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Foreign direct investment and human capital development in Africa

By Phyllis Papadavid, Sherillyn Raga and Dirk Willem te Velde

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Foreign Direct Investment and Human Capital Development in Africa

Conceptual issues and new empirical evidence

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Abstract

This paper addresses conceptual issues and broad empirical regularities on human capital development and foreign direct investment (FDI) in Africa. There are many links between FDI and human capital: human capital helps to attract FDI and, conversely, FDI can help to develop human capital. Using a sample of 91 countries over 1970–2015, we show that inward FDI supports human capital development by supporting education enrolment rates, especially at secondary and tertiary levels, both independently from and through income effects. The results are stronger the higher the level of initial skills endowments, and are robust to measures of FDI that account for possible endogeneity. However, the effects are less strong in Africa, where the interaction between FDI and initial skills endowment has become insignificant, especially since 2000. We argue that this can in part be explained by the type of FDI that has been attracted to Africa after 2000, including FDI in natural resources and construction – which may not have had the positive synergies between FDI and human capital (separate from income effects) that we have seen in other developing countries. The use of sector examples around garments, ICT, and natural resources allows us to explore more deeply the relationship between different types of firms and different types of education, skills and human capital. We argue that the impacts of inward FDI on education depends on the sector and the policy and institutional context. In further research, country case studies can ask a range of questions to further explore the detailed links between FDI and human capital at the country level, and build on the richness that has emerged from a review of sector experiences.

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1. *Introduction*

This paper, which is part of the AERC project on Human Capital Development in Africa (HCA), addresses conceptual issues and broad empirical regularities related to human capital development and foreign direct investment (FDI) in Africa. The overall project examines: (1) the determinants of human capital; (2) human capital deep drivers and consequences; and (3) human capital depletion. It also covers the links between FDI and human capital formation. FDI can help to promote human capital by offering skilled work and training. Human capital also helps to attract more (foreign) investment. But FDI can also be exploitative, employing few local people, with few positive incentives for human capital development. This paper unpacks both these positive and negative linkages.

This paper examines the relationship between FDI and human capital by providing insights on what characteristics, strategies and contexts of FDI relate strongly to human capital formation, and if so, what types of human capital formation it relates to. Our research also responds to the question: how does FDI affect different measures of human capital formation (e.g., primary, secondary to tertiary education enrolment) in African countries?

This paper contributes to the literature on FDI and human capital development through a succinct literature review, the development of a supply and demand framework to analyse the links, new empirical estimates, and a description of specific experiences of and suggestions for how questions can be explored in more detail at a country level.

The structure is as follows. Section 2 reviews the literature on the links between FDI and human capital. Section 3 provides a framework to consider FDI and human capital from both the demand and supply side. Section 4 provides new empirical estimates on how FDI may affect human capital formation, based on correlations between long-runs of data. Data analysis can be informative, but is limited in scope through data availability and quality. Section 5 provides complementary sectoral case study evidence on FDI and human capital, with specific reference to Africa, and these case studies allow us to explore more deeply the link between different firms and different measures of skills, education and human capital. Section 6 concludes with insights and limitations, as well as a list of key questions that can be asked at the country level to gain deeper insights into FDI and human capital development.

2. *The links between FDI and human capital in Africa*

Human capital development (HCD) is crucial for development in African countries. Investment in human beings – through education and training, learning and experience, or health interventions – is vital in improving social and economic outcomes and shaping income and productivity in the future. HCD is both multidimensional and dynamic: it can be augmented through investment or reduced by economic shocks, depreciation, illness or job loss (Goldin and Katz, 2020; Liu and Fraumeni, 2020). African economies with a relatively young labour force have particular scope for HCD given that extreme and moderate working poverty is comparatively higher in part because of the skills gap (ILO, 2020).

Poorer countries lag behind in HCD. International household-survey data suggest that experience-wage profiles are flatter in poorer countries compared to higher income economies, indicating that workers in the former accumulate less human capital from their experience and employment.[2] This amplifies the role of human capital in accounting for cross-country income differences (Lagakos et al., 2014). Education and technology-based HCD measures are key for Africa (Vinod and Kaushik, 2007); however, more recent estimates suggest health-based HCD measures are more significant for predicting African growth (Ogundari and Awokuse, 2018). This review focuses on education- and vocation-based framing of HCD.

Human capital is a significant and positive determinant of inward FDI (Noorbakhsh et al 2001; te Velde and McGrath, 2005; te Velde, 2005). Equally, multinational enterprises (MNEs) usually provide more training than local firms and employ more skilled workers (te Velde and Morrissey, 2003; te Velde and Morrissey, 2004). There is comparatively less evidence on how the presence of MNEs affects incentives for skills development throughout the economy – for example, through technology spill-overs. In this sense, more investment can lead to economic development, including skills and HCD, but such FDI spill-overs (Te Velde, 2019) depend on domestic absorptive capacity through previous skills and technology accumulation. This suggests an important contextual and pathway-dependent factor which can be influenced by local policies and institutions.

The role of education and training in attracting FDI in Africa

The presence of human capital is a key determinant of FDI and, equally, is enhanced by the presence of multilateral corporations (MNCs) in developing economies. For African economies, the availability of natural resources, typically for exports, has been the principal determinant for FDI (UNCTAD 2020; Anyanwu 2011; Asiedu, 2006). Additionally, market access is an FDI determinant for non-tradable services that must be produced where they are consumed. This includes, for example, telecommunication or financial services. Crucially, studies that examine the role of barriers to FDI inflows suggest that human capital appears to be one of the most challenging of such barriers (Brooks et al., 2010; Assuncao, Forte, and Teixeira, 2011). The challenge to scale up HCD could intensify with the ongoing

[2] Lagakos et al. (2014) define experience as the number of years that have elapsed since the end of schooling. Their finding is robust to alternative definitions of experience.

shift of FDI towards more capital-, knowledge- and skill-intensive industries (Agbebi 2018; Hale and Xu, 2016).

Countries with education systems that are both adequate and efficient (Hanushek and Kimko, 2000) typically attract the kind of FDI that plugs domestic investment gaps and facilitates technology transfer (Newman et al., 2015; Keller, 2010). In practice, educational adequacy is hard to precisely define (Wise, 1983). Equally, educational efficiency (or the capacity of the education system to use the totality of its resources effectively) should lead to a strong correlation between education, wages and productivity (Mouhoud, 2013) – but does not always do so. The capacity to translate education into income is more important than the years of education in attracting FDI, particularly in developing countries (Miningou and Tapsoba, 2017). This points to the importance of the quality of education, and not just quantity of education as an input variable. This link is important to understand in practice given the break in the data, and its declining significance post-2000, as observed in this paper's empirical results.

Overall, the experience of successfully industrialised economies suggests that the presence of secondary and tertiary education is crucial in fostering inward FDI. We discuss the importance of tertiary education for developing economies through empirical results in this paper. Ecosystems of innovation (Cai et al., 2020), whereby the public, private and the academic sectors collaborate to identify needed industry skills, result in the supply of skilled labour being successfully matched to demand in real time and flexibly in the future. FDI attractiveness is enhanced in developing countries through implementing increased access to secondary vocational training and higher education. Thus far, some of the evidence base suggests that Chinese FDI into sub-Saharan Africa (SSA) – which constitutes an increasingly important share of FDI – does not contribute significant to HCD (Oya and Schaefer, 2019; Brautigam et al., 2018).

Education within a sector investment context

Successfully industrialised economies' growth models were predicated on HCD. Germany's dual vocational education and training (VET) and Singapore's clustering strategy are key examples (Baethge and Wolter, 2015; Tan, Koh and Choy, 2016). In particular, shifting policy emphasis to technical education at polytechnic institutes and facilitating a clustering effect between the public, private and academic sectors fostered greater HCD in their industrial paradigms. VET policy models are being discussed as a budget priority for STEM-based investments in SSA (Moyo, 2018), and would be particularly effective: the intensity of human capital spill-over is greater in industries in which human capital matters more, in larger or more densely populated cities (Liu, 2014).

By contrast, resource-rich SSA economies that attract resource-seeking FDI are at risk of poorer HCD, training and education outcomes. Dutch disease and resource curse literature suggests potentially detrimental effects of natural resource sectors on education spending (Cockx and Francken, 2016). The conflict and instability associated with resource rents inhibit the exploration of natural resources that encourage a fair distribution of the wealth.

Illustrative of Dutch disease-like symptoms has been Nigeria's oil sector which has been, in part, an enclave activity with little scope for sustained employment spill-over (Mawejje, 2020; Otaha, 2012; Watts, 2003).

The digital economy[3] can be used to improve economic and social outcomes. Digital platforms facilitate transactions and networking as well as information exchange. Digitalisation can foster the production of higher quality goods and services at reduced costs. And yet, only one in five people in least developed countries (LDCs) uses the internet compared with four out of five in developed countries (UNCTAD, 2019). This suggests that LDCs will find themselves at a disadvantage, as will incumbent local firms, with adverse impacts on employment. Therefore, the net impact of FDI within the realm of information and communication technology (ICT), will depend on Africa's digital readiness, which remains crucial (Songwe, 2019). Impacts on human capital can be assessed across both economic dimensions (e.g., productivity, value added, employment, income and trade) and for different actors (workers and micro, small and medium-sized enterprises).

Small business owners in agriculture and tourism lack the capabilities and skills to leverage digital connectivity for their operations in LDCs (Trendov et al., 2019). This is exacerbated by the vulnerability of LDCs to swings in the prices of agricultural commodities in global markets and the lack of developed domestic financial markets to insure against them. The volatility in revenue in response to these shocks reduces the scope for investment in HCD. One way to address this is to scale up ICT skills development. Building the human capital of smallholder farmers can raise productivity, increase livelihoods and improve food security (Krishnan et al., 2020). Education and training are pivotal in agricultural growth and development because the labour force occupies the centre of production, distribution and consumption.

The impact of and outcomes for education and HCD depend on the strategic context in which FDI takes place. With asset seeking motives strongly related to FDI, state support for human capital accumulation is important as FDI is increasingly directed towards research and development (R&D) and innovation activity. Thus, asset-seeking FDIs will widen the region's access to new markets, new technologies and product development competencies that result in spill-overs from foreign firms to the domestic economy (Okafor et al., 2015). The degree of domestic firm heterogeneity can further help explain the impact of FDI on domestic employment – which depends on firm-specific and country-specific advantages. The impact of FDI on domestic employment depend on the intersection of labour resource seeking, natural resource seeking, and strategic asset seeking (Hong et al., 2019).

