

# Foreign Direct Investment and Productivity: A Cross-Country, Multisector Analysis

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This paper adopts a cross-country, multisector approach to investigate the intra- and inter-industry effects of foreign direct investment (FDI) on the productivity of 15 emerging market economies in 2000 and 2008. Our main finding is that intra-industry FDI has a large positive effect on total and “exported” labor productivity. The effects of FDI on total factor productivity are much more elusive, both in statistical and economic terms. This result suggests that foreign firms raise the performance of their host economies through a direct compositional effect. Foreign firms tend to be larger and more input intensive and have greater access to foreign markets than domestic firms. Their greater prevalence mechanically increases average labor productivity and export performance.

*Keywords:* foreign direct investment, productivity, sector level, services  
*JEL codes:* F23, O16

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## I. Introduction

Many emerging market economies actively seek to attract foreign direct investment (FDI) because they believe that multinational enterprises will contribute to economic growth by creating new job opportunities, enhancing capital accumulation, and increasing total factor productivity (TFP).<sup>1</sup> In practice, these growth-enhancing effects have been difficult to detect. Recent cross-country studies, using a wide range of econometric techniques, do not generally find evidence that FDI affects gross domestic product (GDP) per capita (Carkovic and Levine 2005; Herzer, Klasen, and Nowak-Lehmann 2008; Iamsiraroj and Ulubasoglu 2015). Likewise, single-country, firm-level evidence on the inter- and intra-industry effects of foreign firms on the TFP of domestic firms is

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<sup>1</sup>Excellent surveys of the expected effects of FDI on host economies can be found in Navaretti and Venables (2005), Caves (2007), and Dunning and Lundan (2008).

ambiguous (Havránek and Iršová 2011).<sup>2</sup> Both these strands of the literature have shortcomings. On the one hand, considering a country as the unit of analysis is likely to lead to a significant aggregation bias. On the other hand, firm-level studies are often country specific and tend to focus on the manufacturing sector.<sup>3</sup> In their quest for the indirect effects on the TFP of domestic firms, the latter studies also neglect the direct contribution that foreign firms can make to sector-specific labor productivity.<sup>4</sup> There is therefore a need for a cross-country, multisector investigation of the effects of FDI on various measures of host countries' productivity.

This paper attempts to address this need. We use a sector-level database, covering the years 2000 and 2008, of the FDI presence in 24 manufacturing and service sectors of 15 emerging market economies. Our FDI proxy is the share of the labor force employed by foreign firms. This is a direct and tangible indicator of the prevalence of foreign firms. Our database includes detailed and high-quality information for all sectors on output, inputs, inter-industry linkages, and export indicators. Such a richness allows us to investigate the potentially heterogeneous effects of intra- and inter-industry FDI on the TFP and labor productivity of the manufacturing and service sectors. Lastly, our data are time varying. We can control for a large number of unobserved effects at the country-sector level. Hence, while we do not carry out the type of granular analysis found in firm-specific studies, our empirical analysis offers more external validity than country-specific studies, more internal validity than cross-country studies, greater coverage of sector-specific FDI presence than many studies, an encompassing assessment of the potential effects of FDI on productivity, and relatively high robustness against an omitted variable bias.

We find that a larger foreign presence tends to have a positive and statistically significant impact on TFP through manufacturing backward FDI linkages and within-industry presence. The latter result only holds for service sectors and the economic effects are modest. In the short run, doubling manufacturing backward FDI linkages (intra-industry FDI in services) would increase TFP by about 2% (5%). When we examine the determinants of labor productivity, a different picture emerges. We no longer find consistent inter-industry FDI effects. On the other hand, the effect of intra-industry FDI is large, positive, and statistically significant,

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<sup>2</sup>In line with the rest of the literature, we use "industry" as a synonym for "sector." Occasionally, we refer to "broad industries," which are the secondary and tertiary sectors.

<sup>3</sup>Fernandes and Paunov (2012) is one of the few exceptions. See their literature review for a list of studies on FDI in services and manufacturing TFP.

<sup>4</sup>Lipsey (2004) and Navaretti and Venables (2005) report that foreign firms are usually found to be much more productive than domestic firms, largely because they make much more intensive use (per worker) of physical capital, human capital, and intermediates. They are also likely to be more export oriented. Criscuolo (2006) shows that foreign affiliates, thanks to their higher labor productivity and growing share in total employment, accounted for 40% or more of labor productivity growth in the manufacturing and service sectors of Organisation for Economic Co-operation and Development (OECD) countries in the late 1990s.

and holds across broad industries. Doubling intra-industry FDI in either the manufacturing or service sectors would increase value added per worker by about 20% in the short run. Part of this increase in labor productivity appears to be the outcome of improved FDI-induced export performance. Overall, our results suggest that the presence of foreign firms improves host countries' average performance simply because these firms are larger, unconditionally more productive, and more integrated in the world economy than domestic firms.

The rest of this paper proceeds as follows. In section II, we describe the effects that FDI can be expected to have on host economies' development. In section III, we present our empirical methodology. In section IV, we describe our key variables and the data used. In section V, we provide our results. In section VI, we investigate whether our results apply to the Asian countries of our sample. Finally, in section VII, we conclude and discuss the findings and limitations of our study.

## II. Conceptual Framework

Assume that the labor productivity  $q$  of a domestic firm in a given country can be summarized as  $q^N = \beta z(x)$ , where  $\beta$  is an efficiency parameter and  $x$  is a set of characteristics that determines its productivity.<sup>5</sup> For a foreign firm, we have  $q^F = \alpha z(x)$ . Firms are heterogeneous as they do not share the same set of characteristics. The distribution of domestic firms' employment across domestic firms with different characteristics  $x$  is  $n(x)$ . The average productivity of domestic firms is therefore  $\bar{q}^N = \int \beta z(x)n(x)dx$ ,  $1 = \int n(x)dx$ . The distribution of foreign firms' employment across foreign firms with different characteristics  $x$  is  $m(x)$ . The average productivity of foreign firms is therefore  $\bar{q}^F = \int \alpha z(x)m(x)dx$ ,  $1 = \int m(x)dx$ . The overall average productivity is then  $\bar{q} = (1 - \mu)\bar{q}^N + \mu\bar{q}^F$ , where  $\mu$  is the share of the total labor force employed by foreign firms.

Foreign firms may have characteristics that differ, on average, from those of domestic firms and that allow the former to be generally more productive, i.e.,  $x^F > x^N$ . It is also possible that foreign firms are technically more efficient than domestic firms, i.e.,  $\alpha > \beta$ . Finally, greater intra-industry or inter-industry FDI may also influence  $\beta$  through externalities, i.e.,  $\beta = \beta(\mu)$ .

This conceptual framework suggests two lines of enquiries within the constraints of the data we have at hand. First, we can investigate whether the TFP of an economy is higher when the share of the labor force employed by foreign firms increases. Second, we can look for more general effects by exploring whether a greater foreign presence is associated with higher labor productivity.

<sup>5</sup>This section heavily draws on Navaretti and Venables (2005).

