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

Dwumfour, Richard Adjei and Pan, Lei and Harris, Mark N.

Curtin University, Curtin University, Curtin University

2025

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

Richard Adjei Dwumfour[a], Lei Pan[a,b], Mark N. Harris[a]

[a] *School of Accounting, Economics and Finance, Curtin University, Bentley, 6102, Australia*
[b] *Centre for Development Economics and Sustainability (CDES), Monash University, Australia*

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

*We would like to thank Guido Lorenzoni and Oded Galor for valuable comments about earlier versions of this paper. All errors are our own.

Email address: lei.pan@curtin.edu.au; ORCID: 0000-0002-1054-981X (Lei Pan)

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 skeptical of the technological spillover effects of *FDI*s. 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 suggest restricting foreign firms in certain sectors of the host country to protect local firms that innovate in those sectors, given that the interest 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*s 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.

Based on the dependency theory of *FDI*s (Haggard, 1989; Dixon and Boswell, 1996; Kentor, 1998; Kentor and Boswell, 2003), our hypothesis is that countries that relatively focus on *R&D* will be less dependent on *FDI* for development. This is as the theory suggests that the traditional expectation of positive technological and knowledge externalities/spillovers from *FDI*s, do not always materialize and that *FDI*s can actually lead to negative externalities on host countries. Indeed, Kentor (1998) and Kentor and Boswell (2003) found evidence that dependence on *FDI*s has negative effect on growth of host countries. Hence, we argue that countries that domestically invest more in *R&D* as a source of their innovation and knowledge generation will be 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*s – 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]

These arguments are based on the *appropriate technology concept*, which is that the technology is well-suited for a particular country and period in terms of both psychosocial and biophysical contexts (Stewart, 1983; Willoughby, 1990). Hence, we conjecture that a more "localized learning by doing" (Atkinson and Stiglitz, 1969) approach will be more beneficial for development than would *FDI*s. Multinational corporations (*MNCs*) are profit-oriented and hence may not necessarily be development-oriented in their investment approaches, even though *FDI*s may contribute to development. Given these

compelling points and the quandary of the twin-effect of these two important variables in the development process, this study is necessary to fill this important research gap.

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*s 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*s. 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 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*s 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 that 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*s). Assuming the level of technology transferred (t) is an increasing function of *FDI*s (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*s 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 firm's profit follows marginal diminishing return.

To solve 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,

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

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

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 when 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 firm's technology level through transferred technology, hence reducing 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 regards 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 lietrature 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). *FDI* is the net foreign direct investment inflows as a percentage of GDP. 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 includes 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. *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).

[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. 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 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).

We measure *education* using both secondary school enrolment and tertiary school enrolments (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 the returns to higher education. We expect a more positive impact of higher education on economic and human development and reduce poverty and inequality.

We also control for unemployment measured as the unemployment rate (%). Martínez et al. (2001) in a study of Organization for Economic Co-operation and Development ($OECD$) countries found increased risk of falling into poverty and inequality to be associated with unemployment.

Inflation is measured by the annual change in 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 showed that the relationship between inflation and growth is non-linear with low rates of inflation below the threshold having a positive impact on growth while inflation rates above the threshold reduces growth

(Fischer, 1993; Gillman et al., 2004).

We also control for financial development, measured as 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 that 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 growth and human development and/or welfare and increase 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 favor 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.

Table 1 presents the summary statistics. Mean per capita GDP is around 8 with a maximum 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 moderate level of human development but when adjusted for inequality, *iHDI* averages 0.57 showing 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*s to countries in the sample and gives a broader perspective of the sample to study how relevant *FDI*s 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 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)[3]. *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 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

[3]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.

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*s 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 to protect 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 same as host country investors, providing adequate compensation to foreign investors where their assets are exploited and indicating an independent body like the International Center 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*s. In this way we suggest that *BITs* are an extremely plausible instrument for *FDI*s 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 involves the relationships between *FDI*s 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 add 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*s, 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*s 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*s, the magnitude of the impact of *R&D* on growth is larger. For instance, from

column (4), while a one percent increase in *FDI* net inflows results in a 0.007% increase in GDP p.c. (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 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 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*s. For instance, from column (9), a one percent increase in *FDI*s reduces inequality by 0.21%, while a one percent 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 percent 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 percent 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 (panel e to h) further confirms these results. Similar to the growth regressions, we see that higher expenditures along with higher *FDI* net inflows leads 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*s. 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 confirms these results.

[Insert Tables 6 and 7 about here]

[Insert Figure 6 about here]

The effects of 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 some 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 improve growth but increase inequality and reduce 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, increase 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 dependent 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 orthogonalization 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* specification is appropriate.

The results are presented in Tables 8 and 9. From these we can see that that the lag of the dependent variable(s) are all positive and significant showing that development outcomes persist over time and confirms 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*s 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 to be 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*s 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 non-linear effect of *FDI*s. This indicates that *R&D* complements *FDI*s 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 non-linear effect of *FDI*s. 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*s 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*s 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*s 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. 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 along 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]

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 a 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*s 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*s. Indeed, we find that *FDI*s 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 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*s: *FDI*s begin to hurt development after a certain threshold. This may be because below certain *FDI* thresholds, *FDI*s 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*s, foreign investors who may not necessarily focus on 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 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 in lending same to the parent company when the need be. Besides, where the parent company or other subsidiaries have debt on the books on these subsidiaries, these loans can be recalled leading to onward consequences on the domestic market.

This becomes even critical in periods of major crisis like the global financial crisis and 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*s reaches the threshold and begins to hurt development. At this point *R&D* begins to complement *FDI*s given that host countries would have had enough adaptive/absorptive capacity after spending more on *R&D*. This has relevant policy implication in that more emphasis should be placed on the important role of *R&D* in driving development while promoting *FDI*s especially in anticipation of when *FDI*s reaches its 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*s 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*s 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*s reaches its threshold. Our results are consistent to 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 emphasize that policymakers should prioritize *R&D* initiatives in addition to encouraging *FDI*. A balance between the two must be struck to optimize the positive effects on the development of countries.

References

Abor, J.Y., Dwumfour, R.A., Agbloyor, E.K., Pan, L., 2024. Foreign direct investment and inclusive finance: do financial markets and quality of institutions matter? Empirical Economics , In Press.

Acemoglu, D., 2002. Directed technical change. The Review of Economic Studies 69, 781–809.

Agenor, P.R., 1998. Stabilization policies, poverty and the labor market. Manuscript, International Monetary Fund and the World Bank .

Aghion, P., Askenazy, P., Berman, N., Cette, G., Eymard, L., 2012. Credit constraints and the cyclicality of r&d investment: Evidence from france. Journal of the European Economic Association 10, 1001–1024.

Aitken, B.J., Harrison, A.E., 1999. Do domestic firms benefit from direct foreign investment? evidence from venezuela. American Economic Review 89, 605–618.

Albanesi, S., 2007. Inflation and inequality. Journal of Monetary Economics 54, 1088–1114.

Alfaro, L., Chanda, A., Kalemli-Ozcan, S., Sayek, S., 2004. Fdi and economic growth: the role of local financial markets. Journal of International Economics 64, 89–112.

Alfaro, L., Chanda, A., Kalemli-Ozcan, S., Sayek, S., 2010. Does foreign direct investment promote growth? exploring the role of financial markets on linkages. Journal of Development Economics 91, 242–256.

Altonji, J.G., Elder, T.E., Taber, C.R., 2005. An evaluation of instrumental variable strategies for estimating the effects of catholic schooling. Journal of Human Resources 40, 791–821.

Alvarez, I., Molero, J., 2005. Technology and the generation of international knowledge spillovers: An application to spanish manufacturing firms. Research Policy 34, 1440–1452.

Angrist, J.D., Pischke, J.S., 2009. Mostly harmless econometrics: An empiricist's companion. Princeton University Press.

Appleton, S., Song, L., Xia, Q., 2010. Growing out of poverty: Trends and patterns of urban poverty in china 1988–2002. World Development 38, 665–678.

Arellano, M., Bond, S., 1991. Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. The Review of Economic Studies 58, 277–297.

Arellano, M., Bover, O., 1995. Another look at the instrumental variable estimation of error-components models. Journal of Econometrics 68, 29–51.

Asongu, S.A., Le Roux, S., 2017. Enhancing ict for inclusive human development in sub-saharan africa. Technological Forecasting and Social Change 118, 44–54.

Asongu, S.A., Le Roux, S., Biekpe, N., 2018. Enhancing ict for environmental sustainability in sub-saharan africa. Technological Forecasting and Social Change 127, 209–216.

Atkinson, A.B., Stiglitz, J.E., 1969. A new view of technological change. The Economic Journal 79, 573–578.

Basu, S., Weil, D.N., 1998. Appropriate technology and growth. The Quarterly Journal of Economics 113, 1025–1054.

Beck, T., Demirguc-Kunt, A., Levine, R., 2004. Finance, inequality, and poverty: Cross-country evidence.

Beers, V., 2004. Multinationals and the knowledge economy in small countries. Economic Bulletin 41, 205–08.

Benhabib, J., Spiegel, M.M., 2000. The role of financial development in growth and investment. Journal of Economic Growth , 341–360.

Bhagwat, V., Brogaard, J., Julio, B., 2021. A bit goes a long way: Bilateral investment treaties and cross-border mergers. Journal of Financial Economics 140, 514–538.

Bjorvatn, K., Eckel, C., 2006. Policy competition for foreign direct investment between asymmetric countries. European Economic Review 50, 1891–1907.

Blalock, G., Gertler, P.J., 2008. Welfare gains from foreign direct investment through technology transfer to local suppliers. Journal of International Economics 74, 402–421.

Chen, D.H., Dahlman, C.J., 2005. The knowledge economy, the kam methodology and world bank operations. World Bank Institute Working Paper .

Chowdhury, A., Mavrotas, G., 2006. Fdi and growth: what causes what? World Economy 29, 9–19.

Chuang, Y.C., Lin, C.M., 1999. Foreign direct investment, r&d and spillover efficiency: Evidence from taiwan's manufacturing firms. The Journal of Development Studies 35, 117–137.

Colen, L., Persyn, D., Guariso, A., 2016. Bilateral investment treaties and fdi: Does the sector matter? World Development 83, 193–206.

Cragg, J.G., Donald, S.G., 1993. Testing identifiability and specification in instrumental variable models. Econometric Theory 9, 222–240.

Dixon, W.J., Boswell, T., 1996. Dependency, disarticulation, and denominator effects: Another look at foreign capital penetration. American Journal of sociology 102, 543–562.

Do, Q.A., Le, Q.H., Nguyen, T.D., Vu, V.A., Tran, L.H., Nguyen, C.T.T., 2021. Spatial impact of foreign direct investment on poverty reduction in vietnam. Journal of Risk and Financial Management 14, 292.

Dollar, D., Kraay, A., 2002. Growth is good for the poor. Journal of Economic Growth 7, 195–225.

Doumbia, D., 2019. The quest for pro-poor and inclusive growth: The role of governance. Applied Economics 51, 1762–1783.

Durham, J.B., 2004. Absorptive capacity and the effects of foreign direct investment and equity foreign portfolio investment on economic growth. European Economic Review 48, 285–306.

Dwumfour, R.A., 2020. Poverty in sub-saharan africa: The role of business regulations, policies and institutions. Social Indicators Research 149, 861–890.

Dwumfour, R.A., Agbloyor, E.K., Abor, J.Y., 2017. Correlates of poverty in africa: Exploring the roles of remittances, financial development, and natural resources. International Journal of Social Economics .

Fan, C.S., Hu, Y., 2007. Foreign direct investment and indigenous technological efforts: Evidence from china. Economics Letters 96, 253–258.

Fischer, S., 1993. The role of macroeconomic factors in growth. Journal of Monetary Economics 32, 485–512.

Fu, X., Pietrobelli, C., Soete, L., 2011. The role of foreign technology and indigenous innovation in the emerging economies: technological change and catching-up. World Development 39, 1204–1212.

Galor, O., Zeira, J., 1993. Income distribution and macroeconomics. Review of Economic Studies 60, 35–52.

Gersbach, H., Schneider, M.T., Schneller, O., 2013. Basic research, openness, and convergence. Journal of Economic Growth 18, 33–68.

Gillman, M., Harris, M., Màtyàs, L., 2004. Inflation and growth: Explaining a negative effect. Empirical Economics 29, 149–167.

