Foreign direct investment and economic development: the role of research and development

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Abstract

Using a sample of 130 countries over the period 2004-2019, we revisit the developmental impact of foreign direct investment (*FDI*), but novelly examine the role of research and development (*R&D*) within this framework. Unlike previous literature, we make causality statements by using bilateral investment treaties as an innovative instrument for *FDI*, in the development equations. We find that, compared to *FDI*, expenditure on *R&D* has a more pronounced impact on development outcomes – through increasing growth and human development while reducing poverty and inequality. We also find that countries that spend more on *R&D* are less dependent on *FDI* for development. This suggests that *R&D* and *FDI* are substitutes in the development process with the results showing varying *FDI* and *R&D* thresholds at which the substitution takes place. We also find a diminishing effect of *FDI* on development. Further to this, we find that *R&D* complements *FDI* only when *FDI* reaches a threshold level, and then begins to hurt development – at this stage there is sufficient *R&D* expenditure which possibly suggest sufficient adaptive capacity.

Keywords: *FDI*, *R&D*, economic growth, poverty, income inequality
JEL: F21, F43, I30, I32, O30, O40

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1. Introduction and background

The development impact of private capital flows, particularly foreign direct investment (*FDI*), has been largely espoused in the literature. The positive effects of *FDI* have been found on: economic growth (Agenor, 1998; Alfaro et al., 2004; Durham, 2004; Li and Liu, 2005; Alfaro et al., 2010; Kang and Martinez-Vazquez, 2022); reducing poverty (Do et al., 2021; Magombeyi and Odhiambo, 2018); improving welfare and human development (Blalock and Gertler, 2008; Gohou and Soumaré, 2012; Soumaré, 2015); and enhancing technological spillovers (Aitken and Harrison, 1999; Sabirianova et al., 2005; Alvarez and Molero, 2005; Newman et al., 2015), among many other outcomes (Markusen and Venables, 1999; Chowdhury and Mavrotas, 2006; Yeaple, 2006; Tressel and Verdier, 2011; Ito, 2013). Hence, policy discussions have largely focused on the need for countries to fashion out domestic policies that are favourable to attract increased levels of *FDI* (Bjorvatn and Eckel, 2006).

Among other channels, the development impact of *FDI* has largely been explained through technological transfers (Aitken and Harrison, 1999; Sasidharan and Kathuria, 2011; Gorodnichenko et al., 2020). The traditional thinking has been that foreign firms that decide to invest in other countries have more advanced technologies and hence are able to transfer the same to host countries. This has been confirmed by such notable studies as Aitken and Harrison (1999) and Alvarez and Molero (2005). However, studies like those of Globerman and Meredith (1984) and Fan and Hu (2007) are sceptical of the technological spillover effects of *FDI*. They suggest that most foreign firms already have access to the technology of the parent company, hence have little-to-no incentive to invest in research or new technology in the host country (Beers, 2004; Kathuria, 2008). This is simply because such private multinationals' interests are unlikely to perfectly align with the social interest of the host country (Urata and Lall, 2003). Moreover, not all technologies are transferable given the idiosyncratic differences and needs of countries (Atkinson and Stiglitz, 1969; Basu and Weil, 1998; Acemoglu, 2002). Fu et al. (2011) even suggests restricting foreign firms in certain sectors of the host country to protect local firms that innovate in those sectors, given that the interests of foreign firms do not always accrue to the benefit of the host country.

The key question, therefore, is whether host/destination countries themselves should

focus on domestically promoting innovation through higher research & development (*R&D*) expenditures, rely on technology spillovers from *FDI*, or a mix of the two. The literature has generally focused on whether *FDI* and local *R&D* are substitutes or complements in promoting domestic innovation and/or technological progress (Gersbach et al., 2013), rather than on development outcomes such as economic growth, inequality, poverty and human development. One strand of literature shows that *FDI* and *R&D* are complements mostly in their relationship with innovation and productivity(Hu et al., 2005; Fu et al., 2011; Sasidharan and Kathuria, 2011). Fu et al. (2011) for instance argued for the presence of a parallel indigenous innovation effort by host countries, among other favourable institutional frameworks, to be able to benefit from international technology diffusion. Sasidharan and Kathuria (2011) also documented that *FDI* and *R&D* are complements in a study of Indian manufacturing firms, but this complementary relationship is only seen when the sample of firms is split based on equity ownership – thus, finding that *FDI* and *R&D* are complements for foreign-owned firms. Hu et al. (2005), on the other hand, examined whether *FDI* and *R&D* are substitutes in their relationship with productivity of Chinese firms. Even though the study showed no role of *FDI* in facilitating the transfer of market-mediated technology, the study demonstrated that *FDI* and *R&D* are complements in promoting technology.

Another strand of literature argues that *FDI* and *R&D* are substitutes (Kumar, 1987; Veugelers and Houte, 1990; Chuang and Lin, 1999; Kathuria and Das, 2005; Fan and Hu, 2007; Kathuria, 2008). These studies have largely focused on the impact of *FDI* on *R&D* or *vice versa*. Kumar (1987), for instance, using *FDI* as a measure of technology imports, found a negative impact of *FDI* on local *R&D* intensity, suggesting a substitution effect between *FDI* and local *R&D* intensity. Kathuria and Das (2005) also examined the impact of *FDI* on *R&D* and found that *FDI* and *R&D* are substitutes. More recently, Fan and Hu (2007) in the Chinese context examined how efforts in promoting indigenous technology (*R&D*) are influenced by *FDI*. The study found that *FDI* and *R&D* are substitutes, showing that expenditure of firms on *R&D* reduces with the amount of *FDI* received.

In summary, the evidence on the relationship between *FDI* and *R&D* remains mixed. The literature has confusingly found that *FDI* and *R&D* are either substitutes or complements in their relationship with technological innovation and/or productivity of do-

mestic firms. Moreover, there is very little recent literature on whether *FDI* and *R&D* are substitutes or complements in their relationship with developmental outcomes such as economic growth, poverty, inequality, and human development at the macro level.

Our hypothesis builds on the dependency theory of *FDI* (Dixon and Boswell, 1996; Kentor, 1998; Kentor and Boswell, 2003), positing that countries that relatively focus on *R&D* will be less dependent on *FDI* for development. Dependency theory argues that the traditional expectation of positive technological and knowledge externalities/spillovers from *FDI* does not always materialise and that *FDI* can lead to negative externalities on host countries, particularly in developing economies where power imbalances favour multinational corporations. Indeed, Kentor (1998) and Kentor and Boswell (2003) found evidence that dependence on *FDI*s has a negative effect on the growth of host countries. This perspective contrasts with modernisation theory, which views *FDI* as a vehicle for transferring capital, technology, and management skills to modernise underdeveloped economies, aligning with neoclassical and endogenous growth models (Grossman and Helpman, 1993; Lucas, 1988; Grossman and Rogoff, 1997; Barro and Sala-i Martin, 1995; Romer, 1990; Alfaro et al., 2004). However, modern theories such as absorptive capacity theory (Cohen and Levinthal, 1989; Borensztein et al., 1998; Griffith et al., 2003) bridge these views by emphasising that the benefits of *FDI* depend on the host country's ability to absorb and adapt foreign technologies, often through domestic *R&D* and human capital. If absorptive capacity is low, *FDI* may reinforce dependency by crowding out local innovation, echoing dependency theory's concerns (Girma, 2005; Azman-Saini et al., 2010).

Furthermore, appropriate technology theory (Atkinson and Stiglitz, 1969; Basu and Weil, 1998; Acemoglu and Zilibotti, 2001) complements these frameworks by arguing that technologies must suit the host country's factor endowments, skills, and institutional context to be effective. Inappropriate technologies from advanced economies can exacerbate dependency if they mismatch local conditions, limiting spillovers and growth (Acemoglu, 2002). Absorptive or adaptive capacity thus acts as a moderator: high capacity enables adaptation of potentially inappropriate technologies, turning local *R&D* into a complement for *FDI* and reducing dependency risks (Fu et al., 2011; Crespo and Fontoura, 2007). Hence, we argue that countries that domestically invest more in *R&D* as a source of their innovation and knowledge generation will build such capacity, mak-

ing them less reliant on the possible technological spillover from *FDI* for development. As shown in Figure 1, countries that have a larger share of world net *FDI* inflows are less dependent on FDI when *FDI* is taken as a share of the country's *GDP* (Figure 2). Interestingly, when we observe *R&D* in Figures 3 and 4, compared with Figures 1 and 2, countries that are less dependent on *FDI* – as seen earlier – spend more on *R&D* when *R&D* is considered both as a share of world expenditure on *R&D* and as a share of the respective country's *GDP*. We postulate that these countries would tend to have more home-grown solutions for their development and not be over-reliant on *FDI*, particularly given the recent concerns of the vanishing/threshold effect of *FDI*, where over-reliance on net *FDI* inflows may turn to hurt the host economy.

[Insert Figures 1, 2, 3, 4 Here]

Therefore, we make three important contributions to the literature. First, to the best of our knowledge, this is the first study to provide evidence of the combined effect of *FDI* and *R&D* on development (broadly defined). We provide comprehensive analyses using multiple development indicators (including economic growth/development, inequality, headcount poverty ($1.9, $3.20, and $5.50), multidimensional poverty (Md. poverty), human development index (*HDI*), inequality-adjusted *HDI* (*iHDI*), and inequality, Gini) to provide empirically robust justification for our arguments. Second, no studies so far have used a theory to investigate the relationship between *FDI* and *R&D*. Hence, in this paper, we developed a simple theoretical model to explain the substitution and complementary effects of *FDI* and *R&D* in a country's growth and development. Third, methodologically, we use a novel instrument for *FDI* proposed by Abor et al. (2024). Specifically, we estimate the *causal* relationship between *FDI* and development by using the number of bilateral investment treaties (*BITs*) as an instrument for *FDI* to address any possible endogeneity of *FDI*.

Our results show that even though *FDI* and *R&D* directly enhance all forms of development, the development impact of *R&D* expenditure is more pronounced than that of *FDI*. We, however, find that the impact of *FDI* is non-linear, with a threshold after which *FDI* begins to hurt development. We find that *FDI* and *R&D* are both substitutes and complements in influencing development-related outcomes, depending

on the level of net *FDI* inflows. Specifically, they are substitutes when *FDI* is below its threshold level, but complementary when *FDI* begins to hurt development. Hence, *R&D* mitigates the negative impact of *FDI* on development after *FDI* reaches its threshold. This has important policy implications for countries to invest in *R&D*, especially in anticipation of when the development impact of *FDI* reaches its threshold.

2. A Simple Theoretical Model

In this section, we developed a theoretical model to explain the relationship between *FDI* and *R&D* in an economy's growth and development. Consider a simple economy where all firms have access to the same production function. The technology level of a representative firm comes from two sources: i) internal source – through self *R&D* investment, and ii) external source – technology transferred from *MNCs* (via *FDI*). Assuming the level of technology transferred (t) is an increasing function of *FDI* (i), thus we can define: $t = f(i)$ and $f'(i) > 0$.

The capability of a firm's self technology innovation (n) depends on three factors: i) *R&D* input (r), ii) workers' education level (e), and iii) impact of *FDI* on firm's *R&D* efficiency[1] (i). Hence, we can define: $n = T(r, e, i)$. Assuming n is an increasing function of r, e and i, and *R&D* input follows the rule of marginal diminishing return (*i.e.*, $\frac{\partial^2 T}{\partial r^2} < 0$).

The technology level of a firm (A), therefore, can be written as:

$$A = f(i) + T(r, e, i), \tag{1}$$

and the firm's profit defined as:

$$\pi = F(A) - r = F(f(i) + T(r, e, i)) - r \tag{2}$$

where $F(A)$ is the firm's production function, an increasing function of A. Notably, $\frac{d^2 F}{dA^2} < 0$, indicating that the positive impact of technology level on a firm's profit follows marginal diminishing returns.

[1] As documented in (Aitken and Harrison, 1999), *FDI* can raise *R&D* efficiency via reducing trial and error costs.

To solve the firm's profit maximisation problem, for Equation (2), we take the first order condition with respect to r:

$$F' \frac{\partial T}{\partial r} - 1 = 0. \tag{3}$$

Total differentiation both sides of Equation (3) with respect to i and r yields:

$$(F'' \frac{\partial T}{\partial r} f' + F'' \frac{\partial T}{\partial r} \frac{\partial T}{\partial i} + F' \frac{\partial^2 T}{\partial r \partial i}) di + (F' \frac{\partial^2 T}{\partial r^2} + F'' (\frac{\partial T}{\partial r})^2) dr = 0$$

Hence,

$$\frac{dr}{di} = - \frac{F'' \frac{\partial T}{\partial r} f' + F'' \frac{\partial T}{\partial r} \frac{\partial T}{\partial i} + F' \frac{\partial^2 T}{\partial r \partial i}}{F' \frac{\partial^2 T}{\partial r^2} + F'' (\frac{\partial T}{\partial r})^2}. \tag{4}$$

Since $\frac{\partial^2 T}{\partial r^2} < 0$ and $F'' < 0$, we know that $F' \frac{\partial^2 T}{\partial r^2} + F'' (\frac{\partial T}{\partial r})^2 < 0$. Thus, if and only if the following condition holds:

$$F'' \frac{\partial T}{\partial r} f' + F'' \frac{\partial T}{\partial r} \frac{\partial T}{\partial i} + F' \frac{\partial^2 T}{\partial r \partial i} < 0. \tag{5}$$

Then, $\frac{dr}{di} < 0$.

As $F'' \frac{\partial T}{\partial r} f' < 0$ and $F'' \frac{\partial T}{\partial r} \frac{\partial T}{\partial i} < 0$, from Equation (5) we can see that if the absolute value of $\frac{\partial^2 T}{\partial r \partial i}$ is relatively smaller (thus $F' \frac{\partial^2 T}{\partial r \partial i}$ is relatively smaller) compared with $|F''| f'$, then $\frac{dr}{di} < 0$.

Our model suggests that *FDI* relates to *R&D* activities in two ways: 1) through a *substitution effect*: *FDI* improves a firm's technology level through transferred technology, hence reducing a firm's own need for technological innovation. Such negative impact is stronger especially when i) the marginal growth rate of technology transfer with changes in *FDI* (i, f') is greater; and ii) technological improvement has a greater diminishing marginal rate of return on firm's profits (*i.e.*, the value of $|F''|$ is large); 2) a *complementary effect*: the increase in *FDI* can supplement firm's *R&D* outputs (*i.e.*, $\frac{\partial^2 T}{\partial r \partial i}$ is large), thus encouraging firms to engage more in *R&D* activities. We can summarise our analysis in the following corollary.

