Bilateral FDI flows, Productivity Growth and Convergence:

The North vs. The South[1]

Firat Demir

University of Oklahoma
Department of Economics
436 CCD1, 308 Cate Center Drive
Norman, Oklahoma, USA 73019
E-mail: fdemir@ou.edu

Yi Duan[1]
University of Oklahoma
Department of Economics
Norman, Oklahoma, USA 73019
158 CCD1, 308 Cate Center Drive
E-mail: yiduan@ou.edu

Forthcoming in *World Development*

ABSTRACT

Controlling for the aggregation bias in FDI flows and the home and host country heterogeneity within and between Northern and Southern countries, we explore the effects of bilateral FDI flows on host country productivity growth, and on the productivity convergence dynamics between the host and the productivity-frontier country. Using bilateral FDI flows data from 108 host and 240 home countries over 1990-2012, and employing a variety of estimation techniques together with a rich battery of robustness tests, we find no significant effect of bilateral FDI flows on either host country productivity growth or on the productivity gap between the host and the frontier country. We also show that these findings are not sensitive to the direction of FDI flows, which are South-South, South-North, North-South or North-North. In a decomposition exercise, we also fail to find any significant effect of bilateral or aggregate FDI flows on physical capital growth. Yet, we find some evidence of a positive effect of FDI flows on human capital growth but just in one direction, South-South. Last but not least, we fail to find any productivity growth or convergence effect at the sectoral level, including agricultural, industry or services sectors.

Keywords: Bilateral FDI flows; Productivity growth, Productivity convergence; Home and host country heterogeneity, South-South FDI

JEL Codes: F21, F43, O11, O47

[1] We thank Gregory Burge, Pallab Ghosh, John Harris, Daniel Hicks, Arslan Razmi, and the session participants at the Eastern Economic Association and the Missouri Valley Economic Association meetings in 2015 for their comments on earlier drafts of this paper. We are also thankful to the two anonymous referees of this journal for their constructive suggestions. We thank Xiaoman Duan, Xiaokai Li, Wenliang Ren and Ying Zhang for their excellent research assistance. Firat Demir thanks Fulbright Commission and the Faculty of Economics at the University of Montenegro for his Fulbright visit during 2015-2016. The usual disclaimer applies.

1. INTRODUCTION

The liberalization of international capital flows has been one of the main pillars of the Washington Consensus since the 1980s. The defenders of this consensus argued that a myriad of benefits were to be derived from external financial liberalization, including allocation efficiency, increased credit flows, relaxation of foreign exchange bottlenecks, risk diversification, prevention of rent seeking, higher capital accumulation and job creation as well as technology and skills transfer, all of which were expected to enhance productivity and economic growth. Furthermore, these effects were thought to be stronger in less developed host countries (i.e. the South), allowing them to catch up with the developed world (i.e. the North). Thanks to the financial liberalization wave of this period, global FDI flows increased from $54 billion in 1980 to $208 billion in 1990, and then to $1.5 trillion in 2013. The rapid growth in FDI flows was accompanied by an increased competition among prospective host countries. Each year between 2000 and 2013, an average of 56 countries introduced a total of 1,440 regulatory changes in their investment regimes, 80% of which were to promote and facilitate a more favorable environment for foreign investors. Complementing legislative changes, bilateral investment treaties (BITs) also spiked, reaching 3,140 by 2015, 88% of which were signed after 1990 (UNCTAD, 2014). However, despite this stout pro-FDI stance across countries, and despite the fact that technology transfer remains one of the top expectations of developing countries from FDI, the growth and productivity effects of foreign investment have been a source intense debate in economics with the empirical evidence being inconclusive at best so far.

In this paper, we contribute to the debate on the productivity effects of FDI by addressing two major issues that were previously unaccounted for, which are the aggregation bias and the home and host country heterogeneity within and between Northern and Southern countries. Most empirical work on the topic is based on aggregate FDI flows, assuming that bilateral flows from (to) multiple country pairs are symmetrical and homogenous. In fact, as we discuss later in our data section, FDI flows are highly dynamic and heterogeneous with investments and divestments from different investors taking place simultaneously. They are also likely to differ in sectoral orientation, type (i.e. merger and acquisition vs. Greenfield, horizontal vs. vertical), duration of stay and investment size as well as managerial and operational practices, which may

affect the strength of vertical and horizontal linkages, and eventually the productivity spillover dynamics. Thus, aggregating inherently heterogenic investment flows, as if they all have the same productivity effects, causes what we refer to as the aggregation bias. A second cause of bias is the assumption that investment flows from (to) home (host) countries with different economic development levels have homogenous productivity effects. This is surprising given that there are strong reasons as to why the productivity effects may differ between Northern and Southern home and host countries, including differences in endowments, institutions, know-how, experience, technological sophistication and sectoral concentration. Differences in consumer preferences and the absorptive capacity of host countries also affect the potential for knowledge and technology spillovers. In other words, not all FDI is created equal. Another reason why we should pay attention to differences between Northern and Southern FDI flows is the significant growth of FDI to and from Southern countries, reaching 64% of global inflows and 43% of outflows in 2013 (UNCTAD, 2016).[2] Furthermore, a majority of Southern FDI outflows is now directed to other Southern countries, reaching as high as two thirds of their total in 2010 (UNCTAD, 2011; WB, 2011).

In the empirical analysis, we explore two overlapping questions: (i) what are the total factor productivity (TFP) growth and convergence effects of bilateral FDI flows? (ii) Are the productivity effects of FDI flows conditional on the direction of these flows, that is South-South, South-North North-South or North-North? The empirical results, using a rich panel of bilateral FDI flows data between 108 host and 240 home countries during the period of 1990-2012 suggest that bilateral FDI inflows have no significant effect on either host countries' productivity growth or on the productivity gap between host countries and the frontier country in any of the four directions. The validity of these findings is confirmed using a variety of estimation methods and a rich battery of robustness checks. In a decomposition exercise, we also fail to find any significant effect of bilateral or aggregate FDI flows on physical capital growth. Yet, we find some evidence of positive effect of FDI flows on human capital growth but just in one direction, South-South. We also fail to find any productivity growth or convergence effect at the sectoral level in agriculture, industry or services.

The rest of the paper is organized as follows. Section 2 introduces the literature review. Section 3 describes the data, empirical model and estimation methodology. Section 4 presents the empirical results, including extensions and robustness analysis. Section 5 concludes.

2. LITERATURE REVIEW

Foreign firms are shown to have higher productivity, capital intensity, technology, better risk management, know-how, larger supply of internal finance and easier access to international goods and capital markets (Arnold and Javorcik, 2009). However, the existing empirical evidence on FDI spillovers, using country, firm or industry level data, has been inconclusive.[3] Using firm level data, Djankov and Hoekman (2000) for Czech Republic, Keller and Yeaple (2003) for the US, Haskel et al. (2007) and Harris and Moffat (2013) for the UK, Fu (2008), Fu and Gong (2011) and Demir and Su (2016) for China, Arnold and Javorcik (2009) for Indonesia, and Yasar and Paul (2009) for Turkey find evidence of positive productivity growth spillovers from FDI. In contrast, Haddad and Harrison (1993) for Morocco, Aitken and Harrison (1999) for Venezuela, Liu (2008) and Xu et al. (2014) for China, and Fons-Rosen et al. (2014) for firms in 25 advanced countries do not find any significant or exogenous productivity spillovers from FDI. In fact, after controlling for the self-selection bias (i.e. foreign investment flowing into more productive plants), Aitken and Harrison (1999) report a significantly negative productivity effect from foreign to domestic firms. Harris and Robinson (2002) also find evidence showing a decline in plant-level productivity after foreign firm acquisitions in the U.K. On the macro side, Alfaro et al. (2009) fail to find any exogenous effect of FDI on aggregate TFP growth. Building on these results, Girma et al. (2015) show that foreign ownership has a direct positive productivity effect on foreign-owned firms but an indirect negative effect on non-foreign domestic firms in China.

While not explored before, the spillover effects of FDI may in fact be conditional on home and host country characteristics, especially if aggregate FDI flows are heterogeneous in nature. For example, the productivity effects of South–South flows may lag behind those of North-South flows, if, as argued by the Neoclassical theory, Northern firms have better technology, know-how and managerial skills, better risk-management, and have more experience to pass on to host countries. As a result, the potential for knowledge and technology transfer between a Northern home and a Southern host country should be higher than in any

other directions (Schiff, et al., 2002; Schiff and Wang, 2008). In contrast, the Structuralist as well as the new trade theory suggest that South-South FDI may carry a higher potential for technology transfer as the gap between the home and host country technologies and endowment differences are smaller, allowing for higher complementarity, absorptive capacity and more appropriate technology adoption in host countries (Akamatsu, 1962; Amsden, 1980, 1987; Kokko et al., 1996; De Mello, 1999; UNCTAD, 2011; Mayer-Foulkes and Nunnenkamp, 2009; Amighini and Sanfilippo, 2014; Bahar et al., 2014; Dahi and Demir, 2016). South-South FDI is also argued to encompass older technologies, which, in terms of production techniques and product characteristics, are better fit for technological advancement and productivity improvement in host countries than cutting-edge technologies from Northern investors (Stewart, 1982, 1990; Kaplinsky, 1990, 2013; Nelson and Pack, 1999). Compared to the accumulation aspect of technological change, the assimilation aspect may then be more important for productivity improvements as adoption of imported technologies is easier when the technological gap is smaller and operational capabilities are closer between host and home countries. Thus, when it comes to technology and productivity spillovers, capacity and capability are not necessarily one and the same thing (Lall, 2000). Similarities in tastes and preferences between host and home countries within the global South may also allow for easier technology adoption and productivity improvement while enabling Southern multinational corporations to address local consumer needs better (UNCTAD, 2011: 42; Amighini and Sanfilippo, 2014). Recent empirical work using case studies provide strong support for these hypotheses, showing that developing country technologies are better fit for local needs, demand structures, market size, factor endowments and adaptive capabilities (Atta-Ankomah, 2014; Agyei-Holmes, 2016; Xu et al., 2016).