Globerman, S., Meredith, L., 1984. The foreign ownership-innovation nexus in canada. Columbia Journal of World Business 19, 53–62.

Gohou, G., Soumaré, I., 2012. Does foreign direct investment reduce poverty in africa and are there regional differences? World Development 40, 75–95.

Gorodnichenko, Y., Svejnar, J., Terrell, K., 2020. Do foreign investment and trade spur innovation? European Economic Review 121, 103343.

Gupta, S., Pattillo, C.A., Wagh, S., 2009. Effect of remittances on poverty and financial development in sub-saharan africa. World Development 37, 104–115.

Gyimah-Brempong, K., Paddison, O., Mitiku, W., 2006. Higher education and economic growth in africa. The Journal of Development Studies 42, 509–529.

Haber, S., Maurer, N., Razo, A., 2003. The politics of property rights: political instability, credible commitments, and economic growth in Mexico, 1876-1929. Cambridge University Press.

Haggard, S., 1989. The political economy of foreign direct investment in latin america. Latin American Research Review 24, 184–208.

Harris, M., Mátyás, L., Sevestre, P., 2008. Dynamic models for short panels. The Econometrics of Panel Data: Fundamentals and Recent Developments in Theory and Practice , 249–278.

Holtz-Eakin, D., Newey, W., Rosen, H.S., 1988. Estimating vector autoregressions with panel data. Econometrica , 1371–1395.

Hu, A.G., Jefferson, G.H., Jinchang, Q., 2005. R&d and technology transfer: firm-level evidence from chinese industry. Review of Economics and Statistics 87, 780–786.

Islam, N., 1995. Growth empirics: a panel data approach. The Quarterly Journal of Economics 110, 1127–1170.

Ito, T., 2013. Export-platform foreign direct investment: Theory and evidence. The World Economy 36, 563–581.

Kang, H., Martinez-Vazquez, J., 2022. When does foreign direct investment lead to inclusive growth? The World Economy 45, 2394–2427.

Kathuria, V., 2008. The impact of fdi inflows on r&d investment by medium-and high-tech firms in india in the post-reform period. Transnational Corporations 17, 45.

Kathuria, V., Das, S., 2005. Impact of fdi on r&d strategies of firms in the post-1991 era. IIMB Management Review 17, 17–28.

Keller, W., 2002. Trade and the transmission of technology. Journal of Economic growth 7, 5–24.

Kentor, J., 1998. The long-term effects of foreign investment dependence on economic growth, 1940–1990. American Journal of Sociology 103, 1024–1046.

Kentor, J., Boswell, T., 2003. Foreign capital dependence and development: A new direction. American sociological review , 301–313.

Kirui, O.K., Okello, J.J., Nyikal, R.A., Njiraini, G.W., 2013. Impact of mobile phone-based money transfer services in agriculture: evidence from kenya. Quarterly Journal of International Agriculture 52, 141–162.

Kliner, M., Knight, A., Mamvura, C., Wright, J., Walley, J., 2013. Using no-cost mobile phone reminders to improve attendance for hiv test results: a pilot study in rural swaziland. Infectious Diseases of poverty 2, 1–7.

Kumar, N., 1987. Technology imports and local research and development in indian manufacturing. The Developing Economies 25, 220–233.

Lee, M., Longmire, R., Matyas, L., Harris, M., 1998. Growth convergence: some panel data evidence. Applied Economics 30, 907–912.

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

Magombeyi, M.T., Odhiambo, N.M., 2018. Dynamic impact of fdi inflows on poverty reduction: Empirical evidence from south africa. Sustainable Cities and Society 39, 519–526.

Maican, F.G., Orth, M., Roberts, M.J., Vuong, V.A., 2023. The dynamic impact of exporting on firm r&d investment. Journal of the European Economic Association 21, 1318–1362.

Markusen, J.R., Venables, A.J., 1999. Foreign direct investment as a catalyst for industrial development. European Economic Review 43, 335–356.

Martínez, R., Ayala, L., Ruiz-Huerta, J., 2001. The impact of unemployment on inequality and poverty in oecd countries. Economics of Transition 9, 417–447.

Mishra, V., Bisht, S.S., 2013. Mobile banking in a developing economy: A customer-centric model for policy formulation. Telecommunications Policy 37, 503–514.

Neumayer, E., Spess, L., 2005. Do bilateral investment treaties increase foreign direct investment to developing countries? World Development 33, 1567–1585.

Newman, C., Rand, J., Talbot, T., Tarp, F., 2015. Technology transfers, foreign investment and productivity spillovers. European Economic Review 76, 168–187.

Niebel, T., 2018. Ict and economic growth–comparing developing, emerging and developed countries. World Development 104, 197–211.

Panizza, U., 2002. Income inequality and economic growth: Evidence from american data. Journal of Economic Growth 7, 25–41.

Romer, C.D., Romer, D.H., 1998. Monetary policy and the well-being of the poor.

Roodman, D., 2009. How to do xtabond2: An introduction to difference and system gmm in stata. The Stata Journal 9, 86–136.

Sabirianova, K., Svejnar, J., Terrell, K., 2005. Distance to the efficiency frontier and foreign direct investment spillovers. Journal of the European Economic Association 3, 576–586.

Sasidharan, S., Kathuria, V., 2011. Foreign direct investment and r&d: Substitutes or complements—a case of indian manufacturing after 1991 reforms. World Development 39, 1226–1239.

Soumaré, I., 2015. Does fdi improve economic development in north african countries? Applied Economics 47, 5510–5533.

Stewart, F., 1983. Macro-policies for appropriate technology: An introductory classification. Int'l Lab. Rev. 122, 279.

Stiglitz, J.E., 1993. The role of the state in financial markets. The World Bank Economic Review 7, 19–52.

Teixeira, A.A., Queirós, A.S., 2016. Economic growth, human capital and structural change: A dynamic panel data analysis. Research Policy 45, 1636–1648.

Thoenig, M., Verdier, T., 2010. A macroeconomic perspective on knowledge management. Journal of Economic Growth 15, 33–63.

Tressel, T., Verdier, T., 2011. Financial globalization and the governance of domestic financial intermediaries. Journal of the European Economic Association 9, 130–175.

Urata, S., Lall, S., 2003. Competitiveness, FDI and technological activity in East Asia. E. Elgar Pub.

Veugelers, R., Houte, P.V., 1990. Domestic r&d in the presence of multinational enterprises. International Journal of Industrial Organization 8, 1–15.

Willoughby, K.W., 1990. Technology choice: A critique of the appropriate technology movement. Dr Kelvin Wayne Willoughby.

Yeaple, S.R., 2006. Offshoring, foreign direct investment, and the structure of us trade. Journal of the European Economic Association 4, 602–611.

List of Figures

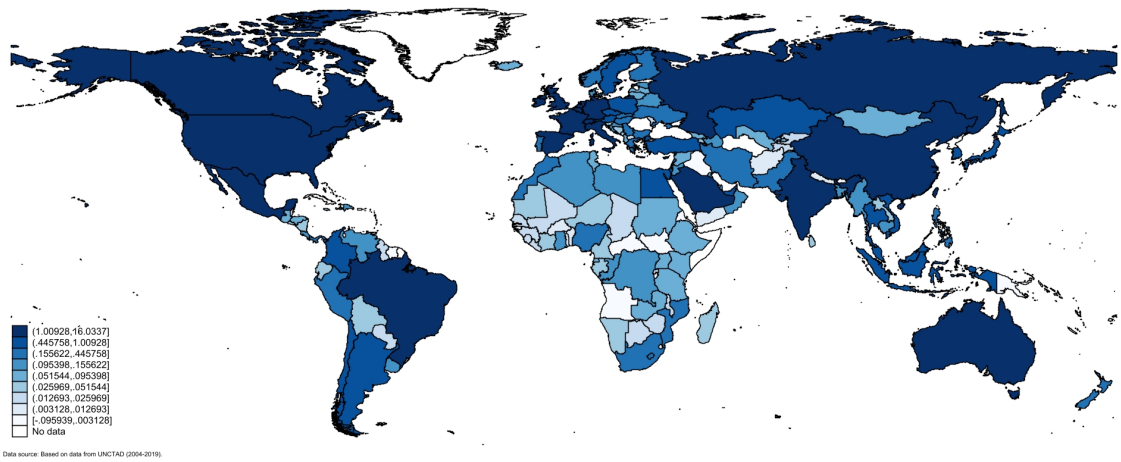


Figure 1: Average net FDI inflows – Share of world FDI inflows (2004-2019)

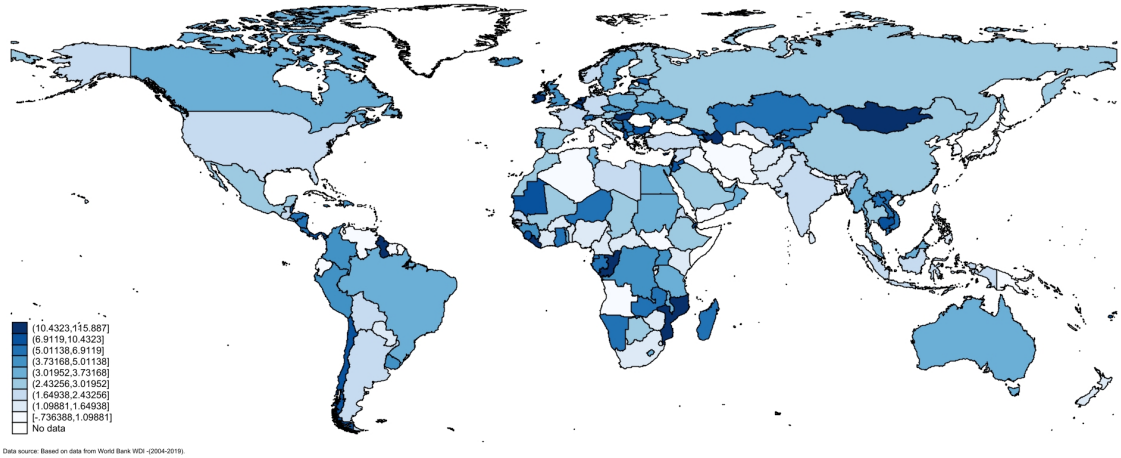


Figure 2: Average net FDI inflows – Share of *GDP* (2004-2019)

List of Tables

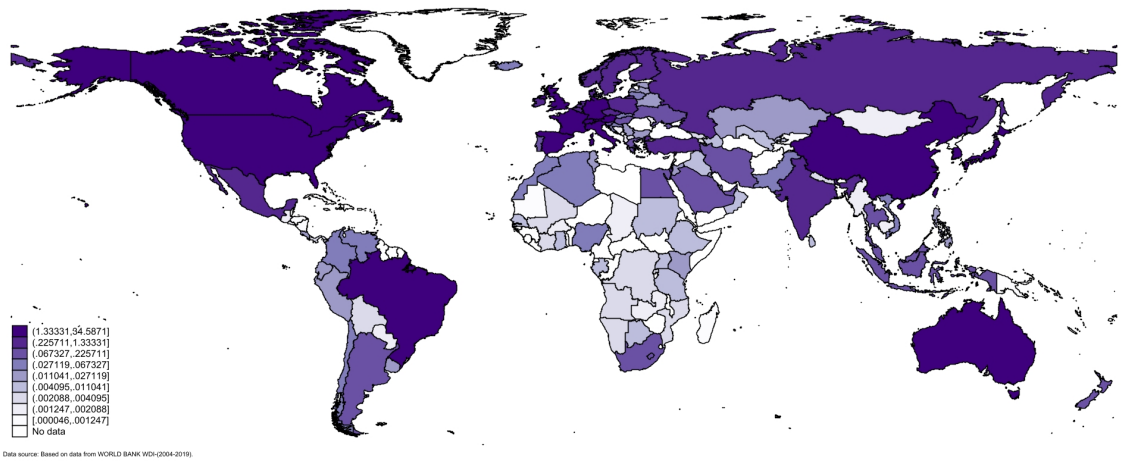


Figure 3: Average *R&D* expenditure – Share of world *R&D* (2004-2019)