Corollary 1: *i) Higher FDI reduces firm's need for R&D activities if and only if the substitution effect is greater than the complementary effect (i.e., R&D plays a minor role*

in firm's output, hence FDI mainly drives economic growth); ii) Higher FDI encourages more firm's R&D activities if and only if the substitution effect is smaller than the complementary effect (i.e., R&D is a major determinants of firm's output, thus key to economic growth).

3. Data and Empirical Methodology

3.1. Data description and sources

We use an unbalanced panel data of 130 countries spanning the period of 2004 to 2019, collected from the World Development Indicators (*WDI*) of the World Bank and the United Nations Development Program (*UNDP*). Data on growth, poverty and inequality are sourced from the *WDI*. Data on HDI and iHDI are obtained from UNDP. Note that the data on our focus variables, *FDI* and *R&D*, are from the *WDI*. We also select a set of standard control variables, based on the prevailing literature (again, these are sourced from the *WDI*). The choice of sample period is based on the availability of sufficient data (at the time of writing) covering most of the development indicators and our main variables of interest (*FDI* and *R&D*).[2] The countries cover both developed and developing. We also examine the differences in these relationships with regard to developing and developed countries.

3.1.1. Development outcomes

The outcome variables considered are: (the natural log of) real GDP per capita; Gini coefficient as a measure of inequality, and four poverty measures. The latter include: the poverty headcount ratio measured at $1.90, $3.20, $5.50 per day (2011 purchasing power parity (PPP)) as a percentage of population; the multidimensional headcount poverty ratio as a percentage of the total population; the human development index (*HDI*); and inequality-adjusted HDI (*iHDI*). These variables have been widely used in the literature as a measure of development outcomes (Alfaro et al., 2004; Li and Liu, 2005; Gupta et al., 2009; Alfaro et al., 2010; Gohou and Soumaré, 2012; Dwumfour, 2020).

[2]Sample sizes may differ depending on the specification, especially on the availability of data for the development indicators. A list of the countries considered is provided in Appendix A.

3.1.2. FDI and R&D

FDI is the net foreign direct investment inflows as a percentage of GDP[3]. To be more specific, as defined by the World Bank in the *WDI*, *FDI* is the equity flows into a country that are direct investments, which include equity capital, reinvestment of earnings, and other capital. A direct investment is indicated to happen when the investor owns 10% or more of the ordinary shares of voting stock.

As we discussed earlier, *FDI* serves as an important conduit for capital and technology transfer, influencing development outcomes through multiple channels. By bringing in advanced machinery, managerial know-how, and access to global markets, multinational enterprises can raise a host economy's productivity and long-run growth potential (Javorcik, 2004). These investments often create employment opportunities and forge linkages with local firms, elevating incomes and helping to reduce poverty. *FDI* can also contribute to human development indirectly: higher income levels and knowledge spillovers lead to improved education, training, and skill development in the domestic workforce. However, the benefits of *FDI* are not automatic or uniformly shared—if the gains accrue mainly to capital owners or skilled workers, FDI may widen income inequality, underscoring the need for sufficient absorptive capacity and inclusive policies to ensure broad-based improvements in living standards. Moreover, some micro-level studies have found cases with limited or even negative spillovers (*e.g.*, crowding out of domestic firms)(Aitken and Harrison, 1999). These outcomes often depend on industry and host conditions, reinforcing that FDI's potential growth effect is context-specific. Hence, the impact of *FDI* on development outcomes is expected to be ambiguous.

R&D is the research and development expenditure as a percentage of GDP. The knowledge economy is seen to be key in driving both economic and human development (Chen and Dahlman, 2005; Thoenig and Verdier, 2010). *R&D* as a key pillar of the knowledge economy is important in the development process of every country (Chen and Dahlman, 2005; Keller, 2002; Aghion et al., 2012; Maican et al., 2023). In line with endogenous growth theory, *R&D* is a primary engine of innovation and long-run economic growth. Investments in *R&D* expand the technological frontier by generating new knowledge, products, and processes, which raise productivity across the economy.

[3]As robustness checks, we also use the stock of *FDI* as a share of GDP.

As these productivity gains accumulate, they translate into higher output and wages, fostering economic growth that can alleviate poverty. *R&D*-driven technological change can, however, have complex distributional effects: innovations are often skill-biased and initially favour high-skilled labour, potentially widening income disparities if education and training systems do not keep pace with evolving skill demands. Nonetheless, a robust domestic *R&D* ecosystem builds human capital and enhances problem-solving capacity, allowing society not only to increase incomes but also to address local development challenges through tailored innovations in areas such as health and agriculture, thereby improving overall human development.

When foreign investment and local innovation capacity interact, they can jointly amplify development outcomes through complementary channels. A strong domestic *R&D* base increases the host economy's absorptive capacity, enabling local firms and workers to learn from and effectively utilise the advanced technologies and practices introduced by *FDI*. This synergy allows multinational enterprises' (*MNEs*) knowledge and productivity spillovers to diffuse more broadly in the economy, rather than remaining confined to foreign affiliates, thereby boosting overall productivity and fostering more inclusive growth. Conversely, *FDI* can bolster domestic innovation efforts by bringing fresh ideas, training, and capital, as well as by connecting local researchers and firms to global knowledge networks. *MNEs* also outsource or offshore certain activities – including manufacturing and *R&D* – via contractual arrangements. For instance, an *MNE* might contract a software development project to a firm in India or a design task to engineers in Eastern Europe. These linkages, part of global value chains, can also bring know-how and jobs to host countries, even if they don't show up as FDI inflows. The trend towards fragmentation of *R&D* has been facilitated by ICT improvements, allowing firms to "unbundle" research activities geographically. As a result, countries with the requisite talent can attract *R&D* mandates or outsourcing even without a large market size. This context is important for interpreting *FDI* data: countries integrated in *MNE* innovation networks benefit via both *FDI* and non-*FDI* channels. Together, these dynamics create a virtuous cycle: foreign capital and know-how fuel indigenous innovation, while domestic *R&D* enhances the returns to foreign investment, leading to faster economic growth and significant improvements in living standards (such as poverty reduction and gains in education and health), provided the fruits of innovation

and investment are equitably shared across society. We therefore test the interaction effect of *FDI* and *R&D* on the development outcomes.

3.1.3. Control variables

Here, as noted earlier, we employ a relatively standard set of control variables as identified in the literature. As a measure of information and communication technology (*ICT*) infrastructure, we use the mobile cellular and telephone subscription per 100 people following the literature (Asongu and Le Roux, 2017; Asongu et al., 2018). *ICT* infrastructure is also a key pillar in the knowledge economy. Niebel (2018) found economic growth to be driven by *ICT*. *ICT* can promote development directly and indirectly by providing tools needed for the improvement in: access to health care; financial inclusion and business processes, among others (Kirui et al., 2013; Kliner et al., 2013; Mishra and Bisht, 2013). However, these gains can be unequally distributed when digital access gaps persist across income groups or geographies, potentially widening disparities even as aggregate outcomes improve.

We measure *education* using both secondary school enrolment and tertiary school enrolment (as %'s of gross). As a key pillar of the knowledge economy, education has been found to help increase economic growth and development (Gyimah-Brempong et al., 2006), as well as reduce poverty and inequality (Appleton et al., 2010). Higher education results in increased human capital in terms of skills and knowledge, which can generate the productivity needed to drive growth and development. Higher education can help lift people out of poverty, as they are more likely to be employed to earn income. Hence, we include both secondary and tertiary enrolment ratios to estimate the returns to higher education. We expect a more positive impact of higher education on economic and human development, and to reduce poverty and inequality. However, we note that the gains from education can be uneven when access and quality are skewed toward richer households or when graduate underemployment and skill mismatches arise; in such cases, distributional effects may be muted or even regressive

We also control for unemployment measured as the unemployment rate (%). Martínez et al. (2001) in a study of Organisation for Economic Co-operation and Development (*OECD*) countries found increased risk of falling into poverty and inequality to be associated with higher unemployment. The magnitude of this link depends on institutional

settings and social protection.

Inflation is measured by the annual change in the consumer price index (%). Empirical evidence has shown increased poverty and inequality levels to be associated with higher inflation (Agenor, 1998; Albanesi, 2007; Doumbia, 2019). Romer and Romer (1998), however, argued that the relationship between inflation and poverty may differ over the short- and long-run. There is evidence that shows that the relationship between inflation and economic growth is non-linear, with low rates of inflation below the threshold having a positive impact on growth, while inflation rates above the threshold reduce economic growth (Fischer, 1993; Gillman et al., 2004).

We also control for financial development, measured as the total domestic credit to the private sector ratio (as % GDP). The relationship between financial development and development outcomes has remained ambiguous (Dollar and Kraay, 2002; Benhabib and Spiegel, 2000). Beck et al. (2004) indicate whether financial development benefits the whole population or not is inconclusive. The authors found that countries with well-developed financial intermediaries see faster declines in inequality and poverty. However, other studies have found that financial development reduced economic growth and human development and/or welfare and increased inequality (Dwumfour et al., 2017; Dwumfour, 2020; Gohou and Soumaré, 2012; Soumaré, 2015). The argument is that development of the financial sector is not pro-poor, hence provision of credit tends to favour the rich. This is mostly the case when higher collateral, along with other demanding loan requirements, make credit acquisition expensive to the poor (Galor and Zeira, 1993; Haber et al., 2003; Stiglitz, 1993), which further widens the inequality gap.

Taken together, these considerations motivate our empirics to treat control-variable effects as potentially heterogeneous and, where relevant, non-linear, rather than assuming uniformly positive or negative signs.

Table 1 presents the summary statistics. Mean per capita GDP is around 8, with a maximum of around 12. For our inequality measure, we see wide variation from a minimum of 23 to a maximum of 65, indicating high levels of inequality around the world. On all our poverty measures, there is widespread poverty with a lot of people living below the various poverty lines from an average of 6% to 27% progressively as the poverty line increases. This shows that the higher the poverty line, the more poverty to be recorded, thus, people are likely to fall below the poverty. Average HDI is 0.69,

showing a moderate level of human development, but when adjusted for inequality, *iHDI* averages 0.57, showing a lower level of human development. Average net *FDI* inflows is around 6% with a minimum of -58% and a maximum of 452%. This implies the wide variation in the net inflows of *FDI* to countries in the sample and gives a broader perspective of the sample to study how relevant *FDI* in these countries are in promoting development. *R&D* expenditure however records an average of around 0.98% of GDP with a minimum of 0.01% and a maximum of 4.9%. Again, we see that while some countries barely spend on *R&D*, others seem to relatively have a decent *R&D* expenditure share of GDP. Table 1 also shows that the average number of *BITs* per country is around 24. On education, we see a wide gap between secondary and tertiary enrolment, with more enrolment seen at the secondary level, averaging 81% compared to an average of 39% at the tertiary level. This may suggest that not many people progress to the tertiary level after secondary school. Average credit to the private sector ratio is around 49% with inflation averaging 5% over the sample period. Unemployment rate averages around 8% over the sample period.

[Insert Table 1 Here]

3.2. Model specification

Following the prevailing related literature, we consider a baseline econometric model of the form:

$$DEV_{it} = \alpha_0 + \alpha_1 FDI_{it} + \alpha_2 R\&D_{it} + \boldsymbol{\gamma Controls}_{it} + \alpha_i + \varepsilon_{it}, \tag{6}$$

where it represents country i at time t; DEV denotes the development outcome variables. As noted, our outcome variables considered are: (the natural log of) real GDP per capita; Gini coefficient as a measure of inequality; and four poverty measures (see above)[4]. *FDI* is the net foreign direct investment inflows as a percentage of GDP. *R&D* is the research and development expenditure as a percentage of GDP. As discussed earlier, we expect

[4]Note that the measure of multidimensional poverty is limited in its interpretation given the possible differences in cross-country measurements. We however add this measure as a form of robustness. Our results remain consistent with the other measures of headcount poverty.

a positive impact of *R&D* on economic and human development as well as a negative impact of *R&D* on poverty and inequality. ***Controls*** is a vector of control variables (*ICT* infrastructure, education, unemployment, financial development and inflation) identified in the literature (Asongu and Le Roux, 2017; Asongu et al., 2018; Gyimah-Brempong et al., 2006; Kirui et al., 2013); $\varepsilon_{i,t}$ is the idiosyncratic error term; and α_i is the usual unobserved (country) effect.

3.3. Identification strategy

The fixed effects (FE) results can be validly questioned due to the potential endogeneity concerns (primarily) of the *FDI* variables. For instance, *FDI* will be endogenous if the economic growth rate of a host country is an important factor for *MNCs* when deciding where to invest. That is, *FDI* can determine and, in part, be determined by the growth rate of the host country. Hence, to identify the causal relationship between development and *FDI*, we use an instrumental variable (IV) approach as our main estimation technique. We adopt a novel instrument for *FDI* developed by Abor et al. (2024). Specifically, we instrument *FDI* using the total number of bilateral investment treaties (*BITs*) ratified and come into force by a country with other countries. As we scale the number of treaties per 100,000 of the total population, this allows us to capture the number of treaties a country signs to allow for private capital inflows in the country relative to its population. *BITs* are voluntary treaties that two countries sign with the basic aim of protecting foreign investment. These agreements are, in their very nature, designed with the explicit aim to encourage foreign investment and protect the same by having clauses or rules that protect foreign investment against political risk. These treaties normally encourage principles such as treating foreign investors the same as host country investors, providing adequate compensation to foreign investors where their assets are exploited and indicating an independent body like the International Centre for Settlement of Investment Disputes (*ICSID*) to settle disputes. Despite the obvious variations in these *BITs*, they all share a common provision: to protect investors' investments (Bhagwat et al., 2021). Indeed, Colen et al. (2016) and Neumayer and Spess (2005) find that *BITs* have a significant positive impact on *FDI*. In this way we suggest that *BITs* are an extremely plausible instrument for *FDI* given that their impact on economic growth, poverty, inequality and welfare, *can only be via FDI*. The main IV estimates

are similarly based on Equation (7). Note that we also utilise the system generalised method of moments (*GMM*) technique, in a dynamic panel data model setting (Harris et al., 2008), following the use of such in many previous growth studies (Islam, 1995; Lee et al., 1998; Panizza, 2002; Soumaré, 2015; Teixeira and Queirós, 2016; Dwumfour et al., 2017; Dwumfour, 2020), as a robustness check.