Differences in sectoral composition of FDI are another potential source of heterogeneity within and between Southern and Northern investment flows. While manufacturing industries are often pointed out to be the key catalyst for productivity spillovers, the same is not true for other sectors (Lee, 2009; Rodrik, 2013). Looking at the distribution of global Greenfield FDI flows to the South, we find that most went to services and primary sectors, jointly accounting for 54% of the total between 2004 and 2013, while manufacturing received the remaining 46%. In terms of total FDI stock in Latin America, more than half of FDI in 2012 was in services, and in the case of South America, once we exclude Brazil, services and primary sectors

accounted for more than 85% of the total FDI stock in 2012 (UNCTAD, 2014, p.63). It is possible that South-South and North-South investment flows differ in their sectoral distributions. In the case of Africa, for example, only 3% of intra-African Greenfield FDI flows went to primary sectors, compared to 24% of flows from the rest of the world between 2009 and 2013. Likewise, the share of manufacturing was 48% for intra-regional flows in Africa compared to 32% for investment flows from outside the region (UNCTAD, 2014, p.41). The sectoral composition of FDI can also affect the convergence dynamics between the North and the South. As manufacturing industries enjoy higher productivity convergence (Rodrik, 2013), foreign investments that are more manufacturing oriented are more likely to facilitate convergence between the productivity frontier and the rest. Controlling for the self-selection of foreign firms into higher productivity firms, Demir and Su (2016) find that FDI has a positive effect on TFP levels in Chinese auto-industry.

There are also doubts as to the technology transfer potential of foreign firms, particularly those from the North, because of their tendency to work in enclaves and to maintain proprietary ownership of intellectual copyrights. For example, only a fraction of research and development (R&D) activities by US majority-owned transnational companies (TNCs) are undertaken abroad, just below 16% in 2010. Of this amount, 80% was done in Northern countries (NSF, 2014; Dahi and Demir, 2016). Furthermore, four countries, Brazil, China, India and South Korea received 68% of the total R&D done by US TNCs in developing countries in 2010 (NSF, 2014; Dahi and Demir, 2016). Yet, there is also no evidence that R&D spending by Southern TNCs in host countries is any higher than their Northern counterparts. Several studies also suggest that Southern investors have a comparative advantage in operating in institutionally less developed and more risky countries (Aleksynska and Havrylchyk, 2013; Demir and Hu, 2016). This advantage may help overcome the disadvantaged position of Southern investors (in technology, operational capabilities, experience, etc.) while facilitating productivity spillovers for host countries.

3. EMPIRICAL ANALYSIS

3.1 Model Speciation and Estimation Methodology

We explore the effects of bilateral FDI flows on aggregate productivity growth using equation (1), as in Levine et al. (2000), Bwalya (2006), Doytch and Uctum (2011), and Aghion et al. (2009):

$$Growth_{it} = \alpha_0 + \beta_1 * FDI_{ijt-1}^{SS} + \beta_2 * FDI_{ijt-1}^{SN} + \beta_3 * FDI_{ijt-1}^{NS} + \beta_4 * FDI_{ijt-1}^{NN} + \gamma' X_{it-1} + \delta_{ij} + \delta_t + \varepsilon_{it} \quad (1)$$

where $Growth_{it}$ refers productivity growth in host country *i* in year *t*, and its measurement is discussed in the next section. δ_{ij} and δ_t control for country-pair and year fixed effects, and ε is the error term. In order to control for the lagged growth effects as well as the reverse causality problem, all control variables are lagged by one period.[4]

FDI_{ijt-1} is FDI inflows from home country *j* to host country *i* at time *t-1*, normalized by host country GDPs. The normalization helps correct for size and scale differences between host economies and FDI flows. *SS*, *SN*, *NS* and *NN* refer to the direction of FDI flows that are South-South, South-North (i.e. from Southern home to Northern host country), North-South (i.e. from Northern home to Southern host country) and North-North, respectively. Thus, the effect of FDI on host country productivity growth is conditional on the direction of the flows as given by β_1 for South-South, β_2 for South-North, β_3 for North-South, and β_4 for North-North flows. As discussed before, the expected sign and significance of these coefficients may be conditional on the direction of FDI flows. For example, based on the neoclassical theory, North-South flows are assumed to have a positive and more significant effect on productivity growth than South-South flows while North-North, or South-South flows are not expected to have any significant effect given similarities in their endowments and technology. Likewise, South-North flows should have an insignificant effect since the South lags the North in productive capacity. On the other hand, if income, production structure, endowments, adaptive capacities and preference similarities are more important for spillover effects, as argued by the new trade theory and the Structuralist literature, than we would expect South-South and North-North flows to be more conducive for TFP growth than North-South or South-North flows.

X_{it-1} is a vector of control variables and includes the following:

lnY_{it-1} is the (log) of real GDP per capita in host country *i* in year *t-1* (in constant 2005 dollars). We expect productivity growth to be faster in higher income countries because of their better human capital, physical and institutional infrastructure, and R&D activities. $Inflation_{it-1}$ is the inflation rate, measured by the annual percentage change in GDP deflator. High inflation can cause distortions in resource allocation with

negative effects on productivity (Bitros and Panas, 2006). $Openness_{it-1}$ is openness to trade, measured by the share of exports and imports in GDP and is expected to have a positive effect on productivity growth (Miller and Upadhyay, 2000). $Government_{it-1}$ is the share of government consumption in GDP and controls for the effects of government size on productivity growth through crowding-in or crowding-out effects (Peden and Bradley, 1989). $Credit_{it-1}$ is the share of domestic credit to private sector in GDP and controls for the expected positive effect of financial depth on productivity growth (Aghion et al., 2009; Alfaro et al., 2009).

In equation (2) we extend equation (1) into a two-country framework and explore the effect of FDI flows on the productivity convergence between the host country *i* and the productivity-frontier country *j*. This is an important question for the growth and development prospects of developing countries especially given the growing divergence in incomes between the North and the South. If FDI flows to the South, for example, help these countries catch up with the productivity frontier, then we expect FDI to play a positive role in global convergence in incomes. Likewise, Eq. (2) allows us to test the OECD convergence to see whether FDI flows within the North play any role in equalizing productivity levels among Northern countries.

$$\ln\left(\frac{A_{it}}{A_{jt}}\right) = \alpha_0 + \beta_1 * FDI^{SS}_{ijt-1} + \beta_2 * FDI^{SN}_{ijt-1} + \beta_3 * FDI^{NS}_{ijt-1} + \beta_4 * FDI^{NN}_{ijt-1} + \gamma' X_{it} + \delta_{ij} + \delta_t + \varepsilon_{ijt} \quad (2)$$

where $ln\left(\frac{A_{it}}{A_{jt}}\right)$ is the relative productivity level of the country *i* compared to the frontier country *j*, which is assumed to be the USA. In the robustness analysis, we also use the weighted and unweighted averages of G-7 countries as the frontier. The β's here capture the impact of FDI on the relative productivity gap between host country and the frontier. *X* includes the same set of control variables as in Eq. (1).

We estimate equations (1) and (2) using the two stage least squares (2SLS) method, which helps control for the endogeneity problem by using the lagged FDI (in years *t-2* and *t-3*) as instruments for FDI in year *t-1*. All regressions include country-pair and year fixed effects, which account for all unobserved country-pair specific and time-invariant factors as well as any global shocks that affect all countries symmetrically. Our identification strategy also allows us to control for any other unobserved spillovers from home to host countries so that we can separate the effects of FDI flows from others. As a robustness check, we also

employ the OLS and the two-step GMM methods with country-pair and time fixed effects. We test the validity of our instruments using the Hansen over-identification test. We also check whether our instruments can explain the variation of lagged FDI using the Cragg-Donald Wald F-statistic, where the null hypothesis is that the chosen variables are weak instruments.[5] All regressions results are with asymptotically robust standard errors.[6]

3.2 Measurement of Total Factor Productivity

Total factor productivity (TFP) measures the degree of technology advancement as well as organizational innovation and improvement in efficiency and can be estimated using a variety of methods, the choice of which depends on the research question and, perhaps more importantly, on data availability (Bartelsman and Doms, 2000; Hulten, 2001).[7] In this study we follow the most commonly used method of TFP estimation in macro studies, namely the growth accounting, which treats the residual after subtracting the contribution of inputs to GDP growth as productivity advancement. Using a standard Neoclassical aggregate production function, total output (*Y*) in each country *i* at time *t* is produced with labor (*L*), physical capital (*K*) and human capital (*H*) as in Eq. (3):[8]

$$Y_{it} = A_{it} * F(K_{it}^{\alpha} + (L_{it} * H_{it})^{\beta}) \quad (3)$$

where A_{it} is the measure of technical efficiency, or *TFP*, and it varies across country and time. *F(…)* is assumed to be homogenous of degree one, and displays diminishing marginal returns. Following the convention, we use a superlative index number based on the translog production technology (Griffith et al., 2004; Cameron et al., 2005). The coefficients α and β are the income shares of capital and labor and are allowed to vary across country and time.[9] Under the assumption of constant returns to scale, the sum of α and β is equal to one. We then use the average income shares between period *t* and *t-1* as our proxy for output elasticities (i.e. the Törnqvist index).[10] Taking logarithms and differencing with respect to time gives us Eq. (4) where TFP growth is equal to the difference between the growth rate of output and the growth rate of TFP, physical capital, human capital and labor:

$$\Delta lnA_{it} = \Delta lnY_{it} - (\tfrac{1}{2} * (\alpha_{it} + \alpha_{it-1}) * \Delta lnK_{it} + (1 - \tfrac{1}{2} * (\alpha_{it} + \alpha_{it-1})) * \Delta lnL_{it} + (1 - \tfrac{1}{2} * (\alpha_{it} + \alpha_{it-1})) * \Delta lnH_{it}) \quad (4)$$

