.32*** (0.00)
Sch				−0.05* (0.08)	0.08 (0.12)
Open				0.02*** (0.00)	0.02*** (0.00)
Credit				0.001 (0.35)	0.001 (0.40)
POPG				0.002** (0.04)	0.004** (0.03)
IPA		0.02*** (0.00)	0.02*** (0.00)	0.01*** (0.00)	0.01*** (0.00)
FDIDTF			−0.01*** (0.00)		−0.04*** (0.00)
Constant	0.20*** (0.00)	0.18*** (0.00)	0.22*** (0.00)	0.16*** (0.00)	0.19*** (0.00)
No. of obs.	1395	1395	1395	1395	1395
No. of groups	45	45	45	45	45
No. of instruments	65	66	67	70	71
AR(1) p-value	0.01	0.03	0.03	0.02	0.01
AR(2) p-value	0.35	0.40	0.38	0.54	0.46
Hansen J-test (p-value)	0.68	0.55	0.60	0.70	0.52
Difference-in-Hansen test (p-value)	0.63	0.47	0.54	0.48	0.33

Notes: p-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% levels, respectively.

huge technology gap presents an impediment to the absorption of any potential spillovers from FDI in African countries. IPA has a positive and significant effect which suggests that the existence of an investment and promotion agency has a positive effect on TFP growth.

Table 5 reports the results of the estimation using the two-step system GMM method. The coefficient on FDI is positive and significant but very small. The interaction term (FDIDTF) and relative backwardness (DTF) term have a negative and significant effect in all columns included. This is consistent with results from the fixed effects estimation shown in Table 4. This is not consistent with the convergence hypothesis of Findlay (1978). The finding suggests that the lower the level of technological development in the host country the smaller the capacity of the host country to absorb any potential spillovers from FDI, implying that there is no catching up effect for African economies. As Findlay (1978) observes, the technological gap should not be huge, otherwise the negative effect of the transfer of technology outweighs the benefit to the developing countries. Our results are consistent with Danquah and Ouattara (2014); Baltabaev (2014), Falvey et al. (2005), and Sjöholm (1997) who show that that huge technology gaps presents an impediment to absorption of any potential spillovers from FDI.

5. Robustness checks

To check the robustness of the results we use a different measure of technology gap (relative backwardness). We follow Li and Liu (2005) in using the income gap (GAP) as a proxy. This is defined in Eq. (4). The results are presented in Tables 6 and 7. In Table 6 we present our results using the fixed-effects method. FDI has no significant effect on TFP growth as shown by the results in all the columns. The relative backwardness term (GAP) is negative but not significant except in column 2. The interaction tem FDIGAP has no significant effect on TFP growth as shown in Table 6. Table 7 presents the results of the estimation using the two-step system GMM method. FDI is shown to have a positive and significant effect on TFP growth, but the interaction variable (FDIGAP) and the relative backward variable (GAP) have a negative and significant effect. This means that the lower the level of technological development in the host country, the smaller the impact of FDI on total factor

Table 6
Fixed effects model estimation, with TFP growth as the dependent variable.

Independent variables	1	2	3	4	5
Lagged TFP growth	0.35*** (0.00)	0.32*** (0.00)	0.38*** (0.00)	0.40*** (0.00)	0.42*** (0.00)
FDI	0.001 (0.30)	0.003 (0.33)	0.001 (0.40)	0.003 (0.35)	0.002 (0.42)
GAP	−0.004 (0.48)	−0.01* (0.00)	−0.003 (0.42)	−0.004 (0.00)	−0.002 (0.34)
IPA		0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)
Sch				0.01** (0.03)	0.01** (0.04)
Open				0.002 (0.45)	0.004 (0.52)
Credit				0.002 (0.72)	0.002 (0.68)
POPG				0.003*** (0.00)	0.004*** (0.00)
FDI ∗ GAP			−0.003 (0.18)		−0.0003 (0.12)
Constant	0.08*** (0.00)	0.10*** (0.00)	0.07*** (0.00)	0.14*** (0.00)	0.10 (0.35)
No. of obs.	1484	1484	1484	1484	1484
No. of groups	45	45	45	45	45
F test (p-value)	0.00	0.00	0.00	0.00	0.00
R squared	90.6	90.66	90.56	90.87	90.73

Notes: p-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% levels, respectively.

Table 7
Two step system GMM model estimation results, with TFP growth as the dependent variable.