MNEs and local firms: comparing employment and training practices

There is a long-standing debate on the relationship between FDI from MNEs and their domestic employment effects. The empirical results remain inconclusive (Sidebottom, 2017). Some studies find that inbound FDI from MNEs into a developing economy, and domestic

[3] There is no widely accepted definition of the digital economy. Foundational aspects of the digital economy include fundamental innovations (semiconductors, processors), core technologies (computers, telecommunication devices) and enabling infrastructures (Internet and telecoms networks) (UNCTAD 2019).

employment, have a negative relationship (Amusan, 2018) while other studies find a complementary link (Federico and Minerva, 2008; Desai et al., 2009). Others report results that are dependent on the country, the policy context, the sector or the MNE (Saurav et al., 2020; Mitra and Ranjan, 2010).

Vertical FDI (parent-subsidiary linked vertically) tends to reduce domestic employment, whereas horizontal FDI tends to increase it. Inward FDI from an MNE may replace its domestic employees with new employees hired by its affiliates (Greenaway and Kneller, 2007). On the other hand, an MNE's FDI may generate more domestic employment due to expanded operations (Hansen, 2014) if it is horizontal, market-seeking FDI. This typically occurs when an MNE expands its production base and global market access and needs to increase its input for expanded operations.

Direct and indirect MNE productivity effects and incentives for HCD

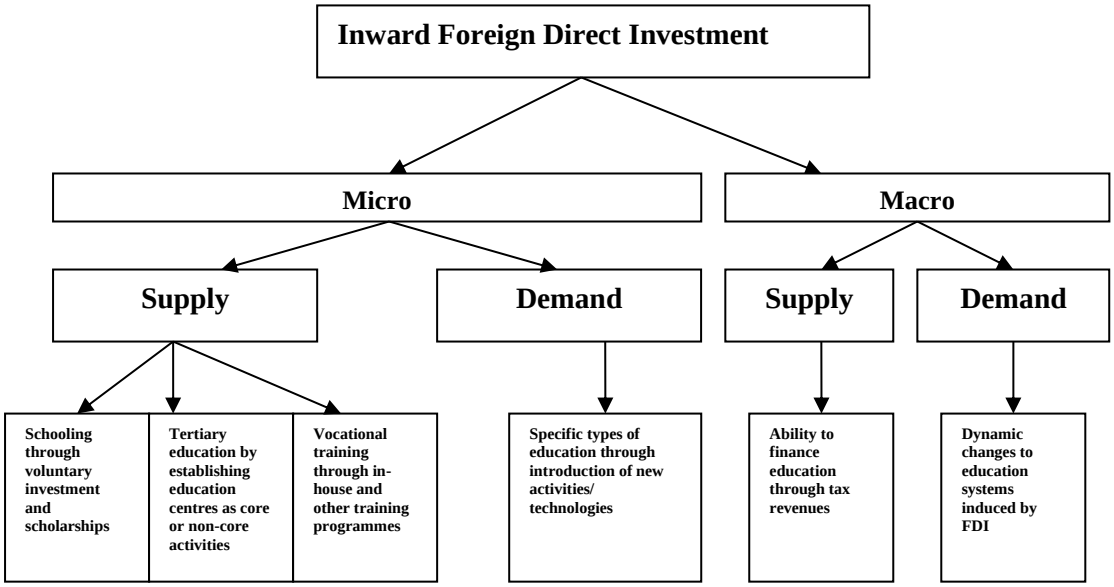
Human capital enhancement can be expected to lead to higher productivity and profitability as a direct result of the increased capacity of employees (Cleeve et al., 2015) and the indirect effect of employees utilising the codified and tacit knowledge and their greater willingness, commitment and motivation. Firms will benefit from the training of its local staff – and for the economy as a whole, movement to rival firms, or staff turnover, generates further positive spill-over effects as firms benefit from recruiting already skilled labour.

Beyond externalities and spill-overs, MNEs are catalysts for structural change (Narula and Pineli, 2018). Interaction with MNEs is not linear over time given technology and knowledge transfers (Newman et al., 2015) and as such add to a country's economic complexity – the pool of knowledge it holds and is able to combine for productive purposes (Sorensen, 2020). It is possible to infer complexity from the ability to export diverse and sophisticated products (Hidalgo and Hausmann, 2009). There is a positive and robust link between the level of sophistication of complex products exported by local firms and the presence of MNEs located in upstream, supplying sectors – signifying a learning effect.

3. *A supply and demand framework of FDI and HCA*

FDI affects the supply and demand for skills and human capital in different ways. Following Te Velde (2002), Figure 1 illustrates the links from (inward) FDI to human capital. FDI can affect the demand and supply of education and training, and the effects are usually different from the effects of local investment. We also distinguish between micro (firm and sector level) and macro effects. The latter incorporate dynamic macro-effects, for example via enhanced growth and government revenues.

Figure 1 The effects of foreign direct investment on human capital



Source: Te Velde (2002)

FDI affects the demand for skills by introducing new economic activities and technologies that require skills (Teece, 1977). For example, there is currently an increase in FDI in African digital technology which requires high level ICT and cognitive, non-routine skills, affecting the skilled segment of the labour market. In addition, FDI can make the economy more dynamic, generating more resources and changing the incentives to acquire human capital. These are indirect macro effects which will provide incentives for the demand for skills. Such incentives are strong when FDI supports structural transformation, but they are weak or negative when FDI is in enclave, resource extracting industries or activities displacing local firms. In Africa, significant FDI has been in natural resources or around take-overs in telecommunications and finance, which may not have led to significant dynamic incentives.

FDI also affects the supply of skills, through training and on-the-job learning or the provision of education. Te Velde (2002; 2019) provides several examples in which foreign firms provide more training to their workers compared to local firms. *Training combined with labour mobility* facilitates spill-overs in essentially two ways. Firstly, enhanced training and experience gained inside foreign firms, or training provided in their suppliers, raises the stock of knowledge and productivity of workers, which diffuses faster through the entire local economy through labour mobility. Knowledge gained can be used for start-ups of other firms. Gorg and Strobl (2005) use firm-level data in Ghana and show that domestic firms run by owners that used to work for foreign firms in the same industry immediately prior to starting their own firm have greater productivity growth than other local firms. This suggests that entrepreneurs accumulate certain knowledge that can be used to raise productivity. This knowledge is sector-specific as there are no productivity effects in case the entrepreneur started in a different sector. Reviewing the literature on China–Africa, Calabrese and Tang (2020) show that Chinese engagement has not yet led to major productivity spill-over effects in African countries.

Secondly, FDI can also directly enhance human capital through education schemes of companies or through investing in universities and business schools. The scale of on-the-job training is potentially large, e.g., for garments workers in Ethiopia or Kenya, but the voluntary education schemes are still limited.

The supply and demand framework can be extended to explore the different impact on low and high skilled workers (Te Velde, 2002), and can be used to explain the impact of FDI on wages, wage inequality and labour markets more generally, including in Africa (Te Velde and Morrissey, 2003). In this context, it is crucial to understand how MNEs affect supply or demand for labour and skills. If they incentivise more demand compared to adding to supply, this may push up (relative) wages of (skilled) workers within countries. This paper focus on development of human capital at country and sector levels.

4. Impact of FDI on human capital in Africa: empirical estimates

The evidence and framework in the previous sections suggests FDI affects human capital development through supply and demand routes. This section examines how this has worked for different education levels and different type of countries. We first discuss the econometric specification that will be used to explore these effects, then the data, and finally the empirical results.

Econometric model

New trade theory based on endogenous growth (e.g., Grossman and Helpman, 1991) indicates that upon opening to trade, productivity gains would stem from the specialisation of production process, depending on initial factor endowments. With imperfect knowledge transfer, openness to trade will lead high-skill countries to specialise in high-skill, high-productivity sectors while low-skill countries will focus in traditional manufacturing (assembly) sectors. Wood and Ridao-Cano (1999) provide empirical evidence suggesting that trade openness raised inequality in the provision of education by increasing secondary and tertiary enrolments more in high-skill, high-income countries than in other countries. Similarly, Te Velde and Xenogiani (2007) show that FDI enhances skills development (via higher secondary and tertiary enrolments) in countries with higher skills endowments to start with.

To further examine the effects of FDI on skills inequality among countries, particularly in sub-Saharan Africa, this paper updates the econometric estimates in Te Velde and Xenogiani (2007). The models include period sub-samples to identify any structural change before and after 2000. The model is derived from the Heckscher-Ohlin model of two countries with two factors (skilled and unskilled labour) and two goods (skill-intensive and labour-intensive goods) and is a modified version of the Wood and Ridao-Cano (1999) specification examining impact of trade openness on skills inequality.

The demand for labour is a function of the number of skilled workers relative to unskilled ones (n) and FDI (or TR for openness to trade), while the supply of labour is a function of relative number of skilled to unskilled labour, and other opportunities (or EO) for education

and skill acquisition independent of the current level of demand

$$D(n, FDI\ or\ TR) = S(n, EO) \quad (1)$$

with the reduced form,

$$n = f(FDI\ or\ TR, EO) \ (2)$$

To allow differential impact of FDI or trade openness for different types of countries, we constructed countries' deviation from world average skill (and land) endowments

$$\widetilde{SE}_{it} = \frac{SE_{it} - SE_t}{\sigma SE_{it}} \qquad \widetilde{LE}_{it} = \frac{LE_{it} - LE_t}{\sigma LE_{it}}, \qquad (3)$$

where *i* is the country index and *t* stands for the year of observation. A positive (negative) sign of the $\widetilde{SE}_{it}$ indicate that a country's skill endowment is above (below) the world average.

To investigate how FDI affects human capital development, enrolment rates (ER) are modelled as a function of EO (proxied by government expenditure on education and number of pupils per teacher), GDP per capita (pcy), trade (TR, trade as a ratio to GDP) and FDI indicators (flow as % of GFCF, or stock as % of GDP).

$$ER_{it} = \beta_1 TR_{it} + \beta_2\left(TR_{it} * \widetilde{SE}_{it}\right) + \beta_3\left(TR_{it} * \widetilde{LE}_{it}\right) + \delta_1 FDI_{it} + \delta_2\left(FDI_{it} * \widetilde{SE}_{it}\right)$$

$$+ \delta_3\left(FDI_{it} * \widetilde{LE}_{it}\right) + \pi EO_{it} + \theta log(pcy_{it}) + \varepsilon_{it} \quad (4)$$

Following Te Velde and Xenogiani (2007), we implement a parsimonious model including FDI and interactions between FDI and factor endowments,

$$ER_{it} = \delta_1 FDI_{it} + \delta_2\left(FDI_{it} * \widetilde{SE}_{it}\right) * SSA + \pi EO_{it} + \theta log(pcy_{it}) + \varepsilon_{it} \qquad (5)$$

where *i* is the country index and *t* stands for time (5-year time intervals for *ER, FDI, EO, pcy*). Enrolment rates are used as independent variables separately for primary, secondary and tertiary (*PER, SER* and *TER*, respectively) education.