In order to test the productivity convergence hypothesis in Eq. (2), we follow Cameron et al. (2005) to get the relative productivity of county *i* compared to country *j,* the productivity frontier, and use the average income shares in two countries for output elasticities in Eq. (5):

$$\ln\left(\frac{A_{it}}{A_{jt}}\right) = \ln\left(\frac{Y_{it}}{Y_{jt}}\right) - \frac{1}{2} * (\alpha_{it} + \alpha_{jt}) * \ln\left(\frac{K_{it}}{K_{jt}}\right) - \left(1 - \frac{1}{2} * (\alpha_{it} + \alpha_{jt})\right) * \ln\left(\frac{L_{it}}{L_{jt}}\right) - \left(1 - \frac{1}{2} * (\alpha_{it} + \alpha_{jt})\right) * \ln\left(\frac{H_{it}}{H_{jt}}\right) \quad (5)$$

3.3 Data

The bilateral FDI data are gathered from the OECD and UNCTAD FDI databases as well as from individual country statistical offices for the period of 1990–2012.[11] The data availability was the main constraint in country and time period selection and we have dropped those country pairs that had no data for any of the years during the period analyzed. The final dataset is a panel of 379,186 country-year observations from 17,994 country pairs including 240 host and 243 home countries. The bi-directionally disaggregated and large size of the sample limits the multicollinearity and aggregation bias in our empirical analysis. The FDI data are expressed in current US dollars and are normalized by the host country's GDP. The full list of sample countries is provided in the online Appendix.

In the TFP calculations of Eqs. (3)-(5), *Y* is measured using the real GDP series (in constant 2005 US dollars), *K* is measured by gross capital formation (in constant 2005 US dollars), and *L* is measured by the total labor force, all from the World Development Indicators (WDI) of the World Bank.[12] *H* is measured by an index of human capital per person, based on the total number of years of schooling and returns to education, and is from the Penn World Tables (PWT 8.1). The labor income shares are also from the PWT 8.1. Because of data unavailability for many small Southern countries, we have been able to calculate the TFP

growth for only a subset of the original sample, which brought down the number of host countries from 240 to 108. Other control variables including trade openness, inflation rate, government consumption as a share of GDP and the share of domestic credit to private sector are from the WDI.

Defining the North and the South is not an easy task and, in doing so, we took into account countries' incomes, production and trade structures, factor endowments, and institutional and human development. For consistency, we have kept the group of countries constant and not allowed any country switching. Our rule of thumb was the timing of a country's move up (or down) in the development ladder. South Korea, today an upper-income industrialized country, for example, was one of the poorest back in the 1960s, and even in 1990s it was still classified as a middle income country by the World Bank. Thus, we kept it in the South. In the empirical analysis, the North includes the high-income OECD countries of Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. The South includes the rest. However, in the robustness analysis, we also experimented with alternative classifications of the North and the South.

Table 1 provides summary statistics for variables used in the regression analysis. We find that the highest level of average bilateral FDI flows are in North-North and North-South directions and are the lowest in South-South and South-North directions. We also see that the maximums are the highest in North-South direction, reaching as high as 85% of host country GDP, thanks to the small size of some Southern economies. As expected, the data also reveals that average TFP growth is slower in the South than in the North and displays a much higher variation, highlighting the greater degree of country heterogeneity among developing countries than developed ones. The average TFP gap between the South and the productivity frontier, the USA, is negative, highlighting the lagging TFP levels in Southern economies. We also observe that TFP growth is significantly lower for Southern countries, which also have a bigger TFP gap with the frontier.

<Insert Table 1 Here>

Figure 1 displays the share of FDI flows in host country GDPs, grouped by country-type pairs, and suggests a significant level of country heterogeneity, particularly so within South-South and North-South directions. One reason for this pattern is that many Southern countries have relatively smaller economies and therefore even moderate amounts of FDI inflows measure up to significant share of their GDPs. We also find that the North is the largest investor in both Southern and Northern host countries during the period analyzed. The data coverage is also more complete in later years creating higher sample variation, an issue we take up to in the sensitivity analysis section.

<Insert Figure 1 Here>

Figure 2 shows the scatter plots for TFP growth rates in the South and the North. While the TFP growth rates of both country groups are centered around zero, there is a much higher variation within the South than the North, again highlighting greater country heterogeneity. Figure 3 shows the Kernel densities for the relative productivity gap between the Northern and Southern countries, and the productivity frontier, the USA. As noted before, there is a significantly higher heterogeneity within the South than the North. Moreover, an overwhelming majority of Southern countries lack behind the US in productivity and their density lies to the left of the density for Northern countries, which clusters around a zero-level of productivity gap. The density for Northern countries also confirms the OECD convergence phenomena.

<Insert Figures 2-3 Here>

4. EMPIRICAL RESULTS

Table 2 presents benchmark regression results from equation (1) using the OLS (columns 1-2), 2SLS (columns 3-4), and the GMM methods (columns 5-6). For comparison, in columns (1), (3), and (5), we first report results without separating host and home countries into the North and the South. We then separate FDI flows into four directions in columns (2), (4), and (6), i.e. South-South, South-North, North-South and North-North.[13] Overall, independent of estimation method, we do not find any significant productivity growth effect of bilateral FDI flows, either globally or in any of the four directions. None of the coefficients are statistically or economically significant and do not yield any robust effect. The only exception is the

statistically (10% level) and economically marginal positive effect in South-North direction in the OLS estimation of column (2). Yet, the coefficient loses its statistical significance and changes its sign in columns (4) and (6) with the 2SLS and GMM estimations. The OLS results, which do not control for the endogeneity problem, also suffer from the "attenuation bias" as the coefficient estimates are biased toward zero.

<Insert Table 2 Here>

Turning to other variables of interest, similar to previous studies and again independent of specification or estimation method, we find that host country per capita income (*Y*) and financial development (*Credit*) have a positive and significant effect on productivity growth. Openness to trade (*Openness*) appears with a negative albeit only marginally significant economic effect.[14] Supporting the crowding-in hypothesis, government consumption (*Government*) is found to have a positive but statistically insignificant effect. Likewise, inflation appears to have a negative but statistically insignificant effect on productivity growth. We confirm the validity of instruments used in the 2SLS and GMM analyses using the Cragg-Donald F-statistics and the Hansen over-identification test. Despite the size of the sample, which, to the best of our knowledge, is the largest in macro panel studies on FDI flows, the R-squared is quite high, ranging between 0.16 and 0.22, depending on specification.

Next, in Table 3 we report regression results from Eq. (2) where we analyze the effect of FDI flows on the productivity gap between the host country *i* and the frontier country *j* (the USA). Similar to Table 2, we report results using the OLS (columns 1-2), 2SLS (columns 3-4) and the GMM methods (columns 5-6). Independent of specification or the estimation method, we again do not detect any statistically or economically significant productivity convergence effect of FDI flows globally or in any of the four directions. In fact, all coefficient estimates for the FDI effect turn out to be negative, even though at statistically insignificant levels, except in column (2) with the OLS estimation where South-South and North-North FDI flows appear with a statistically marginal (10%) and economically negligible negative effect.

<Insert Table 3 Here>

Turning to other control variables, we find that higher per capita incomes, openness, inflation and government consumption have a significantly positive productivity convergence effect on host countries. Interestingly, the strongest determinants of productivity convergence are found to be the per capita incomes and government consumption. Contrary to our expectations, the effect of financial depth appeared to be negative, albeit with a marginal economic effect.[15] Overall, Hansen over-identification test suggests that the model is correctly specified while the Cragg-Donald F statistic rejects the null hypothesis of weak instruments.

4.1 Sensitivity analysis

To test the robustness of our findings, we conduct a variety of sensitivity tests. For space considerations, we only report results from the 2SLS method but those from the GMM method were similar and are available in the online Appendix. We first start with the sample selection issue. As shown in Table 1, net bilateral FDI flows (by non-residents) can be negative when outflows (including profit repatriations or exits) outweigh inflows in a given year. In our sample, around 12% of observations are negative. While the disaggregated nature of the data is a significant advantage in our identification strategy, one may argue that positive productivity spillovers can only occur in the net FDI recipient countries. In addition, similar to the zero vs. missing trade problem in the international trade literature, we have zero FDI flows between multiple country pairs and it is impossible to know whether they are true zeros or just missing observations. Therefore, following the Gravity literature, in Table 4 we repeat our benchmark regressions of Tables 2 and 3 after dropping, first all negative, and then, nonpositive FDI observations. The results are presented in columns (1)-(2) and (6)-(7) of Table 4. Next, we control for the skewed distribution of FDI flows as a significant number of them are quite small compared to the host country economic sizes. For example, the 75th percentile of FDI inflows (as a share of GDP) is only 0.004, which may explain why we fail to find any significant productivity spillovers from FDI in any of the four directions. Therefore, in Columns (3) and (8), we repeat our regression analysis by restricting the sample to those FDI inflows (as a share of GDP) that are 10% or higher.[16] Third, we test the sensitivity of our results to the duration of investments from a particular home country. In the sample we observe a significant variation in the duration of foreign investment activity across home countries with some having much longer investment experiences abroad. Therefore, in columns (4) and (9) we repeat

our benchmark regressions after dropping the top 25th percentile of the sample based on the number of home country-year observations (i.e. 2,293).[17] Fourth, the dataset we use is unbalanced and include a large number of missing observations that may not be randomly distributed. One way to deal with this problem is to use a censored or truncated estimation method. However, our FDI variable takes both positive and negative values and is not censored or truncated at any specific point. To partially deal with this issue, we introduce a dummy variable equaling one if the FDI observation is not missing, and zero otherwise. In columns (5) and (10), we add the (unreported) lagged dummy indicators up to 10 periods to control for the occurrence pattern in case there is some systematic reason why some countries do not receive or report FDI inflows. After these tests, our earlier results remain unchanged.