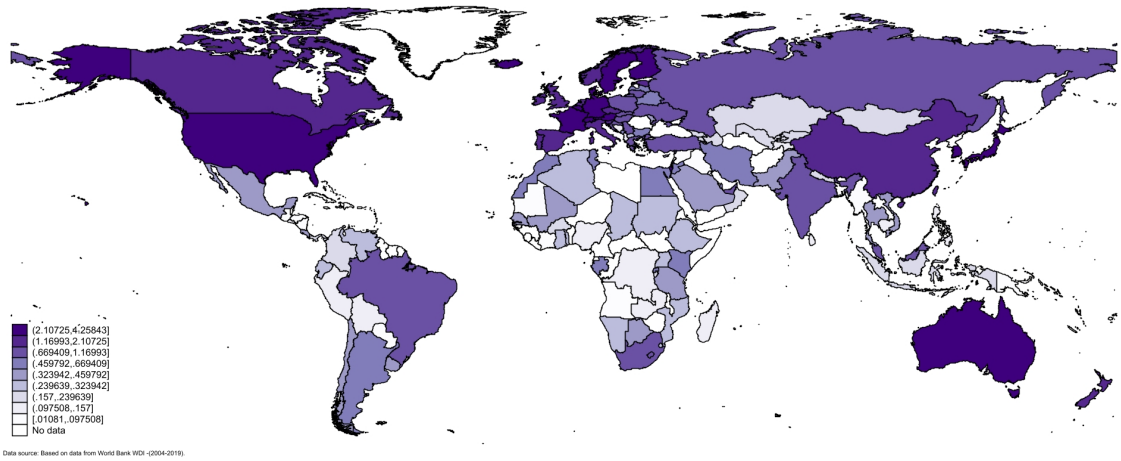
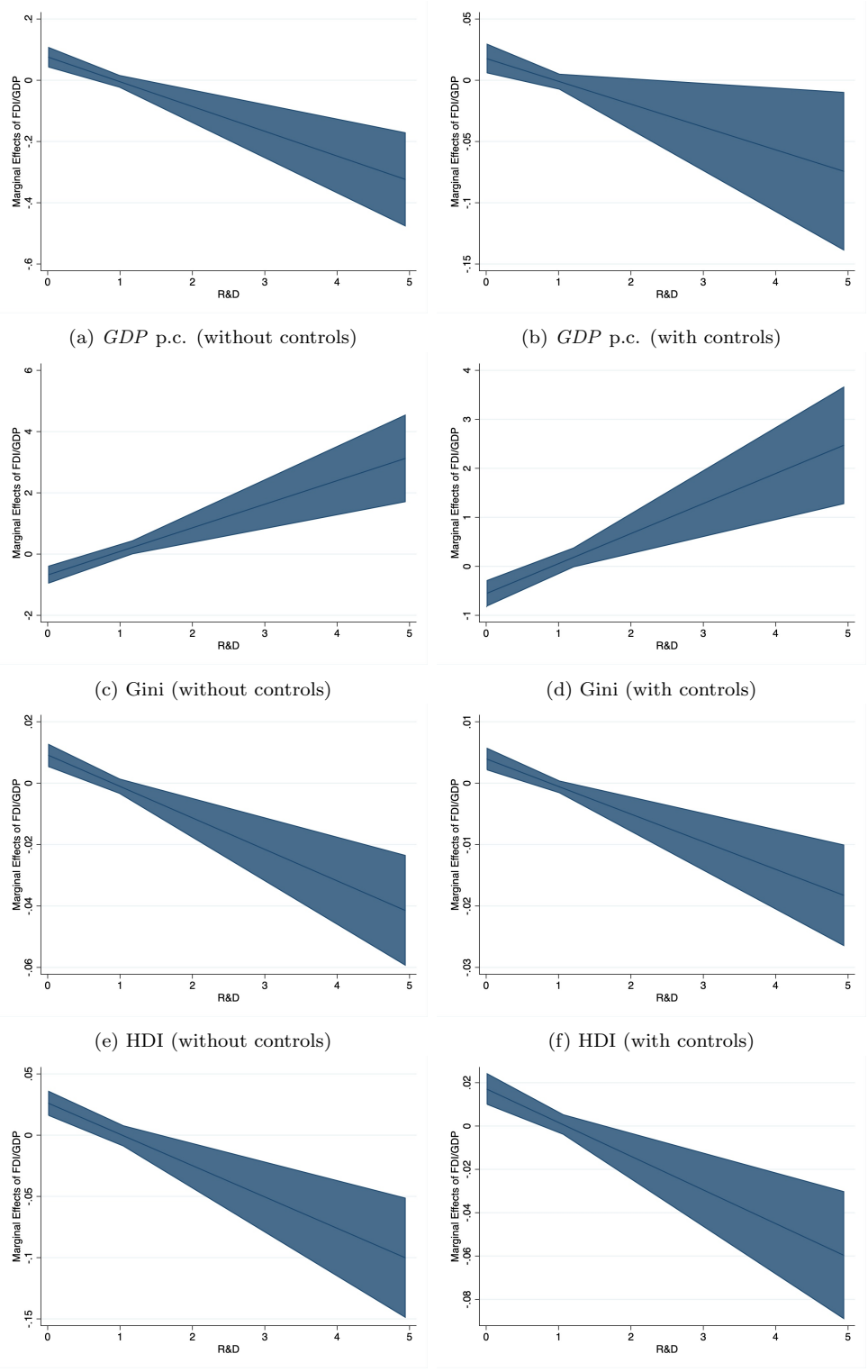


Figure 4: Average *R&D* expenditure – Share of *GDP* (2004-2019)



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

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

(c) Gini (without controls)

(d) Gini (with controls)

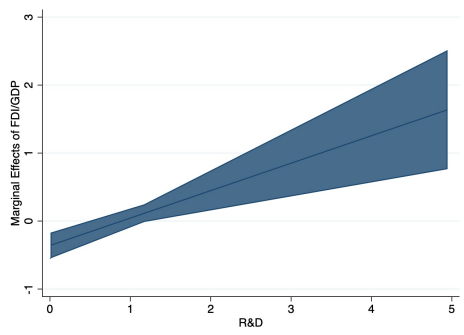
(e) HDI (without controls)

(f) HDI (with controls)

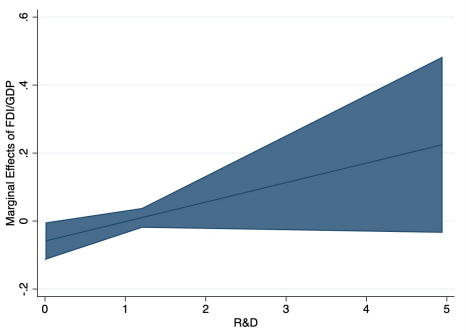
(g) iHDI (without controls)

(h) iHDI (with controls)

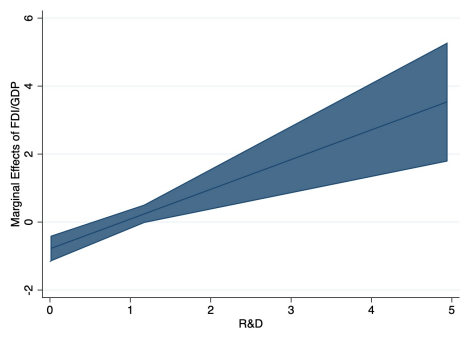
Figure 5: Marginal effects of FDI on growth, inequality and welfare (with 95% CI), IV regression



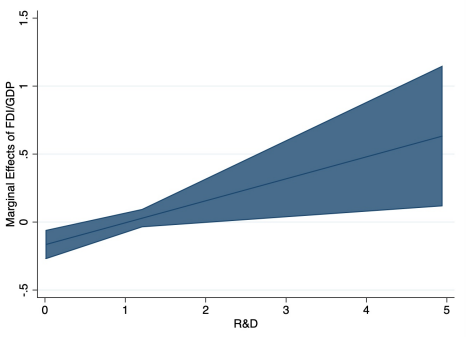
(a) Poverty ($1.90) (without controls)



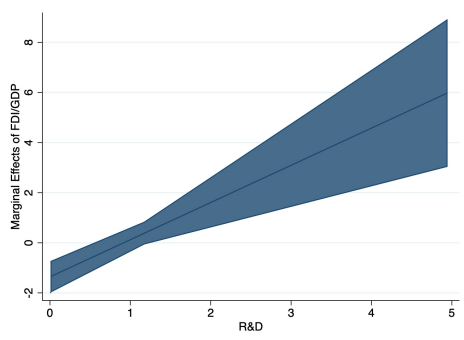
(b) Poverty ($1.90) (with controls)



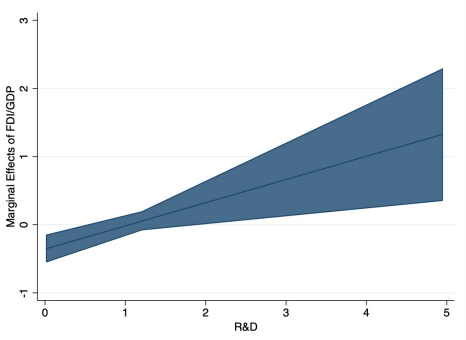
(c) Poverty ($3.2) (without controls)



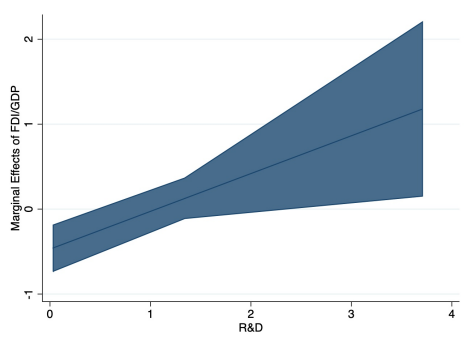
(d) Poverty ($3.2) (with controls)



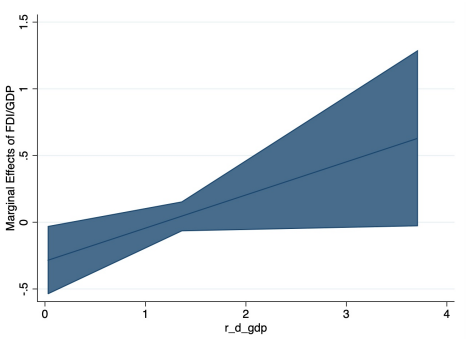
(e) Poverty ($5.50) (without controls)



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

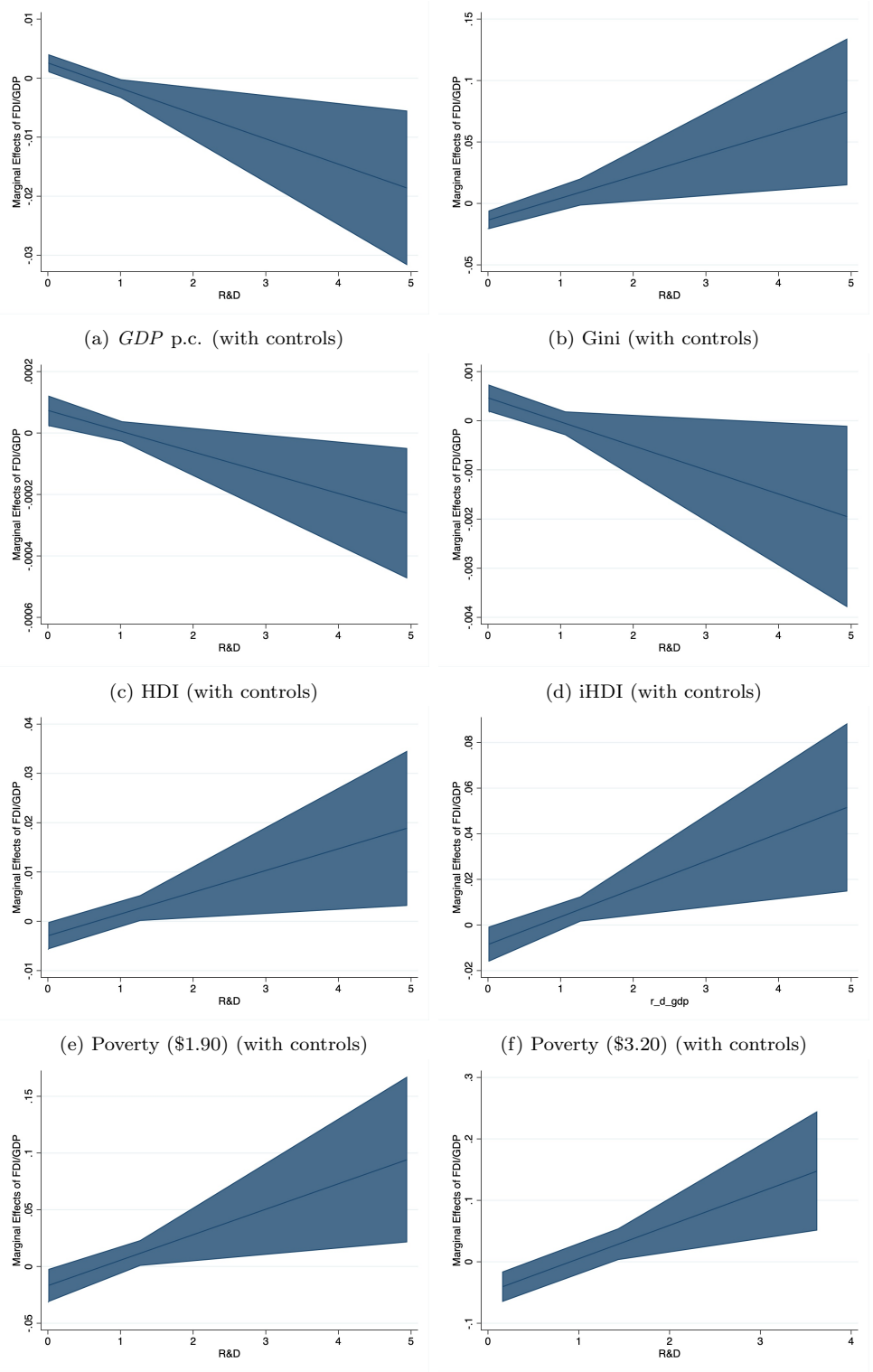


(g) Md. poverty (without controls)