The main interest in this empirical investigation is to examine the coefficient δ_2 of the interaction term between FDI and $\widetilde{SE}$. For example, if δ_1 is positive, and δ_2 is positive and significant, this would indicate that FDI leads to skills enhancement of countries already well-endowed with skills. Meanwhile, if δ_1 is positive, and δ_2 is negative and significant, this means that FDI leads to further skills deterioration of countries with already poor endowment of skills. We also investigate the presence of a differentiated impact by time or region by creating a period dummy (before and after 2000) and run regressions on a sub-sample covering SSA countries.

To address potential endogeneity bias (e.g., that enrolment rates and FDI maybe jointly

determined since skill endowments may create incentives for FDI and vice versa), the skill endowment measure in terms of average number of years of schooling was determined at the beginning of the five-year period, while the enrolment rates are measured as averages of current five-year period. We employ OLS and panel estimations with fixed effects and random effects. A sensitivity analysis using alternative measure of FDI was also conducted to check the robustness of results.

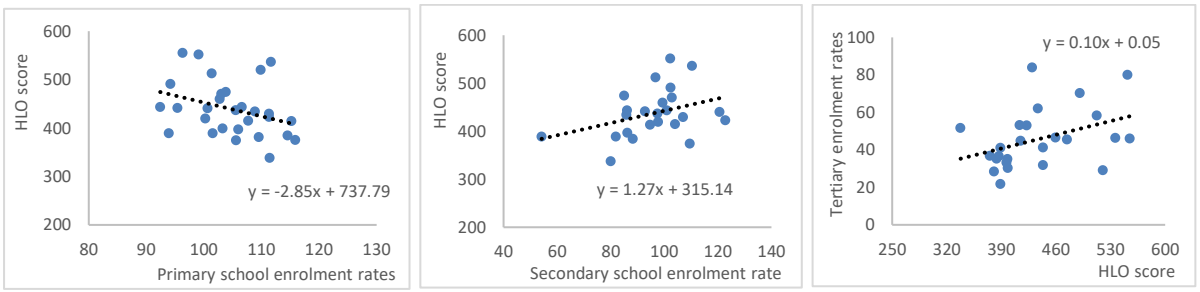
Description of the data

This paper combines 1970–2019 data from different data sources, including WDI, UNDP, UNCTAD and the Barro and Lee educational attainment data set. The sample includes 91 low- and middle-income countries (L&MIC) with available educational attainment data necessary for computation of skills endowment (our main variable of interest). Within these L&MIC countries, 31 are in SSA. The panel data includes 10 five-year time periods. The dependent variable is the gross enrolment rate in primary, secondary and tertiary education. These separate series were taken from the WDI database and constructed as averages over the relevant five-year time period (e.g., 1970–74, 1975–79, etc.).

We recognise the limitation that enrolment rates do not automatically reflect learning outcomes, with the latter being the more relevant indicator in assessing the contribution of FDI on human capital (skills) formation. The World Bank's (Angrist et al., 2018; 2021) 'Harmonised Learning Outcomes (HLO)' index, which covers comparable schooling quality measure at the primary and secondary levels over 164 countries from 1965–2017, is an ideal data source. However, this dataset as of December 2020 only covers 22 African countries at peak of data availability in 2005. In other years, African country coverage can be as low as one (1980,1990) or two countries (2015).

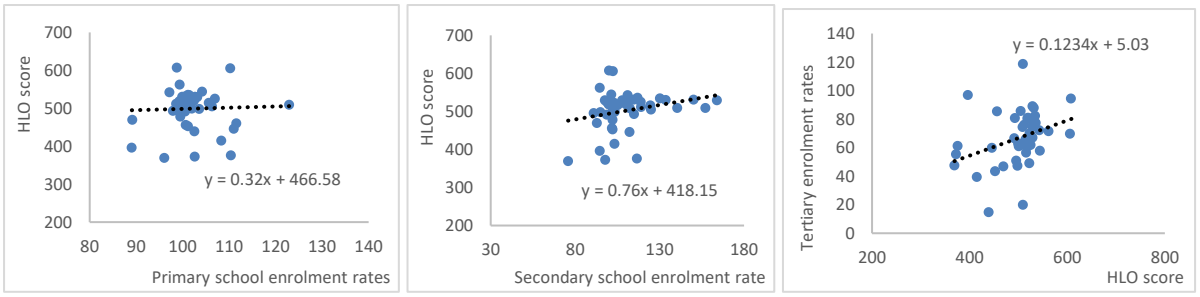
While our chosen dependent variable on enrolment rates has limitations, this is nonetheless positively correlated with learning outcome indicators, especially for secondary and tertiary enrolment rates in middle-income countries (Figure 2). In fact, the correlations are stronger for learning outcomes and secondary enrolment rates in middle-income countries than in high-income countries (Figure 3). In both country groupings, better learning outcomes in primary and secondary education also appear to drive higher tertiary enrolment rates. These positive correlations provide us motivation to use secondary and tertiary enrolment rates (in absence of comprehensive learning outcome indicators) as indicator on how FDI builds human capital formation for this paper.

Figure 2. Correlations between learning outcomes and enrolment rates in middle-income countries, 2015



Notes: HLO scores utilised in these correlations cover 35 lower-middle and upper-middle income countries and are based on average HLO scores processed by Our World in Data (ourworldindata.org), based on data from Angrist, et al. (2018). The average scores are from standardised, psychometrically-robust international and regional student achievement tests. Tests have been harmonized and pooled across subjects (math, reading and science) and levels (primary and secondary education).

Figure 3. Correlations between learning outcomes and enrolment rates in high-income countries, 2015



Notes: HLO scores utilised in these correlations cover 52 high-income countries and are based on average HLO scores processed by Our World in Data (ourworldindata.org), based on data from Angrist, et al. (2018). The average scores are from standardised, psychometrically-robust international and regional student achievement tests. Tests have been harmonized and pooled across subjects (math, reading and science) and levels (primary and secondary education).

High enrolment rates, without an increase in the ratio of teacher per student, could impair learning outcomes. This might partly explain the negative (positive) correlation of primary enrolment rates and HLO scores in middle-income (high-income) countries (Figures 2 and 3, first panels). For instance, as of 2018, primary school enrolment rates reached 100% in low-, middle-, and high-income countries and yet in these country groups, pupil-to-teacher ratios in primary education are at 39, 25 and 14, respectively.[4] However, we recognise the prerequisite role of primary education in establishing fundamental literacy for higher-level education. FDI may also encourage human capital formation (e.g., higher level of education) indirectly through its impact on primary school enrolment rates.

The main explanatory variables are comprised of three sets, detailed below.

- First, the average years of schooling is utilised as a measure of the stock of human capital or initial skill endowments in a country. Following te Velde and Xenogiani (2007), the initial skill endowment is measured at the beginning of the five-year interval. The data from 1970 to 2010 are based on Barro and Lee (2013, dataset updated as of 2018) and 2015 data are from the UNDP Human Development Report

[4] Based on World Development Indicators database.

database. The world average years of schooling is based on the mean years of schooling of 144 countries worldwide (and including high income countries) from the same sources.

- The second set of explanatory variables refer to educational opportunities, which is proxied by government expenditure on education as a percentage of GDP. The ratio of pupils to teachers in primary education is used as a proxy for education quality. The data are constructed as averages over the relevant five-year time period.
- The third set of explanatory variables consists of FDI variables. Data to construct FDI flows as a percentage of GDP and net FDI inflows as percentage of gross fixed capital formation are from WDI. Data on FDI flows and stocks are from UNCTAD. The data are constructed as averages over the relevant five-year time period. We also include income in terms of GDP per capita as an additional control variable, defined at the beginning of the five-year period.

Detailed information on data definition, frequency, construction and sources are available in Appendix 1.

Discussion of the results

We focus the discussion on the impact of FDI and its interaction with skills endowment on enrolment rates in primary, secondary and tertiary education. The impact of other variables on enrolment rates are presented in Appendices 2 to 4.

First, FDI (stocks and flows) is positively associated with primary enrolment rates in full L&MICs, and is significant in ordinary least squares (OLS) and random effect models (see Appendix 2). The main variables of interest – the interaction term of FDI and skills endowment – are negative and significant when FDI stock is used, but not significant in models that utilise FDI inflows for the sample covering the full period (1990–2015). However, results from regressions accounting for period sub-samples show a significant and positive interaction term in the first period (1990–2000) and significant and negative in the second period (2005–2015).

In other words, the impact of FDI on primary enrolment rates before 2000 seems to be more favourable in L&MICs with relatively well-endowed skills initially. Since 2005, however, the FDI seems to lower primary enrolment rates in L&MICs with already relatively poor skill endowments to start with. The results are similar when using either FDI flows or FDI stocks, with higher coefficients for the former. For the SSA sub-sample, the coefficients of the interaction term in full and sub-period regressions follow the same trend in L&MICs but are insignificant, potentially driven by the insignificance of FDI in driving primary enrolments in SSA.

It may be noted, however, that the explanatory power (as indicated by R-squared) in all models with primary enrolment as dependent variables is low – a similar problem encountered by te Velde and Xenogiani (2007) – indicating that other factors (e.g., political/global pressure for access to universal basic education) outside our chosen controls

in driving primary school enrolments.

Second, Appendix 3 shows that FDI (flow and stock) is significant and positively associated with secondary enrolment rates in the full sample of L&MICs in all estimation methods and models. This is different from earlier findings by te Velde and Xenogiani (2007) which indicate that FDI has a significant but negative effect on enrolment rates. Our results suggest that the impact of recent FDI is more favourable in increasing the L&MICs' secondary enrolment rates than in earlier decades. This is further confirmed by the relatively higher and significant coefficients of FDI inflows in the second period (2005–2015) as well as the significance of FDI stock in the second period (2005–2015) in L&MICs. Similar trends are observed in the SSA sub-sample, albeit not statistically significant.

At first glance, the signs of the interaction term are inconclusive across models or when FDI flows or stock are used. Based on Hausman test and explanatory power, we focus on the results of panel regression with fixed effects (that use FDI stock) which show a significant and negative sign of the interaction term. The results differ from the positive interaction term in te Velde and Xenogiani (2007). The difference might have been driven by the more recent FDI after 2000, which has a less favourable (but insignificant) effect on secondary enrolments in L&MICs that have relatively low skills endowment initially. Meanwhile, for the SSA sub-sample, the interaction term is positive in all sub-periods.