<Insert Table 4 Here>

In columns (1) and (5) of Table 5 we check the sensitivity of our results to sample period given that the data are skewed towards later years. Particularly, we repeat our regressions after limiting the sample to the post-1995 period, which account for 90% of total observations. This is also the period that witnessed significant changes in global economy including a radical wave of trade and financial liberalization. Next, we consider alternative definitions of the North and the South, first for productivity growth in columns (2)-(4), and later for productivity convergence in (6)-(8). In column (2) and (6) we redefine the North as high-income OECD members in 2012, and then in columns (3) and (7) we adopt the International Monetary Fund (IMF) definition of advanced economies.[18] In columns (4) and (8) we experiment with including the Emerging economies in the North rather than in the South as they may have more in common with the North than the South (i.e. in physical and human capital, institutional infrastructure, incomes and productivity).[19] Once again, our main conclusions remain unchanged.

<Insert Table 5 Here>

In Table 6 we test the sensitivity of our results to regional heterogeneity by dropping one geographical region at a time from the sample (using the World Bank classification). Part A reports the results for productivity growth and Part B reports for productivity convergence. The results are again similar to

those before. For space considerations, in Tables 6-9, we report results only for the FDI variables but full results are reported in the online Appendix.

<Insert Table 6 Here>

In Table 7 we explore the sensitivity of our results from Eq. (2) to the choice of frontier country and replace the US as the productivity frontier with the unweighted and weighted average productivity levels of the G7 economies (using the GDP, GDP per capita and population sizes as weights).[20] We again detect no significant effect of FDI on relative productivity.

<Insert Table 7 Here>

It is possible that bilateral FDI flows are too scattered and/or too small to affect TFP growth or convergence separately. It is also probable that flows from different home countries to the same host country are not independent of each other and either display co-movement, or produce externalities to each other and to the host economy collectively, which are noticeable only at the aggregate level. To test these possibilities, we aggregate bilateral flows at the host country level in columns (1) and (5) of Table 8 so that FDI flows capture total FDI flows in each direction. In columns (2) and (6), we look at the effect of aggregate FDI flows without separating their direction. In columns (3)-(4) and (7)-(8), we repeat the same exercise by focusing on Southern and Northern host countries alone to test the productivity effects of aggregate FDI flows. After these exercises, we still do not find any robust or economically and statistically significant productivity growth or convergence effect from FDI flows. While in Column (1), we find a positive effect from South-South and South-North flows and a negative effect from North-North flows, these are statistically and economically marginal effects and are not robust to estimation method.[21] As for Column (5), the positive convergence effect from South-North flows (at 5% significance level) drop by half in size and significance level (to 10%) in the GMM estimation (which is reported in the online Appendix).

<Insert Table 8 Here>

Another possible source of estimation error is that missing observations in the sample reflect some systematic reporting error between certain country pairs. To control for this possibility, we created a strongly balanced panel for all possible country pairs and then used the Heckman two-step procedure to control for the selection bias in the first stage. We experimented with different methods to choose the threshold level of truncation including the following: i) We first took the absolute values of FDI variable to make all the observations non-negative and introduced a dummy variable for positive FDI flows (equaling one if FDI is positive, and zero otherwise). ii) Second, we repeated the same exercise but treated zero FDI flows as missing. iii) Third, we kept only non-negative FDI flows, including zero flows. iv) Fourth, we kept only positive FDI flows and treated zero and missing observations both as missing. We then run the Heckman two-step procedure so that in the selection equation we run a probit model and estimated the inverse mills ratio to be included in the second equation to control for the selection bias. After these exercises, all our earlier results remain unchanged as we do not detect any significant productivity growth or convergence effect of FDI flows even after controlling for the selection bias. We report the regression results in the online Appendix.

One issue that we have not yet controlled for is the possible non-linearity in FDI effects. To test for this possibility, we included the squared term of FDI and repeated our earlier regression analysis for productivity growth and convergence effects. As reported in the online Appendix, we do not detect any nonlinear effects of FDI flows as the squared term is found to be insignificant.

As argued by Borensztein et al. (1998), Xu (2000) and Damijan et al. (2013), the productivity effects of FDI flows may be conditional on host countries' absorptive capabilities. To test for this possibility, we introduce two interaction terms for human capital (HK), as measured by human capital per person index from PWT 8.1, and economic openness, measured by the share of exports and imports in GDP. As reported in Table 9, our results remain mostly unchanged as the interaction terms came out insignificant, so did the net effect of FDI flows. However, we find that the level of human capital has a significantly positive effect on both TFP growth and TFP convergence. Furthermore, we show that human capital interaction with FDI is positive and significant in South-South direction for TFP convergence, and yet it is not strong enough to turn the net effect of FDI into a positive and significant magnitude.

<Insert Table 9 Here>

4.2 A decomposition analysis: TFP vs. physical and human capital growth

While we have not found any significant or robust productivity growth or convergence effect from FDI, a growth decomposition exercise can allow us to examine whether other components of aggregate growth in Eq. (3) respond differently to FDI. Particularly, we replace the dependent variable in Eq. (1) with the physical capital growth (columns (1)-(4)) and human capital growth (columns (5)-8)) and report the results from the 2SLS and GMM estimations in Table 9. To make comparison easier with previous studies, we also include the aggregated FDI flows variable in columns (1)-(2) and (5)-(6). Similar to Alfaro et al. (2009) and independent of the estimation method in columns (1)-(4), we do not find any significant effect of aggregate or bilateral FDI flows on physical capital growth. Turning to columns (5)-(6), however, we detect a significantly positive effect of aggregate FDI flows on human capital growth. Furthermore, when we focus on bilateral flows, we find that the positive effect is present in only one direction that is South-South.

<Insert Table 10 Here>

4.3 Sector-specific productivity effects

The sectoral composition of FDI, as discussed earlier, can be a significant determinant of productivity effects. Manufacturing FDI, for example, can have different effects both on intra and inter-industry productivity growth than services or agricultural FDI. Likewise, sectoral distribution of FDI is likely to be time-variant and heterogeneous across different home and host countries. In our regression analysis we used aggregate bilateral FDI flows given that there is no bilateral FDI data for most of our sample countries at the sectoral level. Regarding sectoral TFP, while sectoral output and employment data are available, sectoral capital stock data are quite sketchy and are available only for few countries, mostly from the OECD. Human capital variable is even more problematic as it is not available at the sectoral level. Another issue is the lack of income shares data at the sectoral level. These problems make the calculation of sectoral TFP quite difficult. Having said this, however, we experimented with two sector-specific productivity variables: i) Labor productivity, measured by sectoral valued added/sectoral employment for 165 countries, and ii) Sectoral TFP for 39 countries. Both

variables are calculated for the agricultural, services, and industry sectors and the details of variable definitions are provided in the online Appendix. Because of data unavailability, sectoral TFP calculations assumed that the human capital and income shares are the same across sectors. Using these two proxies of sectoral productivity, we repeated our empirical analysis of Tables 2 and 3 for TFP growth and convergence effects. Given the space limitations, we reported results from these exercises in the online Appendix. Confirming our previous findings, we continue to find an insignificant TFP growth or convergence effect from bilateral FDI flows even at the sectoral level.[22]

5. CONCLUSION

In spite of a significant increase in global investment flows, there is no conclusive evidence showing that FDI stimulates productivity or aggregate growth in host countries. In this paper we contribute to this debate by addressing two issues that were previously unexplored, which are the aggregation bias in FDI flows and the home and host country heterogeneity. Instead of relying on aggregate FDI flows, which are highly heterogeneous by nature, we built a unique dataset on bilateral FDI flows between 240 host and 243 home countries between 1990 and 2012. Using bilateral flows, we were then able to control for investor and country heterogeneity including home and host country characteristics as well as any differences in the time series properties of the data. Furthermore, we also accounted for unobserved country heterogeneity within and between different groups based on economic development levels. The empirical results using a variety of estimation techniques and a rich battery of sensitivity checks suggest that bilateral FDI flows do not have a significant or robust productivity growth enhancing effect in host countries. Likewise, we do not detect any productivity convergence effect between host countries and the productivity frontier(s). We also find no evidence of any productivity spillover difference between FDI flows in any of the four directions that are South-South, South-North, North-South or North-North. Our results remained unchanged when we accounted for the absorptive capabilities of host countries, measured by human capital and trade openness. In a decomposition exercise we also fail to find any significant effect of FDI flows in any four directions on physical capital growth. However, we find some evidence showing a significantly positive effect of FDI flows on human capital growth but only in one direction, the South-South. Last but not least, when examining

sectoral productivity effects, we find no significant effect of bilateral aggregate FDI flows on agricultural, services or industry productivity growth or convergence.

We should note, however, that our findings do not settle the debate on the productivity effects of FDI once and for all. While we tackle the direction of flows as well as country heterogeneity, there are other issues that our study does not address. Particularly, we hope that future studies will be able to shed further light on the sectoral heterogeneity of FDI flows while at the same time accounting for country and investor heterogeneity. Particularly, while there is evidence showing productivity convergence within manufacturing industries across countries, the same is not true for any other sector (Rodrik, 2013). As a result, we are more likely to find productivity enhancing effects of FDI flows when they are in manufacturing industries. There is also a need to explore further the inter-sectoral spillover effects from FDI, as is attempted in Fernandes and Paunov (2012). Furthermore, there is a need to differentiate merger and acquisitions from greenfield FDI as they may have different productivity-inducing effects.