3.4. Testing for interactions between FDI and R&D

Our key hypotheses involve the relationships between *FDI* and *R&D* in the developmental process: are they substitutes or complements? We can employ the following simple strategy to test for this by considering the augmented specification of

$$DEV_{it} = \alpha_0 + \alpha_1 FDI_{it} + \alpha_2 R\&D_{it} + \alpha_3 (FDI_{it} \times R\&D_{it}) + \boldsymbol{\gamma Controls}_{it} + \alpha_i + \varepsilon_{it}, \quad (7)$$

where all variables are as defined before. The coefficient of interest is α_3, which is expected to be either positive or negative depending on the development indicator used. That is, a positive sign indicates that *FDI* and *R&D* are complements in relation to economic or human development but substitutes in relation to poverty or inequality, while a negative sign indicates that *FDI* and *R&D* are substitutes in relation to economic or human development but complements in relation to poverty and inequality.

4. Empirical Results and Discussion

We first present the baseline FE results in Tables 2 and 3. In almost all the estimations, *FDI* has no significant impact on any of our dependent variables. However, this *may* be a result of the potential endogeneity issues noted earlier, between *FDI* and the development outcomes. We therefore proceed with the main IV estimations.

[Insert Tables 2 and 3 about here]

4.1. Main IV results

Since we use a single instrument, the test for over-identification is not defined (Angrist and Pischke, 2009). Here we test the sensitivity of our estimates by starting with a baseline specification with no other controls, and then adding them consecutively (Altonji et al., 2005). As can be seen in Tables 4 to 7, our main variables of interest remain

statistically significant after adding the controls. From these tables, we also see that the coefficient of *BITs* in the first stage is positive and statistically significant. Also, the Cragg and Donald (1993) *Wald* F-statistic test of weak identification is rejected as the values are greater than the Stock-Yogo (2005) weak ID test critical values from 5.53 (25% critical value) to 16.38 (10% critical value), indicating that the instrument is relevant. These findings, along with the fact that *BITs* can only have an impact on our development outcomes via *FDI*, suggest that it is an appropriate instrument.

The results from Table 4 show that *FDI* has a significant positive impact on growth in all estimations at 1% level, confirming the important role of *FDI* in driving growth in the host countries. *R&D* similarly has a significant positive impact in almost all of the regressions, and again mostly at the 1% level. Importantly, we see that compared to *FDI*, the magnitude of the impact of *R&D* on growth is larger. For instance, from column (4), while a one per cent increase in *FDI* net inflows results in a 0.007% increase in GDP per capita (growth), a percentage increase in *R&D* results in a 0.54% increase in growth, which is about one-third standard deviation of growth. These show that *FDI* and *R&D* do not only have a statistically significant impact on growth but also have an economic effect on growth, with *R&D* having a more pronounced impact.

[Insert Table 4 about here]

As described above, to investigate whether *FDI* and *R&D* are substitutes or complements in relation to growth, we interact *FDI* and *R&D*. As we can see in columns (3) and (5) under GDP p.c., while the level effect of *FDI* and *R&D* remains positive and statistically significant, the interaction term is negative and statistically significant at a 5%, or higher level. This shows that *FDI* and *R&D* are substitutes. This is confirmed by the marginal effects plots in Figure 5 (a & b). From this, we can see that the positive marginal effect of *FDI* on growth reduces along with higher *R&D* expenditures, with even higher *R&D* expenditures leading to a negative marginal effect on growth.

From Table 4, we can also see that *FDI* and *R&D* have a significant negative impact on inequality in all estimations (at 1%). This suggests that *FDI* has the potential to bridge the income gap between the top and bottom earners. Quantitatively, we see again that the impact of *R&D* on inequality is larger than that of *FDI*. For instance, from

column (9), a one per cent increase in *FDI* reduces inequality by 0.21%, while a one per cent increase in *R&D* leads to a 2.43% decrease in inequality. Here also, from columns (8) and (10), we see that the interaction of *FDI* and *R&D* is positive while the level effects of these variables remain negative. This is also demonstrated by the marginal effect plots in Figure 5 (c & d), which confirms that *FDI* and *R&D* are substitutes in their relationship with income inequality. Here, increasing *R&D* expenditure along with *FDI* eventually leads to a positive marginal effect of *FDI* on inequality.

[Insert Figure 5 about here]

Moving onto human development, from Table 5 the results show a significant positive impact of both *FDI* and *R&D* on both HDI and iHDI at a 1% significance level. Again, these results confirm the important roles of both *FDI* and *R&D* in improving human development. We, however, see that the impact of *R&D* is larger than that of *FDI*. For instance, from columns (4) and (9), a one per cent increase in *FDI* leads to an increase of 0.001 and 0.01 points on HDI and iHDI, respectively. Meanwhile, from the same columns, a one per cent increase in *R&D* leads to a 0.053 and 0.130 points increase in HDI and iHDI, respectively. This shows that countries are more likely to improve more in their human development from expenditure in *R&D* than *FDI* inflows. Again, the interaction of *FDI* and *R&D* as seen in columns (3), (5), (8) and (10) show that *FDI* and *R&D* are substitutes. The marginal effects plots in Figure 5 (panels e to h) further confirm these results. Similar to the growth regressions, we see that higher expenditures, along with higher *FDI* net inflows, lead to a negative marginal effect of *FDI* on welfare.

[Insert Table 5 about here]

The results on poverty headcount are presented in Tables 6 and 7. From these, we again find a significant negative impact of *FDI* on all poverty measures, while we find a negative impact of *R&D* on most of the poverty measures (at 10% levels or higher). From columns (4) and (9) of both Tables 6 and 7, we see that a one percent increase in *FDI* leads to a 0.03%, 0.08%, 0.17% and 0.20% decrease in poverty headcount at $1.90, $3.20, $5.50 and, multidimensional poverty respectively. We see a progressive impact of *FDI* on poverty as the poverty line is increased from $1.90 to $5.50 and to a multidimensional

measure. We find similar qualitative results for *R&D*. However, quantitatively, we see that the impact of *R&D* on poverty is larger than the impact of *FDI*. For instance, from columns (4) of both Tables 6 and 7, we see that a one percent increase in *R&D* leads to a 0.37%, and 2.75% decrease in poverty headcount at $1.90 and $5.50, respectively. Also, from column (9) of Table 6, the impact of *R&D* on poverty headcount at $3.20 is 0.11 though not significant but from column (9) of Table 7, a one percent increase in *R&D* leads to a 6.07% decrease in multidimensional poverty. These results further show a larger impact of *R&D* on poverty than do *FDI*. Here also, the interaction of *FDI* and *R&D* show that these variables are substitutes in their relationship with poverty. The marginal effects in Figure 6 further confirm these results.

[Insert Tables 6 and 7 about here]

[Insert Figure 6 about here]

The effects of the remaining control variables are generally in line with the existing literature. For example, we find that *ICT* infrastructure helps to promote growth, improve human development and reduce poverty levels (Asongu and Le Roux, 2017; Gohou and Soumaré, 2012). We also find evidence of returns to education as people progress in the educational ladder. While the impact of secondary education on growth, inequality and poverty is weak with a few significant instances, we find that generally, the impact of tertiary education is significant in improving growth, reducing inequality and poverty in almost all the estimations (Gyimah-Brempong et al., 2006; Appleton et al., 2010).

On financial development, we find an ambiguous impact on development outcomes. Specifically, we find that financial development generally improves growth but increases inequality and reduces human development. Financial development, however, has no significant impact on poverty. These results are similar to those of Dwumfour et al. (2017), Dwumfour (2020), Gohou and Soumaré (2012) and Soumaré (2015), for example. We find similar results for inflation. Inflation reduces growth and human development, but reduces inequality. This may suggest the non-linear impact of inflation on development as discussed earlier. Furthermore, unemployment generally reduces growth, increases inequality and poverty.

5. Robustness Checks

We now allow for state-dependence in our outcome variables by considering dynamic panel data models and the systems-*GMM* approach. We also consider different specifications of the models to provide robustness checks to our previous findings. We examine the non-linear impact of *FDI* on development. We also provide additional results by instrumenting for *R&D*. Additionally, we check whether our main IV results remain robust for sub-samples, including comparing results for developed and developing countries and estimating a sample excluding the top and bottom deciles of *FDI* and *R&D* and winsorizing the data (These results are provided in the Supplementary Online Appendix).

5.1. Allowing for dynamics: a dynamic panel data approach

Due to the well-known issues in estimating a dynamic panel data (dpd) model (Harris et al., 2008), we use the standard current approaches to address these. Indeed, following Roodman (2009), for example, using lags of the independent variables as instruments does lose data, and hence we adopt the collapsing method of Holtz-Eakin et al. (1988) to reduce the loss of data points. We also use Arellano and Bover (1995)'s forward orthogonalisation method to limit the number of instruments. To check the validity of our estimates, we test for over-identifying restrictions using the *Hansen* test. Our estimates fail to reject the null hypothesis of valid over-identifying restrictions. Again, for system *GMM* estimates, it is indicative to test any correlations between deeper lags of the instruments and disturbances (Arellano and Bond, 1991). Based on the test of the second-order serial correlations, AR(2), we reject the null of serial correlations. This shows that our *GMM* specifications are appropriate.

The results are presented in Tables 8 and 9. From these, we can see that the lag of the dependent variable(s) is all positive and significant, showing that development outcomes persist over time and confirm the dynamic nature of the model. Importantly, though, the results further confirm our earlier results that while *FDI* and *R&D* have positive (negative) impact on growth and human development (inequality and poverty), their interactions show a substitution effect in this relationship. These are also confirmed by the marginal effect plots in Figure 7. From these figures, we see that increasing *R&D* along with *FDI* shows a negative (positive) marginal effect on growth and human development (inequality and poverty). This further shows that countries with relatively

low expenditures in *R&D* tend to be dependent on *FDI* for development, while countries with higher expenditures in *R&D* are less dependent on *FDI* for their development.

[Insert Tables 8 and 9 about here]

[Insert Figure 7 about here]

5.2. Testing the non-linear impact of FDI on development

Following the literature (Kentor and Boswell, 2003), we test for a non-linear effect of *FDI* on development by specifying

$$DEV_{i,t} = \alpha_0 + \alpha_1 FDI_{i,t} + \alpha_2 FDI^2{}_{i,t} + \alpha_3 R\&D_{i,t} + \alpha_3 FDI_{i,t} \times R\&D_{it} + \alpha_4 FDI^2{}_{i,t} \times R\&D_{it} + \boldsymbol{\gamma Controls}_{i,t} + \alpha_i + \varepsilon_{i,t} \quad (8)$$

Here, we *a priori* expect the coefficient of *FDI*, α_1, to be positive while that of FDI^2, α_2, is negative suggesting the non-linear effect of *FDI* on development. In this case, this will be an inverted U-shaped relationship with *FDI* having an initial positive impact on development up to a threshold after which the relationship turns negative. We instrument for *FDI* and its squared with *BITs* and *BITs* squared, respectively.

The results are presented in Tables 10 to 12. From these, we can indeed see a non-linear impact of *FDI* on development. For instance, from columns (2) and (3) in Table 10, the average threshold effect of *FDI* on growth occurs around 171% at which point the effect of *FDI* begins to diminish. The interaction between *FDI* and *R&D* remains negative while the interaction between FDI^2 and *R&D* becomes positive, suggesting the complementary role of *R&D* after *FDI* reaches its threshold. This is confirmed by the marginal effects evaluated at the minimum, mean and maximum *R&D* values from the interaction between *FDI*, FDI^2, and *R&D*, which show a positive marginal effect as *R&D* increases along with a non-linear effect of *FDI*. This indicates that *R&D* complements *FDI* only when *FDI* reaches its threshold and begins to hurt development. We observe similar results when we use HDI and iHDI in Table 11. We again see that *FDI* has a positive marginal effect on welfare as *R&D* increases, along with a non-linear effect of *FDI*. These are confirmed by the marginal effects plots in Figure 8 (a, b and c). Here, we see that *FDI* has an initial negative marginal effect on growth and welfare, but after

R&D expenditure reaches around 2% of *GDP*, we see the complementary nature of *R&D* in the *FDI*-growth/welfare relationship.

We see similar results for inequality, where in this case we find an average *FDI* threshold of 190%. Again, the interaction between *FDI* and *R&D* remains positive while the interaction between FDI^2 and *R&D* becomes negative, suggesting the complementary role of *R&D* after *FDI* reaches its threshold. We find a negative marginal effect from the interactions showing that *R&D* complements *FDI* to reduce inequality as *R&D* increases, along with the non-linear effect of *FDI* on inequality.

[Insert Table 10 about here]

In Table 11, we find the non-linear impact of *FDI* on HDI and iHDI with an average threshold of 154% and 114% for HDI and iHDI, respectively. Here also, the interaction between *FDI* and *R&D* remains negative while the interaction between FDI^2 and *R&D* becomes positive, suggesting the complementary role of *R&D* after *FDI* reaches its threshold. Again, we find a positive marginal effect as *R&D* increases along with the non-linear effect of *FDI* in relation to HDI and iHDI, showing the complementary role of *FDI* and *R&D* after *FDI* reaches its threshold.

[Insert Table 11 Here]

From Table 12, we see the non-linear impact of *FDI* on all the poverty measures. The average threshold *FDI* from the table is 193%. Here also, the interaction between *FDI* and *R&D* remains positive while the interaction between FDI^2 and *R&D* becomes negative, indicating the complementary role of *R&D* after *FDI* reaches its threshold. We find a negative marginal effect from the interactions showing that *R&D* complements *FDI* to reduce poverty as *R&D* increases, along with the non-linear effect of *FDI* on inequality.

[Insert Table 12 about here]

These thresholds seem large given that some countries in the sample have larger *FDI* inflows as a share of *GDP*. As we show in the Supplementary Online Appendix, the

thresholds are significantly lower when we remove the sample of top and bottom deciles of *FDI* and *R&D*. Importantly, the policy relevance of these results is that countries need to invest more in *R&D* in anticipation of the threshold effect of *FDI* because at this point, it is sufficient adaptive or absorptive capacity of countries, through higher *R&D* investments, that can help mitigate the negative impact of *FDI* on development. What we add to the literature here is that if countries invest more domestically in *R&D*, the potential negative impact of *FDI* on development after its threshold would be mitigated. The marginal effects of *FDI* on poverty indicators are confirmed by the marginal effects plots in Figure 8(d to h). Here, we see that *FDI* has an initial positive marginal effect (substitution) on all poverty measures, but after *R&D* expenditure reaches around 2% of *GDP*, we see a negative marginal effect-this shows the complementary nature of *R&D* in the *FDI*-poverty nexus with about 2% of *GDP* in *R&D* expenditure.