(h) Md. poverty (with controls)

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



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

(b) Gini (with controls)

(c) HDI (with controls)

(d) iHDI (with controls)

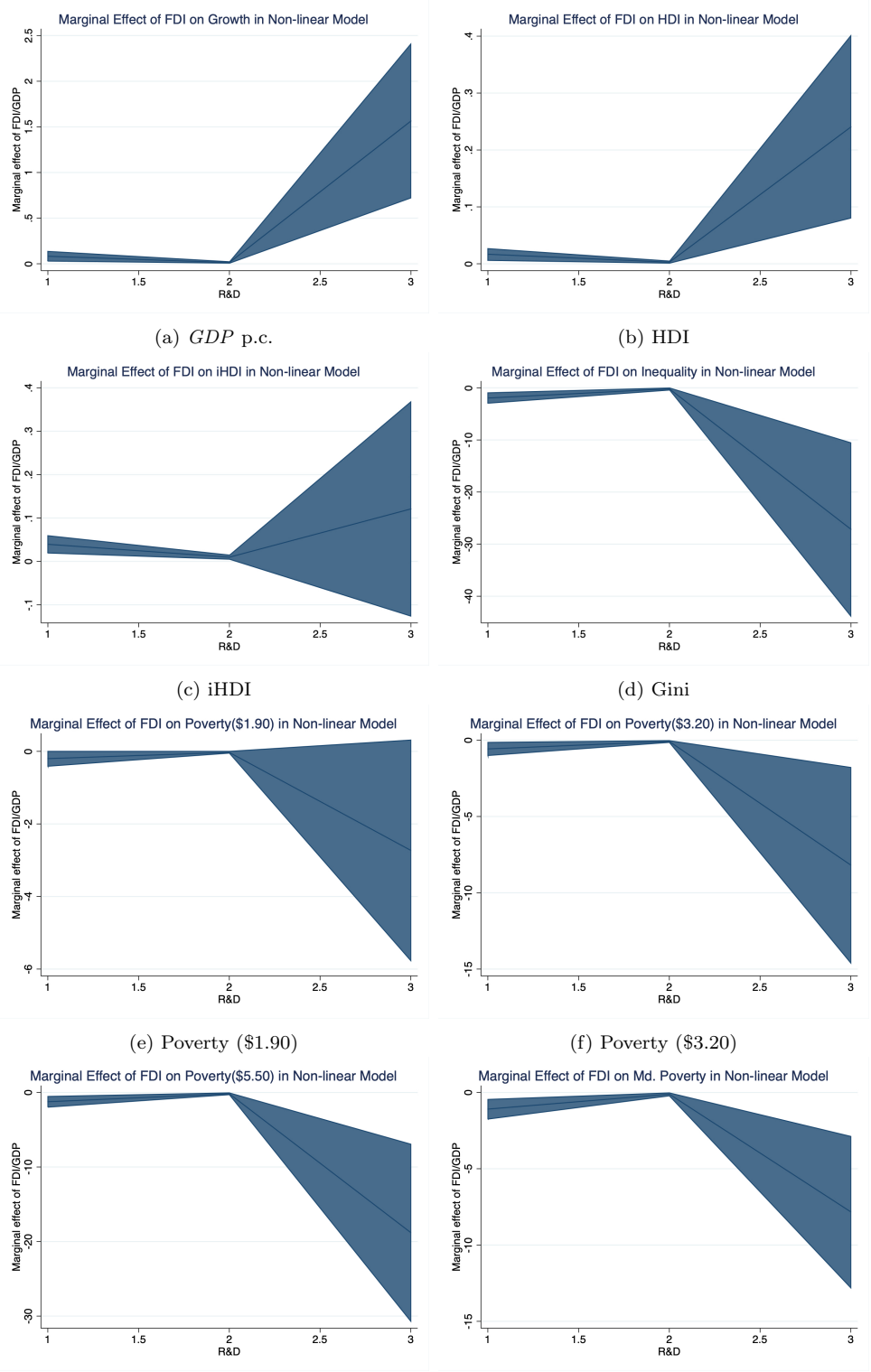
(e) Poverty ($1.90) (with controls)

(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

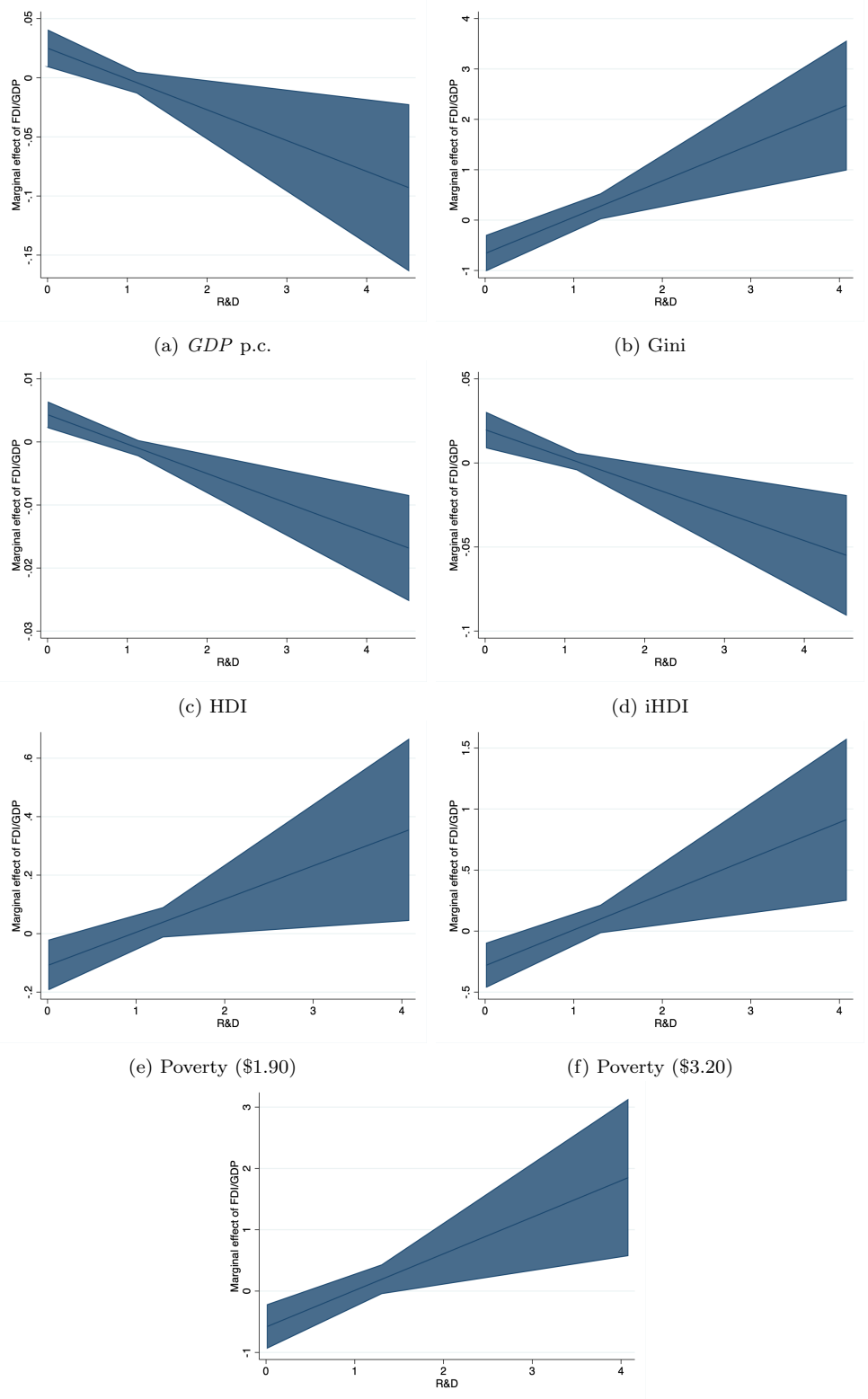
(e) Poverty ($1.90)

(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 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

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)
$FDI/GDP \times R\&D$			-0.0355**			0.9127***
			(0.0140)			(0.2596)
$FDI/GDP^{2} \times R\&D$			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	

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

Supplementary Online Appendix

A1. Using alternative specification: lags of independent variables

Here, as further robustness checks, we re-estimate our benchmark econometric models using lags of the independent variables. Perhaps, FDI and R&D may have some kind of gestation lag before they exert some impact on development. Moreover, using lags reduces the likelihood of any contemporaneous correlations and thus reduces any potential endogeneity concerns. The results as shown in Tables A1 and A2 are substantially unchanged. The marginal plots in Figure A1 further confirm the earlier results that FDI and R&D are substitutes.

A2. Differences across developed/developing countries

As further robustness checks, we examine how the development status of the countries influences the inter-relationships between FDI, development outcomes and R&D. We do this by using a dummy variable of whether a country is developed or developing (based on the United Nation's classification) with the amended specification being

$$\begin{aligned} DEV_{i,t} = \alpha_0 + \alpha_1 FDI_{i,t} \times Developed_{it} + \alpha_2 FDI_{i,t} \times Developing_{it} + \alpha_3 R\&D_{i,t} \times Developed_{it} \\ + \alpha_4 R\&D_{i,t} \times Developing_{it} + \alpha_5 (FDI_{i,t} \times R\&D_{i,t} \times Developed_{it}) \\ + \alpha_6 (FDI_{i,t} \times R\&D_{i,t} \times Developing_{it}) + \boldsymbol{\gamma Controls}_{i,t} + \zeta_{i,t} \quad \text{(A1)} \end{aligned}$$

The results are reported in Tables A3 and A4. From these we can see that the coefficient of BITs in the first stage is positive and statistically significant. Also, the Cragg and Donald (1993) *Wald* F-statistics test of weak identification is again rejected.