### III. Empirical Methodology

#### A. Total Factor Productivity Estimation

To investigate the impacts of intra- and inter-industry FDI presence on TFP, we adopt the following econometric model:

$$\begin{aligned} \ln(GO_{sit}) = & \beta_1^B \ln(K_{sit}) + \beta_2^B \ln(L_{sit}) + \beta_3^B \ln(I_{sit}) + \beta_4 \ln(HFDI_{sit}) \\ & + \beta_5 \ln(BWFDIM_{sit}) + \beta_6 \ln(FWFDIM_{sit}) + \beta_7 \ln(BWFDIS_{sit}) \\ & + \beta_8 \ln(FWFDIS_{sit}) + \rho \ln(TFP_{sit-5}) + \alpha_{si} + \alpha_{st} + \varepsilon_{sit} \end{aligned} \quad (1)$$

where  $GO_{sit}$  is gross output of sector  $s$  in country  $i$  at period  $t$ ,  $K_{sit}$  is capital services,  $L_{sit}$  is labor services,  $I_{sit}$  is intermediate inputs,  $HFDI_{sit}$  is intra-industry FDI,  $BWFDIM_{sit}$  is backward linkages from FDI in downstream manufacturing sectors,  $FWFDIM_{sit}$  is forward linkages from FDI in upstream manufacturing sectors,  $BWFDIS_{sit}$  is backward linkages from FDI in downstream service sectors,  $FWFDIS_{sit}$  is forward linkages from FDI in upstream service sectors,  $TFP_{sit-5}$  is 5-year lagged TFP,  $\alpha_{si}$  is a country-sector-specific effect,  $\alpha_{st}$  is a sector-time-specific effect, and  $\varepsilon_{sit}$  is the error term. We allow  $\beta_1 - \beta_3$  to differ across broad industries  $B$  (manufacturing and services).

Equation (1) is estimated in two distinct ways. We initially use a random effects (RE) estimator, replacing  $\alpha_{si}$  by  $\alpha_s$  and  $\alpha_i$ . This allows us to exploit both the cross-sectional and time dimensions of our data to identify parameters of interest. More information can crucially matter in the context of explanatory variables measured with error. However, the consistency of the RE estimator is partly based on the assumption that the explanatory variables are not correlated with an unobserved time-invariant, country-specific factor that is part of the composite error term. This assumption could be too strong; for example, foreign investors may choose to locate in more structurally productive sectors. Hence, we also use a fixed effects (FE) estimator. By identifying our parameters solely on the basis of the time series variation in our data, we control for the influence of an unobserved time-invariant, country-sector-specific effect. On the other hand, we no longer exploit the information provided by the cross-sectional variation.

The input factors may also be correlated with unobserved time-invariant, country-sector-specific factors. They may also be simultaneously determined with output; in that case, an FE estimator would not help us to deal with this issue (Van Beveren 2012). For this reason, we also generate indirect estimates of TFP based on the use of an instrumental variables estimation. Exploiting all the years available in our database, omitting the FDI variables, and applying a system generalized methods-of-moments estimator (Blundell and Bond 1998), we estimate equation (1) separately for the secondary and tertiary sectors. Our

indirect estimates of  $\ln(TFP)$  are then  $\ln(\widehat{TFP}_{sit}) = \ln(GO_{sit}) - \widehat{\beta}_1^B \ln(K_{sit}) - \widehat{\beta}_2^B \ln(L_{sit}) - \widehat{\beta}_3^B \ln(I_{sit})$ . One drawback of this method is that estimates can be sensible to the choice of the internal instruments.<sup>6</sup>

We also include in our econometric models a 5-year lagged TFP term.<sup>7</sup> We do so for two reasons. First, we know from the literature on economic growth that the evolution of TFP toward its equilibrium value may follow a partial adjustment or convergence process (Solow 1956, Swan 1956). As such, emerging economies are expected to grow faster than developed economies. One reason for this is that the former are able to imitate new technology rather than having to innovate themselves, which would be costlier (Gerschenkron 1962, Barro and Sala-i-Martin 1997). Second, this lagged TFP term can capture unobserved country-sector factors.<sup>8</sup>

Overall, each estimation method has its pros and cons. To eliminate any concern about cherry-picking our favorite estimates, we report all results. Standard errors are clustered at the country-sector level.

## B. Labor Productivity Estimation

The estimation of equation (1) reduces the impact of FDI to an effect on TFP. However, as stressed in section II, foreign firms may also have broad positive direct compositional effects on their host economies, leading to a rise in labor productivity (higher real value added per worker). We estimate therefore, in a second stage, the following model:

$$\begin{aligned} \ln(VA_{sit}) = & \gamma_1 \ln(VA_{sit-s}) + \gamma_2 \ln(HFDI_{sit}) + \gamma_3 \ln(BWFDIM_{sit}) \\ & + \gamma_4 \ln(FWFDIM_{sit}) + \gamma_5 \ln(BWFDIS_{sit}) + \gamma_6 \ln(FWFDIS_{sit}) \\ & + \alpha_{si} + \alpha_{st} + \varepsilon_{sit} \end{aligned} \quad (2)$$

where  $VA_{sit}$  is value added per worker in sector  $s$  in country  $i$  at period  $t$ . We estimate equation (2) using either an RE estimator or an FE estimator.

Finally, we explore whether the influence of FDI on labor productivity partly occurs through the impact of FDI on export performance. Our outcome variables in this third and final stage are real gross exports per worker ( $X$ ), real direct domestic value added embodied in gross exports per worker ( $VAX$ ), and the ratio

<sup>6</sup>We use the second to fourth lags of the potentially endogenous variables and we collapse the set of instruments. For details, see Roodman (2009).

<sup>7</sup>Following Griffith (1999), when we estimate equation (1), the 5-year lagged term is proxied by the 5-year lagged input and output terms.

<sup>8</sup>It is well known that the dynamic RE and FE estimators are biased. However, whereas the bias of the estimator of the autoregressive parameter is large (and negative), the Monte Carlo simulations of Judson and Owen (1999) show that this is not the case for the bias of the estimators of the coefficients on the explanatory variables (1%–3% of the true value). Hence, we focus on short-run effects. Unlike long-run effects, their calculations do not involve the use of the estimated value of  $\rho$ .

of the two preceding variables ( $VAX/X$ ). We adopt an econometric model similar to equation (2).

#### IV. Key Variables and Data

Our sector-level data on gross output, capital services, labor services (proxied by labor compensation per Fox and Smeets [2011]), employment, intermediate inputs, and input–output tables come from the World Input–Output Database.<sup>9</sup> Data on value added, gross exports, and domestic value added embodied in gross exports come from the Trade in Value Added Database created by the Organisation for Economic Co-operation and Development (OECD).<sup>10</sup> All values are deflated using country-sector-specific gross output and value added deflators.

We define intra-industry FDI ( $HFDI_{sit}$ ) as the share of workers employed by foreign firms. Our data on the number of foreign workers come from the Investment Map database provided by the International Trade Centre.<sup>11</sup> Based on data originally collected by Dun & Bradstreet, this website provides sector-specific data on the latest number of foreign affiliates, the number of foreign affiliates established since 2000, and the total number of workers for a sample of the existing foreign affiliates.

We make the following assumptions to calculate  $HFDI_{sit}$ : (i) we assume that the latest year is 2008, (ii) we calculate the number of foreign affiliates in 2000 as the latest number minus the number of foreign affiliates established since 2000, (iii) we calculate the average number of workers in the foreign affiliates for which we have the data and consider that this average is reasonably close to the population average, and (iv) we multiply the average number of workers by the number of foreign affiliates in 2000 and 2008. As such, we find that industries employ foreign employees at an average rate of 19%, with industries such as electrical and optical equipment; coke, refined petroleum, and nuclear fuel; and financial intermediation employing significantly more than that (see Tables A2 and A3 in the Appendix).