[Insert Figure 8 about here]

5.3. Sub-sample Analysis

Here, we compare results for developed and developing countries and estimate a sample excluding the top and bottom deciles of *FDI* and *R&D* and winsorizing the data. These results are provided in the Supplementary Online Appendix. For the developed and developing countries, we confirm the differential impact between developed and developing countries with the joint significance test of equality, showing an asymmetric impact between developed and developing countries. These results generally show that the development impact of *FDI* is larger for developing countries than for developed countries. This may explain why these countries tend to be dependent on *FDI*. However, even though *R&D* only has a significant impact on HDI and iHDI for developing countries, the impact is more pronounced than that of the *FDI*. On the other hand, we find that R&D in developed countries plays a significant development role, showing a larger impact on growth, inequality, human development and poverty. This further validates the argument that countries tend to benefit more from R&D than they do from FDI and that countries, particularly developing, should focus more on expenditures in *R&D*. Again, we re-estimate our main results by excluding the top and bottom deciles of *FDI* and *R&D* and also winsorize the data at the top and bottom 1%. The results are

consistent with our main findings that *FDI* and *R&D* are substitutes in the development process and that *R&D* has a more pronounced impact on development outcomes.

5.4. Instrumenting for both FDI and R&D

Here, we provide a further (final) robustness check by instrumenting for *both FDI* and *R&D*, with the number of researchers engaged in *R&D*, expressed as per million people, providing the instrument for the latter. We argue that the more researchers a country has, the higher the potential for R&D activities, which could lead to higher R&D expenditures. Indeed, from the first stage results in Table 13, we see that the number of researchers engaged in *R&D* has a significant correlation with R&D expenditure at the 1% level. We believe that this is a plausible instrument for *R&D* expenditure, given that its impact on development outcomes can only effectively be through their engagement in *R&D*. While we lose a lot of observations due to missing data for the instrument, the results in Table 13 remain qualitatively and quantitatively very similar to our earlier findings. We confirm from Figure 9 that *FDI* and *R&D* are substitutes in the development process. Again, we see that the positive (negative) marginal effect of *FDI* on growth and welfare (poverty and inequality) reduces with higher *R&D* expenditures, with higher *R&D* expenditures leading to a negative (positive) marginal effect on growth and welfare (poverty and inequality).

[Insert Table 13]

[Insert Figure 9 Here]

5.5. Alternative measure of FDI

Here, obtain data on the stock of *FDI* from the UN Trade and Development (UNCTAD). *FDI* stocks are the accumulated value held at the end of the year. We use *FDI* as a ratio of GDP. The results presented in the Supplementary Online Appendix confirm our main findings that *FDI* and *R&D* are substitutes in the development process and that compared with *FDI*, *R&D* has a more pronounced impact on development outcomes.

6. Conclusion and Policy Implications

We examined the influence of *FDI* on development and the role of *R&D* in this relationship. In this regard, we test whether *FDI* and *R&D* are substitutes or complements in a country's growth and development. To the best of our knowledge, this is the first study to provide comprehensive evidence of the combined effect of *FDI* and *R&D* on development. In this regard, we develop a simple theoretical model to explain the substitution and complementary effects of *FDI* and *R&D* on a country's growth and development. As a further contribution to the literature, we use bilateral investment treaties (*BITs*) as a novel instrument for *FDI* to address any possible endogeneity of FDI.

Our results show that both *FDI* and *R&D* are important in driving growth, improving human development, reducing income inequality and poverty. We also find that the development impact of *R&D* is more pronounced than *FDI*. Indeed, we find that *FDI* and *R&D* are substitutes in their impact on development outcomes. This means more investments/expenditures in *R&D* leads to less dependence on *FDI* for development, and *vice versa*. Importantly, policymakers should not only focus on promoting *FDI* inflows but also spend more on *R&D* in their domestic countries as a way of driving innovation and their productive capacities to be able to achieve the needed development.

This is crucial given that we also find a diminishing effect of *FDI*: *FDI* begin to hurt development after a certain threshold. This may be because below certain *FDI* thresholds, *FDI* are relevant as they provide the initial benefits of increasing growth and human development and also reducing income inequality and poverty. However, after certain thresholds of *FDI*, foreign investors may not necessarily focus on the development areas of host countries, leading to adverse selection. In particular, foreign investors who have control of domestic firms are likely to have significant influence in the respective host countries, and thus repatriation of profits and other financial transaction decisions may deteriorate the balance of payments, among other consequences for the host country. In terms of these *FDI* reversals, higher control of foreign investors who may have large leverage in the domestic market may lead them to lend the same to the parent company when the need be. Besides, where the parent company or other subsidiaries have debt on the books of these subsidiaries, these loans can be recalled,

leading to onward consequences on the domestic market.

This becomes even critical in periods of major crises like the global financial crisis and the COVID-19 pandemic. These actions of multinationals can cause instability in the macroeconomic environment, particularly exchange rate volatility and instability in the financial sector. We see the crucial role of *R&D*, especially after *FDI* reaches the threshold and begins to hurt development. At this point *R&D* begins to complement *FDI* given that host countries would have had enough adaptive/absorptive capacity after spending more on *R&D*. This has relevant policy implications in that more emphasis should be placed on the important role of *R&D* in driving development while promoting *FDI*, especially in anticipation of when *FDI* reach their threshold in the development process.

We see this to be particularly relevant for developing countries (see Supplementary Online Appendix for results and discussion), given that their developed counterparts seem to be benefiting more from *R&D*s than *FDI* in their development process. Interestingly, we see that while having more *BITs* helps increase *FDI* inflows for both developed and developing countries, developed countries tend to receive more *FDI* inflows from these treaties. In fact, we find that signing more *BITs* by developed countries reduces *FDI* inflows to developing countries. While *FDI* may be the preferred form of private capital flows for developing countries, over-reliance on these flows without strong adaptive capacity through higher investment in *R&D* may have direct consequences for the development process when the development impact of *FDI* reaches its threshold. Our results are consistent with several robustness checks, including using different estimation techniques, model specifications and sub-sample analysis.

In conclusion, while *FDI* and *R&D* are both catalysts for development, we show the importance of *R&D* in driving economic development and emphasise that policymakers should prioritise *R&D* initiatives in addition to encouraging *FDI*. A balance between the two must be struck to optimise the positive effects on the development of countries.

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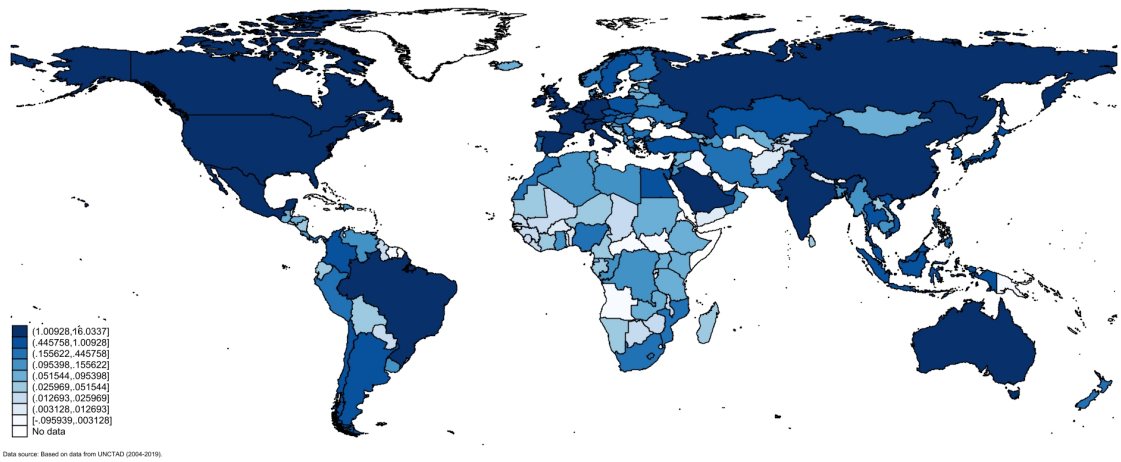

Figure 1: Average net FDI inflows – Share of world FDI inflows (2004-2019)

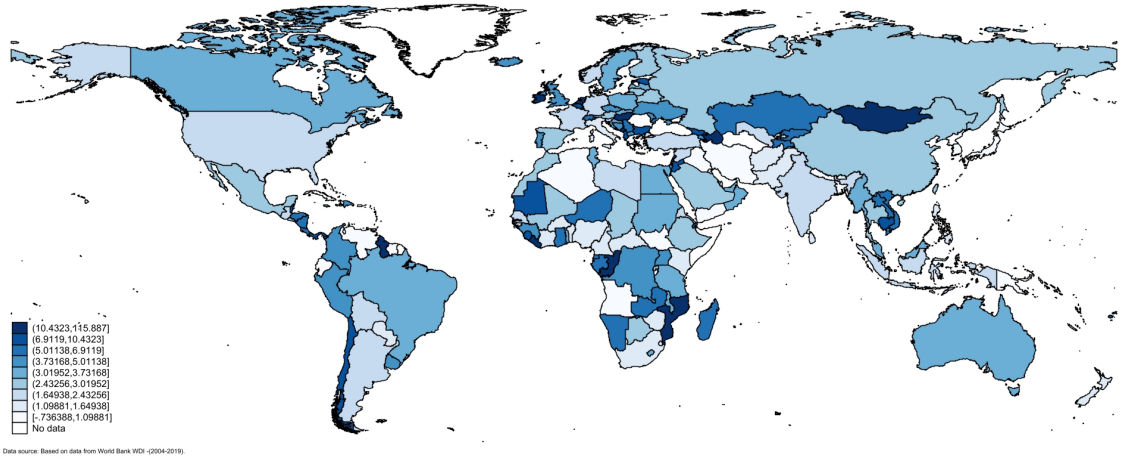

Figure 2: Average net FDI inflows – Share of *GDP* (2004-2019)

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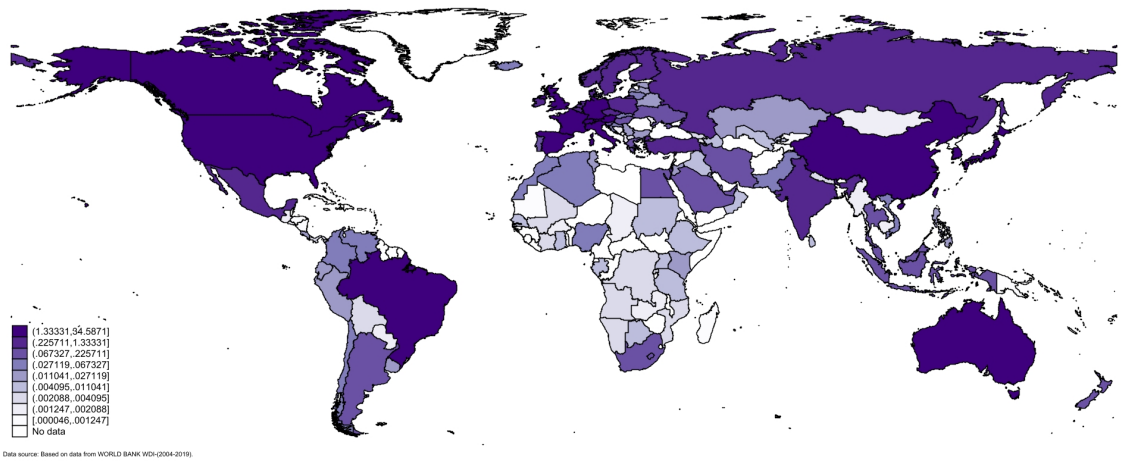


Figure 3: Average *R&D* expenditure – Share of world *R&D* (2004-2019)

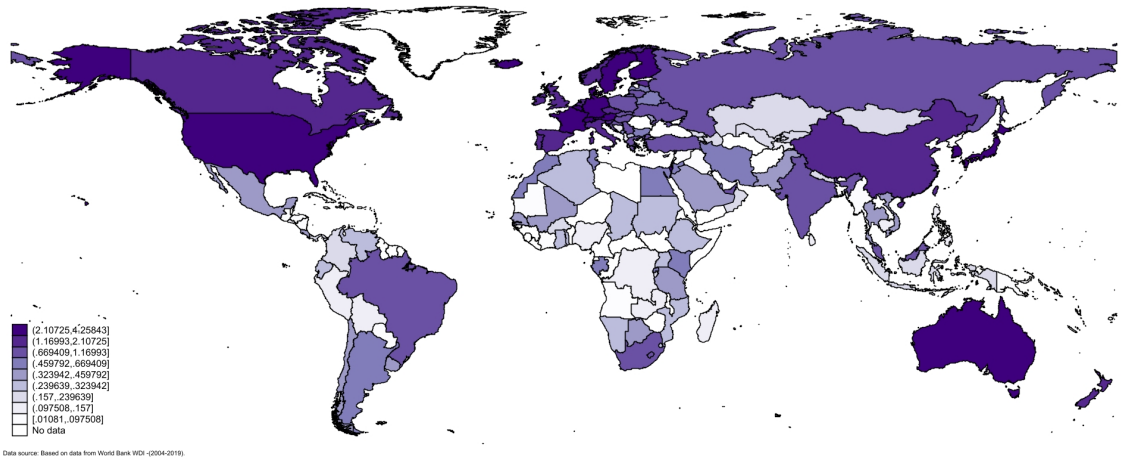
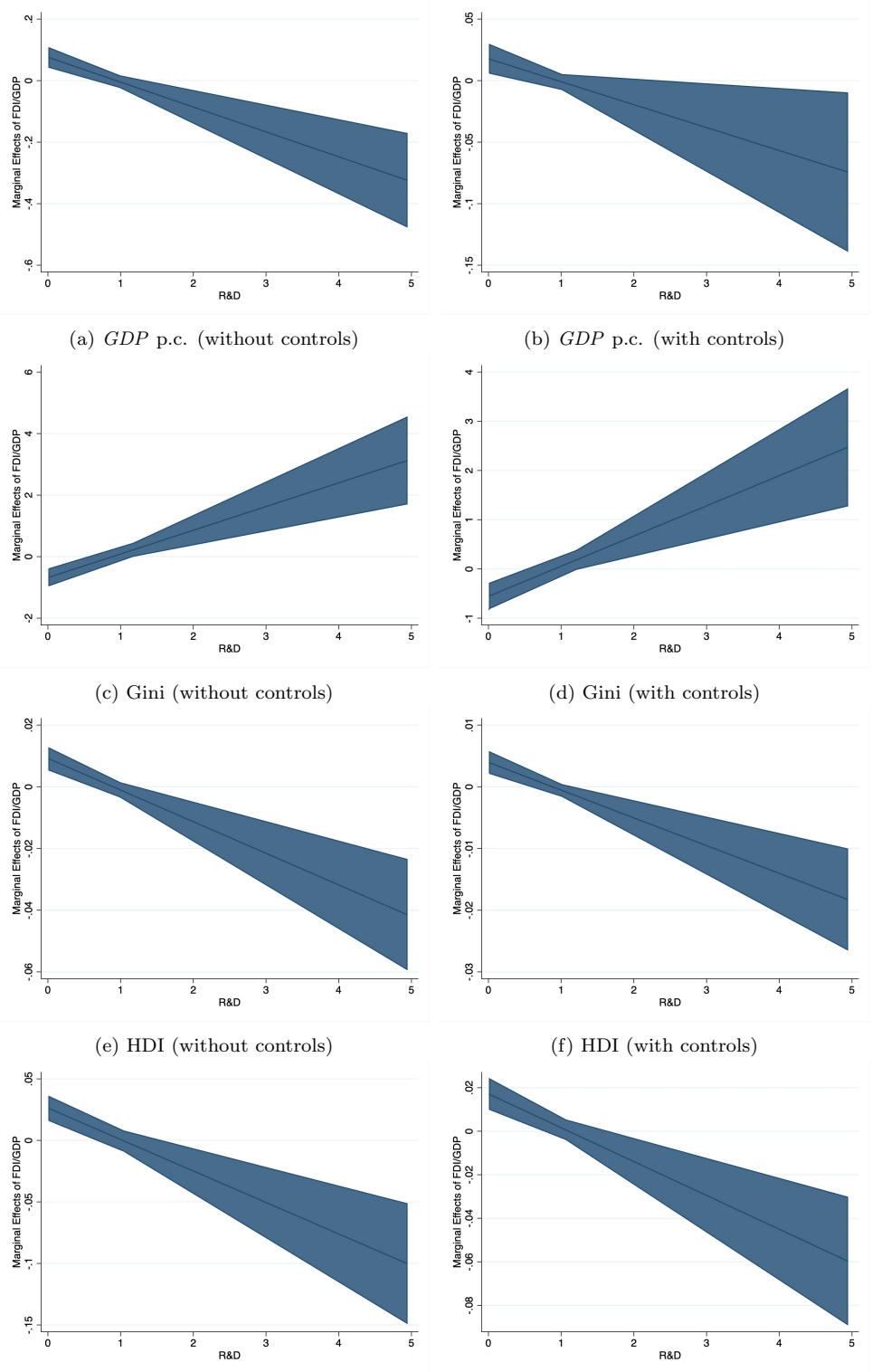