Independent variables	1	2	3	4	5
Lagged TFP growth	0.42*** (0.00)	0.40*** (0.00)	0.44*** (0.00)	0.38*** (0.00)	0.40*** (0.00)
FDI	0.001*** (0.00)	0.004*** (0.00)	0.001*** (0.00)	0.001*** (0.00)	0.001*** (0.00)
GAP	−0.03*** (0.00)	−0.02*** (0.00)	−0.02*** (0.00)	−0.02*** (0.00)	−0.02*** (0.00)
Sch				0.05 (0.34)	0.06 (0.36)
Open				0.02** (0.03)	0.01** (0.03)
Credit				0.004* (0.07)	0.01 (0.15)
POPG				0.005** (0.03)	0.01*** (0.00)
IPA		0.03*** (0.00)	0.03*** (0.00)	0.02*** (0.00)	0.02*** (0.00)
FDIGAP			−0.001** (0.04)		−0.0008*** (0.00)
Constant	0.12*** (0.00)	0.08*** (0.00)	0.09*** (0.00)	0.10*** (0.00)	0.08*** (0.000)
No. of obs.	1395	1395	1395	1395	1395
No. of groups	45	45	45	45	45
No. of instruments	65	66	67	70	71
AR(1) p-value	0.02	0.01	0.01	0.02	0.02
AR(2) p-value	0.40	0.34	0.52	0.46	0.62
Hansen J-test (p-value)	0.68	0.56	0.60	0.72	0.80
Difference-in-Hansen test (p-value)	0.62	0.59	0.56	0.48	0.53

Notes: p-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% levels, respectively.

productivity. The results then further indicate that there is no evidence of any catch-up in African economies.

6. Conclusion and policy recommendations

Empirical literature on the relationship between FDI and productivity growth has produced mixed results. In this paper we examine the impact of FDI on productivity growth and the role of relative backwardness (the technology gap) on a panel of 45 African countries over the period 1980–2012. We use two measures of relative backwardness, namely: the distance from technological frontier (DTF) and the income gap (GAP). We apply the fixed effects, and the system GMM methods to account for the issues of endogeneity. The different estimation methods used should help to check for the robustness of the findings.

Our results show a generally positive but weak effect of FDI on productivity growth in African countries. This suggests that FDI has a limited effect on productivity in African countries. The paper supports previous studies that have questioned the widespread enthusiasm associated with FDI (Carkovic and Levine, 2005; Aitken and Harrison, 1999). The failure by many African countries to fully adopt foreign technologies may be because of the limited absorptive capacity (relative backwardness). Blomstrom and Kokko (2003) observe that spillovers from FDI are not automatic and that they depend on local conditions. In particular, Borensztein et al. (1998) and Xu (2000) show that FDI is more productive than domestic investment only when the host economy has sufficient human capital development.

Our findings do not support the convergence theory of Findlay (1978) and Wang and Blomstrom (1992) that relative backwardness would lead to higher productivity growth via the adoption of foreign technology. This observation is also shared by Glass and Saggi (1998) who earlier show that relative backwardness is a deterrent to the absorption of spillovers from FDI as it limits the kind of technology that can be transferred. The results are also in line with Danquah and Ouattara (2014) who show, based on a different sample and sample period, that proximity to the frontier is a significant determinant of productivity in SSA.

Falvey et al. (2005) emphasise that having a huge technological gap is unlikely to lead to greater knowledge diffusion and catch-up, unless certain preconditions exist that allow countries to absorb the inflow of foreign ideas and knowledge. Empirical evidence shows that institutions help in the diffusion of technology and that countries with better institutions tend to experience better technology diffusion than those countries lacking basic institutions (Manca, 2009). African governments therefore need to strengthen their institutions so as to improve their absorptive capacity and thereby close the technology gap.

References

Abizadeh, S., Pandey, M., Tosun, M.S., 2007. Impact of trade on productivity of skilled and unskilled intensive industries: a cross-country investigation. Am. Econ. Rev. 89, 379–399.

Acemoglu, D., 2009. Introduction to Modern Economic Growth. Princeton University Press, pp. 77–80.

Aghion, P., Howitt, P., 2009. The Economics of Growth. MIT Press.

Aitken, B.J., Harrison, A.E., 1999. Do domestic firms benefit from direct foreign investment? Evidence from Venezuela. Am. Econ. Rev. 89, 605–618.

Alfaro, L., Chanda, A., Kalemli-Ozcan, S., Sayek, S., 2004. FDI and economic growth: the role of local financial markets. J. Int. Econ. 64, 89–112.

Alfaro, L., Kalemli-Ozcan, S., Sayek, S., 2009. FDI, productivity and financial development. World Econ. 32 (1), 111–135.