Our assumptions are unlikely to fully hold in practice. Nevertheless, given that we have a large range of sectors and countries, as well as a large gap between our 2 years, we expect  $HFDI_{sit}$  to have a reasonably high signal-to-noise ratio between and within country–partner pairs. Furthermore, the correlation coefficient between our intra-industry FDI variable and the share of financial FDI stocks in value added (for which we have very unbalanced data) is 0.5, which is significant at the 1% level.<sup>12</sup> Lastly, to reduce the influence of extremely high observations,

<sup>9</sup>See <http://www.wiod.org/home>.

<sup>10</sup>See <https://stats.oecd.org/index.aspx?queryid=66237>.

<sup>11</sup>See <http://www.investmentmap.org/>.

<sup>12</sup>In addition, the correlation coefficient between our intra-industry FDI variable and the share of workers employed by foreign firms reported in the OECD Activity of Multinational Enterprises database for five countries from our sample in 2008 is 0.7, which is significant at the 1% level.

we cap  $HFDI_{sit}$  to 1 and transform it as  $HFDI_{sit} * 100 + 1$ . We adopt the same transformation for the other FDI variables that we now describe.

To take into account the productivity effects of FDI in downstream sectors, we construct the following backward FDI linkage variables:

$$BWFDIM_{sit} = \sum_{k=1}^M \gamma_{skit} * HFDI_{kit} \quad (3)$$

$$BWFDIS_{sit} = \sum_{k=1}^S \gamma_{skit} * HFDI_{kit} \quad (4)$$

where  $\gamma_{skit}$  is the share of sector  $s$ ' gross output that is supplied to downstream manufacturing ( $M$ ) or service ( $S$ ) sector  $k$  in country  $i$  at time  $t$ . As can be seen in Table A3 in the Appendix, firms supply on average 31% of their output to domestic downstream industries, with 11% going to downstream manufacturing industries and 18% to service industries.

Likewise, to take into account the productivity effects of FDI in upstream sectors, we construct the following forward FDI linkage variables:

$$FWFDIM_{sit} = \sum_{k=1}^M \delta_{skit} * HFDI_{kit} \quad (5)$$

$$FWFDIS_{sit} = \sum_{k=1}^S \delta_{skit} * HFDI_{kit} \quad (6)$$

where  $\delta_{skit}$  is the share of sector  $s$ ' total inputs supplied by upstream manufacturing ( $M$ ) or service ( $S$ ) sector  $k$  in country  $i$  at time  $t$ .<sup>13</sup> As can be seen in Table A3, firms source on average 61% of their inputs from domestic upstream industries other than their own. Furthermore, 18% of the inputs come from manufacturing industries and 36% from service industries.

Overall, matching the data that we have and focusing on emerging economies, we end up with a sample of 15 countries, 13 manufacturing sectors, 11 service sectors, and the years 2000 and 2008.<sup>14</sup> From a development perspective, this is an interesting sample since none of the countries were classified as high income in 2000. It includes large countries such as Brazil, India, the People's Republic of China (PRC), and the Russian Federation, as well as a group of Central and Eastern European economies that were going through a period of transitioning from a state-led to a market economy.<sup>15</sup> During 2000–2008, these

<sup>13</sup>Javorcik (2004) has pioneered the use of these linkage measures in the FDI literature.

<sup>14</sup>For data availability reasons, the latest year in section V is 2010.

<sup>15</sup>See [https://en.wikipedia.org/wiki/World\\_Bank\\_high-income\\_economy](https://en.wikipedia.org/wiki/World_Bank_high-income_economy).

Table 1. **Total Factor Productivity and Intra-Industry Foreign Direct Investment**

	ln(GO)	ln(GO)	ln(TFPe)	ln(TFPe)
	RE	FE	RE	FE
	[1]	[2]	[3]	[4]
ln(HFDI)	0.014** (0.006)	0.029*** (0.010)	0.014** (0.006)	0.023** (0.009)
Number of observations	702	702	702	702

FE = fixed effects estimator, GO = gross output, HFDI = intra-industry foreign direct investment, RE = random effects estimator, TFPe = total factor productivity estimates.

Notes: \*\*\*p-value < 0.01, \*\*p-value < 0.05, and \*p-value < 0.10. Cluster-robust standard errors are in parentheses. All regressions include 5-year lagged total factor productivity terms and sector-specific time effects. The GO columns include the log values of capital services, labor services, and intermediates, as well as their interactions with a dummy variable indicating whether the sector belongs to the broad services industry. The RE columns include country and sector fixed effects. The FE columns include country-sector fixed effects.

Sources: International Trade Centre. Investment Map. <http://www.investmentmap.org/>; Organisation for Economic Co-operation and Development. 2015. Trade in Value Added Database. <https://stats.oecd.org/index.aspx?queryid=66237>; and World Bank. 2000–2014. World Input–Output Tables. <http://www.wiod.org/home>.

countries experienced annual GDP growth rates of 5.6%, with the average for Asian countries reaching 7.4%. At the same time, these countries received significant sums of FDI inflows that comprised 5.2% of GDP annually.<sup>16</sup> As such, we believe this sample serves as an interesting case to examine the effects of FDI on productivity. The Appendix shows additional summary statistics.

## V. Results

### A. Total Factor Productivity

We report four sets of estimates, reflecting the use of two different methodologies to estimate TFP (direct and indirect) and two different panel data estimators (RE estimator and FE estimator). We consider a finding to be relevant if the magnitude, sign, and statistical significance of the coefficient on a given variable are highly consistent across estimation methods.

#### 1. Intra-Industry Foreign Direct Investment

In Table 1, we only look at the impact of intra-industry FDI presence on TFP. In column 1, using direct TFP estimates and an RE estimator, a greater foreign presence in a given sector appears to be associated in a statistically significant

<sup>16</sup>See <https://data.worldbank.org/data-catalog/world-development-indicators>.



Table 2. Total Factor Productivity, Intra- and Inter-Industry Foreign Direct Investment

	ln(GO) RE [1]	ln(GO) FE [2]	ln(TFPe) RE [3]	ln(TFPe) FE [4]
ln(HFDI)	0.012** (0.006)	0.024** (0.010)	0.010* (0.006)	0.024** (0.011)
ln(BWFDIM)	0.031*** (0.011)	0.028* (0.016)	0.031** (0.012)	0.028* (0.015)
ln(FWFDIM)	0.025** (0.012)	0.011 (0.014)	0.015 (0.012)	0.005 (0.014)
ln(BWFDIS)	-0.015 (0.018)	-0.046** (0.023)	-0.022 (0.019)	-0.054** (0.024)
ln(FWFDIS)	0.023 (0.017)	0.033* (0.019)	0.019 (0.017)	0.019 (0.021)
Number of observations	702	702	702	702

BWFDIM = manufacturing backward foreign direct investment linkages, BWFDIS = services backward foreign direct investment linkages, FE = fixed effects estimator, FWFDIM = manufacturing forward foreign direct investment linkages, FWFDIS = services forward foreign direct investment linkages, GO = gross output, HFDI = intra-industry foreign direct investment, RE = random effects estimator, TFPe = total factor productivity estimates.