Table A1: Impact of FDI on growth, inequality and welfare (lag of independent variables), IV regression

Variable	GDP p.c.		Inequality (GINI)		HDI		iHDI	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FDI/GDP (t-1)	0.0079***	0.0186***	-0.1794***	-0.5169***	0.0014***	0.0040***	0.0079***	0.0150***
	(0.0026)	(0.0061)	(0.0561)	(0.1175)	(0.0005)	(0.0009)	(0.0020)	(0.0030)
R&D (t-1)	0.4266***	0.4940***	-2.2329***	-4.5367***	0.0521***	0.0660***	0.1192***	0.1469***
	(0.0336)	(0.0491)	(0.5184)	(0.9397)	(0.0036)	(0.0061)	(0.0148)	(0.0185)
FDI/GDP (t-1) × R&D (t-1)		-0.0192**		0.5982***		-0.0045***		-0.0143***
		(0.0078)		(0.1466)		(0.0010)		(0.0034)
ICT Infrastructure (t-1)	0.0123***	0.0127***	-0.0275***	-0.0421***	0.0015***	0.0026***	0.0021***	0.0024***
	(0.0007)	(0.0007)	(0.0092)	(0.0118)	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Secondary education (t-1)	0.0001	0.0001	-0.0038**	-0.0032*				
	(0.0001)	(0.0001)	(0.0016)	(0.0018)				
Tertiary education (t-1)	0.0091***	0.0083***	-0.1389***	-0.1053***				
	(0.0014)	(0.0015)	(0.0157)	(0.0214)				
Financial development (t-1)	0.0030***	0.0032***	0.0408***	0.0383**	-0.00001	0.00002	-0.0019***	-0.0018***
	(0.0008)	(0.0008)	(0.0145)	(0.0187)	(0.0001)	(0.0001)	(0.0005)	(0.0005)
Inflation (t-1)	-0.0225***	-0.0226***	-0.1277***	-0.1297**	-0.0007*	-0.0008**	-0.0009	-0.0019***
	(0.0057)	(0.0058)	(0.0453)	(0.0524)	(0.0004)	(0.0004)	(0.0006)	(0.0009)
Unemployment (t-1)	-0.0094***	-0.0099***	0.1171*	0.1391**	0.0011***	0.0008**	0.0028***	0.0025***
	(0.0034)	(0.0035)	(0.0646)	(0.0711)	(0.0004)	(0.0004)	(0.0009)	(0.0010)
Turning Point: FDI [R&D]	-	25.73 [0.97]	-	7.58 [0.86]	-	14.67 [0.89]	-	10.27 [1.05]
Obs.	1110	1110	767	767	1222	1222	741	741
First Stage regression								
BITs	13.3351***	4.5954***	14.5167***	4.8440***	12.9803***	4.7055***	4.6941***	2.4561***
	(4.1640)	(1.0016)	(4.5390)	(1.1232)	(4.0646)	(1.0098)	(1.1284)	(0.5237)
Cragg-Donald F-Stats	195.62	75.54	146.42	52.55	205.21	83.37	29.35	21.09

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

Table A2: Impact of FDI on poverty (lag of independent variables), 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)
FDI/GDP (t-1)	-0.0306***	-0.0753***	-0.0825***	-0.2045***	-0.1685***	-0.4024***	-0.2183*	-0.3357**
	(0.0106)	(0.0293)	(0.0237)	(0.0583)	(0.0454)	(0.1067)	(0.1140)	(0.1578)
R&D (t-1)	0.4293*	0.1247	-0.1567	-0.9894*	-2.7794***	-4.3766***	-6.2652***	-6.2212***
	(0.2373)	(0.3210)	(0.3653)	(0.5519)	(0.5580)	(0.9271)	(1.7929)	(1.6301)
FDI/GDP (t-1) × R&D (t-1)		0.0791**		0.2162***		0.4147***		0.3126*
		(0.0367)		(0.0738)		(0.1353)		(0.1603)
ICT Infrastructure (t-1)	-0.0863***	-0.0883***	-0.1594***	-0.1647***	-0.2403***	-0.2504***	-0.0262	-0.0412*
	(0.0137)	(0.0136)	(0.0169)	(0.0171)	(0.0176)	(0.0184)	(0.0215)	(0.0214)
Secondary education (t-1)	0.0008	0.0009	-0.0004	-0.0001	0.0046	0.0050	-0.0180**	-0.0199***
	(0.0033)	(0.0033)	(0.0039)	(0.0038)	(0.0038)	(0.0038)	(0.0071)	(0.0061)
Tertiary education (t-1)	-0.1140***	-0.1096***	-0.2304***	-0.2183***	-0.3827***	-0.3594***	-0.1025***	-0.0765**
	(0.0183)	(0.0184)	(0.0249)	(0.0253)	(0.0301)	(0.0314)	(0.0394)	(0.0309)
Financial development (t-1)	0.0036	-0.0114	0.0045	0.0036	-0.0128	-0.0145	0.0791	0.0635
	(0.0042)	(0.0678)	(0.0081)	(0.0092)	(0.0144)	(0.0164)	(0.0557)	(0.0424)
Inflation (t-1)	-0.0112	0.0679	-0.0100	-0.0107	0.0487	0.0473	0.7138**	0.8441***
	(0.0679)	(0.0520)	(0.0847)	(0.0849)	(0.1013)	(0.1032)	(0.2969)	(0.2685)
Unemployment (t-1)	0.0650	0.0679	0.1622**	0.1701**	0.3863***	0.4015***	0.4066***	0.4381***
	(0.0518)	(0.0520)	(0.0755)	(0.0763)	(0.0946)	(0.0969)	(0.1343)	(0.1228)
Turning Point: FDI [R&D]	-	[0.95]	-	4.57[0.95]	-	10.55[0.97]	-	19.90[1.07]
Obs.	767	767	767	767	767	767	349	349
First Stage regression								
BITs	14.5167***	4.8440***	14.5167***	4.8440***	14.5167***	4.8440***	3.2797**	2.1185***
	(4.5390)	(1.1232)	(4.5390)	(1.1232)	(4.5390)	(1.1232)	(1.3541)	(0.6930)
Cragg-Donald F-Stats	146.42	52.55	146.42	52.55	146.42	52.55	7.30	8.24

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

From the tables, we can see that FDI inflows into developing countries have a significant impact on development outcomes: mainly Gini, HDI, iHDI, and on headcount poverty ($1.90 and $3.20) with significance at 1% level. Economically, we see that a one percent increase in FDI leads to a 0.87%, 0.87%, and 1.10% decrease in the Gini index, headcount poverty at $1.90 and $3.20 respectively. Moreover, one percent increase in FDI leads to a 0.011 and 0.017 points increase in HDI and iHDI respectively. However, for developed countries, we see that FDI inflows have a significant impact on development outcomes mainly on: Gini, HDI, iHDI, and on headcount poverty ($1.90, $3.20 and $5.50) with significance level of at least 5%. Meanwhile, for these countries a one percent increase in FDI leads to a 0.20%, 0.04%, 0.08% and 0.14% decrease in the Gini index, headcount poverty at $1.90 , $3.20 and $5.50 respectively. Again, a one percent increase in FDI leads to a 0.001 and 0.009 percentage point increase in HDI and iHDI, respectively. We confirm the differential impact of FDI between developed and developing countries on these development outcomes with the Joint significance test of equality showing evidence of asymmetric impact.

Moving on to the impact of R&D, we find that the development impact of R&D is more pronounced in developed countries than in developing countries. Here, R&D in developing countries only has a significant positive impact on HDI and iHDI with a one percent increase in R&D leading to a 0.020 and 0.080 points increase in HDI and iHDI respectively. For developed countries, a one percent increase in R&D leads to a 0.63% in GDP per capita, and a substantial increase of 0.074 and 0.141 points increase in HDI and iHDI respectively. A one percent increase in R&D however leads to a 3.04%, 0.44%, 1.09% 2.14% and 5.39% decrease in the inequality (Gini), headcount poverty at $1.90 , $3.20, $5.50 and multidimensional poverty respectively. These effects are quite substantial especially for developed countries showing the important role of R&D in these countries. Here also, we confirm the differential impact between developed and developing countries with the joint significance test of equality showing 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

Table A3: Impact of FDI on growth and development (developing and developed countries), 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 × Developing	0.0278	-0.8691***	0.0107***	0.0172***	-0.8695***	-1.1034***	0.4508	-0.3388
	(0.029)	(0.306)	(0.003)	(0.006)	(0.277)	(0.395)	(0.400)	(0.714)
FDI/GDP × Developed	0.0039	-0.2031***	0.0014***	0.0090***	-0.0384**	-0.0846***	-0.1435***	-0.1453
	(0.003)	(0.072)	(0.001)	(0.003)	(0.015)	(0.029)	(0.045)	(0.102)
R&D × Developing	0.0165	-0.2348	0.0201***	0.0843***	-0.6618	-0.4907	0.2253	2.7677
	(0.036)	(0.884)	(0.007)	(0.021)	(0.711)	(0.964)	(1.053)	(7.268)
R&D × Developed	0.4916***	-3.0430***	0.0738***	0.1413***	-0.4421*	-1.0938**	-2.1394***	-5.3944***
	(0.072)	(0.627)	(0.008)	(0.022)	(0.253)	(0.444)	(0.621)	(1.574)
ICT Infrastructure	0.0124***	-0.0219**	0.0013***	0.0019***	-0.0858***	-0.1723***	-0.2443***	-0.0273
	(0.001)	(0.011)	(0.000)	(0.000)	(0.014)	(0.017)	(0.019)	(0.030)
Secondary education	0.0001	-0.0013	-		0.0057	0.0025	-0.0044	-0.0082
	(0.000)	(0.003)	-		(0.004)	(0.005)	(0.005)	(0.005)
Tertiary education	0.0087***	-0.1458***	-		-0.1089***	-0.2320***	-0.3646***	-0.0440
	(0.002)	(0.020)	-		(0.021)	(0.028)	(0.031)	(0.045)
Financial Development	0.0043***	0.0351**	-0.0001	-0.0020***	-0.0024	-0.0048	-0.0153	0.0381
	(0.001)	(0.018)	(0.000)	(0.001)	(0.005)	(0.009)	(0.013)	(0.047)
Inflation	-0.0130*	-0.0766	-0.0011*	-0.0004	0.1547*	0.2014*	0.0341	0.2086
	(0.007)	(0.068)	(0.001)	(0.001)	(0.093)	(0.114)	(0.131)	(0.297)
Unemployment	-0.0083**	0.1146	0.0014***	0.0033***	0.0700	0.1455*	0.3614***	0.3884***
	(0.003)	(0.070)	(0.000)	(0.001)	(0.051)	(0.079)	(0.098)	(0.140)
	(0.104)	(2.114)	(0.014)	(0.028)	(3.064)	(3.861)	(3.824)	(5.798)
Obs.	1111	776	1,223	664	776	776	776	314
Joint Test of FDI/GDP × Developing = FDI/GDP × Developed. χ^2	-	5.09**	15.52***	2.73*	9.53***	7.09***	-	-
Joint Test of R&D × Developing = R&D × Developed. χ^2	-	21.73***	41.39***	27.90***	-	-	-	-
First Stage regression	**Dependent Variable: FDI × Developing**							
BITs x Developing	3.0070***	4.1349***	3.5893***	3.8713***	4.1349***	4.1349***	4.1349***	4.2264***
	(0.6846)	(0.9183)	(0.6779)	(1.0996)	(0.9183)	(0.9183)	(0.9183)	(0.7309)
BITs x Developed	-0.9939***	-0.3566***	-0.9387***	0-.6909***	-0.3566***	-0.3566***	-0.3566***	-0.2548***
	(0.1679)	(0.0594)	(0.1708)	(0.1700)	(0.0594)	(0.0594)	(0.0594)	(0.0509)
	Dependent Variable: FDI × Developed							
BITs x Developed	15.6017***	12.9318***	15.2742***	4.4722***	12.9318***	12.9318***	12.9318***	3.6341**
	(4.6349)	(4.5129)	(4.5214)	(1.1099)	(4.5129)	(4.5129)	(4.5129)	(1.4341)
BITs x Developing	0.2941	0 .7459	0.0577	-1.0986	0 .7459	0 .7459	0 .7459	-0.9204
	(1.1916)	(1.6001)	(1.1391)	(1.0340)	(1.6001)	(1.6001)	(1.6001)	2.8127
Cragg-Donald F-Stats	16.50	31.95	25.10	7.70	31.95	31.950	31.950	3.76