Figure 4: Average *R&D* expenditure – Share of *GDP* (2004-2019)



(a) *GDP* p.c. (without controls)

(b) *GDP* p.c. (with controls)

(c) Gini (without controls)

(d) Gini (with controls)

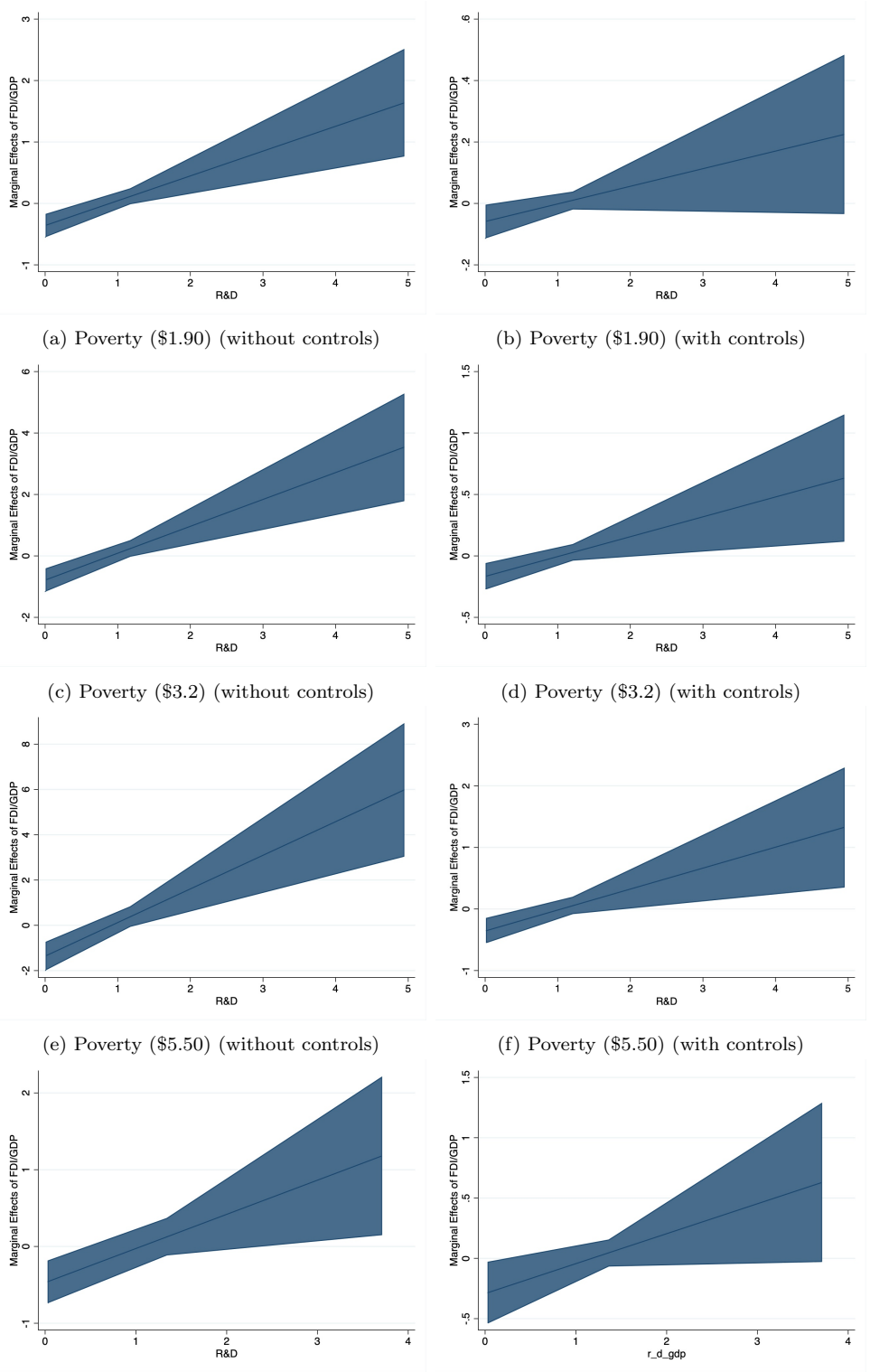
(e) HDI (without controls)

(f) HDI (with controls)

(g) iHDI (without controls)

(h) iHDI (with controls)

Figure 5: Marginal effects of FDI on growth, inequality and welfare (with 95% CI), IV regression



(a) Poverty ($1.90) (without controls)

(b) Poverty ($1.90) (with controls)

(c) Poverty ($3.2) (without controls)

(d) Poverty ($3.2) (with controls)

(e) Poverty ($5.50) (without controls)

(f) Poverty ($5.50) (with controls)

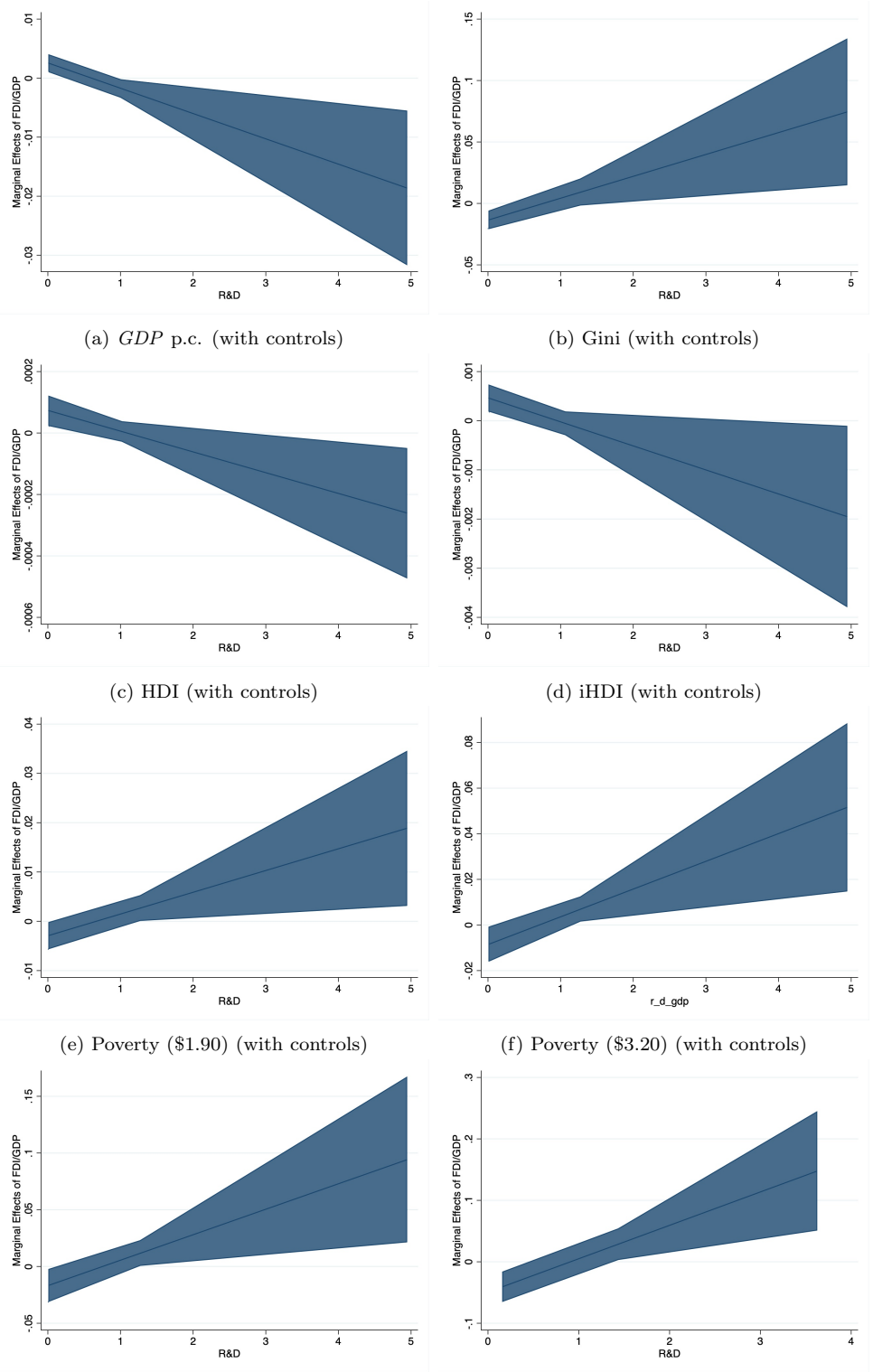
(g) Md. poverty (without controls)

(h) Md. poverty (with controls)

Figure 6: Marginal effects of FDI on poverty (with 95% CI), IV regression

Table 1: Descriptive statistics

Variable	Full-Sample			
	Mean	Std. Dev.	Min	Max
Real *GDP* per capita -natural log (*GDP* p.c.)	8.504	1.498	4.855	11.685
Gini index (Gini)	36.810	8.155	23.200	64.800
Human development index (HDI)	0.691	0.159	0.285	0.957
Inequality-adjusted HDI (iHDI)	0.572	0.192	0.208	0.899
Headcount poverty ratio at $1.90 %population(Headcount Poverty $1.90)	6.423	13.979	0.000	94.300
Headcount poverty ratio at $3.20 %population(Headcount Poverty $3.20)	13.449	21.715	0.000	98.500
Headcount poverty ratio at $5.50 %population(Headcount Poverty $5.50)	24.489	29.268	0.000	99.700
Multidimensional headcount poverty %population (Multidimensional poverty)	26.990	11.312	2.370	74.200
Net *FDI* inflows as a share of *GDP* % (*FDI* /*GDP*)	6.209	18.240	-58.323	451.639
Research and development expenditure as a % of *GDP* (*R&D*)	0.977	0.982	0.011	4.941
No. of bilateral treaties (*BITs*)	24.485	26.819	0	150
Mobile and telephone subscriptions per 100 people (*ICT* infrastructure)	106.114	56.933	0.862	364.872
Secondary school enrolment, %Gross (Secondary education)	81.876	28.647	8.707	163.935
Tertiary school enrolment, %Gross (Tertiary education)	38.849	27.802	0.494	142.852
Domestic credit to the private sector as a % of *GDP* (Financial Development)	49.469	41.125	0.186	308.978
Consumer price index % (Inflation)	5.449	11.599	-60.496	379.848
Unemployment rate % (Unemployment)	7.697	5.866	0.091	37.250
Number of Researchers engaged in R&D per million people	6.877	1.598	1.781	8.995



(a) *GDP* p.c. (with controls)

(b) Gini (with controls)

(c) HDI (with controls)

(d) iHDI (with controls)