Appendix 4 shows a consistently positive and significant effect of FDI (inflows and stocks) on tertiary enrolments in L&MICs in all estimation models, as well as the strongly favourable impact of FDI in increasing tertiary enrolments in L&MICs with already high endowments of skills to begin with. The results also display stronger significance for regressions using FDI stocks. However, FDI remains to have positive but weakly significant impact on tertiary enrolments in SSA countries. The interaction term has positive coefficient, with significant effects especially in regressions that utilise FDI stock.

Table 1 below presents the summary of results of our baseline model showing the main variables of interest, FDI and the interaction term (FDI*skills endowment) in panel regressions with fixed effect. In Africa, we find that FDI does: 1) not significantly enhance primary education enrolment rates; 2) significantly enhances secondary education enrolment rates since 2005 (but not before); and 3) significantly enhances enrolment rates in tertiary education. Overall, the interaction term has positive and significant effects in tertiary education, and in secondary education (but not significant after 2000).

Table 1. Summary results: panel with fixed effects regressions, FDI stock

	Full-year samples (models 9 and 10)		Samples accounting for sub-periods (models 11 and 12)			
	1970-2015		1970-2000	2005-2015	1970-2000	2005-2015
	FDI	FDI*skill	FDI	FDI	FDI*skill	FDI*skill
I. Baseline model						
Primary education enrolment rates						
L&MICs	(+)	(-)***	(-)	(+)	(+)	(-)***
SSA	(-)	(-)	(-)	(+)	(+)	(-)
Secondary education enrolment rates						
L&MICs	(+)***	(-)*	(+)	(+)***	(+)**	(-)
SSA	(+)	(+)	(+)	(+)***	(+)***	(+)
Tertiary education enrolment rates						
L&MICs	(+)***	(+)***	(+)***	(+)***	(+)***	(+)***
SSA	(+)*	(+)	(+)	(+)***	(+)**	(+)**
II. Dynamic model (baseline model, but using lagged FDI indicator)						
Primary education enrolment rates						
L&MICs	(-)***	(-)**	(+)	(+)	(+)**	(-)***
SSA	(+)	(-)	(+)***	(+)***	(+)***	(-)
Secondary education enrolment rates						
L&MICs	(+)	(-)	(+)	(+)***	(+)	(-)***
SSA	(-)	(-)	(+)	(+)***	(+)***	(+)
Tertiary education enrolment rates						
L&MICs	(+)***	(+)***	(+)	(+)***	(+)	(+)***
SSA	(-)*	(+)	(+)	(+)**	(+)**	(+)

*Significance at the 10% level, **significance at 5% level, ***significance at 1% level; robust estimation.
Notes: The results are based on unbalanced panel data of 91 L&MICs countries, 31 of which are in Sub-Saharan Africa, where we excluded countries or certain years with outlier indicators (i.e., Liberia with FDI stock worth 500% of GDP on average from 1980 to 2015; 270% of GDP in Mozambique in 2015). The results with or without outliers do not materially affect the results. Full results of the dynamic model are available upon request from the authors.

For sensitivity analysis (and further account for possible endogeneity between FDI and education), we use a dynamic regression form by using a lagged measure of FDI (lower panel, Table 1). We lagged FDI by one period with the interpretation that FDI (average of a five-year period) provides incentives for skills development in the next five years, while also addressing potential endogeneity concerns that education and FDI might be jointly determined (following te Velde and Xenogiani, 2007).

The regression results of the dynamic model (using lagged FDI) broadly reflect the same relationships from our baseline model, except with the significant effects of FDI on primary education enrolment rates after five years. This indicates the lagged effects of FDI on other factors that drive primary enrolment rates not captured in the model, such as increasing tax revenues from FDI that increase public spending on primary education.

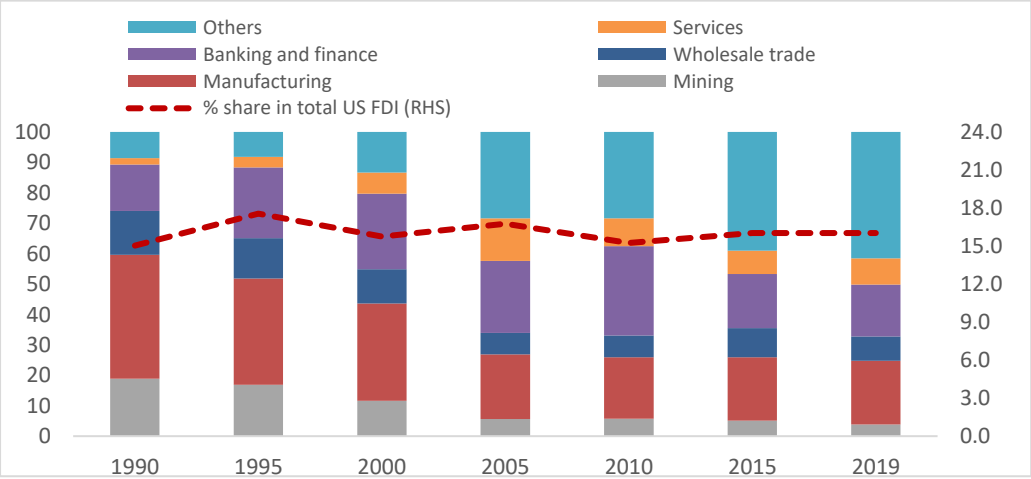
Similar to the baseline model, the dynamic model also shows positive and significant coefficients of the interaction term in Africa from 1970 to 2000, but these have not been significant beyond this period. We argue that the insignificance of the interaction term can in part be explained by the type of FDI that has been attracted to Africa after 2000, including FDI in natural resources and construction, which may not have had the positive synergies between FDI and human capital (separate from income effects) we have seen in other developing countries in Asia. For example, the reinforcing effect of FDI on initial

endowments is somewhat reflected in the descriptive evidence on the types of FDI stock of major investors in Asia (with relatively higher initial educational attainment and digital skills) compared with that in Africa (with relatively lower initial educational attainment and digital skills). As of 2015, East Asia Pacific countries have an average of 7.8 years of educational attainment, compared to 5.3 years in SSA (Barro and Lee, 2018). As of 2018, the share of population using the internet (as a proxy for digital skills) is at 56.6% in East Asia Pacific, compared to 25.1% in SSA (WDI, 2021).

Figure 3 shows that the share of US FDI in the mining sector in US FDI in Asia and the Pacific has declined from 19% in 1990 to 4% in 2019, providing space for more sophisticated FDI that can utilise and enhance Asia and the Pacific's relatively higher skilled labour force. On the other side of the spectrum, Figure 4 shows that while the share of US FDI in low-skill mining sector in total US FDI in Africa has decreased in the past two decades, it remains the major recipient of US FDI (38% share) in the continent. Low-skill sectors (e.g., mining and construction) have also been the target of major investments from UK (Figure 5) and China (Figure 6), disincentivising labour force upskilling in the lack of FDI that requires high-skill employment in Africa. In the past decade and on average, the US, the UK and China account for almost 20% of FDI stock in Africa.

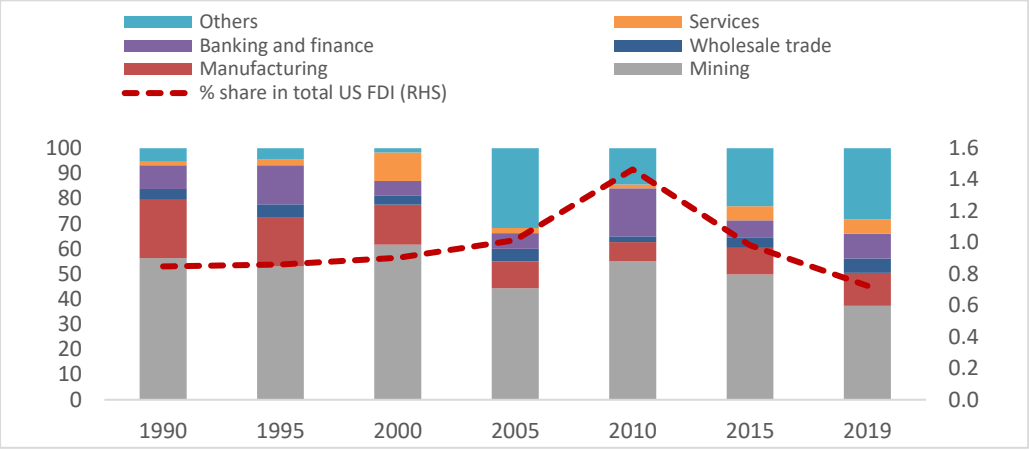
In conclusion, the evidence suggests that FDI enhances initial conditions (of skill endowment) with larger impact at the top end, suggesting the facilitating role of FDI in exacerbating skills inequality within and among countries. This makes a stronger case for African policymakers to encourage not only the volume of FDI, but more importantly, the quality of FDI that can catalyse transformative impact (e.g., firms that bring quality jobs with higher and distributive income, employ knowledge transfer and management training) that will incentivise higher education and training, and eventually contribute to narrowing the skills gap.

Figure 3. US FDI stock in Asia and Pacific, by industry (% share of total FDI to the region)



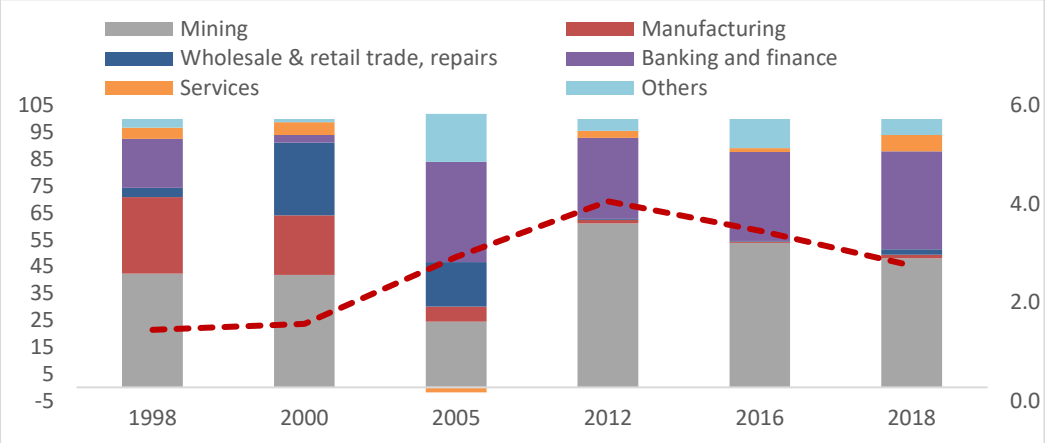
Source: Authors' computation based on US Bureau of Economic Analysis data