Notes: \*\*\* p-value < 0.01, \*\* p-value < 0.05, and \* p-value < 0.10. Cluster-robust standard errors are in parentheses. All regressions include 5-year lagged total factor productivity terms and sector-specific time effects. The GO columns include the log values of capital services, labor services, and intermediates, as well as their interaction with a dummy variable indicating whether the sector belongs to the broad services industry. The RE columns include country and sector fixed effects. The FE columns include country-sector fixed effects.

Sources: International Trade Centre. Investment Map. <http://www.investmentmap.org/>; Organisation for Economic Co-operation and Development. 2015. Trade in Value Added Database. <https://stats.oecd.org/index.aspx?queryid=66237>; and World Bank. 2000–2014. World Input–Output Tables. <http://www.wiod.org/home>.

manner with higher TFP in the same sector. This result holds when we use the indirect TFP estimates (column 3) and when we apply an FE estimator (columns 2 and 4). Given the lack of evidence supporting the existence of intra-industry externalities (Iršová and Havránek 2013), the effect of intra-industry FDI is likely to be related to the greater TFP of foreign versus domestic firms.

## 2. Intra-Industry and Inter-Industry FDI

In Table 2, we introduce in our initial model proxies for FDI linkages with manufacturing and services. We still find that intra-industry FDI raises TFP. Furthermore, in line with the microeconomic FDI literature, we find statistical evidence for a positive effect on TFP of an FDI presence in downstream manufacturing sectors. The economic effects are modest. In the short run, on the basis of the estimates reported in column 4, doubling intra-industry FDI from the

Table 3. Total Factor Productivity and Broad-Industry-Specific Estimates for Intra-Industry Foreign Direct Investment

	ln(GO) RE [1]	ln(GO) FE [2]	ln(TFPe) RE [3]	ln(TFPe) FE [4]
ln(HFDI)*MAN	0.012** (0.006)	0.010 (0.011)	0.009 (0.006)	0.011 (0.012)
ln(HFDI)*SERV	0.000 (0.009)	0.055** (0.023)	0.004 (0.009)	0.050** (0.021)
ln(BWFDIM)	0.031*** (0.011)	0.029* (0.017)	0.032*** (0.012)	0.032** (0.015)
ln(FWFDIM)	0.025** (0.012)	0.013 (0.015)	0.015 (0.012)	0.006 (0.014)
ln(BWFDIS)	-0.015 (0.018)	-0.056** (0.023)	-0.023 (0.019)	-0.063** (0.025)
ln(FWFDIS)	0.023 (0.017)	0.029 (0.019)	0.019 (0.017)	0.012 (0.021)
Number of observations	702	702	702	702

BWFDIM = manufacturing backward foreign direct investment linkages, BWFDIS = services backward foreign direct investment linkages, FE = fixed effects estimator, FWFDIM = manufacturing forward foreign direct investment linkages, FWFDIS = services forward foreign direct investment linkages, GO = gross output, HFDI = intra-industry foreign direct investment, MAN or SERV = dummy variable indicating either manufacturing or services, RE = random effects estimator, TFPe = total factor productivity estimates.

Notes: \*\*\*p-value < 0.01, \*\*p-value < 0.05, and \*p-value < 0.10. Cluster-robust standard errors are in parentheses. All regressions include 5-year lagged total factor productivity terms and sector-specific time effects. The GO columns include the log values of capital services, labor services, and intermediates, as well as their interaction with a dummy variable indicating whether the sector belongs to the broad services industry. The RE columns include country and sector fixed effects. The FE columns include country-sector fixed effects.

Sources: International Trade Centre. Investment Map. <http://www.investmentmap.org/>; Organisation for Economic Co-operation and Development. 2015. Trade in Value Added Database. <https://stats.oecd.org/index.aspx?queryid=66237>; and World Bank. 2000–2014. World Input–Output Tables. <http://www.wiod.org/home>.

current 19% to 38% would increase TFP in a given sector by  $([2^{0.024}] - 1) * 100\% = 1.7\%$ . Similarly, doubling backward linkages from FDI in manufacturing sectors, by either doubling the supply coefficient from the current 11% (Table A3) or doubling the current share of foreign employees in downstream manufacturing industries (27%), would increase TFP by  $([2^{0.028}] - 1) * 100\% = 1.96\%$ . At the average sample values, the corresponding semielasticity terms are 0.10 and 0.66, the latter being in range of those reported in Havránek and Iršová (2011).

In Table 3, we investigate whether our estimates for intra-industry FDI diverge across broad industries (manufacturing and services). The FE estimates suggest that the impact of intra-industry FDI may be much stronger in service sectors, as indicated by  $\ln(HFDI) * SERV$ . In the short run, on the basis of the estimates reported in column 4, doubling intra-industry FDI linkages would increase TFP in service (manufacturing) sectors by 3.5% (0.8%).

Table 4. Specific Services-Forward Foreign Direct Investment Linkages

	ln(GO) RE [1]	ln(GO) FE [2]	ln(TFPe) RE [3]	ln(TFPe) FE [4]
ln(HFDI)	0.012** (0.006)	0.025** (0.010)	0.011* (0.006)	0.025** (0.010)
ln(BWFDIM)	0.031*** (0.011)	0.027* (0.016)	0.031*** (0.012)	0.028* (0.015)
ln(FWFDIM)	0.026** (0.012)	0.012 (0.015)	0.016 (0.012)	0.006 (0.014)
ln(BWFDIS)	-0.015 (0.018)	-0.043* (0.024)	-0.023 (0.019)	-0.053** (0.024)
ln(FWFDISS)	0.022 (0.018)	0.030 (0.019)	0.022 (0.018)	0.019 (0.021)
Number of observations	702	702	702	702

BWFDIM = manufacturing backward foreign direct investment linkages; BWFDIS = services backward foreign direct investment linkages; FE = fixed effects estimator; FWFDIM = manufacturing forward foreign direct investment linkages; FWFDISS = services-forward foreign direct investment linkages related to the following upstream sectors: (i) electricity, gas and water supply; (ii) transport and communications; (iii) financial intermediation; and (iv) real estate and business services; GO = gross output; HFDI = intra-industry foreign direct investment; RE = random effects estimator; TFPe = total factor productivity estimates.

Notes: \*\*\* p-value < 0.01, \*\* p-value < 0.05, and \* p-value < 0.10. Cluster-robust standard errors are in parentheses. All regressions include 5-year lagged total factor productivity terms and sector-specific time effects. The GO columns include the log values of capital services, labor services, and intermediates, as well as their interaction with a dummy variable indicating whether the sector belongs to the broad services industry. The RE columns include country and sector fixed effects. The FE columns include country-sector fixed effects.

Sources: International Trade Centre. Investment Map. <http://www.investmentmap.org/>; Organisation for Economic Co-operation and Development. 2015. Trade in Value Added Database. <https://stats.oecd.org/index.aspx?queryid=66237>; and World Bank. 2000–2014. World Input–Output Tables. <http://www.wiod.org/home>.

In Table 4, we examine the distinct influence of specific forward linkages from FDI in service sectors. Following Fernandes and Paunov (2012), we focus on linkages with the following upstream service sectors: (i) electricity, gas, and water supply; (ii) transport and communications; (iii) financial intermediation; and (iv) real estate and business services. As indicated by Fernandes and Paunov, these sectors are characterized by the facilitating and intermediating role they play for downstream firms. In addition, Table A2 shows that these are the service sectors that exhibit the highest foreign employment shares. However, we still fail to find an impact of forward linkages from FDI in service sectors on TFP.