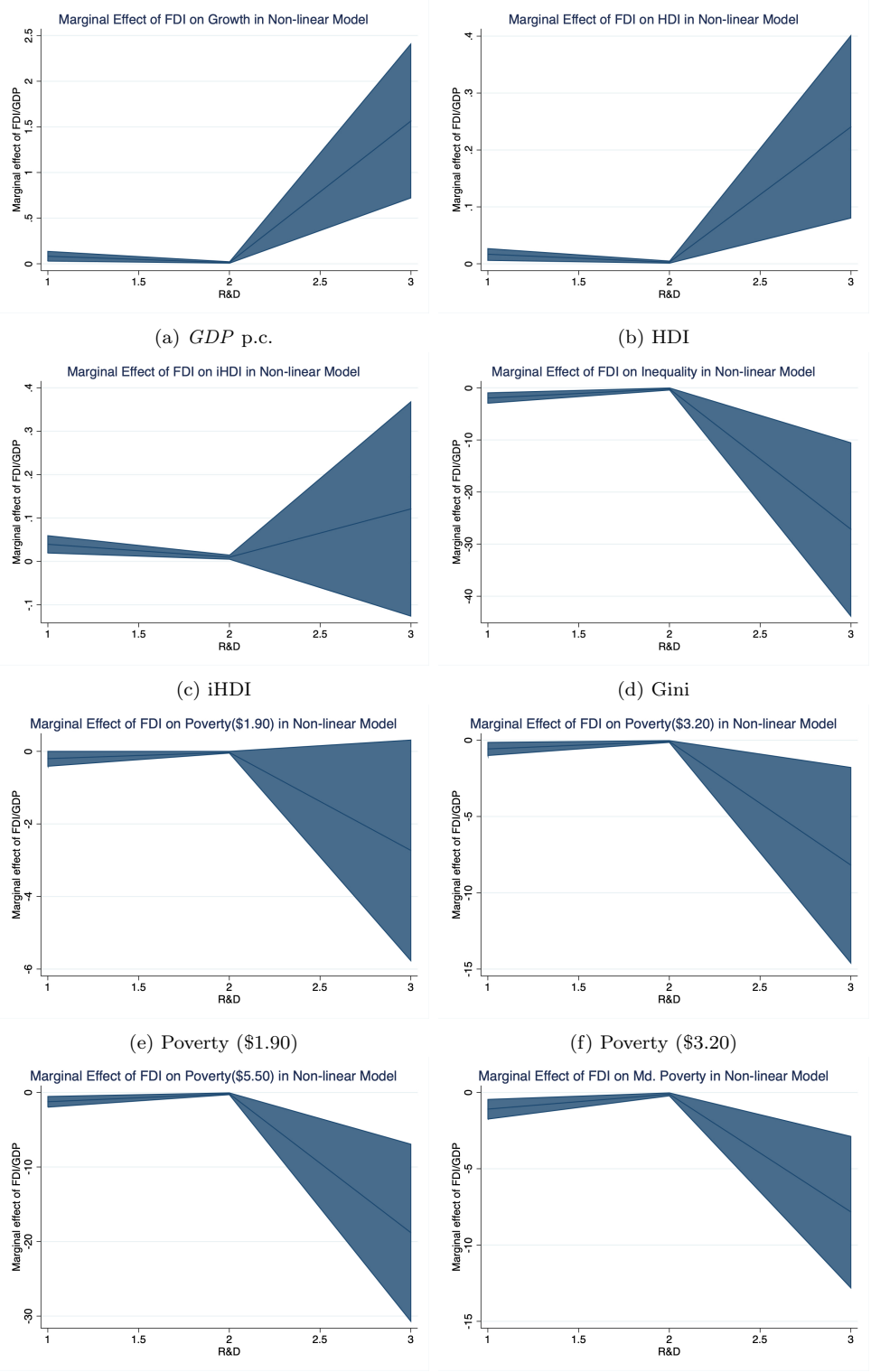
(e) Poverty ($1.90) (with controls)

(f) Poverty ($3.20) (with controls)

(g) Poverty ($5.50) (with controls)

(h) Md. poverty (with controls)

Figure 7: Marginal effects of *FDI* on growth and development (with 95% CI), *GMM* estimate



(a) *GDP* p.c.

(b) HDI

(c) iHDI

(d) Gini

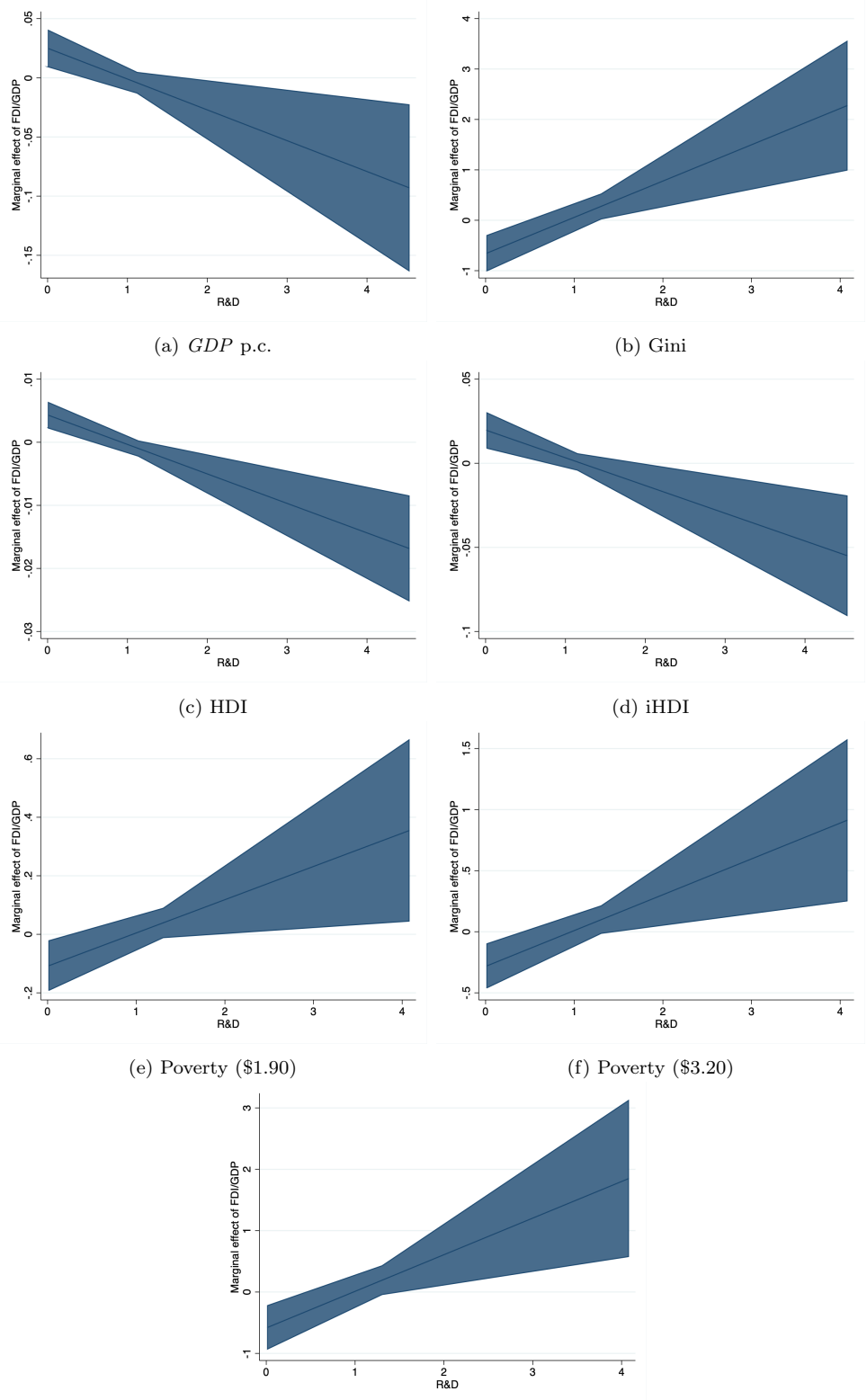
(e) Poverty ($1.90)

(f) Poverty ($3.20)

(g) Poverty ($5.50)

(h) Poverty (Md. Poverty)

Figure 8: Marginal effects of *FDI* on development outcomes non-Linear *FDI* model (with 95% CI), IV regression



(a) *GDP* p.c.

(b) Gini

(c) HDI

(d) iHDI

(e) Poverty ($1.90)

(f) Poverty ($3.20)

(g) Poverty ($5.50)

Figure 9: Marginal effects of *FDI* on growth and development (with 95% CI), IV regression-instrumenting both *FDI* and *R&D*

Table 2: Impact of FDI on economic growth and welfare, FE regression

Variable	*GDP* p.c.		Income inequality (Gini)		HDI		iHDI	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FDI /GDP	-0.00006	0.0002	-0.0020	-0.0006	-0.00001	0.0001	-0.0001**	-0.0001
	(0.0002)	(0.0005)	(0.0033)	(0.0057)	(0.0000)	(0.00004)	(0.00005)	(0.0001)
R&D	0.0834*	0.0836*	0.1478	0.1474	0.0178***	0.0202***	0.0106	0.0106
	(0.0467)	(0.0467)	(0.4947)	(0.4941)	(0.0049)	(0.0054)	(0.0078)	(0.0078)
FDI /GDP × *R&D*		-0.0004		-0.0023		-0.0001**		0.00002
		(0.0006)		(0.0060)		(0.0001)		(0.0001)
ICT	0.0067***	0.0067***	-0.0343***	-0.0343***	0.0005***	0.0005***	0.0003*	0.0003*
	(0.0006)	(0.0006)	(0.0061)	(0.0061)	(0.00005)	(0.00005)	(0.0001)	(0.0001)
Secondary education	0.000001	0.000001	0.0002	0.0002				
	(0.0001)	(0.0001)	(0.0008)	(0.0008)				
Tertiary education	0.0017*	0.0017	-0.0114	-0.0116				
	(0.0011)	(0.0011)	(0.0113)	(0.0113)				
Financial Development	0.0003	0.0003	0.0089*	0.0090*	-0.00004	-0.00003	0.0001	0.0001
	(0.0007)	(0.0007)	(0.0052)	(0.0053)	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Inflation	-0.0013	-0.0013	0.0105	0.0104	-0.0005**	-0.0005**	-0.0003	-0.0003
	(0.0021)	(0.0021)	(0.0216)	(0.0216)	(0.0002)	(0.0002)	(0.0003)	(0.0003)
Unemployment	-0.0211***	-0.0211***	0.1608***	0.1608***	-0.0008*	-0.0008*	-0.0021***	-0.0021***
	(0.0033)	(0.0033)	(0.0410)	(0.0410)	(0.0004)	(0.0004)	(0.0006)	(0.0006)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Countries	128	128	90	90	130	130	112	112
Obs.	1131	1131	779	779	1223	1223	664	664
Adj. R2	0.99	0.99	0.96	0.96	0.99	0.99	0.99	0.99

Note: All variables are as defined earlier. *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors in parenthesis

Table 3: Impact of FDI on poverty, FE regression

Variable	Headcount poverty $1.90		Headcount poverty $3.20		Headcount poverty $5.50		Multidimensional poverty	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FDI/*GDP*	-0.0022	-0.0032	-0.0057	-0.0078	-0.0083	-0.0084	-0.0026	0.0088
	(0.0015)	(0.0027)	(0.0041)	(0.0069)	(0.0065)	(0.0113)	(0.0085)	(0.0164)
R&D	0.2752	0.2754	0.8795	0.8800	0.9995	0.9996	-1.0175	-1.0516
	(0.3378)	(0.3383)	(0.6899)	(0.6911)	(0.9780)	(0.9785)	(1.2559)	(1.0673)
FDI/GDP × *R&D*		0.0016		0.0034		0.0002		-0.0142
		(0.0027)		(0.0062)		(0.0109)		(0.0167)
ICT Infrastructure	-0.0372***	-0.0372***	-0.0923***	-0.0924***	-0.1377***	-0.1377***	0.0010	0.0022
	(0.0066)	(0.0066)	(0.0163)	(0.0163)	(0.0173)	(0.0173)	(0.0255)	(0.0155)
Secondary education	-0.0015	-0.0015	-0.0046**	-0.0046**	-0.0042	-0.0042	-0.0018	-0.0017
	(0.0014)	(0.0014)	(0.0023)	(0.0023)	(0.0027)	(0.0027)	(0.0019)	(0.0155)
Tertiary education	-0.0114	-0.0112	-0.0343	-0.0340	-0.0802**	-0.0801**	-0.0545	-0.0540**
	(0.0121)	(0.0121)	(0.0245)	(0.0244)	(0.0352)	(0.0352)	(0.0344)	(0.0222)
Financial development	-0.0052	-0.0053	-0.0133	-0.0134	-0.0267*	-0.0267*	-0.0402	-0.0427***
	(0.0043)	(0.0042)	(0.0091)	(0.0091)	(0.0146)	(0.0145)	(0.0248)	(0.0158)
Inflation	0.0169	0.0169	0.0721	0.0721	0.1175	0.1175	0.2120	0.2109*
	(0.0174)	(0.0174)	(0.0511)	(0.0678)	(0.0871)	(0.0872)	(0.1602)	(0.1119)
Unemployment	0.0877***	0.0878***	0.2151***	0.2151***	0.4878***	0.4878***	0.7257***	0.7339***
	(0.0306)	(0.0307)	(0.0677)	(0.0678)	(0.1043)	(0.1043)	(0.1119)	(0.0770)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Countries	90	90	90	90	90	90	44	44
Obs.	779	779	779	779	779	779	314	314
Adj. R^2	0.96	0.96	0.95	0.95	0.97	0.97	0.93	0.93

Note: All variables are as defined earlier. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis

Table 4: Impact of *FDI* on economic growth and inequality (Gini), IV regression

Variable	*GDP* p.c.					Income inequality (Gini)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FDI / GDP	0.0921***	0.0286***	0.0761***	0.0074***	0.0178***	-0.3205***	-0.2303***	-0.6831***	-0.2147***	-0.5574***
	(0.0248)	(0.0082)	(0.0163)	(0.0025)	(0.0061)	(0.1033)	(0.0754)	(0.1478)	(0.0747)	(0.1313)
R&D		0.9510***	1.2558***	0.4298***	0.4953***		-3.1491***	-6.1353***	-2.4300***	-4.7411***
		(0.0314)	(0.0794)	(0.0342)	(0.0494)		(0.2949)	(0.7955)	(0.5855)	(0.9931)
FDI / GDP × *R&D*			-0.0809***		-0.0186**			0.7704***		0.6130***
			(0.0185)		(0.0078)			(0.1699)		(0.1445)
ICT Infrastructure				0.0133***	0.0136***				-0.0215**	-0.0369***
				(0.0007)	(0.0007)				(0.0094)	(0.0119)
Secondary education				0.0001	0.00003				-0.0037**	-0.0032*
				(0.0001)	(0.0001)				(0.0016)	(0.0019)
Tertiary education				0.0087***	0.0079***				-0.1410***	-0.1042***
				(0.0013)	(0.0014)				(0.0173)	(0.0224)
Financial development				0.0033***	0.0035***				0.0462**	0.0428**
				(0.0008)	(0.0008)				(0.0182)	(0.0215)
Inflation				-0.0164***	-0.0166***				-0.1186**	-0.1138**
				(0.0061)	(0.0062)				(0.0480)	(0.0562)
Unemployment				-0.0085**	-0.0090***				0.1044	0.1232*
				(0.0034)	(0.0034)				(0.0684)	(0.0760)
First Stage regression										
BITs	8.8705***	13.7681***	4.4273***	13.3312***	4.5932***	11.4574***	12.7215***	4.2233***	12.1992***	4.5207***
	(2.2090)	(3.7148)	(0.8463)	(4.1642)	(1.0016)	(3.4515)	(3.9833)	(0.9151)	(4.2430)	(1.0810)
Cragg-Donald Wald F-stats	344.55	259.20	85.25	195.65	75.53	176.13	140.34	49.91	113.22	48.85
Turning point: *FDI* [*R&D*]	-	-	15.52[0.94]	-	26.63[0.96]	-	-	7.96 [0.89]	-	7.73 [0.90]
Obs.	2707	1301	1301	1111	1111	1163	859	859	776	776

Note: All variables are as defined earlier. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis

Table 5: Impact of *FDI* on welfare (HDI and iHDI), IV regression

Variable	Human Development Index (HDI)					Inequality-adjusted HDI (iHDI)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FDI/GDP	0.0103***	0.0032***	0.0092***	0.0014***	0.0040***	0.0331***	0.0119***	0.0263***	0.0100***	0.0172***
	(0.0028)	(0.0009)	(0.0019)	(0.0005)	(0.0009)	(0.0086)	(0.0030)	(0.0051)	(0.0026)	(0.0036)
R&D		0.0852***	0.1238***	0.0525***	0.0662***		0.1087***	0.1789***	0.1301***	0.1576***
		(0.0028)	(0.0092)	(0.0037)	(0.0060)		(0.0056)	(0.0190)	(0.0161)	(0.0198)
FDI/GDP × *R&D*			-0.0103***		-0.0045***			-0.0256***		-0.0156***
			(0.0022)		(0.0010)			(0.0057)		(0.0036)
ICT Infrastructure				0.0015***	0.0016***				0.0022***	0.0025***
				(0.0001)	(0.0001)				(0.0002)	(0.0002)
Financial development				-0.00001***	0.00003				-0.0023***	-0.0021***
				(0.0001)	(0.0001)				(0.0006)	(0.0006)
Inflation				-0.0007*	-0.0008**				-0.0008	-0.0018*
				(0.0004)	(0.0004)				(0.0007)	(0.0009)
Unemployment				0.00101***	0.0008**				0.0030***	0.0029***
				(0.0004)	(0.0004)				(0.0010)	(0.0010)
First Stage regression										
BITs	8.8941***	13.7681***	4.4273***	12.98***	4.7150***	4.1790***	5.2987***	2.2942***	3.828***	2.2089***
	(2.2164)	(3.7148)	(0.8463)	(4.0645)	(1.0109)	(1.0574)	(1.3943)	(0.4914)	(1.0229)	(0.5353)
Cragg-Donald F-Stats	344.64	259.20	82.25	205.38	83.67	49.17	34.55	18.23	19.53	17.25
Turning Point: *FDI* [*R&D*]	-	-	12.02 [0.89]	-	14.71 [0.89]	-	-	6.99 [1.03]	-	10.10 [1.10]
Obs.	2709	1301	1301	1223	1223	1372	699	699	664	664

Note: All variables are as defined earlier. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis

Table 6: Impact of *FDI* on headcount poverty ($1.90, $3.20), IV regression

Variable	Headcount poverty $1.90					Headcount poverty $3.20				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FDI/GDP	-0.3915***	-0.1225***	-0.3598***	-0.0269**	-0.0590**	-0.7450***	-0.2727***	-0.7870***	-0.0767***	-0.1671***
	(0.1315)	(0.0440)	(0.0936)	(0.0113)	(0.0275)	(0.2466)	(0.0923)	(0.1864)	(0.0252)	(0.0545)
R&D		-2.1320***	-3.6969***	0.3735*	0.1573		-5.4027***	-8.7944***	-0.1058	-0.7155
		(0.2829)	(0.6355)	(0.2216)	(0.2927)		(0.4339)	(1.1145)	(0.3492)	(0.5024)
FDI/GDP × *R&D*			0.4037***		0.057*			0.8750***		0.1617***
			(0.1059)		(0.0318)			(0.2100)		(0.0628)
ICT Infrastructure				-0.0786***	-0.0801***				-0.1651***	-0.1691***
				(0.0121)	(0.0019)				(0.0159)	(0.0159)
Secondary education				0.0017	0.0017				-0.0022	-0.0021
				(0.0035)	(0.0035)				(0.0040)	(0.0039)
Tertiary education				-0.0982***	-0.0947***				-0.2200***	-0.2103***
				(0.0172)	(0.0172)				(0.0243)	(0.0243)
Financial Development				0.0033	0.0030				0.0041	0.0032
				(0.0041)	(0.0629)				(0.0082)	(0.0087)
Inflation				0.0369	0.0373				0.0722	0.0735
				(0.0630)	(0.0630)				(0.0794)	(0.0798)
Unemployment				0.0646	0.0663				0.1371*	0.1421*
				(0.0474)	(0.0476)				(0.0794)	(0.0750)
First Stage regression										
BITs	11.4574***	12.7215***	4.2233***	12.1992***	4.5207***	11.4574***	12.7215***	4.2233***	12.1992***	4.5207***
	(3.4515)	(3.9833)	(0.9151)	4.2430)	(1.0810)	(3.4515)	(3.9833)	(0.9151)	(4.2430)	(1.0810)
Cragg-Donald F-Stats	176.13	140.34	49.91	113.22	48.85	176.13	140.34	49.91	113.20	48.85
Turning Point: *FDI* [*R&D*]	-	-	9.16[0.89]	-	[1.04]	-	-	10.05[0.90]	-	[1.03]
Obs.	1163	859	859	776	776	1163	859	859	776	776

Note: All variables are as defined earlier. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis

Table 7: Impact of *FDI* on headcount poverty ($5.50) and multidimensional poverty, IV regression

Variable	Headcount poverty $5.50					Multidimensional poverty				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FDI/GDP	-1.1124***	-0.4887***	-1.3613***	-0.1669***	-0.3572***	-0.3034***	-0.2469***	-0.4714***	-0.1974**	-0.2921**
	(0.3625)	(0.1587)	(0.3145)	(0.0507)	(0.1028)	(0.0953)	(0.0782)	(0.1432)	(0.0990)	(0.1327)
R&D		-11.8012***	-17.5559***	-2.7537***	-4.0359***		-7.5602***	-8.2545***	-6.0734***	-6.0509***
		(0.6606)	(1.7520)	(0.5590)	(0.8683)		(0.6682)	(0.8809)	(1.5014)	(1.3886)
FDI/GDP × *R&D*			1.4846***		0.3403***			0.4449**		0.2483**
			(0.3527)		(0.1182)			(0.1750)		(0.1241)
ICT Infrastructure				-0.2534***	-0.2619***				-0.0418*	-0.0576**
				(0.0171)	(0.0175)				(0.0221)	(0.0229)
Secondary education				-0.0009	-0.0006				-0.0081	-0.0113***
				(0.0039)	(0.0039)				(0.0053)	(0.0037)
Tertiary education				-0.3751***	-0.3547***				-0.0767*	-0.0553
				(0.0039)	(0.0305)				(0.0430)	(0.0358)
Financial Development				-0.0146	-0.0164				0.0596	0.0481
				(0.0150)	(0.0162)				(0.0483)	(0.0358)
Inflation				0.1571	0.1598				0.4770	0.5831*
				(0.1152)	(0.1175)				(0.3556)	(0.3460)
Unemployment				0.3610***	0.3715***				0.4060***	0.4309***
				(0.1004)	(0.1024)				(0.1437)	(0.1363)
First Stage regression										
BITs	11.4574***	12.7215***	4.2233***	12.1992***	4.5207***	6.4018***	6.2766***	2.9662***	3.4458***	2.2922***
	(3.4515)	(3.9833)	(0.9151)	(4.2430)	(1.0810)	(1.5129)	(1.6368)	(0.6397)	(1.3788)	(0.7191)
Cragg-Donald F-Stats	176.13	140.34	49.91	113.22	48.85	27.97	19.36	13.25	8.24	10.13
Turning Point: *FDI* [*R&D*]	-	-	11.83[0.92]	-	11.86[1.05]	-	-	8.55[1.06]	-	24.37[1.18]
Obs.	1163	859	859	776	776	405	325	325	314	314

Note: All variables are as defined earlier. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis

Table 8: Impact of *FDI* on growth, inequality (Gini) and welfare (HDI and iHDI), *GMM* results

Variable	*GDP* p.c.		Income inequality (Gini)		HDI		iHDI	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L1.Depndent variable	0.8769***	0.949***	0.9459***	0.9253***	0.9180***	0.9122***	0.9620**	0.9585***
	(0.0403)	(0.0263)	(0.0340)	(0.0198)	(0.0206)	(0.0246)	(0.0101)	(0.0123)
FDI/GDP	0.0004*	0.0026***	-0.0030*	-0.0136***	0.00004***	0.0001***	0.0001**	0.0005***
	(0.0002)	(0.0008)	(0.002)	(0.0038)	(0.00001)	(0.00002)	(0.00002)	(0.0001)
R&D	0.1168**	0.0417*	-0.0294	-0.0577	0.0086***	0.0083***	0.0056***	0.0084***
	(0.0463)	(0.0224)	(0.231)	(0.0757)	(0.0022)	(0.0023)	(0.0022)	(0.0032)
FDI/GDP × *R&D*		-0.0043***		0.0178***		-0.0001***		-0.0004**
		(0.0015)		(0.0078)		(0.00002)		(0.0002)
ICT Infrastructure	0.0021***	0.0011**	-0.0053***	-0.0047***	0.0001***	0.0001***	0.0001***	0.0001***
	(0.0007)	(0.0004)	(0.0018)	(0.0017)	(0.0022)	(0.00002)	(0.00002)	(0.00002)
Secondary education	-0.00002	-0.0001	-0.0042***	-0.0027***				
	(0.00008)	(0.0001)	(0.0011)	(0.0007)				
Tertiary education	0.0018**	0.0006	-0.0092	-0.0134***				
	(0.0008)	(0.0001)	(0.0086)	(0.0051)				
Financial development	-0.0011***	-0.0005**	0.0065***	0.0038***	-0.00003**	-0.00002	-0.00004**	-0.0001**
	(0.0003)	(0.0002)	(0.0023)	(0.0011)	(0.00001)	(0.00002)	(0.00002)	(0.00003)
Inflation	-0.0012	-0.0015	-0.0032	-0.0138*	-0.0001	-0.0002	0.0005*	0.0004
	(0.0011)	(0.0010)	(0.0170)	(0.0080)	(0.0002)	(0.0003)	(0.0003)	(0.0003)
Unemployment	0.0025**	-0.0027***	0.0134	0.0188	0.0001**	0.0001**	0.0001	0.0001
	(0.0011)	(0.0009)	(0.0170)	(0.0139)	(0.0001)	(0.00001)	(0.0001)	(0.0001)
No. of countries	128	128	64	64	130	130	102	102
No. of instruments	40	39	45	45	14	14	22	22
AR(2)	0.883	0.837	0.131	0.115	0.436	0.414	0.550	0.350
Hansen p-value	0.122	0.139	0.740	0.881	0.734	0.330	0.111	0.185
Obs.	1061	1061	647	647	1148	1148	574	574
Turning Point: *FDI* [*R&D*]	-	9.63[0.60]	-	[0.76]	-	83[1.00]	-	21[1.25]

Note: All variables are as defined earlier. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis

Table 9: Impact of *FDI* on headcount poverty ($1.90, $3.20 and $5.50) and multidimensional poverty, *GMM* results

Variable	Headcount poverty $1.90		Headcount poverty $3.20		Headcount poverty $5.50		Multidimensional poverty	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
L1.Dependent variable	0.7780***	0.7976***	0.8180***	0.8398***	0.8700***	0.8811***	0.7152***	0.8692***
	(0.0086)	(0.0130)	(0.0082)	(0.0146)	(0.0122)	(0.0125)	(0.0448)	(0.0256)
FDI/GDP	-0.0016**	-0.0029**	-0.0026***	-0.0086**	-0.0104***	-0.0169**	-0.0079*	-0.0494***
	(0.0006)	(0.0014)	(0.0005)	(0.0039)	(0.0029)	(0.0072)	(0.0045)	(0.0146)
R&D	-0.1286**	-0.0302*	-0.1766***	-0.1231**	-0.3996**	-0.3324***	-0.8737*	-0.0977
	(0.0644)	(0.0128)	(0.0465)	(0.0462)	(0.2026)	(0.1226)	(0.5086)	(0.1868)
FDI/GDP × *R&D*		0.0044**		0.0122***		0.0225**		0.0544***
		(0.0019)		(0.0045)		(0.0088)		(0.0171)
ICT Infrastructure	-0.0029***	-0.0013*	-0.0024**	-0.0040**	-0.0118***	-0.0087**	-0.0479***	0.0007
	(0.0006)	(0.0019)	(0.0012)	(0.0019)	(0.0020)	(0.0045)	(0.0095)	(0.0070)
Secondary education	-0.00071***	-0.0005***	-0.0016***	-0.0014***	-0.0016***	-0.0019***	0.0031	-0.0011***
	(0.0001)	(0.0001)	(0.0004)	(0.0002)	(0.0006)	(0.0006)	(0.0095)	(0.0004)
Tertiary education	-0.0054***	-0.0034**	-0.0068**	0.0093***	-0.0294***	-0.0167**	-0.0566***	-0.0758***
	(0.0015)	(0.0013)	(0.0030)	(0.0032)	(0.0076)	(0.0067)	(0.0159)	(0.0163)
Financial development	0.0020*	-0.0002	-0.0007	-0.0005	0.0012	-0.0016	0.0082	0.0168***
	(0.0012)	(0.0002)	(0.0008)	(0.0006)	(0.0026)	(0.0014)	(0.0075)	(0.0054)
Inflation	-0.0139***	-0.0075	-0.0203***	-0.0091	-0.0217**	-0.0153*	-0.0368	-0.0921**
	(0.0051)	(0.0048)	(0.0041)	(0.0094)	(0.0089)	(0.0087)	(0.0844)	(0.0441)
Unemployment	0.0113***	0.0114***	0.0144***	0.0207***	0.0522***	0.0485***	0.1116***	0.0418**
	(0.0037)	(0.0027)	(0.0052)	(0.0070)	(0.0130)	(0.0150)	(0.0351)	(0.0194)
No. of countries	64	64	64	64	64	64	36	36
No. of instruments	60	60	61	61	61	61	31	31
AR(2)	0.326	0.291	0.867	0.876	0.467	0.483	0.183	0.325
Hansen P-Value	0.161	0.521	0.387	0.189	0.499	0.424	0.704	0.677
Obs.	647	647	647	647	647	647	262	262
Turning Point: *FDI* [*R&D*]	-	7.27[0.66]	-	10.09[0.70]	-	14.77[0.75]	-	[0.91]

Note: All variables are as defined earlier. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis

Table 10: Non-linear impact of *FDI* on economic growth (*GDP* p.c.) and inequality (Gini), IV regression