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

Table A4: Impact of FDI on growth and development with three-way interaction terms (developing and developed countries), 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 × Developing	0.0617	-2.9330**	0.0218***	0.0179***	-2.3294*	-2.6880*	2.4139	0.7515
	(0.051)	(1.492)	(0.008)	(0.007)	(1.256)	(1.596)	(1.723)	(1.235)
FDI/GDP × Developed	0.0031	-0.5618***	0.0045***	0.0139***	-0.1257*	-0.2251**	-0.2315**	-0.1365
	(0.005)	(0.148)	(0.001)	(0.003)	(0.066)	(0.095)	(0.103)	(0.141)
R&D × Developing	0.1943	-13.6511*	0.0815***	0.0900***	-10.0715	-10.7259	12.7789	11.9104
	(0.123)	(7.611)	(0.025)	(0.020)	(6.646)	(8.180)	(8.985)	(7.398)
R&D × Developed	0.4628***	-5.8170***	0.0961***	0.1490***	-1.3732*	-2.3873**	-2.1619*	-4.4820***
	(0.073)	(1.330)	(0.017)	(0.020)	(0.775)	(1.103)	(1.245)	(1.449)
FDI/GDP × R&D × Developing	-0.0982	8.2275*	-0.0172**	-0.0161	5.7654	6.2726	-7.6853	-3.2119
	(0.063)	(4.579)	(0.007)	(0.010)	(3.865)	(4.787)	(5.374)	(2.318)
FDI/GDP × R&D × Developed	-0.0007	0.6141***	-0.0050***	-0.0127***	0.1263*	0.2216**	0.2109*	0.1213
	(0.007)	(0.161)	(0.002)	(0.003)	(0.073)	(0.106)	(0.116)	(0.120)
ICT Infrastructure	0.0136***	-0.0333**	0.0015***	0.0023***	-0.0880***	-0.1763***	-0.2487***	-0.0290
	(0.001)	(0.015)	(0.000)	(0.000)	(0.015)	(0.020)	(0.018)	(0.027)
Secondary education	-0.0001	-0.0013	-	-	0.0061	0.0028	-0.0054	-0.0119**
	(0.000)	(0.004)	-	-	(0.005)	(0.005)	(0.005)	(0.005)
Tertiary education	0.0081***	-0.1156***	-	-	-0.1084***	-0.2257***	-0.3396***	0.0002
	(0.001)	(0.030)	-	-	(0.025)	(0.033)	(0.034)	(0.042)
Financial Development	0.0056***	0.0285	-0.0001	-0.0016***	-0.0050	-0.0082	-0.0143	0.0086
	(0.001)	(0.023)	(0.000)	(0.000)	(0.007)	(0.011)	(0.012)	(0.037)
Inflation	-0.0123*	-0.2286***	-0.0019**	-0.0007	0.0650	0.0991	0.1327	0.0875
	(0.007)	(0.085)	(0.001)	(0.001)	(0.087)	(0.102)	(0.129)	(0.327)
Unemployment	-0.0094***	0.0338	0.0008*	0.0027***	-0.0003	0.0728	0.4722***	0.4114***
	(0.003)	(0.086)	(0.000)	(0.001)	(0.067)	(0.093)	(0.117)	(0.136)
	(0.164)	(4.103)	(0.025)	(0.027)	(4.472)	(5.574)	(5.529)	(5.447)
Obs.	1111	776	1223	664	776	776	776	314
Turning Point: FDI [R&D] -Developing	-	1.66[0.37]	4.74[1.27]	-	-	-	-	-
Turning Point: FDI [R&D] -Developed	-	9.47[0.91]	19.22[0.90]	11.73[1.41]	10.87[1.78]	10.77[1.02]	10.25[1.10]	-
First Stage regression	**Dependent Variable: FDI × Developing**							
BITs x Developing	1.7895***	1.2849**	1.7139***	2.7487***	1.2849**	1.2849**	1.2849**	1.9454***
	(0.4551)	(0.5955)	(0.5230)	(0.8494)	(0.5955)	(0.5955)	(0.5955)	(0.3021)
BITs x Developed	-0.3560***	-0.2221***	-0.6141***	-0.3901***	-0.2221***	-0.2221***	-0.2221***	-0.2023***
	(0.0927)	(0.0474)	(0..0859)	(0.1171)	(0.0474)	(0.0474)	(0.0474)	(0.0347)
	Dependent Variable: FDI × Developed							
BITs x Developed	5.5412***	5.0816***	5.4933***	2.5003***	5.0816***	5.0816***	5.0816***	2.4594***
	(1.1824)	(1.2827)	(1.1465)	(.5494)	(1.2827)	(1.2827)	(1.2827)	(0.7520)
BITs x Developing	0.1623	0.5270	0.3119	0.6843	0.5270	0.5270	0.5270	3.0561
	(0.5668)	(0.9493)	(0.5618)	(0.6536)	(0.9493)	(0.9493)	(0.9493)	(1.8426)
Cragg-Donald F-Stats	14.92	8.87	10.87	9.03	8.87	8.87	8.87	5.42

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

tend to be dependent on FDIs. 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 FDIs. On the other hand, we find that R&D in developed countries plays a significant development role showing more 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 FDIs and that countries, particularly developing, should focus more on expenditures in R&D.

A3. Excluding top and bottom deciles of FDI and R&D

Given that some countries have comparatively high net FDI inflows and R&D (as shares of GDP), we proceed to estimate the results by excluding the top and bottom deciles of FDI and R&D from our data sample following Donaubauer et al. (2016) [1]. The descriptive statistics shown in Table A5 indicate relatively lower mean, minimum and maximum values for the variables.

This is to help consider the relevant thresholds of FDIs and to check whether our major results are dependent on the selected sample. The results are reported in Tables A6 and A7. Here, once more, the coefficient of BITs in the first stage is positive and statistically significant. Again, except for the results for iHDI and multidimensional poverty in Table A6, the Cragg and Donald (1993) *Wald* F-statistics test of weak identification is rejected for all estimations as the values are greater than the relevant critical values, indicating that the models are identified, and the instrument is relevant.

While we see that the size of the coefficients of FDIs and R&D differ from our main results, the results are qualitatively similar to our earlier findings with FDI having a significant positive impact on growth and HDI and a significant negative impact on inequality and all poverty headcount measures. While we observe a much greater impact of FDI on the development outcomes compared to the results of the full sample, we still see that R&D has a more pronounced impact on the development outcomes than FDIs.

[1] We also winsorize the data at the top and bottom 1% as additional robustness checks. As discussed subsequetly, our results remain consistent.

We therefore confirm the earlier results that FDIs and R&D are substitutes with the interaction being negative. The marginal effect plots in Figure A2 further confirm that FDI and R&D are substitutes. Here, we see that increasing R&D expenditure along with FDIs leads to a negative (positive) marginal effect of FDIs on growth and welfare (poverty and inequality). From Table A7, we confirm the non-linear impact of FDI on the development outcomes. We however find that the thresholds are significantly lower averaging around 6% showing that countries that fall between the bottom and top deciles even experience the non-linear effect of FDIs at much lower FDI shares of GDP. This suggests the even more important role of absorptive capacity of these countries through higher R&D investments to mitigate the negative threshold effect of FDI on development. Again, we find the interaction of FDI and R&D is negative indicating that the two are substitutes. This is further confirmed by the marginal effects plots in Figure A2. From the figures, we again see that increasing R&D along with FDI eventually leads to negative (positive) marginal effect of FDI on growth and welfare (poverty and inequality). As noted, we also winsorized the data at the bottom and top 1%, leading conclusions essentially unchanged.

A4. Winsorizing the Data

We provide further robustness by winsorizing our data at the top and bottom 1%. This provides additional robustness for the thresholds and turning points without losing data compared to the exclusion of the top and bottom deciles as done earlier. We do this with and without instrumenting for R&D. The results are presented in Tables A8 and A9. Again, our results are robust and similar to the main findings and we further confirm from Figures A3 and A4 that FDI and R&D are substitutes in the development process with the varying thresholds.

Table A5: Descriptive Statistics - Winsorized data and sample excluding top and Bottom decile of FDI and R&D

Variable	Sample Excluding Top and Bottom Deciles of FDI and R&D				Wnsorized Data			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
GDP per capita -natural log (GDP p.c.)	8.906	1.256	5.090	11.528	8.505	1.490	5.651	11.340
Gini Index (Gini)	36.345	8.041	23.200	64.800	36.780	8.052	24.600	57.100
Human Development Index (HDI)	0.761	0.115	0.332	0.954	0.691	0.158	0.354	0.943
Inequality-adjusted HDI (iHDI)	0.660	0.138	0.219	0.895	0.572	0.192	0.230	0.884
Headcount poverty ratio at $1.90 (Headcount Poverty $1.90)	3.157	8.629	0	94.300	6.371	13.712	0	71.700
Headcount poverty ratio at $3.20 (Headcount Poverty $3.20)	8.080	14.419	0	98.500	13.428	21.638	0	89.600
Headcount poverty ratio at $5.50 (Headcount Poverty $5.50)	18.408	22.616	0	99.700	24.482	29.249	0	96.900
Mutidemensional Headcount Poverty (Mutidemensional Poverty)	28.904	10.758	2.370	65.700	26.978	11.137	8.200	63.800
Net FDI inflows as a share of GDP % (FDI/GDP)	3.801	2.666	0.403	12.179	5.440	8.129	-5.670	53.056
Research and Development Expenditure as a share of GDP % (R&D)	0.756	0.602	0.100	2.523	0.974	0.972	0.022	4.078
No. of Bilateral Treaties (BITs)	39.325	26.716	0	141	24.311	26.111	0	120
Mobile and Telephone subscriptions per 100 people (ICT Infrastructure)	124.328	48.348	1.337	364.872	105.551	55.200	2.589	229.054
Secondary Enrolment Ratio (Secondary Eduction)	167.938	215.108	14.299	788.926	187.422	251.905	15.714	786.353
Tertiary Enrolment Ratio (Tertiary Eduction)	48.714	23.050	1.510	142.852	38.642	23.420	1.510	95.864
Domestic credit to the private sector as a share of GDP %(Financial Development)	58.081	39.440	0.186	194.647	49.136	39.708	2.722	187.241
Consumer Price Index % (Inflation)	4.962	5.487	-1.736	59.220	5.122	5.885	-2.078	36.522
Unemployment rate % (Unemployment)	8.746	6.076	0.170	37.250	7.668	5.743	0.548	27.789

Table A6: Impact of FDI on growth and development (excluding top and bottom deciles of 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	0.1882**	-6.1750***	0.0451***	0.3324	-2.9383***	-5.9192***	-8.2880***	14.9509
	(0.074)	(1.971)	(0.011)	(0.310)	(0.817)	(1.529)	(2.306)	(42.822)
R&D	1.2621***	-16.2257***	0.1450***	0.8849	-9.9542***	-20.5205***	-33.0556***	24.2372
	(0.271)	(5.621)	(0.036)	(0.813)	(3.167)	(5.399)	(7.364)	(74.042)
FDI/GDP × R&D	-0.1582**	2.1985*	-0.0174**	-0.1590	2.4160***	4.5972***	6.1216***	-7.6293
	(0.065)	(1.216)	(0.009)	(0.168)	(0.758)	(1.254)	(1.664)	(18.570)
ICT Infrastructure	0.0140***	-0.0090	0.0016***	-0.0019	-0.0723***	-0.1579***	-0.2411***	-0.2390
	(0.001)	(0.025)	(0.000)	(0.004)	(0.016)	(0.025)	(0.033)	(0.585)
Secondary education	-0.0003*	-0.0004	-	-	0.0004	-0.0004	0.0079	-0.0139
	(0.000)	(0.004)	-	-	(0.004)	(0.005)	(0.006)	(0.014)
Tertiary education	0.0050***	-0.1266***	-	-	-0.1074***	-0.2374***	-0.3960***	-0.0575
	(0.002)	(0.038)	-	-	(0.026)	(0.040)	(0.052)	(0.275)
Financial development	0.0042***	0.0668***	0.0000	-0.0007	0.0047	0.0065	-0.0079	-0.0007
	(0.001)	(0.019)	(0.000)	(0.001)	(0.009)	(0.016)	(0.023)	(0.215)
Inflation	-0.0119*	0.0143	-0.0008	0.0028	0.0362	0.0930	0.1659	-0.5554
	(0.007)	(0.125)	(0.001)	(0.006)	(0.074)	(0.123)	(0.197)	(4.179)
Unemployment	-0.0051	0.0927	0.0009	0.0068	0.1003*	0.2155*	0.4864***	0.6444
	(0.004)	(0.122)	(0.001)	(0.008)	(0.059)	(0.113)	(0.166)	(0.559)
	(0.320)	(8.337)	(0.051)	(0.796)	(4.957)	(7.502)	(9.860)	(64.448)
Turning Point: FDI [R&D]	7.98 [1.19]	7.38 [2.81]	8.33 [2.59]	-	4.12 [1.22]	4.46 [1.29]	5.40 [1.35]	-
Obs.	725	512	775	436	512	512	512	196
First Stage regression								
BITs	0.8533**	0.7481*	0.9482***	-0.0028	0.7481*	0.7481*	0.7481*	-0.2411
	(0.360)	(0.406)	(0.364)	(0.322)	(0.406)	(0.406)	(0.406)	(0.336)
Cragg-Donald F-Stats	10.38	8.46	12.84	0.48	8.45	8.46	8.46	0.06