Figure 4. US FDI stock in Africa, by industry (% share of total US FDI to the region)



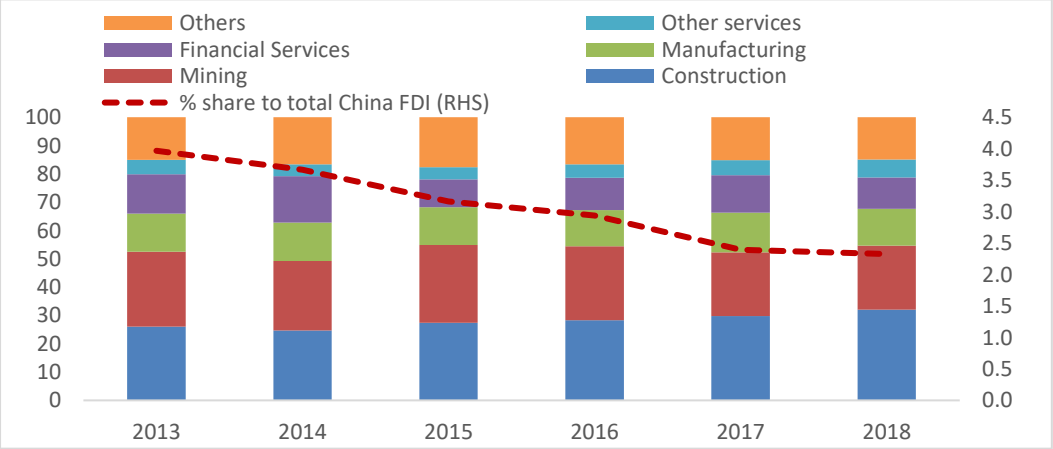
Source: Authors' computation based on US Bureau of Economic Analysis data

Figure 5. UK FDI stock Africa, by industry (% share of total UK FDI to the region)



Source: Authors' computation based on ONS Office for National Statistics data

Figure 6. China FDI stock Africa, by industry (% share to total China FDI in the region)



Source: Authors' computation based on Johns Hopkins University SAIS China-Africa Research Initiative data

5. *Sector experiences of FDI and human capital development in Africa*

We review a number of African sector experiences to complement the data-based work in the previous section. This provides five examples around the impact of FDI on human capital in Africa, centred around manufacturing, ICT and natural resources in different African countries. The use of these qualitative sector experiences also allows for analysis on how different types of skills, education, experience and human capital interact with FDI (and going beyond the data driven regression results in the previous section).

Ethiopia's Garment Industry

Manufacturing in garments requires basic skills and is a step up for HCD in countries such as Ethiopia. Bangladesh, the world's garment exporting countries, owes its success in part to the presence of a foreign company (South Korea's Daewoo), which aided learning, new production processes via advanced technologies, built capacity and facilitated further training and the transfer of skills (Balchin and Calabrese, 2019). Similarly, in Ethiopia, the rapid growth of export-oriented garment manufacturing owes much to a favourable mix of proactive, state-led industrial policies (Mitta, 2020). Crucially, priority is accorded to FDI and particularly to higher value-added, export-oriented investment.

Foreign manufacturers, mostly Chinese and Turkish firms (Negash et al., 2020), have invested in garment production bases in Ethiopia to supply major international brands and retailers. This has facilitated rapid growth in Ethiopia's exports: apparel exports expanded from less than $250,000 in 2000 to $63 million in 2016. Vertically integrated local firms and MNEs are a distinguishing feature in most SSA garment-exporting countries (Staritz et al., 2016).

Despite the growth in FDI and in exports within the garment industry – and within light manufacturing – the impact on HCD in Ethiopia has been somewhat limited. Local subcontracting, overall domestic industrial capabilities, skills development and domestic management capacity remain significant concerns in terms of Ethiopia's ability to take advantage of the influx of FDI. Women at work in the apparel sector face risks that sometimes affect their well-being and their ability to excel at work, they often have low levels of education and awareness of their rights, precarious living conditions, and often hold the lowest paying, lowest status jobs. Turnover rates across the industry average at 8 percent per month – resulting in 100 percent turnover on an annual basis (Yost and Shields, 2017).

Automobile Industry in Morocco and South Africa

Morocco's automobile industry experienced a major transformation when, in 2005, the multinational automobile manufacturer Groupe Renault became majority shareholder in SOMACA[5] and production of the model Dacia Logan was produced for export to the EU, the Middle East and North Africa (MENA) region (IFC, 2019). This collaboration resulted in fast

[5] Société marocaine de constructions automobiles was founded in 1959 in Casablanca to assemble vehicles for the local market, with technical assistance from Fiat and its French subsidiary.

growth of automobile exports to almost $4.5bn in 2017 – an increase of 1000 per cent since 2005, also taking into account car-related intermediate products.

Despite the fact that foreign inputs account for a large share of the value of exports, the domestic value-added content of exports has increased, highlighting the complementarity between domestic and foreign value added in global value chains. In the case of Morocco, domestic companies operate in the labour-intensive assembly of final cars, which benefited employment. The country developed a vast ecosystem around the automotive industry, which not only produces cars, but also seats, articles of rubber, insulated wires and other electrical equipment that is needed for the production of automobiles. Building on the success of the past decade, Morocco has further attracted a second foreign multinational firm, PSA Peugeot-Citroen, which opened a new production site in 2019 (Riera and Paetzold, 2018).

Crucially, Morocco's government supported the creation of interlinked ecosystems through the provision of industrial parks and special economic zones with a preferential regulatory system. Additionally, it reduced corporate tax rates and import and export duties to attract foreign firms in order to develop domestic production capacities. Moreover, the government subsidised human resource development in the automotive cluster and opened targeted training schools (IFMIA), that have a capacity to develop skilled technicians for the automotive industry, fostering clusters (World Bank, 2019; Amraoui et al., 2019; Auktor and Hahn, 2017).

This positive interaction between the human capital base and foreign investment in Moroccan automobiles also reflects the experience in South Africa. Te Velde and McGrath (2005) discuss the relationships between the automotive industry and education and training systems in South Africa. The automotive industry consists of seven MNCs and has gone from a protected industry under the Apartheid system to producer and exporter of top-quality cars. Skills development has been at the forefront (in addition to the incentives programme) in making this industry internationally competitive, and the car producers have taken an active role in the formulation of human resource policies.

Key institutes include the public Automotive Industry Development Centre (AIDC), which sees itself as a facilitator between the supply-side (public further and higher education and training institutions) and the demand side (the automotive sector). It has signed agreements with a number of higher education providers to develop programmes for which there is a clear industry demand. Between 2001 and 2004, the AIDC invested ZAR28 million in three public providers in, leveraging in an additional ZAR16 million from industry to support capacity-building. The investments have led to 26 new academic posts and reached more than 13,000 learners by mid-2004. The industry became a supporter of human resource policies. While the industry may not be a representative for the rest of (South) Africa, the account shows that it is possible to build up a competitive industry in the presence of appropriate mechanisms to coordinate skills development.

Nigeria's Oil Sector

There are characteristics of Nigeria's oil industry that limit the scope for HCD. First, the political instability and transnational interests that often accompany subsoil wealth (Siakwah, 2017) are associated with poor economic growth, with a key channel of transmission being human capital accumulation (Aisen and Veiga, 2011). Second, the scarcity of specialised schools, vocational centres, haphazard verification and matching of skills to demand has hindered inward investment (Ostensson, 2020; Mtegha and Toigo, 2015). This owes to a lack of incentives for local skills development due to Nigeria's economic extraversion, dependence on foreign expertise and particular types of MNC investments that safeguard their interests and have been characterised as engaging in 'skills protectionism' (ECDPM 2017; Jiboku and Akpan, 2018).

Nigeria's public and private-sector HCD programmes are extended to the community as a whole; human capital development programmes should consider the need for alternative economic activities to support the community during and after the life of the mine operation. In Nigeria, UNDP has worked with Shell to support the preparation of a sub-regional Human Development Report for the Niger Delta, which resulted in initiatives for skills development for the youth. A key to HCD is the 'transferring of business DNA' to local entrepreneurs. The viability and scalability of interventions, such as those aimed at expanding economic opportunity, depend on capacity-building for local cohorts of suppliers and distributors in a variety of locations (Adedeji et al., 2016).

Although much more limited than in other industries, extractive sector employment offers significantly higher income than employment in other sectors of local economies. To prepare for human resource needs, and enhance developmental impact, the policy context is increasingly one in which extractive companies are investing in education facilities and domestic technical training (Ostensson, 2020). After decades of MNCs being present in Nigeria's extractive sector without substantively narrowing the skills disparities between local and expatriate employees, MNCs are starting to target shortage categories such as geologists, petroleum and mining engineers (Jiboku and Akpan, 2019). Overcoming this has been linked to unions mitigating both casualisation and conflict in the Niger Delta region (Houeland 2015; Fajana, 2005).

Natural resources in Zambia

Zambia's inward FDI from China has largely been resource-seeking in nature, targeting the mining and construction sectors; and inward FDI into these sectors has had the biggest requisite impact on employment (Sinkala and Zhou, 2014). Although some Chinese FDI into Zambia is market seeking, China's demand for raw materials could remain at a level that threatens economic diversification (Abdelghaffar et al., 2016; Kamwanga and Koyi, 2009). Chinese businesses that are largely state-owned and have access to preferential finance do not operate conventionally as profit maximising firms would, often willing to provide concessions in order to gain access to markets, bidding at very low prices, sourcing cheap inputs from China, and using fairly skilled Chinese workers, rather than local hires (ibid.).

The link between China's FDI and Zambia's human capital development is weak owing to China's investments largely targeting the latter's resources (predominantly its copper) and in mining, rather than higher value-added activities, such as processing (Ofstad, 2020). Lubinda and Jian (2018) highlight some of the major investments undertaken by state-owned, independent and private Chinese companies in Zambia. They are largely extractive in nature and include investments in Zambia's Special Industrial Zones (in the Chambishi Copperbelt and in Lusaka East and South). Additionally, there is a Chinese-owned copper smelter in Chambishi, which also undertakes smelting for additional copper mines. Additional high profile Chinese investors, such as electronics company Huawei, have also built a presence in Zambia's special industrial zones. In a number of its investment activities, China's involvement has by some been characterised as exploitative, abusive of human rights, showing little evidence of contributing to Zambia's human capital development through its FDI (Osondu-Oti, 2016; Ndulu, 2013).