Alonso-Borrego, C., Arellano, M., 1999. Symmetrically normalized instrumental variable estimation using panel data. J. Bus. Econ. Stat. 17 (1), 36–49.

Ang, J.B., 2009. Foreign direct investment and its impact on the Thai economy: the role of financial development. J. Econ. Financ. 33 (3), 316–323.

Arellano, M., Bond, S., 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. Rev. Econ. Stud. 58, 277–297.

Arellano, M., Bover, O., 1995. Another look at the instrumental-variable estimation of error-components models. J. Econ. 68, 29–52.

Ashraf, A., Herzer, D., 2014. The effects of greenfield investment and M&As on domestic investment in developing countries. Appl. Econ. Lett. 21 (14), 997–1000.

Ashraf, A., Herzer, D., Nunnenkamp, P., 2014. The effects of greenfield and cross-border M&As on total factor productivity. Kiel Working Papers No. 1941 July 2014.

Azman-Saini, W.N.W., Baharumshah, A.Z., Law, S.H., 2010. Foreign direct investment, economic freedom and economic growth: international evidence. Econ. Model. 27 (5), 1079–1089.

Baltabaev, B., 2014. FDI and total factor productivity growth: new macro evidence. World Econ. 37 (2), 311–334.

Bitzer, J., Gorg, H., 2009. Foreign direct investment, competition and industry performance. World Econ. 32 (2), 221–233.

Blalock, G., Gertler, P., 2009. How firm capabilities affect who benefits from foreign technology. J. Dev. Econ. 90 (2), 192–199.

Blomstrom, M., Kokko, A., 2003. The economics of foreign direct investment incentives. NBER Working Paper 9489.

Blundell, R., Bond, S., 1998. Initial conditions and moment restrictions in dynamic panel data models. J. Econ. 87 (1), 115–143.

Borensztein, E., De Gregorio, J., Lee, J.W., 1998. How does foreign direct investment affect economic growth? J. Int. Econ. 45, 115–135.

Buckley, P.J., Cross, A.R., Tan, H., Xin, L., Voss, H., 2008. Historic and emergent trends in Chinese outward direct investment. Manag. Int. Rev. 48 (6), 715–747.

Carkovic, M., Levine, R., 2005. Does Foreign Direct Investment Accelerate Economic Growth? In: Moran, T.H., Graham, E. M., Blomström, M. (Eds.), Does Foreign Direct Investment Promote Development?Institute of International Economics, Washington DC

Caselli, F., 2005. Accounting for cross-country income differences. In: Aghion, Phillipe, Durlauf, Steven N. (Eds.), Handbook of Economic Growth vol. 1A. Elsevier, pp. 679–741.

Castellani, D., Zanfei, A., 2003. Technology Gaps, Absorptive Capacity and – The Impact of Inward Investments on Productivity of European Firms. Economics of Innovation and New Technology.

Cecchini, L., Lai-Tong, C., 2008. The links between openness and productivity in Mediterranean countries. Appl. Econ. 40 (6), 685–697.

Crespo, N., Fontoura, M., 2007. Determinant factors of FDI spillovers what do we really know? World Dev. 35 (3), 410–425.

Danquah, M., Ouattara, B., 2014. Productivity growth, human capital and distance to frontier in sub-Saharan Africa. J. Econ. Dev. 39 (4), 27–48.

De Mello, L.R., 1999. Foreign Direct Investment-Led Growth: Evidence Form Time Series and Panel Data. Department of Economics, Keynes Collage, University of Kent, Oxford Economic Papers 51 pp. 133–151.

Durham, J.B., 2004. Absorptive capacity and the effects of foreign direct investment and equity foreign portfolio investment on economic growth. Eur. Econ. Rev. 48 (2), 285.

Easterly, W., Levine, R., 2001. It's not factor accumulation: stylized facts and growth models. World Bank Econ. Rev. 2001.

Falvey, R., Foster, N., Greenaway, D., 2005. Relative backwardness or absorptive capacity: how does knowledge spill over across borders? GEP Research Paper 05/07. The Leverhulme Centre for Globalization and Economic Policy

Findlay, R., 1978. Relative backwardness, direct foreign investment, and the transfer of technology: a simple dynamic model. Q. J. Econ. 92, 1–16.

Girma, S., 2005. Absorptive capacity and productivity Spillovers from FDI: a threshold regression analysis. Oxf. Bull. Econ. Stat. 67 (3), 281–306.

Girma, S., Gorg, H., 2005. Foreign direct investment, spillovers and absorptive capacity: evidence from quantile regressions. Discussion Paper Series 1, Economic Studies No. 13/2005.