Finally, a word of caution for policy makers might be in place here. Ours as well as previous studies' findings highlight the importance of FDI heterogeneity, which might be a determining factor for FDI effectiveness. If this is indeed the case, one size fits all type government policies to attract FDI may be ineffective. Instead, governments and policy makers should concentrate their efforts to identify what types of FDI flows are productivity enhancing and then develop their policies accordingly. Obviously, such an undertaking will require an active industrial policy to enhance the effectiveness of foreign investment and to widen the scope and scale of linkages between domestic and foreign investments.

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ENDNOTES

[1] Corresponding author. Tel: +1 (405) 325 2861.

[2] The South includes all non-high-income OECD countries as well as South Korea and Hong Kong.

[3] The choice of estimation methodology is reported to have an effect on the results. For a discussion see Görg and Strobl (2001) and Girma et al. (2015).

[4] We find no evidence of spurious regressions caused by any correlation between the four FDI variables and other controls as the cross correlation between them is found to be in the range of [-0.006, 0.065]. We included the full correlation matrix in the online Appendix.

[5] Stock and Yogo (2005) provide the critical values for this F-test.

[6] The 2SLS and GMM estimates are obtained using the xtivreg2 command in Stata 13.0 by Schaffer (2010).

[7] We should note that TFP also includes measurement error and omitted variables, and therefore can be interpreted simply as a measure of our ignorance.

[8] Some simplifying assumptions are needed here. First, technology advancement is Hicks-neutral and can be separated from the input variables. Second, the inputs market is competitive and each input is paid its marginal product so that we can use their income shares instead of output elasticities.

[9] We also experimented with the conventional assumption and made α equal to 1/3 and β to 2/3. The (unreported) results were highly similar and are available in the online appendix.

[10] Törnqvist index uses the average value shares in the consecutive periods as weights, and helps smooth out the volatility in income shares.

[11] The data from these three sources are merged using the following procedure. For FDI inflows and outflows to and from OECD members, we used the OECD dataset. For FDI flows from and to non-OECD members, we used the UNCTAD and/or individual country data. When there is discrepancy between inflows to *i* and outflows from *j*, we used the host country data for those that are both (or none) high-income OECD members. If only one of the countries is high-income OECD, we gave priority to its inflows and outflows data over others. The data in non-USD currencies are converted to the USD using average annual exchange rates from the IMF.

[12] The results are robust to the use of alternative GDP and capital stock series in current or constant international dollars from the PWT. However, the use of the PWT data reduces the sample size considerably.

[13] In the online Appendix, we report a bare-bones version of Table 2, dropping all controls except the real GDP per capita.

[14] The results remain practically unchanged when we exclude *Openness* from the regressions.

[15] Excluding this variable does not affect any of our results. It is also possible that financial development is negatively correlated with productivity in the short run due to financial fragility during the transitionary period (Loayza and Ranciere, 2006).

[16] We also used alternative thresholds such as 5%, 15% and 20%, and also removed the top and bottom 1%. Additionally, we dropped the top and bottom one percentiles using GDP per capita. The results were similar.

[17] We test different thresholds by limiting the sample to those above the 25th as well as the 75th percentiles.

[18] High-income OECD countries include: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Israel, Japan, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, South Korea, Spain, Sweden, Switzerland, U.K., and U.S. The IMF definition of Advanced economies includes: Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Italy, Israel, Japan, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, San Marino, Singapore, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Taiwan, U.K. and U.S.

[19] We follow the IMF, FTSE, Standard & Poor's, and Dow Jones to define the Emerging economies, including: Argentina, Brazil, Chile, China, Colombia, Czech Republic, Estonia, Egypt, Hungary, India, Indonesia, Malaysia, Mexico, Morocco, Nigeria, Pakistan, Peru, Philippines, Poland, Romania, Russia, Slovakia, Slovenia, South Africa, South Korea, Thailand and Turkey.

[20] The G7 includes Canada, France, Germany, Italy, Japan, U.K and U.S.

[21] As reported in the online Appendix Table 8b, except for the South-South FDI flows (at 10% level), other FDI variables in the growth equation become insignificant in the GMM estimation.

[22] While bilateral sectoral FDI data are not available, if sectoral distribution of FDI is homogenous within each group of countries, our identification will control any sectoral composition differences in FDI flows.

Table 1: Summary Statistics

Variables	N	Mean	Std. Dev.	Min	Max
FDI_{ijt} *(% of GDP)*	61,236	0.099	1.269	-81.119	85.451
South-South	19,245	0.044	0.340	-4.507	13.373
South-North	23,208	0.024	0.837	-43.171	53.731
North-South	12,525	0.231	1.774	-55.557	85.451
North-North	6,258	0.279	2.534	-81.119	71.204
TFP Growth$_{it}$ *(%)*	1,720	0.0005	0.136	-2.711	2.419
$South_i$	1,286	-0.001	0.155	-2.711	2.419
$North_i$	434	0.002	0.043	-0.153	0.447
Relative TFP_{ijt}	1,738	-0.683	0.622	-3.051	1.510
South-USA	1,303	-0.915	0.541	-3.051	1.510
North-USA	435	0.011	0 .160	-0.397	0.524
Y_{it}	1,720	8.499	1.597	4.943	11.382
$RGDP_{it}$ *(millions)*	1,849	440,218	1,377,365	819.381	1.38e+07
K_{it} *(millions)*	1,849	101,489	311,578	13.111	3,172,047
L_{it} *(millions)*	1,849	25.178	89.348	0.141	782.422
H_{it}	1,849	2.553	0.523	1.132	3.619
Labor income share$_{it}$	1,849	0.535	0.124	0.164	0.852
Openness$_{it}$ *(%)*	1,708	86.027	55.208	14.731	439.657
Inflation$_{it}$ *(%)*	1,700	25.510	181.782	-26.300	4,107.297
Government$_{it}$ *(%)*	1,707	16.264	5.335	2.047	39.582
Credit$_{it}$ *(%)*	1,668	61.101	51.456	1.385	319.461

Notes: *FDI* is the share of bilateral FDI in host country *i*'s GDP. *South-South*, *South-North*, *North-South* and *North-North* refer to FDI flows as a share of GDP from home to host country in each direction. *TFP Growth* is the total factor productivity growth, *Relative TFP* is relative TFP between host country and the US. *South-USA* and *North-USA* refer to relative productivity gap between Southern and Northern host countries and the USA, respectively. *Y* is real GDP per capita, *RGDP* is real GDP, *K* is real gross capital formation. *L* is labor force in millions and *H* is the human capital index. *Labor income share* is the share of labor income in national income. *Openness* is the share of exports and imports in GDP, *Inflation* is the percentage change in GDP deflator, *Government* is government consumption as a share of GDP, *Credit* is the percentage share of domestic credit to the private sector in GDP. All real values are in constant 2005 US dollars.

Table 2: Productivity growth and FDI flows: North vs. South

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	2SLS	2SLS	GMM	GMM
FDI_{ijt-1}	0.0001		0.004		0.004	
	(0.0002)		(0.003)		(0.003)	
FDI_{ijt-1} *South-South*		0.004		0.021		0.022
		(0.003)		(0.019)		(0.019)
FDI_{ijt-1} *South-North*		0.0003*		-0.001		-0.001
		(0.0001)		(0.003)		(0.003)
FDI_{ijt-1} *North-South*		1.87e-05		0.0004		0.0003
		(0.0004)		(0.001)		(0.001)
FDI_{ijt-1} *North-North*		0.0001		-0.002		-0.002
		(0.0002)		(0.002)		(0.002)
$(ln)Y_{it-1}$	0.153***	0.153***	0.109***	0.108***	0.109***	0.108***
	(0.011)	(0.011)	(0.006)	(0.006)	(0.006)	(0.006)
$Inflation_{it-1}$	-9.36e-06***	-9.33e-06***	-8.68e-06	-8.63e-06	-8.70e-06	-8.70e-06
	(2.93e-06)	(2.92e-06)	(6.24e-06)	(6.23e-06)	(6.24e-06)	(6.23e-06)
$Openness_{it-1}$	-0.0004***	-0.0004***	-0.0004***	-0.0004***	-0.0004***	-0.0004***
	(3.91e-05)	(3.91e-05)	(3.56e-05)	(3.56e-05)	(3.56e-05)	(3.55e-05)
$Government_{it-1}$	0.008***	0.008***	0.001	0.001	0.001	0.001
	(0.0008)	(0.0008)	(0.001)	(0.001)	(0.001)	(0.001)
$Credit_{it-1}$	-0.0001***	-0.0001***	0.0002***	0.0002***	0.0002***	0.0002***
	(2.96e-05)	(2.96e-05)	(2.42e-05)	(2.41e-05)	(2.42e-05)	(2.41e-05)
Observations	83,518	83,518	59,215	59,215	59,215	59,215
R-squared	0.162	0.162	0.224	0.225	0.224	0.225
Groups	10,305	10,305	8,061	8,061	8,061	8,061
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic	0.000	0.000	0.000	0.000	0.000	0.000
Hansen	-	-	0.412	0.310	0.412	0.310
Cragg-Donald	-	-	413.139	132.456	413.139	132.456

Notes: Dependent variable is the host country TFP growth. Robust standard errors are in parentheses, ***, **, and * represent significance at 1%, 5%, and 10% levels. Groups refer to the number of country pairs. Year FE is year fixed effects. Test statistics, except for Cragg-Donald F-statistics are given by their p-values. Hansen is the Hansen overidentification test. For other variable definitions, refer to Table 1.