Kenya's Digital Economy

Known as the 'Silicon Savannah', Kenya has seen its ICT sector grow an average of 10.8% annually since 2016, becoming a significant source of economic development and job creation with spill-over effects in almost every sector of the economy (World Bank, 2019). However, a move towards expanding the digital economy requires different types of upgraded skills, particularly non-routine cognitive tasks where there is scope for employment growth (Banga and te Velde, 2018a; Banga and te Velde, 2018b). Inward FDI into Kenya has been conducive to increased technology diffusion and skills transfer and employment, particularly in services (AFDB 2019; Osano and Koine, 2016).

Kenya's digital economy brought about the success of mobile money, the creation of Africa's most vibrant tech scene and the computerisation of the election process. Despite Kenya's inward FDI of the recent past, and the increased presence of the digital economy (Nyabola, 2018), Kenya's human capital development still ranks at a relatively low level; policy interventions targeted to the technical, vocational, education and training sector remain crucial and overdue in ICT– particularly when preparing the economy for the fourth industrial revolution (Wakiaga, 2020; Maina, 2016). Kenya's digital entrepreneurs face limited access to finance, the sector lacks a pipeline of digitally skilled talent and Kenya also faces a significant digital divide, with 44% of the urban population and 17% of the rural population having the ability to access the internet (World Bank, 2019).

Creating a larger, more deeply integrated 'Single Digital Market' across East Africa, and increased integration globally, would provide a larger base for Kenya's inward FDI. This would contribute to its human digital capital, build a digitally savvy workforce for Kenya to capitalise on emerging opportunities in high growth sectors, create more jobs for the youth and close the digital divide. Kenya's digital firms face a challenge of small market scale relative to many competitors (Ndung'u, 2019), these include further improving connectivity across the country, ensuring a fully functional mobile payments platform and implementing

measures to strengthen multiple forms of financial and regulatory protections (ibid.).

Conclusions

Table 2 summarises the impact and confirms the impacts founds in Section 4 around supply and demand for education. The examples suggest that the impact varies by sector of FDI, possibly home country of FDI, initial skill levels and policy context.

Table 2 Summary of five cases of FDI and human capital development

	Direct impact	Significance of dynamic effects	Link to Figure 1 (supply and demand)
Ethiopian garments	Moderately positive for low skilled garments workers	Few spill-overs	Supply: Limited training for many, CSR Demand: moderate effects for above average manufacturing skill levels
Moroccan automobile	Positive for high skilled workers	Significant scale through demand and supply	Supply Training, Demand: dynamic incentives through transformation
Nigerian oil	Few effects on primary and secondary skills	Few spill-overs	Supply: CSR Demand: weak effects
Zambian mining and construction	Few effects from Chinese FDI	Few spill-overs	Supply: n/a Demand: weak effects
Kenyan digital economy	Positive for a select number of skilled ICT workers	Limited but increasing spill-overs through demand and supply	Supply: Training, Demand: dynamic incentives through transformation

Source: this section

6. *Conclusions and implications for country analysis*

Conclusions and limitations

There are many links between FDI and human capital: human capital helps to attract FDI and FDI can help to develop human capital. We examined the mutual links between FDI and human capital and presented a supply and demand framework to consider the impact of FDI and HCA, applying to both micro and macro levels.

- Supply
    - Micro: scholarships and schooling, establishing education centres, vocational and in-house training
    - Macro: dynamic effects through economic development and increased resources for education.

- Demand
    - Micro: introduction of new technologies at firm level which requires skills
    - Macro: dynamic effects through economic transformation which requires higher skills levels.

We provided new empirical estimates for a sample of 91 countries over 1970–2015 showing that inward FDI supports human capital development by supporting education enrolment rates, especially at secondary and tertiary levels, both independently from and through income effects. The results are stronger the higher the level of initial skills endowments. However, the effects are less strong in Africa where the interaction between FDI and initial skills endowment has become insignificant, especially since 2000. We argue that this can in part be explained by the type of FDI that has been attracted to Africa after 2000, including Chinese and UK FDI in natural resources and construction, which may not have had the positive synergies between FDI and human capital (separate from income effects) we have seen in other developing countries.

We reviewed five cases of the interaction between FDI and human capital development in Ethiopian garments, Moroccan ad South African automobiles, Nigerian oil, Zambian copper and Kenyan ICT. These case studies enriched the data driven statistical evidence and show that the impacts of inward FDI on different types of skills, education and human capital further depends on sector, policy and institutional context.

There are limitations to the evidence presented here. There are always limitations to data driven exercises in poor country settings, but they also offer robust evidence over longer runs of data. Unfortunately, it was not possible to go into more details in the regression about the exact type of human capital and education, e.g., which technical or managerial skills are most helpful, or whether focusing on learning outcomes rather than enrolment rates alters the results. Widely available data at the country level FDI also do not capture the full complexity of MNEs. Further, the five case studies were very short and did not involve in-

country discussions. These shortcomings can potentially be addressed through country case studies, elaborating on the richness that already emerged from the sector case studies.

Implications for country analysis

Country-level analyses provide further insights into the FDI and human capital links by asking the following type of questions in their analysis

- What is the sector distribution of FDI, the skill and technology intensity of the sector, the motives and strategies of the multinationals, and the skills composition of the workforce?
- Does the multinational provide training, if so what types and to whom? And how different is this from local firms?
- Does the multinational have a CSR educational programme? What are the effects
- Is the policy context conducive for spill-overs: e.g., is there strong interaction between education system and foreign firms, or effective linkage programmes?
- Does FDI support the transformation of the whole economy, or does it do so in a very limited way, e.g., by operating in enclaves

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Appendix 1: Data definition and sources

	Indicator	Definition by source	Years covered	Source	Construction, following te Velde and Xenogiani (2007)
Dependent variable (3 variables)	1) Primary education enrolment rate	Gross enrolment ratio is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.	1970-2019, with substantial missing data in some years and in several countries	World Bank – World Development Indicators (WDI)	Averages over the current 5-year period (i.e., 1970-1974, 1975-1979,…, 2015-2019)
	2) Secondary education enrolment rate				
	3) Tertiary education enrolment rates				
Independent variables	A. Proxy for stock of human capital or initial skill endowments: Average number of years 1) primary, 2) secondary and 3) tertiary schooling	Average number of years of for population aged 25 and over. Data available for total, primary, secondary and tertiary years of schooling.	1950 to 2010, in 5-year interval	Barro, R. and Lee, J. (2013) 'A New Data Set of Educational Attainment in the World, 1950-2010' Journal of Development Economics, vol 104, pp.184-198. Accessed updated data set v. 2.2, June 2018 via http://www.barrolee.com/	- Used average years of secondary schooling, but also included primary and tertiary education to check robustness of results. - Measured initial skill endowment at the beginning of the 5-year interval
		Average number of years of education received by people ages 25 and older	1990 to 2018, annual	UN Human development report (HDR) http://hdr.undp.org/en/indicators/103006	
	B. Proxy for educational opportunities: Government expenditure per student as percentage	Government expenditure per student is the average general government	1995-2018, with substantial missing data in	WDI	Averages over the current 5-year period

	Indicator	Definition by source	Years covered	Source	Construction, following te Velde and Xenogiani (2007)
	of GDP per capita: separately in primary, secondary and tertiary education	expenditure (current, capital, and transfers) per student in the given level of education, expressed as a percentage of GDP per capita.	some years and in several countries		
	Government expenditure on education as % of GDP	General government expenditure on education (current, capital, and transfers) is expressed as a percentage of GDP. It includes expenditure funded by transfers from international sources to government. General government usually refers to local, regional and central governments.	1970-2019. Only 17 countries have 2019 data, few available data in 2018	WDI	Averages over the current 5-year period
	Ratio of pupils to teachers in primary education (proxy for education quality)	Primary school pupil-teacher ratio is the average number of pupils per teacher in primary school.	1970-2019. Only 3 countries have 2019 data	WDI	Averages over the current 5-year period
	C.1 Foreign direct investment (FDI) variables FDI net inflows as % of gross capital formation	FDI are the net inflows of investment to acquire a lasting management interest (10% or more of voting stock) in an enterprise operating in an	1970-2019 (with negative values)	WDI	Averages over the current 5-year period

	Indicator	Definition by source	Years covered	Source	Construction, following te Velde and Xenogiani (2007)
		economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. Total net FDI: In BPM6, financial account balances are calculated as the change in assets minus the change in liabilities. Net FDI outflows are assets and net FDI inflows are liabilities. Data are in current U.S. dollars.			
		Gross fixed capital formation (GFCF) includes land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. According to the 1993			

	Indicator	Definition by source	Years covered	Source	Construction, following te Velde and Xenogiani (2007)
		SNA, net acquisitions of valuables are also considered capital formation. Data are in current U.S. dollars.			
	11) Inward FDI stock as % of GDP	Inward FDI stock Current GDP	1980-2019 1960-2019	UNCTAD WDI	Averages over the current 5-year period
	GDP per capita	GDP per capita, in constant 2010 US dollar	1960-2019	WDI	- Log of GDP per capita - Measured at the beginning of the 5-year interval