## B. Labor Productivity

In Table 5, we examine whether intra- and inter-industry FDI influences labor productivity (real value added per worker). This single factor productivity indicator is of great interest to policy makers and is frequently employed to make

Table 5. Labor Productivity and Multisector Foreign Direct Investment

	ln(VA) RE [1]	ln(VA) FE [2]	ln(X) RE [3]	ln(X) FE [4]	ln(VAX) RE [5]	ln(VAX) FE [6]	VAX/X RE [7]	VAX/X FE [8]
ln(HFDI)	0.174*** (0.030)	0.258*** (0.085)	0.217*** (0.037)	0.421*** (0.136)	0.217*** (0.039)	0.348*** (0.114)	-0.005 (0.004)	-0.018 (0.012)
ln(BWFDIM)	0.024 (0.054)	0.166 (0.120)	-0.066 (0.071)	-0.047 (0.156)	-0.070 (0.074)	-0.082 (0.154)	0.004 (0.006)	-0.022 (0.017)
ln(FWFDIM)	0.017 (0.053)	-0.018 (0.077)	0.044 (0.078)	-0.086 (0.121)	0.002 (0.078)	-0.146 (0.117)	-0.021*** (0.006)	-0.020* (0.011)
ln(BWFDIS)	-0.008 (0.068)	-0.678*** (0.185)	-0.121 (0.105)	-0.720*** (0.233)	-0.089 (0.108)	-0.621*** (0.226)	0.008 (0.009)	0.031 (0.028)
ln(FWFDIS)	0.154** (0.071)	0.147 (0.135)	0.325*** (0.111)	0.171 (0.202)	0.396*** (0.110)	0.143 (0.194)	0.000 (0.008)	-0.011 (0.024)
Number of observations	696	696	696	696	696	696	696	696

BWFDIM = manufacturing backward foreign direct investment linkages, BWFDIS = services backward foreign direct investment linkages, FE = fixed effects estimator, FWFDIM = manufacturing forward foreign direct investment linkages, FWFDIS = services forward foreign direct investment linkages, HFDI = intra-industry foreign direct investment, RE = random effects estimator, SERV = dummy variable indicating whether the sector belongs to the broad services industry, VA = value added per worker, VAX = direct domestic value added embodied in exports per worker, VAX/X = share of direct domestic value added in gross exports, X = gross exports per worker.  
 Notes: \*\*\* p-value < 0.01, \*\* p-value < 0.05, and \* p-value < 0.10. Cluster-robust standard errors are in parentheses. All regressions include 5-year lagged total factor productivity terms and sector-specific time effects. The RE columns include country and sector fixed effects. The FE columns include country-sector fixed effects.  
 Sources: International Trade Centre. Investment Map. <http://www.investmentmap.org/>; Organisation for Economic Co-operation and Development. 2015. Trade in Value Added Database. <https://stats.oecd.org/index.aspx?queryid=66237>; and World Bank. 2000–2014. World Input–Output Tables. <http://www.wiod.org/home>.

international performance comparisons. It is also less sensitive to assumptions than TFP. Another advantage is that it allows us to account for the effects of FDI on domestic activity that are not mediated via TFP changes, e.g., different usage of factors of production.

In columns 1 and 2, we find that intra-industry FDI is strongly associated with higher labor productivity. In contrast with our previous findings, the economic effects are much larger. Using the estimates reported in column 2, in the short run, doubling intra-industry FDI would increase labor productivity by about 20%. Columns 3 through 6 show that part of this effect appears to be driven by FDI-induced integration via global value-added chains. Intra-industry FDI is consistently associated with improved export performance, measured either as exports per worker ( $X$ ) or direct domestic value added embodied in exports per worker ( $VAX$ ). In columns 7 and 8, we look at whether multisectoral FDI can induce value-added upgrading in the sense of increasing the share of domestic value-added content in gross exports ( $VAX/X$ ). This does not appear to be the case, including for intra-industry FDI. On the other hand, greater manufacturing forward FDI linkages tend to induce value-added downgrading, possibly because firms make greater use of inter-industry intermediates that are produced by foreign firms.

In Table 6, we investigate whether these results hold when we allow for a differential effect of intra-industry FDI across broad industry sectors by interacting  $\ln(HFDI)$  with an industry dummy variable that indicates whether the host industry is a manufacturing sector ( $\ln(HFDI) * MAN$ ) or a service sector ( $\ln(HFDI) * SERV$ ). We still observe a strong effect of intra-industry FDI, particularly in the manufacturing sector. On the other hand, the effect is insignificant in the service sectors. In section VI, we will come back to this difference between broad industry classifications.

Lastly, focusing on inter-industry FDI variables, as in the previous section, results are ambiguous as the sign, magnitude, and statistical significance of the coefficients on these variables vary widely across columns. For example, it is not clear how FDI in service sectors influences labor productivity or export performance, although our results suggest a positive role for forward linkages from FDI in service sectors. In addition, we do not find a statistically significant effect for backward linkages from FDI in manufacturing sectors anymore. To the extent that these externalities truly exist at the TFP level, they do not appear to be translated into greater labor productivity.

## VI. Regional Comparisons

Table A1 shows that countries located in Central and Eastern Europe are predominant in our sample. In this last section, we explore how our results compare across the three regions mentioned in Table A1. To do so, we interact the FDI variables with three dummy variables,  $CEEU$ ,  $LAC$ , and  $Asia$ , which take the value

Table 6. Labor Productivity and Broad-Industry-Specific Estimates for Intra-Industry Foreign Direct Investment

	ln(VA)		ln(VA)		ln(X)		ln(X)		ln(VAX)		ln(VAX)		VAX/X		VAX/X	
	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]
ln(HFDI)*MAN	0.194*** (0.035)	0.247** (0.099)	0.234*** (0.040)	0.472*** (0.164)	0.233*** (0.043)	0.382*** (0.139)	-0.004 (0.005)	-0.016 (0.013)	0.194*** (0.035)	0.247** (0.099)	0.234*** (0.040)	0.472*** (0.164)	0.233*** (0.043)	0.382*** (0.139)	-0.004 (0.005)	-0.016 (0.013)
ln(HFDI)*SERV	-0.069 (0.050)	0.045 (0.130)	-0.057 (0.059)	-0.202 (0.188)	-0.057 (0.062)	-0.131 (0.178)	-0.001 (0.006)	-0.005 (0.021)	-0.069 (0.050)	0.045 (0.130)	-0.057 (0.059)	-0.202 (0.188)	-0.057 (0.062)	-0.131 (0.178)	-0.001 (0.006)	-0.005 (0.021)
ln(BWFDIM)	0.010 (0.054)	0.170 (0.121)	-0.077 (0.071)	-0.067 (0.157)	-0.081 (0.074)	-0.095 (0.155)	0.004 (0.006)	-0.023 (0.017)	0.010 (0.054)	0.170 (0.121)	-0.077 (0.071)	-0.067 (0.157)	-0.081 (0.074)	-0.095 (0.155)	0.004 (0.006)	-0.023 (0.017)
ln(FWFDIM)	0.020 (0.054)	-0.017 (0.077)	0.047 (0.078)	-0.093 (0.124)	0.004 (0.078)	-0.150 (0.119)	-0.021*** (0.006)	-0.020* (0.011)	0.020 (0.054)	-0.017 (0.077)	0.047 (0.078)	-0.093 (0.124)	0.004 (0.078)	-0.150 (0.119)	-0.021*** (0.006)	-0.020* (0.011)
ln(BWFDIS)	0.004 (0.068)	-0.686*** (0.186)	-0.112 (0.106)	-0.681*** (0.236)	-0.080 (0.108)	-0.595** (0.231)	0.008 (0.009)	0.032 (0.028)	0.004 (0.068)	-0.686*** (0.186)	-0.112 (0.106)	-0.681*** (0.236)	-0.080 (0.108)	-0.595** (0.231)	0.008 (0.009)	0.032 (0.028)
ln(FWFDIS)	0.159** (0.071)	0.142 (0.134)	0.330*** (0.112)	0.192 (0.198)	0.400*** (0.111)	0.157 (0.193)	0.000 (0.009)	-0.011 (0.024)	0.159** (0.071)	0.142 (0.134)	0.330*** (0.112)	0.192 (0.198)	0.400*** (0.111)	0.157 (0.193)	0.000 (0.009)	-0.011 (0.024)
Number of observations	696	696	696	696	696	696	696	696	696	696	696	696	696	696	696	696