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

Table A7: Non-linear impact of FDI on growth and development (excluding top and bottom deciles of 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	0.2558	-19.7259***	0.1005***	0.1853***	-2.3843	-6.6204**	-12.3261**	-0.4500
	(0.211)	(6.925)	(0.037)	(0.066)	(1.467)	(3.204)	(5.779)	(2.662)
FDI/GDP ^{2}	-0.0221	1.6806***	-0.0084***	-0.0156***	0.1847	0.5403**	1.0533**	0.0113
	(0.018)	(0.597)	(0.003)	(0.006)	(0.125)	(0.273)	(0.496)	(0.247)
R&D	0.6147***	-6.343***	0.0488***	0.0954***	-0.1974	-1.8292**	-7.9450***	-5.5497***
	(0.050)	(1.671)	(0.008)	(0.019)	(0.443)	(0.865)	(1.418)	(1.240)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Turning Point: FDI	-	5.87	5.98	5.94	-	6.13	5.85	-
Obs.	725	512	725	400	512	512	512	196
First Stage regression								
BITs	0.1567***	0.1589***	0.1567***	0.1750***	0.1589***	0.1589***	0.1589***	0.1497**
	(0.053)	(0.057)	(0.053)	(0.065)	(0.057)	(0.057)	(0.057)	(0.066)
Cragg-Donald F-Stats	10.23	9.28	10.23	9.25	9.28	9.28	9.29	6.01

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

Table A8: Impact of FDI on growth and development -(Winsorizing the data), 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	0.0367***	-1.2267***	0.0099***	0.0244***	-0.1430**	-0.3816***	-0.7347***	-0.3470**
	(0.014)	(0.220)	(0.002)	(0.006)	(0.059)	(0.112)	(0.176)	(0.165)
R & D	0.4891***	-5.8067***	0.0770***	0.1447***	0.1388	-0.7553	-3.9190***	-5.0549***
	(0.059)	(0.859)	(0.008)	(0.018)	(0.338)	(0.532)	(0.790)	(1.052)
FDI/GDP x R & D	-0.0174*	0.7274***	-0.0060***	-0.0149***	0.0740**	0.1940***	0.3500***	0.1847*
	(0.010)	(0.138)	(0.001)	(0.004)	(0.038)	(0.072)	(0.113)	(0.106)
ICT Infrastructure	0.0133***	-0.0131	0.0015***	0.0019***	-0.0751***	-0.1571***	-0.2385***	-0.0376*
	(0.001)	(0.011)	(0.000)	(0.000)	(0.012)	(0.015)	(0.017)	(0.021)
Secondary education	-0.0000	0.0015			0.0021	-0.0007	0.0023	-0.0089**
	(0.000)	(0.003)			(0.003)	(0.004)	(0.004)	(0.004)
Tertiary education	0.0082***	-0.1245***			-0.1065***	-0.2367***	-0.3961***	-0.0703*
	(0.001)	(0.020)			(0.018)	(0.025)	(0.029)	(0.036)
Financial Development	0.0039***	0.0434***	-0.0001	-0.0010***	0.0018	-0.0010	-0.0292**	0.0036
	(0.001)	(0.012)	(0.000)	(0.000)	(0.004)	(0.008)	(0.012)	(0.019)
Inflation	-0.0189***	-0.1091	-0.0013**	-0.0011	0.0469	0.0986	0.2243	0.5124
	(0.006)	(0.067)	(0.001)	(0.001)	(0.081)	(0.102)	(0.146)	(0.325)
Unemployment	-0.0092**	0.0412	0.0009**	0.0032***	0.0526	0.1112	0.3174***	0.4540***
	(0.004)	(0.067)	(0.000)	(0.001)	(0.048)	(0.074)	(0.100)	(0.128)
Turning Point: FDI [R&D]	28.11[2.11]	7.98[1.69]	12.83[1.65]	9.71[1.64]	[1.93]	[1.97]	11.20[2.10]	27.37[1.88]
Obs.	1111	776	1,223	664	776	776	776	314
First Stage regression								
BITS	2.4559****	2.8196***	2.4146***	2.0650***	2.8196***	2.8196***	2.8196	2.4650***
	(0.4557)	(0..4773)	(0.4459)	(0.4261)	(0.4773)	(0.4773)	(0.4773)	(0.4843)
Cragg-Donald F-Stats	86.225	82.268	89.505	46.046	82.268	82.268	82.268	40.942

NB: All variables are as defined earlier. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis. All variables are winsorized at the top and bottom 1%

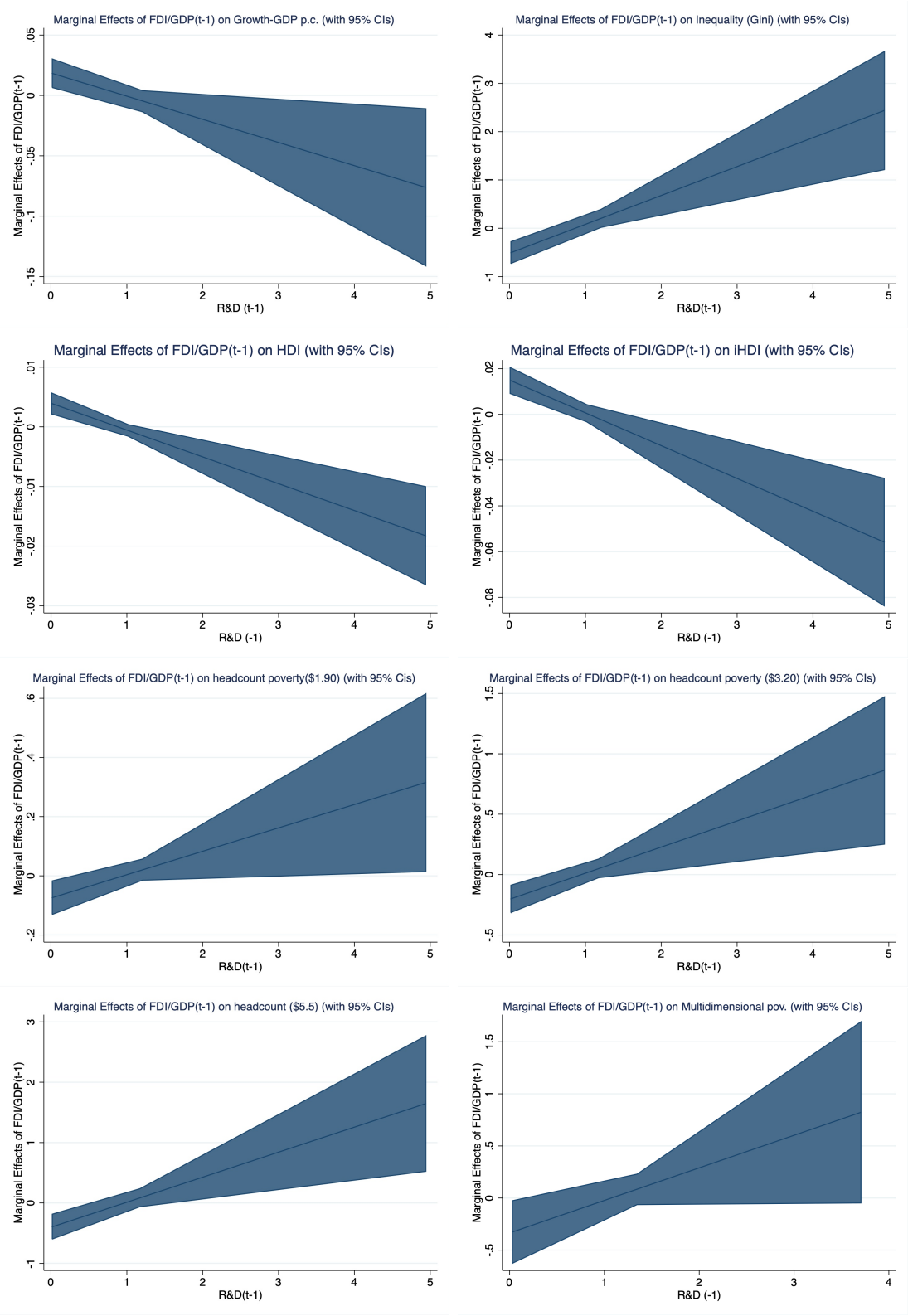


Figure A1: Marginal effects of lag of FDI on growth and development (with 95% CI), IV regression