Table 3: Productivity convergence and FDI flows: North vs. South

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	2SLS	2SLS	GMM	GMM
FDI_{ijt-1}	-0.0004		-0.005		-0.004	
	(0.0006)		(0.004)		(0.004)	
$FDI_{ijt-1}^{South\text{-}South}$		-0.009*		-0.004		-0.002
		(0.005)		(0.024)		(0.024)
$FDI_{ijt-1}^{South\text{-}North}$		0.0004		-0.002		-0.002
		(0.0006)		(0.003)		(0.003)
$FDI_{ijt-1}^{North\text{-}South}$		-0.0002		-0.008		-0.008
		(0.002)		(0.006)		(0.006)
$FDI_{ijt-1}^{North\text{-}North}$		-0.0005*		-0.006		-0.006
		(0.0003)		(0.005)		(0.005)
$(ln)Y_{it-1}$	0.027**	0.027**	0.057***	0.057***	0.057***	0.056***
	(0.014)	(0.014)	(0.007)	(0.007)	(0.007)	(0.007)
$Inflation_{it-1}$	5.97e-05***	5.96e-05***	7.15e-05***	7.14e-05***	7.15e-05***	7.15e-05***
	(6.61e-06)	(6.61e-06)	(4.53e-06)	(4.54e-06)	(4.53e-06)	(4.54e-06)
$Openness_{it-1}$	0.002***	0.002***	0.001***	0.001***	0.001***	0.001***
	(8.01e-05)	(8.02e-05)	(5.88e-05)	(5.96e-05)	(5.87e-05)	(5.95e-05)
$Government_{it-1}$	0.013***	0.013***	0.019***	0.019***	0.019***	0.019***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Credit_{it-1}$	-0.0004***	-0.0004***	-0.0004***	-0.0004***	-0.0004***	-0.0004***
	(5.46e-05)	(5.46e-05)	(3.13e-05)	(3.14e-05)	(3.13e-05)	(3.14e-05)
Observations	83,721	83,721	59,244	59,244	59,244	59,244
R-squared	0.246	0.246	0.312	0.309	0.312	0.309
Groups	10,441	10,441	8,061	8,061	8,061	8,061
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
F statistic	0.000	0.000	0.000	0.000	0.000	0.000
Hansen	-	-	0.683	0.639	0.683	0.639
Cragg-Donald	-	-	415.053	157.296	415.053	157.296

Notes: Dependent variable is the productivity gap between a host country and the US. Robust standard errors are in parentheses. ***, **, and * represent significance at 1%, 5%, and 10% levels. For variable definitions, refer to Tables 1 and 2.

Table 4: Productivity growth, convergence and sample selection bias

	Productivity growth					Productivity convergence				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	FDI≥0	FDI>0	FDI>0.1	jt<75th	Missing Dummy	FDI≥0	FDI>0	FDI>0.1	jt<75th	Missing Dummy
$FDI_{ijt-1}^{South-South}$	0.009	0.006	-0.013	0.019	-0.012	-0.008	-0.008	-0.014	-0.007	-0.070
	(0.01)	(0.01)	(0.018)	(0.019)	(0.034)	(0.022)	(0.022)	(0.025)	(0.024)	(0.060)
$FDI_{ijt-1}^{South-North}$	-0.001	-0.001	-0.001	-0.002	0.001	-0.002	-0.002	-0.001	-0.002	-0.002
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
$FDI_{ijt-1}^{North-South}$	0.0004	0.0002	7.25e-05	0.0004	0.002	-0.008	-0.007	-0.005	-0.009	-0.005
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.006)	(0.005)	(0.005)	(0.006)	(0.003)
$FDI_{ijt-1}^{North-North}$	-0.002	-0.002	-0.002	-0.002	-0.002	-0.005	-0.006	-0.005	-0.006	-0.004
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.006)	(0.006)	(0.005)	(0.005)	(0.003)
$(ln)\ Income_{it-1}$	0.105***	0.094***	0.114***	0.158***	0.125***	0.057***	0.061***	0.026	0.048***	-0.226***
	(0.006)	(0.009)	(0.020)	(0.009)	(0.005)	(0.008)	(0.009)	(0.021)	(0.010)	(0.009)
$Inflation_{it-1}$	-7.04e-06	-7.91e-06	1.04e-05	-1.20e-05	0.002***	7.29e-05***	5.02e-05***	7.72e-05***	6.85e-05***	0.0002
	(6.53e-06)	(6.32e-06)	(2.75e-05)	(7.32e-06)	(0.0001)	(5.16e-06)	(4.32e-06)	(1.88e-05)	(5.38e-06)	(0.0001)
$Openness_{it-1}$	-0.0004***	-0.0002***	-0.0002***	-0.0006***	1.39e-05	0.001***	0.001***	0.001***	0.001***	-0.0003***
	(4.12e-05)	(4.87e-05)	(7.49e-05)	(4.33e-05)	(4.04e-05)	(6.68e-05)	(8.39e-05)	(0.0001)	(7.09e-05)	(6.14e-05)
$Government_{it-1}$	0.002**	0.004***	0.006***	0.005***	-0.00547***	0.019***	0.018***	0.015***	0.017***	0.014***
	(0.001)	(0.001)	(0.002)	(0.0008)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
$Credit_{it-1}$	0.0002***	0.0002***	0.0002**	0.0003***	0.0003***	-0.0005***	-5.45e-05	-4.36e-05	-0.0006***	-0.001***
	(2.79e-05)	(4.14e-05)	(8.50e-05)	(3.01e-05)	(2.57e-05)	(3.53e-05)	(4.40e-05)	(8.05e-05)	(4.24e-05)	(3.20e-05)
Observations	51,047	25,972	7,319	30,447	47,897	51,074	25,991	7,330	30,476	47,917
R-squared	0.217	0.153	0.115	0.210	0.070	0.310	0.296	0.257	0.245	0.289
Number of group	7,813	3,989	1,472	4,599	7,584	7,813	3,990	1,474	4,599	7,584
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F statistic	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hansen	0.428	0.342	0.172	0.405	0.071	0.779	0.797	0.565	0.786	0.999
Cragg-Donald	143.127	72.697	18.676	72.465	165.518	143.221	72.759	18.710	85.621	150.645

Notes: In columns (1)-(5) the dependent variable is the productivity growth, and in columns (6)-(10), it is the productivity gap between the host country and the US. The estimations are based on the 2SLS method. Robust standard errors are in parentheses. ***, **, and * represent significance at 1%, 5%, and 10% levels. For other variable definitions, refer to Tables 1 and 2.

Table 5: Productivity growth, convergence and measurement bias

	Productivity growth				Productivity convergence			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Post-1995	WDI	IMF	North + Emerging	Post-1995	WDI	IMF	North + Emerging
FDI_{ijt-1} *South-South*	0.019	0.019	0.015	-0.0003	-0.004	-0.0101	-0.008	-0.020
	(0.021)	(0.017)	(0.015)	(0.016)	(0.025)	(0.023)	(0.023)	(0.032)
FDI_{ijt-1} *South-North*	-0.001	-0.001	-0.0004	-0.001	-0.002	-0.001	-0.001	-0.001
	(0.003)	(0.002)	(0.001)	(0.002)	(0.004)	(0.003)	(0.002)	(0.003)
FDI_{ijt-1} *North-South*	0.001	0.004	0.004	0.002	-0.006	-0.012	-0.012	-0.006
	(0.001)	(0.003)	(0.003)	(0.002)	(0.005)	(0.013)	(0.014)	(0.009)
FDI_{ijt-1} *North-North*	-0.003	0.002	0.002	0.003	-0.006	-0.001	-0.001	-0.004
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.003)	(0.003)	(0.005)
(ln) Y_{it-1}	0.104***	0.108***	0.108***	0.109***	0.001	0.059***	0.058***	0.058***
	(0.007)	(0.006)	(0.006)	(0.006)	(0.008)	(0.007)	(0.007)	(0.007)
$Inflation_{it-1}$	-0.0002***	-8.52e-06	-8.56e-06	-8.73e-06	0.0004***	7.12e-05***	7.12e-05***	7.15e-05***
	(2.36e-05)	(6.23e-06)	(6.23e-06)	(6.24e-06)	(8.13e-05)	(4.56e-06)	(4.56e-06)	(4.53e-06)
$Openness_{it-1}$	-0.0004***	-0.0004***	-0.0004***	-0.0004***	0.001***	0.001***	0.001***	0.001***
	(3.81e-05)	(3.60e-05)	(3.59e-05)	(3.53e-05)	(6.12e-05)	(6.25e-05)	(6.23e-05)	(6.01e-05)
$Government_{it-1}$	6.16e-05	0.001	0.001	0.001	0.018***	0.019***	0.019***	0.019***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$Credit_{it-1}$	0.0002***	0.0002***	0.0002***	0.0002***	-0.0005***	-0.0004***	-0.0004***	-0.0004***
	(2.77e-05)	(2.41e-05)	(2.41e-05)	(2.42e-05)	(3.23e-05)	(3.13e-05)	(3.13e-05)	(3.14e-05)
Observations	55,593	59,215	59,215	59,215	55,615	59,244	59,244	59,244
R-squared	0.225	0.224	0.225	0.226	0.339	0.310	0.310	0.312
Groups	8,032	8,061	8,061	8,061	8,032	8,061	8,061	8,061
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F statistic	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hansen	0.326	0.786	0.780	0.352	0.535	0.885	0.883	0.995
Cragg-Donald	108.314	83.935	70.625	85.488	131.584	83.986	70.668	85.540

Notes: In columns (1)-(5) the dependent variable is the productivity growth, and in columns (6)-(10), it is the productivity gap between the host country and the US. The results are from the 2SLS method. Robust standard errors are in parentheses. ***, **, and * represent significance at 1%, 5%, and 10% levels. For other variable definitions, refer to Tables 1 and 2.