BWFDIM = manufacturing backward foreign direct investment linkages, BWFDIS = services backward foreign direct investment linkages, FE = fixed effects estimator, FWFDIM = manufacturing forward foreign direct investment linkages, FWFDIS = services forward foreign direct investment linkages, MAN or SERV = dummy variable indicating either manufacturing or services, RE = random effects estimator, VA = value added per worker, VAX = direct domestic value added embodied in exports per worker, VAX/X = share of direct domestic value added in gross exports, X = gross exports per worker.

Notes: \*\* p-value < 0.01, \* p-value < 0.05, and \* p-value < 0.10. Cluster-robust standard errors are in parentheses. All regressions include 5-year lagged total factor productivity terms and sector-specific time effects. The RE columns include country and sector fixed effects. The FE columns include country-sector fixed effects.

Sources: International Trade Centre. Investment Map. <http://www.investmentmap.org/>; Organisation for Economic Co-operation and Development. 2015. Trade in Value Added Database. <https://stats.oecd.org/index.aspx?queryid=66237>; and World Bank. 2000–2014. World Input–Output Tables. <http://www.wiod.org/home>.

of 1 when a country is located in Central and Eastern Europe, Latin America, or Asia, respectively.

In Table 7, the variable  $\ln(HFDI) * SERV * CEEU$  indicates that the effects of intra-industry FDI on TFP are especially present in the service sectors of the Central and Eastern European countries in our sample. On the other hand, Table 8 indicates that the impact of intra-industry FDI on total and exported labor productivity is much higher in the Asian manufacturing sectors than in the other region–sector combinations, especially when we only exploit the time series dimension of our data (the FE estimates). This finding is in line with the more general findings of Tables 3 and 6, which indicated that FDI is associated with higher TFP in services (Table 3) and higher labor productivity in manufacturing sectors (Table 6). In addition, there is some limited evidence that value-added upgrading took place (Table 8, columns 7 and 8).

The fact that intra-industry FDI seems to particularly benefit both European services as well as Asian manufacturing is surprising since they do not share many commonalities. In terms of skill endowments, for example, Table A4 shows that the median of average years of schooling in Europe during 2000–2010 is 10.8, while it is only 6.4 in Asia. In addition, European service sectors in Europe comprise significantly more skilled workers (78%) than Asian manufacturing sectors (44%). Therefore, finding a single factor that can explain why horizontal FDI benefits these region–sectors specifically seems unlikely.

Instead, the explanation is more likely to be related to the underlying differences between our two measures of productivity: TFP and labor productivity. Since value added per worker is also affected by other factors of production, labor productivity can be considered only a partial measure of productivity. TFP, on the other hand, as a residual productivity measure, controls for such input factors that are captured by  $x$  in our conceptual framework. Then, an FDI-induced TFP premium suggests that foreign firms are better able to transform the same inputs into output, meaning that foreign firms' technical efficiency exceeds that of domestic firms ( $\alpha > \beta$ ). On the other hand, evidence of a (significantly higher) FDI-induced labor productivity premium means that foreign firms tend to inhibit more productive characteristics ( $x^F > x^N$ ), such as capital intensity, size, or skilled employees. These more productive foreign firms will then mechanically increase the overall productivity of a host economy, as per the equation  $\bar{q} = (1 - \mu)\bar{q}^N + \mu\bar{q}^F$ , a process known as the compositional effect of FDI (Navaretti and Venables 2005).

In line with that framework, we expect the TFP premium to depend on host economies' absorptive capacity such as the level of human capital. We therefore interact our FDI variables with the years of schooling, as a proxy for human capital, in Table 9. Here, we would expect a positive interaction term, as the TFP spillover from FDI should be higher for more levels of human capital.

Table 7. Total Factor Productivity and Region-Specific Estimates

	ln(GO) RE (1)	ln(GO) FE (2)	ln(TFPe) RE (3)	ln(TFPe) FE (4)
ln(HFDI)*MAN*CEEU	0.012* (0.006)	0.004 (0.011)	0.010 (0.006)	0.010 (0.013)
ln(HFDI)*SERV*CEEU	0.003 (0.009)	0.066*** (0.025)	0.007 (0.009)	0.062*** (0.022)
ln(BWFDIM)*CEEU	0.022* (0.013)	0.028 (0.020)	0.019 (0.013)	0.036* (0.021)
ln(FWFDIM)*CEEU	0.040*** (0.015)	0.008 (0.017)	0.024* (0.014)	-0.009 (0.016)
ln(BWFDIS)*CEEU	-0.016 (0.016)	-0.092*** (0.028)	-0.025 (0.017)	-0.087*** (0.030)
ln(FWFDIS)*CEEU	0.016 (0.020)	0.029 (0.029)	0.003 (0.019)	0.035 (0.029)
ln(HFDI)*MAN*Asia	0.004 (0.007)	0.004 (0.029)	0.009 (0.007)	0.009 (0.029)
ln(HFDI)*SERV*Asia	0.004 (0.018)	0.046 (0.068)	0.009 (0.019)	0.053 (0.086)
ln(BWFDIM)*Asia	0.019* (0.011)	0.018 (0.019)	0.012 (0.012)	0.018 (0.021)
ln(FWFDIM)*Asia	-0.007 (0.015)	0.017 (0.028)	-0.007 (0.016)	0.031 (0.032)
ln(BWFDIS)*Asia	-0.031 (0.030)	-0.022 (0.046)	-0.015 (0.032)	0.013 (0.054)
ln(FWFDIS)*Asia	0.023 (0.018)	0.028 (0.029)	0.039* (0.021)	0.012 (0.031)
ln(HFDI)*MAN*LAC	0.020 (0.019)	0.074 (0.108)	0.017 (0.020)	0.170* (0.100)
ln(HFDI)*SERV*LAC	-0.009 (0.015)	-0.069 (0.192)	-0.003 (0.016)	-0.300** (0.142)
ln(BWFDIM)*LAC	0.042** (0.019)	0.019 (0.043)	0.047** (0.022)	0.031 (0.046)
ln(FWFDIM)*LAC	0.037 (0.034)	0.171 (0.168)	0.045 (0.035)	0.254 (0.159)
ln(BWFDIS)*LAC	-0.004 (0.046)	0.189 (0.146)	-0.004 (0.048)	0.119 (0.157)
ln(FWFDIS)*LAC	0.071 (0.058)	0.150 (0.154)	0.074 (0.059)	-0.095 (0.143)
Number of observations	702	702	702	702