Glass, A., Saggi, K., 1998. International technology transfer and the technology gap. J. Dev. Econ. 55, 369–398.

Gollin, D., 2002. Getting income shares right. J. Polit. Econ. 110 (2), 458–474.

Haddad, M., Harrison, A., 1993. Are there positive spillovers from direct foreign investment?: evidence from panel data for Morocco. J. Dev. Econ. 42 (1), 51–74.

Harding, T., Javorcik, B., 2011. Roll out the red carpet and they will come: investment promotion and FDI inflows. Econ. J. 121 (557), 1445–1476.

Holland, D., Pain, N., 2000. On the Road to the Market: The Prospects for Growth in Central Europe. National Institute for Economic Research, London (mimeo).

Hsiao, C., 1986. Analysis of Panel Data. Cambridge University Press, Cambridge.

Javorcik, B.S., 2004. Does foreign direct investment increase the productivity of domestic firms? Search of Spillovers through Backward Linkages. American Economic Review

Johnson, A., 2006. The Effects of FDI inflows on host country economic growth. CESIS Working Paper Series. Royal Institute of Technology, Sweden.

Jones, C.I., 1995. R&D-based models of economic growth. J. Polit. Econ. 103 (4), 759.

Jyun-Yi, W., Chih-Chiang, H., 2008. Does foreign direct investment promote economic growth? Evidence from a threshold regression analysis. Econ. Bull. 15 (12) (July 23).

Keller, W., 2004. International technology diffusion. J. Econ. Lit. 42, 752–782.

Kneller, R., 2005. Frontier technology, absorptive capacity and distance. Oxf. Bull. Econ. Stat. 67 (1), 1–23.

Kokko, A., 1992. Foreign Direct Investment, Host Country Characteristics, and Spillovers. (Doctoral Dissertation). Stockholm School of Economics.

Kumar, N., Pradhan, J.P., 2002. FDI, externalities, and economic growth in developing countries: some empirical explorations and implications for WTO negotiations on investment. RIS Discussion Paper No. 27/2002. New Delhi, India.

Lee, J., 2009. Trade, FDI, and productivity convergence: a dynamic panel data approach in 25 countries. Jpn World Econ. 21, 226–238.

Li, X., Liu, X., 2005. Foreign direct investment and economic growth: an increasingly endogenous relationship. World Dev. 33 (3), 393–407.

Liu, Z., 2008. Foreign direct investment and technology spillovers: theory and evidence. J. Dev. Econ. 85 (1–2), 176–193.

Liu, X., Siler, P., Wang, C., Wei, Y., 2000. Productivity spillovers from foreign direct investment: evidence from UK industry level panel data. J. Int. Bus. Stud. 31 (3), 407.

Loko, B., Diouf, M.A., 2009. Revisiting the determinants of productivity growth: what's new? IMP Working Paper No.225

Manca, F., 2009. Technology catching-up and the role of institutions. Working Papers 2009/12. Research Institute of Applied Economics, p. 2009.

Ng, T.H., 2006. Foreign direct investment and productivity: evidence from the East Asian economies. UNIDO Staff Working Paper 03/2006.

Ng, T.H., 2007. Foreign Direct Investment and Productivity: Evidence from Sub Saharan Africa. Unpublished paper. UNIDO, Vienna.

Roy, S., 2008. Foreign Direct Investment and Total Factor Productivity Growth: Does Distance from Technology Frontier Matter? Louisiana State University

Senbeta, S., 2008. The Nexus between FDI and total factor productivity growth in Sub Saharan Africa. MPRA Paper No. 31067, Munich. University of Antwerp mimeo.

Sjöholm, F., 1997. Technology gap, competition and spillovers from direct foreign investment: evidence from establishment data. Working Paper Series in Economics and Finance 211. Stockholm School of Economics.

Sjoholm, F., 1999. Technology gap, competition and spillovers from direct foreign investment: evidence from establishment data. J. Dev. Stud. 36 (1), 53.

Sjöholm, F., 2008. The Effect of FDI on Employment and Technology in China. Research Institute of Industrial Economics and Örebro University.

Sylwester, K., 2005. Foreign direct investment, growth, and income inequality in less developed countries. Int. Rev. Appl. Econ. 19 (3), 289–300.

Wang, Y., Blomstrom, M., 1992. Foreign investment and technology transfer. Eur. Econ. Rev. 36 (1), 137–155.

Woo, J., 2009. Productivity growth and technological diffusion through foreign direct investment. Econ. Inq. 47 (2), 226–248.

Xu, B., 2000. Multinational enterprises, technology diffusion, and host country productivity growth. J. Dev. Econ. 62, 477–493.