Table 6: Regional sensitivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	No East Asia and Pacific	No Europe and Central Asia	No Latin America and the Caribbean	No Middle East and North Africa	No North America	No South Asia	No Sub-Saharan Africa
Part A: Productivity growth							
$FDI_{ijt-1}^{South\text{-}South}$	0.004	0.019	0.020	0.021	0.021	0.021	0.022
	(0.033)	(0.025)	(0.024)	(0.019)	(0.02)	(0.019)	(0.019)
$FDI_{ijt-1}^{South\text{-}North}$	-0.001	-0.001	-0.001	-0.002	-0.001	-0.001	-0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
$FDI_{ijt-1}^{North\text{-}South}$	0.0005	-0.0002	2.23e-05	0.0003	0.0004	0.0004	0.001
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
$FDI_{ijt-1}^{North\text{-}North}$	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	52,184	46,483	50,903	57,851	57,817	58,712	56,323
R-squared	0.247	0.225	0.236	0.230	0.217	0.227	0.283
Groups	7,229	6,185	7,048	7,833	7,851	8,001	7,569
Country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F statistic	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hansen	0.208	0.253	0.313	0.346	0.301	0.315	0.467
Cragg-Donald	67.513	75.516	96.255	129.437	129.354	130.097	173.724
Part B: Productivity convergence							
$FDI_{ijt-1}^{South\text{-}South}$	-0.022	0.015	-0.031	-0.001	-0.003	-0.005	0.015
	(0.040)	(0.028)	(0.035)	(0.024)	(0.024)	(0.024)	(0.023)
$FDI_{ijt-1}^{South\text{-}North}$	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
$FDI_{ijt-1}^{North\text{-}South}$	-0.008	-0.005	-0.006	-0.008	-0.008	-0.008	-0.009
	(0.006)	(0.004)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
$FDI_{ijt-1}^{North\text{-}North}$	-0.007	-0.005	-0.006	-0.006	-0.006	-0.006	-0.006
	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Observations	52,204	46,512	50,932	57,871	57,846	58,741	56,341
R-squared	0.336	0.355	0.263	0.304	0.314	0.308	0.330
Groups	7,229	6,185	7,048	7,833	7,851	8,001	7,569
Country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F statistic	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hansen	0.752	0.405	0.838	0.548	0.622	0.664	0.719
Cragg-Donald	67.543	96.131	119.410	153.920	153.616	154.680	202.866

Notes: In Part A, the dependent variable is the productivity growth, and in Part B it is the productivity gap between the host country and the US. The estimations are from the 2SLS method. Robust standard errors are in parentheses. ***, **, and * represent significance at 1%, 5%, and 10% levels. For other variable definitions, refer to Tables 1 and 2. All regressions include the same set of (unreported) country controls as in previous tables.

Table 7: Productivity convergence and sensitivity to the choice of productivity frontier

	(1) Unweighted	(2) Weighted by GDP	(3) Weighted by population	(4) Weighted by GDP per capita
$FDI_{ijt-1}^{South\text{-}South}$	0.001	-0.0002	0.0003	0.0008
	(0.022)	(0.023)	(0.022)	(0.022)
$FDI_{ijt-1}^{South\text{-}North}$	-0.002	-0.002	-0.002	-0.002
	(0.004)	(0.003)	(0.003)	(0.004)
$FDI_{ijt-1}^{North\text{-}South}$	-0.008	-0.008	-0.008	-0.008
	(0.006)	(0.006)	(0.006)	(0.006)
$FDI_{ijt-1}^{North\text{-}North}$	-0.006	-0.006	-0.006	-0.006
	(0.005)	(0.005)	(0.005)	(0.005)
Observations	59,244	59,244	59,244	59,244
R-squared	0.278	0.380	0.368	0.295
Groups	8,061	8,061	8,061	8,061
Country controls	Yes	Yes	Yes	Yes
Country-pair FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
F statistic	0.000	0.000	0.000	0.000
Hansen	0.482	0.529	0.514	0.489
Cragg-Donald	157.296	157.296	157.296	157.296

Notes: The dependent variable is the productivity gap between the host country and the G7. The estimations are based on the 2SLS method. Robust standard errors are in parentheses. ***, **, and * represent significance at 1%, 5%, and 10% levels. *Unweighted* refers to the unweighted average of G7 productivity levels. *Weighted by GDP*, *Weighted by population*, and *Weighted by GDP per capita* refer to the weighting method of average productivity in frontier G7 countries. For other variable definitions, refer to Tables 1 and 2. All regressions include the same set of (unreported) country controls as in previous tables.

Table 8: Aggregate FDI flows, productivity growth and convergence

	Productivity Growth				Productivity convergence			
			Host: South	Host: North			Host: South	Host: North
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FDI_{it}		0.0002	0.0007	0.0002		0.0001	-0.001	6.11e-05
		(0.0002)	(0.001)	(0.0002)		(0.0003)	(0.001)	(0.0002)
$FDI_{it-1}^{South\text{-}South}$	0.008*				-0.005			
	(0.005)				(0.008)			
$FDI_{it-1}^{South\text{-}North}$	0.0008*				0.002**			
	(0.0004)				(0.0008)			
$FDI_{it-1}^{North\text{-}South}$	-0.0003				-0.001			
	(0.0006)				(0.001)			
$FDI_{it-1}^{North\text{-}North}$	-0.0002*				-0.0004			
	(0.0001)				(0.0004)			
Observations	1,633	1,621	1,200	421	1,656	1,656	1,234	422
R-squared	0.058	0.065	0.061	0.292	0.180	0.181	0.195	0.430
Number of countries	100	100	77	23	100	100	77	23
Country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F statistic	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hansen	0.421	0.841	0.939	0.440	0.424	0.685	0.394	0.039
Cragg-Donald	49.437	591.334	162.312	98.444	50.358	607.950	171.363	101.149

Notes: In columns (1)-(4) the dependent variable is the productivity growth, and in columns (5)-(8), it is the productivity gap between the host country and the USA. The estimations are based on the 2SLS method. Robust standard errors are in parentheses. ***, **, and * represent significance at 1%, 5%, and 10% levels. For other variable definitions, refer to Tables 1 and 2. All regressions include the same set of (unreported) country controls as in previous tables. The FDI variables are aggregate flows to country *i*.

Table 9: FDI and absorptive capacity in human capital and openness

	(1) TFP Growth	(2) TFP Convergence	(3) TFP Growth	(4) TFP Convergence
$FDI_{ijt-1}^{South\text{-}South}$	0.019	-0.199**	0.021	-0.045
	(0.047)	(0.102)	(0.051)	(0.064)
$FDI_{ijt-1}^{South\text{-}North}$	0.191	0.135	0.011	-0.0005
	(0.136)	(0.221)	(0.007)	(0.008)
$FDI_{ijt-1}^{North\text{-}South}$	0.019	-0.060*	0.001	-0.011
	(0.016)	(0.036)	(0.006)	(0.014)
$FDI_{ijt-1}^{North\text{-}North}$	-0.523	-0.333	0.052	0.025
	(0.421)	(0.374)	(0.037)	(0.025)
$FDI_{ijt-1}^{South\text{-}South} * H_{it-1}$	-0.001	0.071**		
	(0.017)	(0.033)		
$FDI_{ijt-1}^{South\text{-}North} * H_{it-1}$	-0.065	-0.046		
	(0.047)	(0.076)		
$FDI_{ijt-1}^{North\text{-}South} * H_{it-1}$	-0.006	0.017		
	(0.005)	(0.013)		
$FDI_{ijt-1}^{North\text{-}North} * H_{it-1}$	0.177	0.111		
	(0.143)	(0.126)		
$FDI_{ijt-1}^{South\text{-}South} * Openness_{it-1}$			-6.66e-05	0.0001
			(0.0001)	(0.0001)
$FDI_{ijt-1}^{South\text{-}North} * Openness_{it-1}$			-2.75e-05	9.69e-06
			(2.23e-05)	(2.69e-05)
$FDI_{ijt-1}^{North\text{-}South} * Openness_{it-1}$			-7.87e-06	2.53e-05
			(3.96e-05)	(0.0001)
$FDI_{ijt-1}^{North\text{-}North} * Openness_{it-1}$			-0.0001	-7.08e-05
			(0.0001)	(7.30e-05)
H_{it-1}	0.017***	0.029***		
	(0.005)	(0.009)		
$Openness_{it-1}$			-0.0004***	0.001***
			(3.79e-05)	(7.16e-05)
Net effect of FDI				
$FDI_{ijt-1}^{South\text{-}South}$	0.015	-0.010	0.014	-0.034
$FDI_{ijt-1}^{South\text{-}North}$	-0.004	-0.002	0.009	0.0002
$FDI_{ijt-1}^{North\text{-}South}$	0.005	-0.021***	0.0005	-0.009
$FDI_{ijt-1}^{North\text{-}North}$	0.003	-0.003	0.041	0.019
Observations	59,215	59,244	59,148	59,177
R-squared	0.211	0.304	0.209	0.308
Groups	8,061	8,061	8,061	8,061
Country-pair & Year FE	Yes	Yes	Yes	Yes
F statistic	0.000	0.000	0.000	0.000
Hansen	0.480	0.754	0.384	0.184
Cragg-Donald	42.171	42.257	21.623	33.165