Appendix 2. Dependent variable: Primary school enrolment rate

	OLS						Panel fixed effects						Panel random effects					
	(1) L&MIC	(2) L&MIC	(3) L&MIC	(4) SSA	(5) L&MIC	(6) SSA	(7) L&MIC	(8) L&MIC	(9) L&MIC	(10) SSA	(11) L&MIC	(12) SSA	(13) L&MIC	(14) L&MIC	(15) L&MIC	(16) SSA	(17) L&MIC	(18) SSA
FDI indicator 1: net inflow as percentage of gross fixed capital formation (GFCF)	0.22	0.17	0.19	0.37			0.35	0.15	0.12	0.06			0.32	0.16	0.13	0.14		
	0.07 ***	0.07 **	0.06 ***	0.18 **			0.08 ***	0.10	0.08	0.10			0.08 ***	0.08 **	0.07 *	0.11		
Period 1 (1990-2000)					0.11	0.24					0.12	0.03					0.10	0.02
					0.08	0.25					0.07 *	0.25					0.07	0.24
Period 2 (2005-2015)					0.24	0.53					0.15	0.18					0.18	0.29
					0.05 ***	0.27 **					0.07 **	0.13					0.06 ***	0.17 *
Public spending on education		0.87	0.86	2.59	0.77	2.43		1.53	1.50	1.72	1.33	1.66		1.41	1.38	2.06	1.21	1.92
		0.38 **	0.38 **	1.10 **	0.37 **	1.03 **		0.77 **	0.75 **	1.19	0.68 *	1.10		0.64 **	0.63 **	1.19 *	0.57 **	1.08 *
Pupil/teacher ratio		0.13	0.14	0.58	0.13	0.53		0.20	0.19	0.34	0.25	0.42		0.18	0.16	0.44	0.20	0.46
		0.10	0.11	0.18 ***	0.10	0.18 ***		0.22	0.22	0.29	0.22	0.30		0.18	0.18	0.26 *	0.17	0.25 *
Log (GDP per capita)		8.23	8.14	11.49	8.11	11.15		12.31	12.00	25.56	11.15	18.80		9.24	9.32	15.15	8.94	13.39
		1.41 ***	1.41 ***	2.68 ***	1.40 ***	2.68 ***		3.65 ***	3.73 ***	7.03 ***	3.71 ***	6.91 **		2.37 ***	2.39 ***	3.57 ***	2.39 ***	3.55 ***
Skill endowment *Net inflow FDI as % of GCF			0.03	0.09					-0.06	-0.08					-0.05	-0.06		
			0.04	0.10					0.09	0.11					0.06	0.08		
Period 1 (1990-2000)					0.25	0.22					0.15	0.08					0.16	0.07
					0.05 ***	0.16					0.07 **	0.18					0.05 ***	0.15
Period 2 (2005-2015)					-0.10	0.04					-0.18	-0.17					-0.17	-0.13
					0.05 **	0.16					0.09 *	0.17					0.07 **	0.16
Constant	94.72	27.20	27.25	-26.38	28.32	-21.43	93.37	-8.26	-5.20	-108.04	-0.61	-65.23	93.69	17.32	17.69	-40.46	19.69	-28.86
	1.26 ***	13.59 **	13.60 **	22.76	13.57	22.82	0.93 ***	32.07	32.53	51.65 **	32.12	49.82	2.31 ***	23.33	23.34	30.87	23.25	30.38
Observations	684	451	451	163	451	163	684	451	451	163	451	163	684	451	451	163	451	163
R-squared	0.02	0.15	0.15	0.25	0.20	0.31	0.02	0.15	0.14	0.19	0.19	0.26	0.02	0.15	0.14	0.23	0.19	0.29

Figures in second line of each variable refer to robust standard errors; *significance at the 10% level, **significance at 5% level, ***significance at 1% level; robust estimation.

	OLS						Panel fixed effects						Panel random effects					
	(1) L&MIC	(2) L&MIC	(3) L&MIC	(4) SSA	(5) L&MIC	(6) SSA	(7) L&MIC	(8) L&MIC	(9) L&MIC	(10) SSA	(11) L&MIC	(12) SSA	(13) L&MIC	(14) L&MIC	(15) L&MIC	(16) SSA	(17) L&MIC	(18) SSA
FDI indicator 2: Inward FDI	0.13	0.02	0.01	0.08			0.12	0.05	0.003	-0.05			0.12	0.05	0.01	-0.03		
stock as % of GDP	0.03 ***	0.03	0.02	0.08			0.04 ***	0.05	0.05	0.14			0.04 ***	0.04	0.04	0.12		
Period 1 (1990-2000)					-0.02	0.13					-0.04	-0.001					-0.03	0.04
					0.04	0.11					0.05	0.17					0.04	0.15
Period 2 (2005-2015)					0.03	0.26					0.02	0.09					0.02	0.14
					0.02	0.11 **					0.05	0.16					0.04	0.14
Public spending on education		1.14	1.17	2.51	1.20	2.42		0.73	0.54	0.71	0.51	0.71		0.86	0.75	1.16	0.67	1.04
		0.40 ***	0.40 ***	1.01 **	0.41 ***	0.98 **		0.77	0.71	1.10	0.68	1.01		0.64	0.62	1.12	0.59	1.03
Pupil/teacher ratio		0.12	0.10	0.50	0.14	0.47		0.11	0.16	0.13	0.25	0.25		0.13	0.11	0.26	0.19	0.31
		0.10	0.10	0.19 ***	0.10	0.19 **		0.19	0.18	0.22	0.18	0.20		0.15	0.14	0.21	0.14	0.20
Log (GDP per capita)		7.17	7.44	10.40	7.31	8.77		9.04	9.99	18.93	7.62	11.15		7.17	8.55	13.99	7.68	10.47
		1.36 ***	1.37 ***	2.76 ***	1.34 ***	2.78 ***		4.12 **	3.85 **	7.71 **	4.07 *	7.88		2.21 ***	2.29 ***	4.24 ***	2.24 ***	4.15 **
Skill endowment * Inward FDI																		
stock as % of GDP			-0.04	-0.03					-0.20	-0.29					-0.16	-0.26 ***		
			0.02 *	0.06					0.04 ***	0.11					0.03 ***	0.08		
Period 1 (1990-2000)					0.18	0.45					0.02	0.18					0.08	0.26
					0.06 ***	0.19 **					0.07	0.18					0.06	0.18
Period 2 (2005-2015)					-0.08	0.02					-0.18	-0.20					-0.15	-0.15
					0.03 ***	0.08					0.04 ***	0.12					0.03 ***	0.10
Constant	96.37	38.03	36.39	-11.99	36.86	2.63	96.67	25.43	16.98	-49.26	32.98	1.94	96.93	39.46	29.73	-20.42	35.15	4.46
	1.24 ***	12.96 ***	12.97 ***	24.61	12.75	24.38	0.97 ***	32.89	30.40	56.07	31.23	56.37	2.28 ***	20.34 *	20.83	34.27	20.18 *	32.85
Observations	641	422	422	159	422	159	641	422	422	159	422	159	641	422	422	159	422	159
R-squared	0.02	0.14	0.14	0.22	0.17	0.29	0.02	0.13	0.10	0.12	0.12	0.21	0.02	0.13	0.11	0.15	0.15	0.24

Figures in second line of each variable refer to robust standard errors; *significance at the 10% level, **significance at 5% level, ***significance at 1% level; robust estimation.

Appendix 3. Dependent variable: Secondary school enrolment rate

	OLS						Panel fixed effects						Panel random effects					
	(1) L&MIC	(2) L&MIC	(3) L&MIC	(4) SSA	(5) L&MIC	(6) SSA	(7) L&MIC	(8) L&MIC	(9) L&MIC	(10) SSA	(11) L&MIC	(12) SSA	(13) L&MIC	(14) L&MIC	(15) L&MIC	(16) SSA	(17) L&MIC	(18) SSA
FDI indicator 1: net inflow as percentage of gross fixed capital formation (GFCF)	0.51	0.34	0.55	0.49			0.49	0.23	0.22	0.20			0.49	0.27	0.30	0.30		
	0.13 ***	0.09 ***	0.08 ***	0.15 ***			0.10 ***	0.08 ***	0.08 ***	0.18			0.10 ***	0.08 ***	0.08 ***	0.20		
Period 1 (1990-2000)					0.39	-0.01					0.17	-0.30					0.18	-0.25
					0.10 ***	0.20					0.08 **	0.16 *					0.08 **	0.15 *
Period 2 (2005-2015)					0.65	0.94					0.27	0.54					0.40	0.69
					0.10 ***	0.20 ***					0.09 ***	0.26 **					0.09 ***	0.25 **
Public spending on education		1.50	1.42	1.23	1.31	1.17		1.65	1.64	0.80	1.52	0.86		1.75	1.76	1.12	1.58	1.04
		0.59 **	0.56 **	0.62 **	0.53 **	0.59 **		0.68 **	0.68 **	0.36 **	0.61 **	0.34 **		0.69 **	0.69 **	0.48 **	0.61 ***	0.42 **
Pupil/teacher ratio		-0.93	-0.75	-0.17	-0.76	-0.19		-0.83	-0.84	-0.35	-0.80	-0.30		-0.89	-0.89	-0.26	-0.86	-0.26
		0.09 ***	0.09 ***	0.08 **	0.08 ***	0.07 ***		0.20 ***	0.20 ***	0.18 *	0.19 ***	0.17 *		0.18 ***	0.18 ***	0.12 **	0.16 ***	0.11 **
Log (GDP per capita)		10.34	9.47	13.04	9.34	13.23		24.11	24.05	27.02	22.81	19.86		16.56	15.41	15.22	14.29	14.24
		1.18 ***	1.10 ***	1.87 ***	1.07 ***	1.88 ***		3.08 ***	3.10 ***	4.52 ***	3.29 ***	5.54 ***		2.20 ***	2.12 ***	3.20 ***	2.10 ***	3.09 ***
Skill endowment *Net inflow FDI as % of GCF			0.30	0.19					-0.02	0.02					0.04	0.05		
			0.05 ***	0.08 **					0.07	0.12					0.05	0.12		
Period 1 (1970-2000)					0.48	0.01					0.11	-0.21					0.17	-0.17
					0.09 ***	0.14					0.07 *	0.10 **					0.06 ***	0.10 *
Period 2 (2005-2015)					0.20	0.36					-0.07	0.12					-0.01	0.19
					0.06 ***	0.11 ***					0.12	0.16					0.10	0.15
Constant	45.99	-3.69	-3.90	-57.75	-1.96	-58.13	46.2	-109.5	-108.9	-143.6	-100.40	-96.52	46.65	-50.71	-42.50	-67.75	-34.26	-60.75
	1.69 ***	11.32	10.44	13.81 ***	10.07	13.75 ***	1.12 ***	26.73 ***	26.83 ***	33.54 ***	28.15 ***	39.83 **	2.79 ***	20.81 **	20.17	23.78 ***	19.85 *	22.87 ***
Observations	637	423	423	146	423	146	637	423	423	146	423	146	637	423	423	146	423	146
R-squared	0.05	0.58	0.62	0.51	0.64	0.58	0.05	0.53	0.53	0.48	0.55	0.55	0.05	0.56	0.57	0.51	0.60	0.57

Figures in second line of each variable refer to robust standard errors; *significance at the 10% level, **significance at 5% level, ***significance at 1% level; robust estimation.