Asia = dummy variable indicating whether the country is in Asia, BWFDIM = manufacturing backward foreign direct investment linkages, BWFDIS = services backward foreign direct investment linkages, CEEU = dummy variable indicating whether the country is in Central and Eastern Europe, FE = fixed effects estimator, FWFDIM = manufacturing forward foreign direct investment linkages, FWFDIS = services forward foreign direct investment linkages, GO = gross output, HFDI = intra-industry foreign direct investment, LAC = dummy variable indicating whether the country is in Latin America, MAN or SERV = dummy variable indicating either manufacturing or services, RE = random effects estimator, TFPe = total factor productivity estimates, VA = value added per worker, VAX = direct domestic value added embodied in exports per worker, VAX/X = share of direct domestic value added in gross exports, X = gross exports per worker.

*Continued.*



Table 7. *Continued.*

Notes: \*\*\* p-value < 0.01, \*\* p-value < 0.05, and \* p-value < 0.10. Cluster-robust standard errors are in parentheses. All regressions include 5-year lagged total factor productivity terms and sector-specific time effects. The RE columns include country and sector fixed effects. The FE columns include country-sector fixed effects.

Sources: International Trade Centre. Investment Map. <http://www.investmentmap.org/>; Organisation for Economic Co-operation and Development. 2015. Trade in Value Added Database. <https://stats.oecd.org/index.aspx?queryid=66237>; and World Bank. 2000–2014. World Input–Output Tables. <http://www.wiod.org/home>.

On the other hand, the compositional effect depends on the difference between domestic ( $\bar{q}^N$ ) and foreign firms' productivity ( $\bar{q}^F$ ). We therefore want to interact our FDI variables with a measure of domestic firms' productivity. As a proxy, we take the host economies' log labor productivity in the year 2000,  $\ln(VA)_{2000}$ , which is our earliest year of observation. The rationale is that, due to growing FDI over time,  $q$  is least affected by  $\bar{q}^F$ . Here, we expect a negative interaction term since the lower the initial labor productivity in the year 2000, the greater the gap between  $\bar{q}^F$  and  $\bar{q}^N$  and thus the larger the composition effect of FDI. Table A5 provides the descriptive statistics: the average labor productivity per region in the year 2000. As it shows, Latin America has significantly higher value added per worker (\$11,653) than both Central and Eastern Europe (\$5,145) and Asia (\$4,007).

Tables 9 and 10 show evidence in line with our hypotheses. Table 9 shows a significantly positive interaction coefficient between intra-service-industry FDI and our proxy for human capital,  $\ln(HFDI) * SERV * \ln(HC)$ , when using country-sector fixed effects (columns 2 and 4). Apparently, the relatively large amount of years of schooling in Europe (Table A4) can partly explain why the European service sector has been able to achieve higher TFP spillovers from intra-industry FDI. The highly significant interaction coefficient  $\ln(HFDI) * \ln(VA)_{2000}$  in Table 10, on the other hand, can explain why Asian manufacturing labor productivity benefited disproportionately from intra-industry FDI. Namely, while horizontal FDI,  $\ln(HFDI)$ , is associated with significantly higher labor productivity, this effect is significantly larger for host economies that have lower initial labor productivity, as noted by  $\ln(HFDI) * \ln(VA)_{2000}$ . As we know from Table A5, Asia had the lowest labor productivity of all regions, partly providing an explanation for the findings of Table 8.

All in all, these results contribute to the finding that developing economies in our sample benefited from FDI largely through a compositional effect caused by the influx of more productive foreign firms, rather than direct spillovers among foreign and domestic firms. In addition, our results suggest that the three large Asian countries in our sample—India, Indonesia, and the PRC—have disproportionately benefited from the entry of foreign firms and the associated deployment of global value chains.

Table 8. Labor Productivity and Region-Specific Estimates

	ln(VA) RE (1)	ln(VA) FE (2)	ln(X) RE (3)	ln(X) FE (4)	ln(VAX) RE (5)	ln(VAX) FE (6)	VAX/X RE (7)	VAX/X FE (8)
ln(HFDI)*MAN*CEEU	0.185*** (0.036)	0.182** (0.091)	0.244*** (0.044)	0.333** (0.154)	0.235*** (0.048)	0.242** (0.115)	-0.007 (0.005)	-0.009 (0.015)
ln(HFDI)*SERV*CEEU	-0.143** (0.057)	0.040 (0.126)	-0.096 (0.070)	-0.249 (0.195)	-0.108 (0.074)	-0.151 (0.183)	-0.003 (0.007)	-0.003 (0.023)
ln(BWFDIM)*CEEU	0.018 (0.066)	0.082 (0.147)	-0.123 (0.093)	-0.303 (0.227)	-0.123 (0.098)	-0.326* (0.187)	0.007 (0.009)	-0.029 (0.035)
ln(FWFDIM)*CEEU	0.114* (0.068)	0.076 (0.104)	0.106 (0.090)	0.039 (0.194)	0.073 (0.093)	-0.001 (0.170)	-0.021*** (0.007)	-0.020 (0.021)
ln(BWFDIS)*CEEU	-0.061 (0.087)	-0.883*** (0.258)	-0.163 (0.119)	-0.570** (0.265)	-0.168 (0.127)	-0.548** (0.254)	0.002 (0.012)	0.022 (0.041)
ln(FWFDIS)*CEEU	0.144 (0.096)	-0.024 (0.225)	0.298** (0.125)	-0.104 (0.293)	0.383*** (0.133)	-0.162 (0.268)	-0.003 (0.011)	-0.013 (0.042)
ln(HFDI)*MAN*Asia	0.308*** (0.058)	0.886*** (0.196)	0.299*** (0.070)	1.112*** (0.290)	0.325*** (0.074)	1.096*** (0.330)	0.010 (0.006)	-0.004 (0.025)
ln(HFDI)*SERV*Asia	-0.052 (0.079)	-0.158 (0.297)	-0.049 (0.107)	0.119 (0.459)	-0.059 (0.113)	-0.113 (0.488)	-0.010 (0.012)	-0.055 (0.058)
ln(BWFDIM)*Asia	-0.085 (0.087)	-0.061 (0.143)	-0.098 (0.113)	-0.177 (0.281)	-0.130 (0.113)	-0.278 (0.276)	-0.003 (0.010)	-0.042** (0.021)
ln(FWFDIM)*Asia	-0.022 (0.090)	-0.087 (0.149)	0.074 (0.152)	-0.192 (0.236)	0.033 (0.156)	-0.301 (0.233)	-0.013 (0.011)	-0.000 (0.023)
ln(BWFDIS)*Asia	0.025 (0.177)	-0.439 (0.289)	-0.321 (0.249)	-1.284** (0.577)	-0.222 (0.236)	-0.876 (0.533)	0.033 (0.023)	0.117*** (0.042)
ln(FWFDIS)*Asia	-0.012 (0.128)	0.260 (0.207)	0.388** (0.190)	0.371 (0.347)	0.414** (0.187)	0.382 (0.331)	0.011 (0.018)	0.026 (0.028)

Continued.