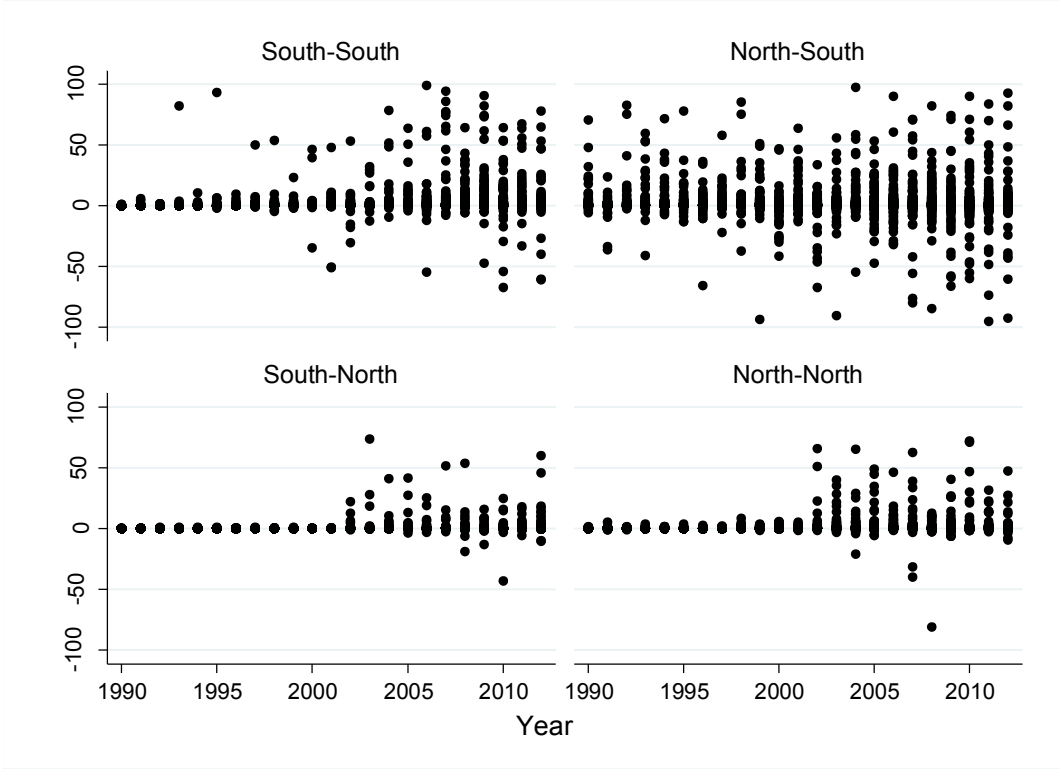
Notes: In columns (1)&(3) the dependent variable is the TFP growth, and in columns (2)&(4) it is the TFP gap. *H* is human capital. All regressions include the same set of (unreported) country controls as before. The results are based on the 2SLS method. *Net effects of FDI* are calculated at the mean values of *H* (2.653, 2.971, 2.296, 2.972) and *Openness* (91.264, 74.979, 87.689, 74.899) for South-South, South-North, North-South and North-North, respectively.

Table 10: Decomposition of growth to physical and human capital

	Physical Capital Growth				Human Capital Growth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2SLS	GMM	2SLS	GMM	2SLS	GMM	2SLS	GMM
FDI_{it-1}	-0.002	-0.002			2.11e-05**	2.12e-05**		
	(0.001)	(0.001)			(9.10e-06)	(9.06e-06)		
$FDI_{ijt-1}^{South\text{-}South}$			-0.035	-0.033			0.002**	0.002**
			(0.033)	(0.033)			(0.001)	(0.001)
$FDI_{ijt-1}^{South\text{-}North}$			-0.002	-0.001			-2.58e-05	-1.39e-05
			(0.007)	(0.007)			(6.95e-05)	(6.91e-05)
$FDI_{ijt-1}^{North\text{-}South}$			-0.007	-0.008			-1.86e-05	-1.88e-05
			(0.008)	(0.008)			(0.0001)	(0.0001)
$FDI_{ijt-1}^{North\text{-}North}$			0.003	0.001			5.94e-06	4.17e-06
			(0.003)	(0.003)			(6.64e-05)	(6.64e-05)
Observations	2,305	2,305	71,638	71,638	2,138	2,138	63,650	63,650
R-squared	0.023	0.023	0.074	0.074	0.199	0.199	0.292	0.293
Groups	144	144	9,256	9,256	130	130	8,776	8,776
Country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F statistic	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hansen	0.983	0.983	0.085	0.085	0.895	0.895	0.424	0.424
Cragg-Donald	567.385	567.385	105.516	105.516	474.325	474.325	157.943	157.943

Notes: In columns (1)-(4) the dependent variable is the physical capital growth, and in columns (5)-(8), it is the human capital growth. Robust standard errors are in parentheses. ***, **, and * represent significance at 1%, 5%, and 10% levels. For other variable definitions, refer to Tables 1 and 2. All regressions include the same set of (unreported) country controls as in previous tables. The estimations are based on the 2SLS method. The FDI variables in columns (1)-(2) and (5)-(6) are aggregate flows to country *i*.

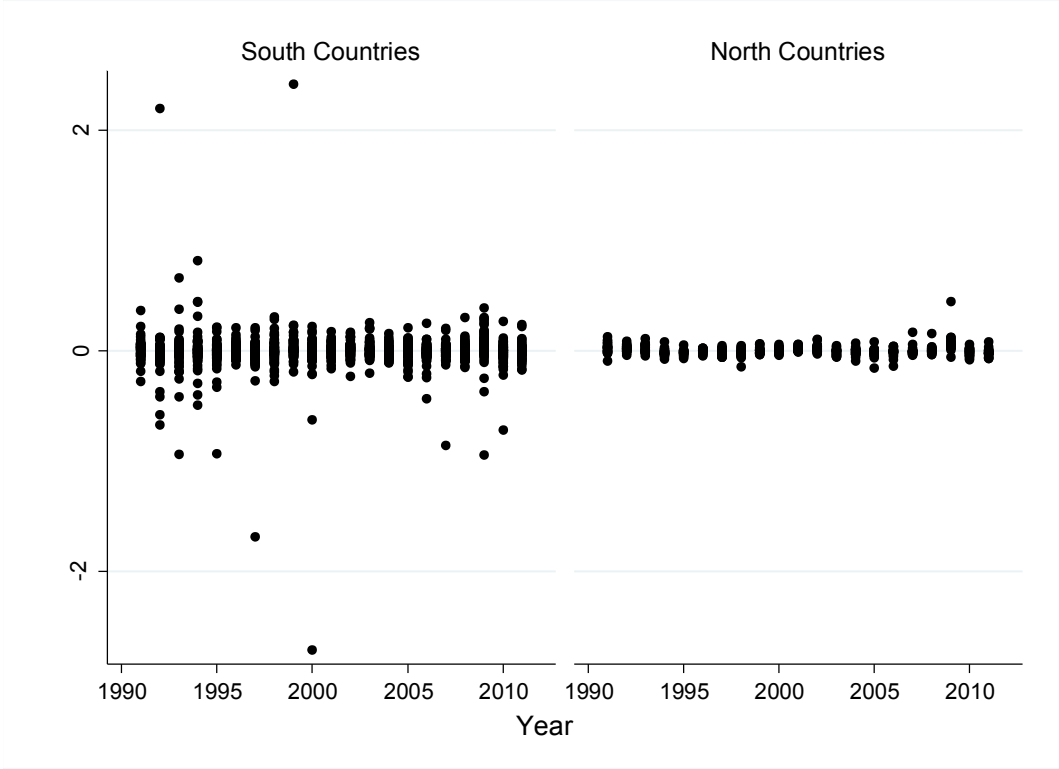
Figure 1: Size of FDI flows in four directions: South-South, South-North, North-South and North-North



Notes: The y-axis shows the percentage of FDI flows as a share of host country GDP.

Source: Authors calculations.

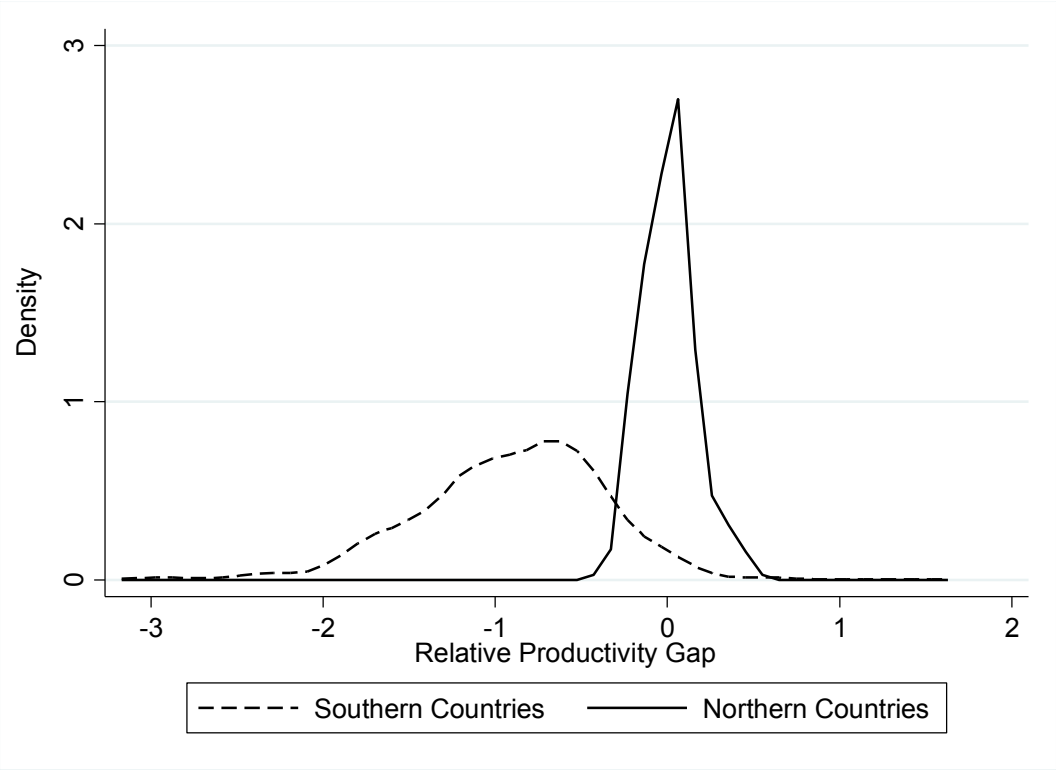
Figure 2: TFP growth in the North and the South



Notes: The y-axis is the TFP growth in Southern and Northern host countries.

Source: Authors' calculations.

Figure 3: Kernel density for relative TFP Gap



Notes: Kernel densities for the productivity gap of Northern and Southern host countries with the US.

Source: Authors' calculations.