	OLS						Panel fixed effects						Panel random effects					
	(1) L&MIC	(2) L&MIC	(3) L&MIC	(4) SSA	(5) L&MIC	(6) SSA	(7) L&MIC	(8) L&MIC	(9) L&MIC	(10) SSA	(11) L&MIC	(12) SSA	(13) L&MIC	(14) L&MIC	(15) L&MIC	(16) SSA	(17) L&MIC	(18) SSA
FDI indicator 2: Inward FDI	0.45	0.17	0.18	0.18			0.33	0.18	0.16	0.23			0.34	0.20	0.20	0.15		
stock as % of GDP	0.05 ***	0.04 ***	0.04 ***	0.12			0.07 ***	0.06 ***	0.05 ***	0.18			0.07 ***	0.05 ***	0.05 ***	0.18		
Period 1 (1990-2000)					0.07	0.10					0.08	0.05					0.08	0.09
					0.06	0.07					0.06	0.12					0.06	0.09
Period 2 (2005-2015)					0.22	0.60					0.19	0.46					0.22	0.51
					0.04 ***	0.13 ***					0.05 ***	0.16 ***					0.05 ***	0.14 ***
Public spending on education		1.19	1.10	1.18	1.18	1.15		1.18	1.07	0.62	0.99	0.54		1.35	1.33	1.03	1.19	0.86
		0.54 **	0.52 **	0.60 *	0.55 **	0.57 **		0.73	0.69	0.57	0.60	0.34		0.73 *	0.72 *	0.65	0.64 *	0.48 *
Pupil/teacher ratio		-0.92	-0.83	-0.25	-0.77	-0.22		-0.68	-0.64	-0.45	-0.50	-0.23		-0.76	-0.78	-0.32	-0.64	-0.23
		0.10 ***	0.09 ***	0.08 ***	0.08 ***	0.07 ***		0.19 ***	0.18 ***	0.22 **	0.16 ***	0.16		0.16 ***	0.16 ***	0.15 **	0.13 ***	0.10 **
Log (GDP per capita)		10.02	8.82	11.66	0.68	10.21		22.69	23.47	24.15	20.27	13.20		14.77	14.19	13.19	13.01	10.80
		1.17 ***	1.14 ***	1.93 ***	1.06 ***	1.49 ***		3.92 ***	3.78 ***	8.32 ***	3.56 ***	5.67 **		2.16 ***	2.11 ***	3.32 ***	1.96 ***	2.47 ***
Skill endowment * Inward FDI																		
stock as % of GDP			0.19	0.11					-0.12	0.00					-0.03	-0.02		
			0.04 ***	0.07					0.06 *	0.11					0.05	0.09		
Period 1 (1990-2000)					0.55	0.50					0.17	0.39					0.31	0.46
					0.07 ***	0.13 ***					0.07 **	0.12 ***					0.06 ***	0.14 ***
Period 2 (2005-2015)					0.10	0.29					-0.10	0.13					-0.03	0.19
					0.04 ***	0.07 ***					0.06	0.09					0.05	0.08 **
Constant	45.02	2.43	9.81	-41.53	9.78	-31.81	47.69	-101.26	-108.29	-119.92	-87.04	-49.73	47.49	-40.12	-35.03	-51.09	-28.41	-34.94
	1.58 ***	11.43	10.78	15.11	9.87	12.30 **	1.56 ***	31.43 ***	30.10 ***	57.71	28.04	39.86	3.10 ***	20.51 **	20.20 *	25.21 **	18.23	19.07 *
Observations	586	389	389	139	389	139	586	389	389	139	389	139	586	389	389	139	389	139
R-squared	0.13	0.62	0.66	0.51	0.71	0.69	0.13	0.59	0.54	0.48	0.60	0.66	0.13	0.61	0.61	0.49	0.68	0.68

Figures in second line of each variable refer to robust standard errors; *significance at the 10% level, **significance at 5% level, ***significance at 1% level; robust estimation.

Appendix 4. Dependent variable: Tertiary school enrolment rate

	OLS						Panel fixed effects						Panel random effects					
	(1) L&MIC	(2) L&MIC	(3) L&MIC	(4) SSA	(5) L&MIC	(6) SSA	(7) L&MIC	(8) L&MIC	(9) L&MIC	(10) SSA	(11) L&MIC	(12) SSA	(13) L&MIC	(14) L&MIC	(15) L&MIC	(16) SSA	(17) L&MIC	(18) SSA
FDI indicator 1: net inflow as % of gross fixed capital formation (GCF)	0.23	0.17	0.29	0.03			0.24	0.11	0.14	0.08			0.23	0.13	0.18	0.07		
	0.07 ***	0.05 ***	0.06 ***	0.03			0.06 ***	0.05 **	0.06 **	0.04 *			0.06 ***	0.04 ***	0.06 ***	0.03 *		
Period 1 (1990-2000)					0.04	-0.17 ***					-0.01	-0.07					-0.03	-0.11
					0.06	0.05					0.07	0.05					0.06	0.05 **
Period 2 (2005-2015)					0.41	0.10					0.20	0.11					0.26	0.11
					0.08 ***	0.05 *					0.07 ***	0.06 *					0.08 ***	0.06 *
Public spending on education		-0.23	-0.27	0.06	-0.38	0.06		0.46	0.52	0.13	0.49	0.14		0.46	0.50	0.13	0.42	0.12
		0.23	0.22	0.08	0.22 *	0.08		0.36	0.38	0.07 *	0.36	0.07 *		0.34	0.36	0.09	0.32	0.08
Pupil/teacher ratio		-0.54	-0.44	-0.05	-0.47	-0.06		-0.36	-0.34	-0.09	-0.35	-0.08		-0.41	-0.39	-0.07	-0.41	-0.07
		0.06 ***	0.06 ***	0.02 **	0.06 ***	0.02 ***		0.10 ***	0.10 ***	0.04 *	0.09 ***	0.04 *		0.09 ***	0.09 ***	0.04 *	0.09 ***	0.03 **
Log (GDP per capita)		5.94	5.47	2.18	5.15	2.25		15.78	16.36	5.04	14.02	3.77		11.11	10.44	2.96	8.99	2.60
		0.77 ***	0.77 ***	0.44 ***	0.74 ***	0.45 ***		2.28 ***	2.38 ***	1.24 ***	2.41 ***	1.27 ***		1.54 ***	1.47 ***	0.71 ***	1.44 ***	0.69
Skill endowment *Net inflow FDI as % of GCF			0.17	0.01					0.09	0.01					0.08	0.02		
			0.04 ***	0.02					0.04 **	0.03					0.04 **	0.02		
Period 1 (1990-2000)					0.11	-0.09					0.01	-0.05					0.00	-0.07
					0.04 ***	0.03 ***					0.05	0.03					0.04	0.03 **
Period 2 (2005-2015)					0.19	0.02					0.11	0.02					0.11	0.02
					0.05 ***	0.03					0.05 **	0.04					0.05 **	0.03
Constant	13.39	-10.93	-11.31	-8.71	-7.17	-8.49	13.23	-92.91	-97.93	-27.70	-79.54	-19.02	13.58	-56.15	-51.92	-13.99	-39.83	-10.97
	0.91 ***	6.49 *	6.39 *	3.18 ***	6.26	3.16 ***	0.66 ***	18.59 ***	19.44 ***	9.20 ***	19.61	9.25	1.46 ***	12.50 ***	11.89 ***	5.39 ***	11.64 ***	5.04 **
Observations	614	414	414	142	414	142	614	414	414	142	414	142	614	414	414	142	414	142
R-squared	0.03	0.47	0.51	0.29	0.54	0.42	0.03	0.41	0.43	0.29	0.45	0.38	0.03	0.44	0.46	0.29	0.50	0.41

Figures in second line of each variable refer to robust standard errors; *significance at the 10% level, **significance at 5% level, ***significance at 1% level; robust estimation.

	OLS						Panel fixed effects						Panel random effects					
	(1) L&MIC	(2) L&MIC	(3) L&MIC	(4) SSA	(5) L&MIC	(6) SSA	(7) L&MIC	(8) L&MIC	(9) L&MIC	(10) SSA	(11) L&MIC	(12) SSA	(13) L&MIC	(14) L&MIC	(15) L&MIC	(16) SSA	(17) L&MIC	(18) SSA
FDI indicator 2: Inward FDI	0.23	0.11	0.13	0.00			0.29	0.17	0.19	0.08			0.28	0.18	0.20	0.03		
stock as % of GDP	0.03 ***	0.03 ***	0.03 ***	0.02			0.04 ***	0.03 ***	0.03 ***	0.04 *			0.03 ***	0.03 ***	0.03 ***	0.04		
Period 1 (1990-2000)					-0.04	-0.03					0.11	0.02					0.08	-0.01
					0.04	0.01 ***					0.03 ***	0.03					0.02 ***	0.01
Period 2 (2005-2015)					0.17	0.12					0.20	0.14					0.21	0.13
					0.03 ***	0.04 ***					0.03 ***	0.04 ***					0.03 ***	0.05 ***
Public spending on education		-0.45	-0.56	0.05	-0.47	0.08		0.27	0.35	0.16	0.36	0.16		0.24	0.30	0.14	0.28	0.13
		0.23 **	0.22 **	0.09	0.20 **	0.08		0.29	0.31	0.14	0.30	0.10		0.26	0.27	0.12	0.25	0.10
Pupil/teacher ratio		-0.53	-0.45	-0.06	-0.42	-0.05		-0.19	-0.22	0.13	-0.18	-0.07		-0.26	-0.27	-0.08	-0.22	-0.05
		0.06 ***	0.05 ***	0.02 ***	0.05 ***	0.02 **		0.07 ***	0.07 ***	0.05 **	0.06 ***	0.03 *		0.07 ***	0.07 ***	0.03 **	0.06 ***	0.02 **
Log (GDP per capita)		5.57	4.63	2.22	4.66	1.90		14.92	14.38	4.83	12.33	2.53		10.67	9.57	2.40	8.34	1.90
		0.84 ***	0.80 ***	0.43 ***	0.78 ***	0.32 ***		2.30 ***	2.15 ***	1.87 **	2.19 ***	1.22 **		1.48 ***	1.37 ***	0.67 ***	1.34 ***	0.44 ***
Skill endowment * Inward FDI																		
stock as % of GDP			0.15	0.00					0.10	0.03					0.10	0.00		
			0.03 ***	0.01					0.02 ***	0.02					0.02 ***	0.02		
Period 1 (1970-2000)					0.19	0.04					0.11	0.07					0.13	0.05
					0.04 ***	0.02 **					0.04 ***	0.03 **					0.03 ***	0.02 **
Period 2 (2005-2015)					0.15	0.05					0.10	0.05					0.11	0.05
					0.03 ***	0.02 **					0.02 ***	0.02 **					0.03 ***	0.03 *
Constant	11.75	-7.58	-1.94	-8.08	-2.63	-6.60	10.52	-93.30	-88.39	-25.05	-73.99	-10.89	10.92	-59.48	-50.99	-9.37	-42.13	-6.74
	0.88 ***	7.03	6.62	3.27 **	6.43	2.53 ***	0.82 ***	17.31 ***	16.05 ***	12.94 *	16.43 ***	8.64	1.36 ***	11.53 ***	10.69 ***	4.95 *	10.40 ***	3.37 **
Observations	563	383	383	136	383	138	563	383	383	136	383	136	563	383	383	136	383	136
R-squared	0.10	0.49	0.55	0.31	0.59	0.55	0.10	0.42	0.47	0.30	0.50	0.51	0.10	0.44	0.50	0.30	0.54	0.55

Figures in second line of each variable refer to robust standard errors; *significance at the 10% level, **significance at 5% level, ***significance at 1% level; robust estimation.