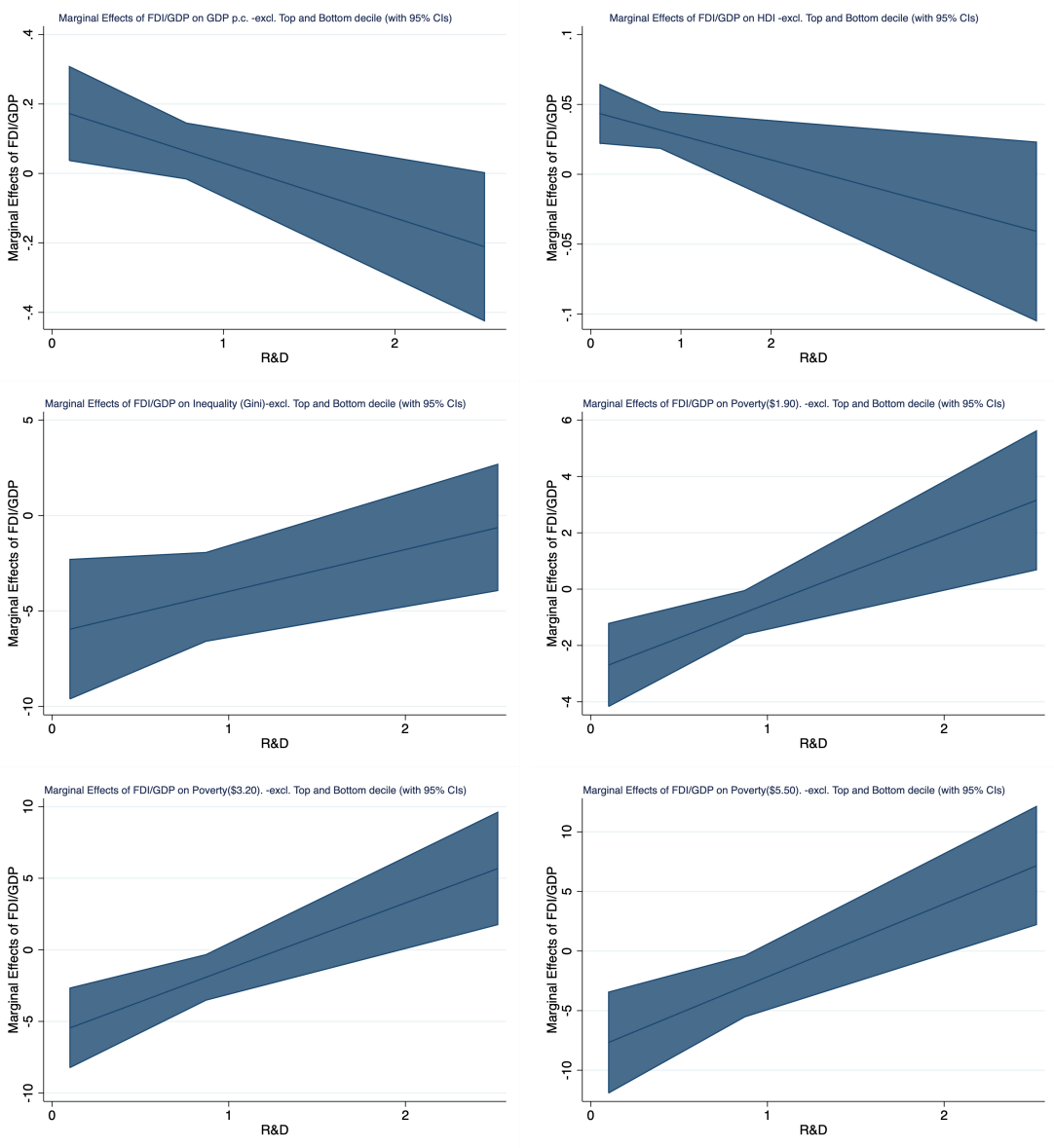
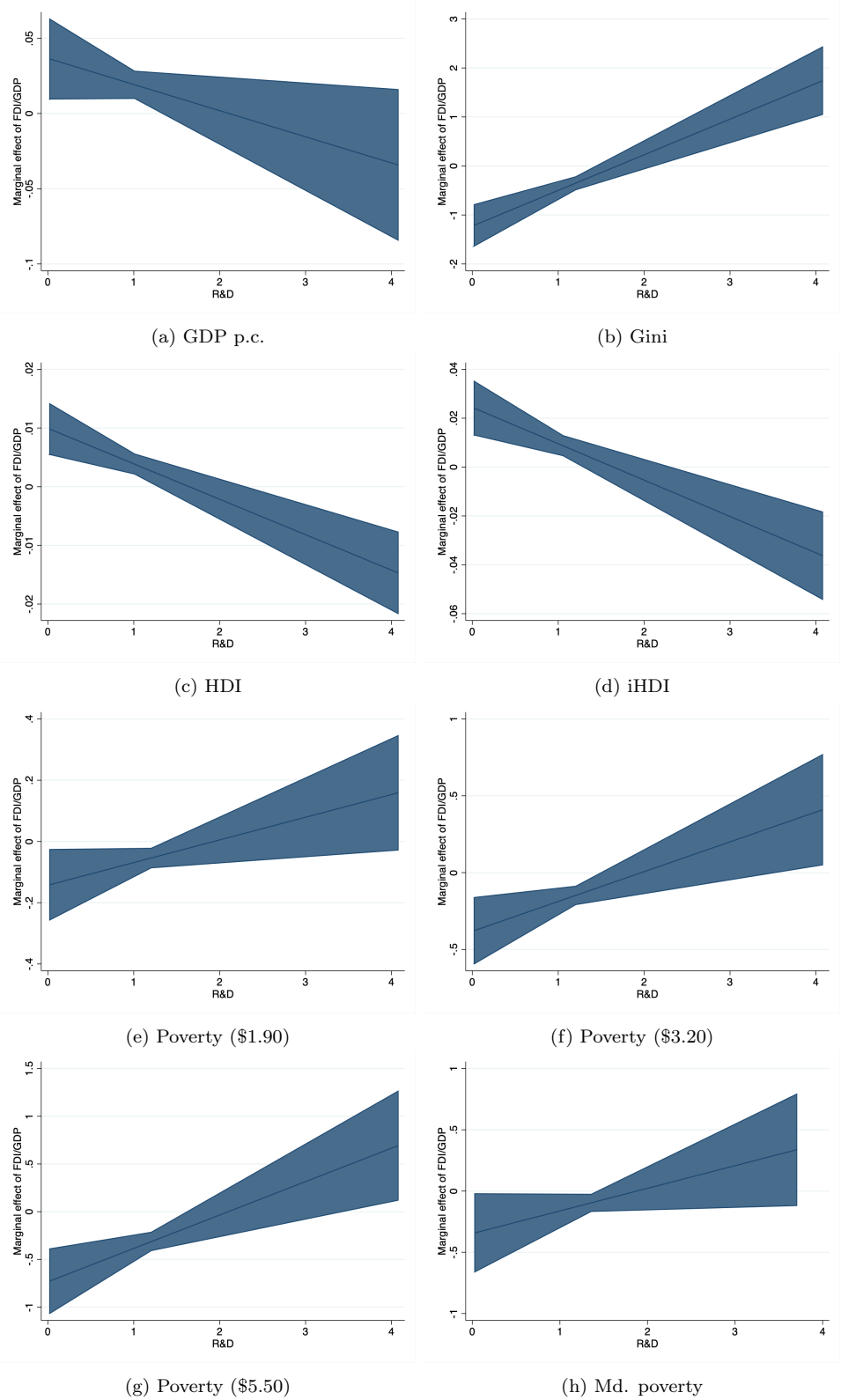


Figure A2: Marginal effects of FDI on develpoment outcomes excluding top and bottom decile of FDI and R&D (with 95% CI), IV regression

Table A9: Impact of FDI on growth and development -(Winsorizing the data and 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	0.0599***	-1.4590***	0.0115***	0.0279***	-0.2507***	-0.6362***	-1.2574***	-0.3120
	(0.019)	(0.287)	(0.003)	(0.007)	(0.087)	(0.169)	(0.286)	(0.223)
R & D	1.0791***	-14.8094***	0.1396***	0.2668***	-4.0190***	-8.6647***	-16.9584***	-5.8296**
	(0.109)	(1.619)	(0.012)	(0.031)	(0.941)	(1.437)	(2.031)	(2.435)
FDI/GDP x R & D	-0.0327***	0.8873***	-0.0069***	-0.0163***	0.1608***	0.3893***	0.7335***	0.1470
	(0.013)	(0.181)	(0.002)	(0.004)	(0.056)	(0.109)	(0.184)	(0.136)
ICT Infrastructure	0.0129***	-0.0198	0.0012***	0.0012***	-0.0628***	-0.1296***	-0.2110***	-0.0390*
	(0.001)	(0.015)	(0.000)	(0.000)	(0.016)	(0.021)	(0.025)	(0.022)
Secondary education	-0.0001	0.0029			0.0007	-0.0003	0.0044	-0.0006
	(0.000)	(0.002)			(0.004)	(0.005)	(0.005)	(0.009)
Tertiary education	-0.0014	0.0534*			-0.0039	-0.0482**	-0.1016**	-0.0572
	(0.002)	(0.032)			(0.012)	(0.024)	(0.043)	(0.036)
Financial Development	-0.0014	0.1059***	-0.0007***	-0.0025***	0.0282***	0.0570***	0.0896***	0.0041
	(0.001)	(0.018)	(0.000)	(0.001)	(0.009)	(0.014)	(0.022)	(0.032)
Inflation	-0.0028	-0.3444***	0.0004	0.0015	-0.0143	-0.0465	-0.0167	0.5767
	(0.008)	(0.102)	(0.001)	(0.001)	(0.101)	(0.152)	(0.254)	(0.361)
Unemployment	0.0005	-0.2548***	0.0017***	0.0071***	-0.0569	-0.1458	-0.2513*	0.4333**
	(0.005)	(0.093)	(0.001)	(0.001)	(0.068)	(0.109)	(0.152)	(0.182)
Turning Point: FDI [R&D]	33[1.83]	16.69[1.64]	20.23[1.67]	16.24[1.71]	25.00[1.56]	22.26[1.63]	23.12[1.71]	-
Obs.	873	638	954	536	638	638	638	294
First Stage regression	***FDI***							
BITS	3.0256***	3.4922***	3.1243***	2.8528***	3.4922***	3.4922***	3.4922***	3.5811***
	(0.5387)	(0.5417)	(0.5473)	(0.5445)	(0.5417)	(0.5417)	(0.5417)	(0.5790)
	R&D							
ln(Researchers in R&D in mil.)	0.4093***	0.5146***	0.5004***	0.4706***	0.5146***	0.5146***	0.5146***	0.5412***
	(0.0201)	(0.0274)	(0.0194)	(0.0233)	(0.0274)	(0.0274)	(0.0274)	(0.0472)
Cragg-Donald F-Stats	34.027	32.499	36.906	17.477	32.499	32.499	32.499	11.025

NB: All variables are as defined earlier. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parenthesis. All variables are winsorized at the top and bottom 1%



(a) GDP p.c.

(b) Gini

(c) HDI

(d) iHDI

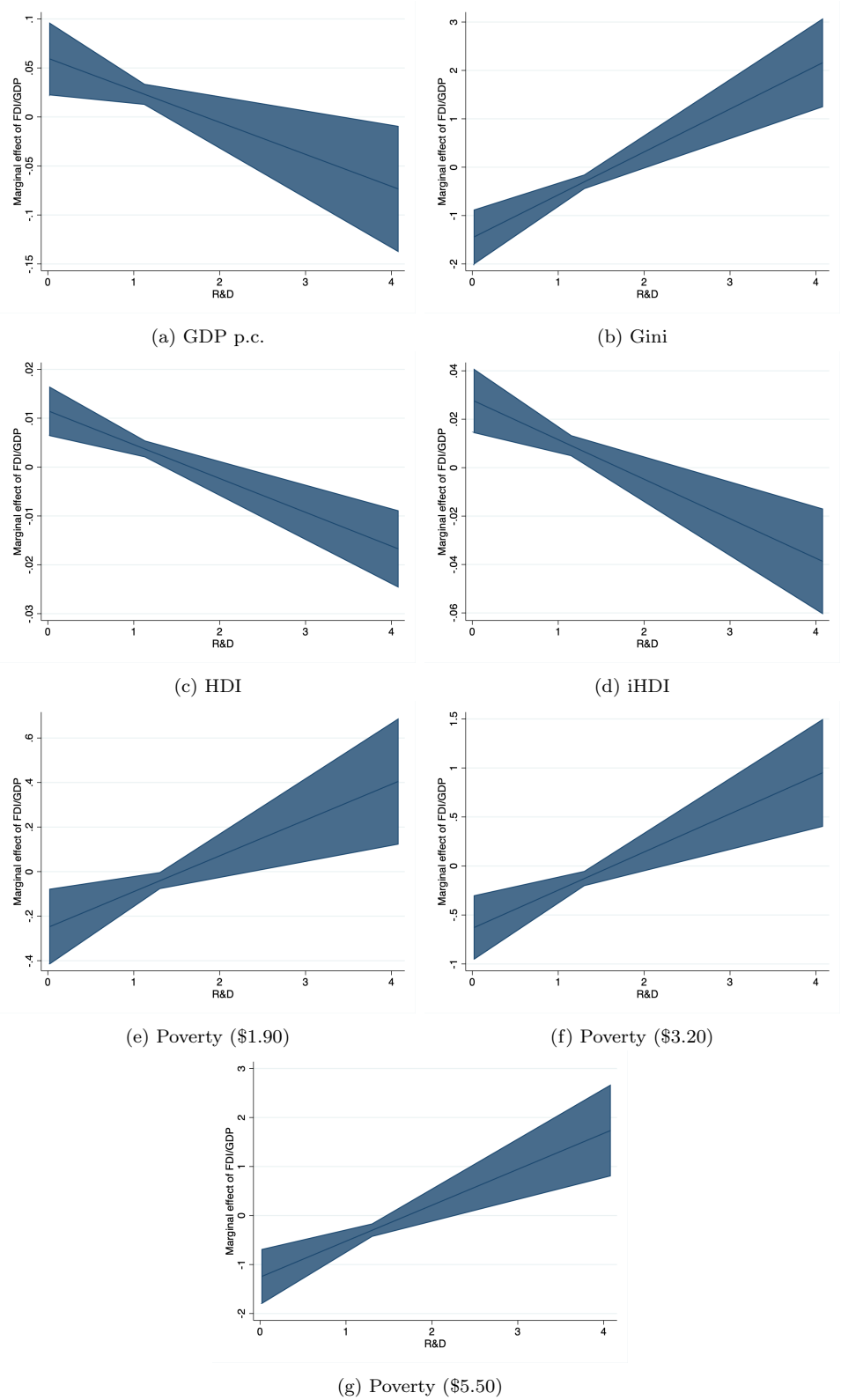
(e) Poverty ($1.90)

(f) Poverty ($3.20)

(g) Poverty ($5.50)

(h) Md. poverty

Figure A3: Marginal effects of FDI on growth and development (with 95% CI), IV regression-Winsorizing data



(a) GDP p.c.

(b) Gini

(c) HDI

(d) iHDI

(e) Poverty ($1.90)

(f) Poverty ($3.20)

(g) Poverty ($5.50)

Figure A4: Marginal effects of FDI on growth and development (with 95% CI), IV regression-Winsorizing data and instrumenting for FDI and R&D

References

Cragg, J.G., Donald, S.G., 1993. Testing identifiability and specification in instrumental variable models. Econometric Theory 9, 222–240.

Donaubauer, J., Meyer, B., Nunnenkamp, P., 2016. Aid, infrastructure, and fdi: Assessing the transmission channel with a new index of infrastructure. World Development 78, 230–245.