Variable	*GDP* p.c.			Income inequality (Gini)		
	(1)	(2)	(3)	(4)	(5)	(6)
FDI/GDP	0.2669***	0.0303***	0.0471***	-1.0526***	-0.7734***	-1.2331***
	(0.0470)	(0.0113)	(0.0179)	(0.2672)	(0.2267)	(0.3404)
FDI/GDP ^{2}	-0.0007***	-0.0001**	-0.0003***	0.0028***	0.0020***	0.0063***
	(0.0002)	(0.00003)	(0.0001)	(0.0009)	(0.0007)	(0.0018)
R&D		0.4829***	0.5491***		-3.5599***	-5.8213***
		(0.0494)	(0.0744)		(0.8854)	(1.3517)
FDI/GDP × *R&D*			-0.0355**			0.9127***
			(0.0140)			(0.2596)
FDI/GDP ^{2} × *R&D*			0.0004***			-0.0081***
			(0.0001)			(0.0024)
ICT Infrastructure		0.0128***	0.0127***		-0.0083	-0.0142
		(0.0008)	(0.0008)		(0.0133)	(0.0113)
Secondary education		0.00005	0.00002		-0.0019	-0.0014
		(0.0001)	(0.0001)		(0.0026)	(0.0030)
Tertiary education		0.0091***	0.0085***		-0.1577***	-0.1254***
		(0.0015)	(0.0014)		(0.0277)	(0.0208)
Financial development		0.0016	0.0031***		0.0821***	0.0496**
		(0.0014)	(0.0010)		(0.0287)	(0.0199)
Inflation		-0.0186***	-0.0177***		-0.0543	-0.0808
		(0.0067)	(0.0067)		(0.0603)	(0.0615)
Unemployment		-0.0089**	-0.0075**		0.1106	0.0749
		(0.0036)	(0.0035)		(0.0802)	(0.0762)
Turning Point	190.64	151.50	-	187.96	193.35	-
Obs.	2695	1111	1111	1163	776	776
First Stage regression						
BITs	3.1559***	3.1679***	1.8643***	3.6252***	3.4131***	2.0905***
	(0.5127)	(0.8833)	(0.04974)	(0.7931)	(0.9398)	(0.5379)
Cragg-Donald F-Stats	155.92	47.41	54.88	68.72	47.41	46.57
Marginal Effect						
Minimum	-	-	0.0825***	-	-	-1.9392***
			(0.0281)			(0.5303)
Mean	-	-	0.0134***	-	-	-0.1913**
			(0.0050)			(0.0838)
Maximum	-	-	1.5646***	-	-	-27.1511***
			(0.4302)			(8.4945)

Note: All variables are as defined earlier. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis

Table 11: Non-linear impact of *FDI* on welfare, IV regression

Variable	HDI			iHDI		
	(1)	(2)	(3)	(4)	(5)	(6)
FDI/GDP	0.0301***	0.0063***	0.0105***	0.0757***	0.0202***	0.0274***
	(0.0056)	(0.0021)	(0.0034)	(0.0222)	(0.0069)	(0.0073)
FDI/GDP ^{2}	-0.0001***	-0.00002***	-0.0001***	-0.0003***	-0.0001***	-0.0001***
	(0.00002)	(0.000006)	(0.00002)	(0.0001)	(0.00003)	(0.00003)
R&D		0.0638***	0.0807***		0.1168***	0.1449***
		(0.0073)	(0.0120)		(0.0206)	(0.0221)
FDI/GDP $\times$ *R&D*			-0.0079***			-0.0168***
			(0.0025)			(0.0044)
FDI/GDP ^{2} $\times$ *R&D*			0.0001***			0.0001*
			(0.00002)			(0.00003)
ICT Infrastructure		0.0014***	0.0015***		0.0016***	0.0019***
		(0.0001)	(0.0001)		(0.0003)	(0.0002)
Financial development		-0.0004***	-0.0001		-0.0012**	-0.0010**
		(0.0001)	(0.0002)		(0.0006)	(0.0004)
Inflation		-0.0011***	-0.0111**		-0.00005	-0.0009
		(0.0005)	(0.0005)		(0.0008)	(0.0009)
Unemployment		0.0011***	0.0010**		0.0034***	0.0035***
		(0.0004)	(0.0004)		(0.0011)	(0.0010)
Turning Point	150.50	157.50	-	126.17	101.00	-
Obs.	2709	1223	1223	1372	664	664
First Stage regression						
BITs	3.1591***	3.1133***	1.8335***	1.8285***	1.9086***	1.4092***
	(0.5146)	(0.8538)	(0.4902)	(0.4680)	(0.575)	(0.3276)
Cragg-Donald F-Stats	155.39	49.78	57.14	31.41	16.70	29.39
Marginal Effect						
Minimum	-	-	0.0168***	-	-	0.0358***
			(0.0053)			(0.0095)
Mean	-	-	0.0028***	-	-	0.0090***
			(0.0011)			(0.0027)
Maximum	-	-	0.2405***	-	-	0.0539
			(0.0819)			(0.0777)

Note: All variables are as defined earlier. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis

Table 12: Non-linear impact of *FDI* on poverty, IV regression

Variable	Headcount poverty $1.90			Headcount poverty $3.20			Headcount poverty $5.50			Multidimensional poverty		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
FDI/GDP	-1.2986***	-0.0849**	-0.1287*	-2.4594***	-0.2405***	-0.3636***	-3.6354***	-0.5210***	-0.7799***	-0.5999***	-0.2974**	-0.3709**
	(0.3483)	(0.0427)	(0.0674)	(0.6450)	(0.0882)	(0.1365)	(0.9311)	(0.1598)	(0.2427)	(0.1997)	(0.1440)	(0.1551)
FDI/GDP ^{2}	0.0035***	0.0002*	0.0006*	0.0067***	0.0006**	0.0019***	0.0098***	0.0012***	0.0041***	0.0026***	0.0012**	0.0014**
	(0.0011)	(0.0001)	(0.0003)	(0.0021)	(0.0002)	(0.0007)	(0.0030)	(0.0005)	(0.0013)	(0.0010)	(0.0006)	(0.0006)
R&D		0.2563	0.0436		-0.4372	-1.0252*		-3.4686***	-4.6765***		-5.1693***	-5.2187***
		(0.2546)	(0.3466)		(0.4300)	(0.6220)		(0.7266)	(1.0579)		(1.0817***	(1.0380)
											(1.0817)	
FDI/GDP × *R&D*			0.0878*			0.2498**			0.5352***			0.2199***
			(0.0514)			(0.1052)			(0.1893)			(0.0940)
FDI/GDP ^{2} × *R&D*			-0.0008*			-0.0024**			-0.0055***			-0.00087
			(0.0005)			(0.0010)			(0.0017)			(0.0007)
ICT Infrastructure		-0.0773***	-0.0779***		-0.1612***	-0.1625***		-0.2450***	-0.2471***		-0.0294	-0.0427**
		(0.0123)	(0.0122)		(0.0162)	(0.0160)		(0.0183)	(0.0176)		(0.0230)	(0.0210)
Secondary education		0.0019	0.0019		-0.0017	-0.0016		0.0002	0.0005		-0.0067	-0.0092**
		(0.0035)	(0.0035)		(0.0040)	(0.0040)		(0.0039)	(0.0040)		(0.0062)	(0.0042)
Tertiary education		-0.0999***	-0.0969***		-0.2249***	-0.2165***		-0.3857***	-0.3685***		-0.0574	-0.0435
		(0.0174)	(0.0173)		(0.0251)	(0.0243)		(0.0328)	(0.0302)		(0.0365)	(0.0315)
Financial development		0.0071	0.0038		0.0146	0.0050		0.0082	-0.0137		0.0097	0.0045
		(0.0058)	(0.0045)		(0.0120)	(0.0089)		(0.0218)	(0.0155)		(0.0239)	(0.0120)
Inflation		0.0436	0.0409		0.0911	0.0829		0.1979	0.1786		0.4656	0.5461
		(0.0624)	(0.0627)		(0.0803)	(0.0803)		(0.1216)	(0.1213)		(0.3458)	(0.3353)
Unemployment		0.0652	0.0615		0.1389*	0.1277*		0.3650***	0.3383***		0.4366***	0.4464***
		(0.0474)	(0.0477)		(0.0749)	(0.0750)		(0.1040)	(0.1031)		(0.1343)	(0.1299)
Turning Point	185.51	212.25	-	183.54	200.42	-	185.48	217.08	-	115.37	247.83	-
Obs.	1163	776	776	1163	776	776	1163	776	776	405	314	314
First Stage regression												
BITs	3.6252***	3.4131***	2.0905***	3.6252***	3.4131***	2.0905***	3.6252***	3.4131***	2.0905***	3.2550***	2.3401***	1.8694***
	(0.7931)	(0.9398)	(0.5379)	(0.7931)	(0.9398)	(0.5379)	(0.7931)	(0.9398)	(0.5379)	(0.7863)	(0.9006)	(0.4777)
Cragg-Donald F-Stats	68.72	36.47	46.57	68.72	36.47	46.57	68.72	36.47	46.57	31.34	12.36	36.34
Marginal Effect												
Minimum	-	-	-0.2001*	-	-	-0.5722***	-	-	-1.2462***	-	-	-0.4813**
			(0.1051)			(0.2126			(0.3786)			(0.1926)
Mean	-	-	-0.0286**	-	-	-0.0801***	-	-	-0.1763***	-	-	-0.0670**
			(0.0129)			(0.0291)			(0.0548)			(0.0334)
Maximum	-	-	-2.7290*	-	-	-8.1854**	-	-	-18.7994***	-	-	-0.5557
			(1.5494)			(3.2749)			(6.0729)			(1.1485)

Note: All variables are as defined earlier. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis

Table 13: Impact of *FDI* on growth and development (instrumenting for both *FDI* and *R&D*), IV regression

Variable	*GDP* p.c.	Gini	HDI	iHDI	Headcount poverty $1.90	Headcount poverty $3.20	Headcount poverty $5.50	Multidimensional poverty
FDI/GDP	0.0250***	-0.6624***	0.0043***	0.0198***	-0.1090**	-0.2836***	-0.5858***	-0.3698
	(0.008)	(0.183)	(0.001)	(0.005)	(0.044)	(0.094)	(0.182)	(0.249)
R & D	1.1273***	-14.6149***	0.1287***	0.3043***	-3.8663***	-8.5463***	-17.2200***	-8.4364**
	(0.098)	(2.150)	(0.010)	(0.047)	(0.944)	(1.521)	(2.409)	(3.771)
FDI/GDP x R & D	-0.0260***	0.7202***	-0.0047***	-0.0165***	0.1136**	0.2935***	0.5969***	0.3022
	(0.010)	(0.198)	(0.001)	(0.005)	(0.049)	(0.103)	(0.199)	(0.220)
ICT Infrastructure	0.0141***	-0.0581***	0.0014***	0.0020***	-0.0687***	-0.1454***	-0.2445***	-0.0578**
	(0.001)	(0.017)	(0.000)	(0.000)	(0.016)	(0.021)	(0.025)	(0.025)
Secondary education	-0.0001	0.0012			0.0009	-0.0007	0.0032	-0.0128
	(0.000)	(0.003)			(0.005)	(0.005)	(0.006)	(0.013)
Tertiary education	-0.0041*	0.0897**			0.0009	-0.0272	-0.0544	-0.0339
	(0.002)	(0.040)			(0.012)	(0.024)	(0.044)	(0.035)
Financial Development	-0.0015	0.1037***	-0.0006***	-0.0041***	0.0259***	0.0553***	0.0925***	0.0783
	(0.001)	(0.032)	(0.000)	(0.001)	(0.009)	(0.017)	(0.031)	(0.078)
Inflation	-0.0005	-0.4292***	0.0006	0.0002	-0.0305	-0.0899	-0.1086	0.6057
	(0.007)	(0.119)	(0.001)	(0.001)	(0.101)	(0.155)	(0.262)	(0.392)
Unemployment	0.0019	-0.2212**	0.0015***	0.0072***	-0.0497	-0.1326	-0.2334	0.3177
	(0.005)	(0.104)	(0.000)	(0.002)	(0.068)	(0.111)	(0.158)	(0.232)
Turning Point: *FDI* [*R&D*]	43.36[0.96]	20.29[0.92]	27.38[0.91]	18.39[1.20]	34.03[0.96]	29.12[0.97]	28.85[0.98]	-
Obs.	873	638	954	536	638	638	638	294
First Stage regression	***FDI***							
BITs	5.6680***	5.6446***	5.8917***	3.4644***	5.6446***	5.6446***	5.6446***	3.5515***
	(1.1044)	(1.1505)	(1.1244)	(0.7334)	(1.1505)	(1.1505)	(1.1505)	(0.7626)
	R&D							
ln(Researchers in *R&D* in mil.)	0.4183***	0.5241***	0.4990***	0.4702***	0.5241***	0.5241***	0.5241***	0.5439***
	(0.0206)	(0.0266)	(0.0191)	(0.0236)	(0.0266)	(0.0266)	(0.0266)	(0.0456)
Cragg-Donald F-Stats	26.976	15.742	31.240	5.994	15.742	15.742	15.742	2.504

NB: All variables are as defined earlier. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis. Estimations include instrumenting for both *FDI* and *R&D*

Appendix A List of Countries

This appendix provides the list of countries used in the study.

Table A1: List of countries

Albania	Ghana	North Macedonia
Algeria	Greece	Norway
Angola	Guatemala	Oman
Armenia	Honduras	Pakistan
Australia	Hong Kong SAR, C	Panama
Austria	Hungary	Papua New Guinea
Azerbaijan	Iceland	Paraguay
Bahrain	India	Peru
Belarus	Indonesia	Philippines
Belgium	Iran, Islamic Re	Poland
Bolivia	Iraq	Portugal
Bosnia and Herze	Ireland	Qatar
Botswana	Israel	Russian Federati
Brazil	Italy	Rwanda
Brunei Darussala	Japan	Saudi Arabia
Bulgaria	Jordan	Senegal
Burkina Faso	Kazakhstan	Serbia
Burundi	Kenya	Singapore
Cabo Verde	Korea, Rep.	Slovak Republic
Cambodia	Kuwait	Slovenia
Canada	Kyrgyz Republic	South Africa
Chad	Latvia	Spain
Chile	Lesotho	Sri Lanka
China	Lithuania	Sudan
Colombia	Luxembourg	Sweden
Congo, Dem. Rep.	Madagascar	Switzerland
Costa Rica	Malaysia	Tajikistan
Cote d'Ivoire	Mali	Tanzania
Croatia	Malta	Thailand
Cyprus	Mauritania	Togo
Czech Republic	Mauritius	Trinidad and Tob
Denmark	Mexico	Tunisia
Ecuador	Moldova	Turkey
Egypt, Arab Rep.	Mongolia	Uganda
El Salvador	Montenegro	Ukraine
Estonia	Morocco	United Arab Emir
Eswatini	Mozambique	United Kingdom
Ethiopia	Myanmar	United States
Finland	Namibia	Uruguay
France	Nepal	Venezuela, RB
Gabon	Netherlands	Vietnam
Gambia, The	New Zealand	Zambia
Georgia	Nicaragua	
Germany	Nigeria	