Table 8. *Continued.*

	ln(VA) RE (1)	ln(VA) FE (2)	ln(X) RE (3)	ln(X) FE (4)	ln(VAX) RE (5)	ln(VAX) FE (6)	VAX/X RE (7)	VAX/X FE (8)
ln(HFDI)*MAN*LAC	0.143** (0.056)	-0.595 (1.022)	0.190** (0.084)	0.100 (1.368)	0.205** (0.090)	0.049 (1.664)	-0.009 (0.006)	-0.070 (0.043)
ln(HFDI)*SERV*LAC	-0.065 (0.059)	1.737 (1.784)	-0.084 (0.076)	1.621 (1.949)	-0.088 (0.078)	1.991 (2.232)	-0.001 (0.006)	0.166** (0.083)
ln(BWFDIM)*LAC	0.006 (0.068)	-0.562* (0.295)	-0.077 (0.084)	-0.888** (0.441)	-0.095 (0.085)	-0.829 (0.478)	0.001 (0.006)	0.037* (0.019)
ln(FWFDIM)*LAC	-0.077 (0.066)	-1.214* (0.660)	-0.046 (0.104)	-0.260 (1.207)	-0.086 (0.097)	-0.286 (1.194)	-0.022*** (0.007)	-0.110* (0.060)
ln(BWFDIS)*LAC	0.011 (0.098)	3.106*** (1.087)	0.013 (0.144)	3.668** (1.704)	0.086 (0.143)	3.554** (1.803)	0.012 (0.011)	-0.153** (0.071)
ln(FWFDIS)*LAC	0.191 (0.145)	2.531*** (0.968)	0.386 (0.262)	2.560 (1.766)	0.507** (0.252)	3.064* (1.770)	-0.008 (0.013)	0.145 (0.089)
Number of observations	696	696	696	696	696	696	696	696

Asia = dummy variable indicating whether the country is in Asia, BWFDIM = manufacturing backward foreign direct investment linkages, BWFDIS = services backward foreign direct investment linkages, CEEU = dummy variable indicating whether the country is in Central and Eastern Europe, FE = fixed effects estimator, FWFDIM = manufacturing forward foreign direct investment linkages, FWFDIS = services forward foreign direct investment linkages, GO = gross output, HFDI = intra-industry foreign direct investment, LAC = dummy variable indicating whether the country is in Latin America, MAN or SERV = dummy variable indicating either manufacturing or services, RE = random effects estimator, VA = value added per worker, VAX = direct domestic value added embodied in exports per worker, VAX/X = share of direct domestic value added in gross exports, X = gross exports per worker.

Notes: \*\* p-value < 0.01, \* p-value < 0.05, and \* p-value < 0.10. Cluster-robust standard errors are in parentheses. All regressions include 5-year lagged total factor productivity terms and sector-specific time effects. The RE columns include country and sector fixed effects. The FE columns include country-sector fixed effects.

Sources: International Trade Centre. Investment Map. <http://www.investmentmap.org/>; Organisation for Economic Co-operation and Development. 2015. Trade in Value Added Database. <https://stats.oecd.org/index.aspx?queryid=66237>; and World Bank. 2000–2014. World Input–Output Tables. <http://www.wiod.org/home>.

Table 9. Total Factor Productivity and Human Capital

	ln(GO) RE (1)	ln(GO) FE (2)	ln(TFPe) RE (3)	ln(TFPe) FE (4)
ln(HC)*MAN	0.294*** (0.110)		0.339*** (0.091)	
ln(HC)*SERV	0.002 (0.058)		-0.033 (0.055)	
ln(HFDI)*MAN	0.033 (0.029)	0.118 (0.104)	0.057* (0.030)	0.173* (0.103)
ln(HFDI)*SERV	0.014 (0.058)	-0.275* (0.147)	-0.003 (0.060)	-0.278* (0.167)
ln(HFDI)*MAN*ln(HC)	-0.010 (0.013)	-0.047 (0.043)	-0.022 (0.013)	-0.071 (0.044)
ln(HFDI)*SERV*ln(HC)	-0.006 (0.026)	0.146** (0.064)	0.003 (0.026)	0.146* (0.075)
ln(BWFDIM)	0.012 (0.050)	-0.033 (0.135)	0.017 (0.055)	-0.024 (0.131)
ln(BWFDIM)*ln(HC)	0.007 (0.023)	0.031 (0.062)	0.005 (0.025)	0.027 (0.060)
ln(FWFDIM)	-0.037 (0.064)	0.150 (0.114)	0.009 (0.070)	0.241** (0.114)
ln(FWFDIM)*ln(HC)	0.029 (0.029)	-0.060 (0.052)	0.004 (0.031)	-0.103** (0.051)
ln(BWFDIS)	0.061 (0.094)	0.541*** (0.181)	0.122 (0.102)	0.484** (0.198)
ln(BWFDIS)*ln(HC)	-0.034 (0.041)	-0.279*** (0.085)	-0.066 (0.044)	-0.252*** (0.091)
ln(FWFDIS)	0.168* (0.093)	-0.150 (0.146)	0.160 (0.098)	-0.062 (0.147)
ln(FWFDIS)*ln(HC)	-0.068 (0.043)	0.087 (0.070)	-0.066 (0.045)	0.038 (0.071)
Number of observations	702	702	702	702

BWFDIM = manufacturing backward foreign direct investment linkages, BWFDIS = services backward foreign direct investment linkages, FWFDIM = manufacturing forward foreign direct investment linkages, FWFDIS = services forward foreign direct investment linkages, GO = gross output, HC = log of years of schooling to proxy human capital, HFDI = intra-industry foreign direct investment, MAN or SERV = dummy variable indicating either manufacturing or services, RE = random effects estimator, TFPe = total factor productivity estimates, VA = value added per worker, VAX = direct domestic value added embodied in exports per worker, VAX/X = share of direct domestic value added in gross exports, X = gross exports per worker.

Notes: \*\*\*p-value < 0.01, \*\*p-value < 0.05, and \*p-value < 0.10. Cluster-robust standard errors are in parentheses. All regressions include a 5-year lagged total factor productivity term, sector-specific time effects, and a dummy indicating broad industry classifications. The GO columns include the log values of capital services, labor services, and intermediates, as well as their interaction with a dummy variable indicating whether the sector belongs to the broad service industry. The RE columns include country and sector fixed effects. The FE columns include country-sector fixed effects.

Sources: International Trade Centre. Investment Map. <http://www.investmentmap.org/>; Organisation for Economic Co-operation and Development. 2015. Trade in Value Added Database. <https://stats.oecd.org/index.aspx?queryid=66237>; Wittgenstein Centre for Demography and Global Human Capital. 2015. Wittgenstein Centre Data Explorer Version 1.2. <http://witt.null2.net/shiny/wic/>; and World Bank. 2000–2014. World Input–Output Tables. <http://www.wiod.org/home>.

Table 10. Labor Productivity and Initial Labor Productivity

	ln(VA) RE (1)	ln(VA) FE (2)	ln(X) RE (3)	Ln(X) FE (4)	ln(VAX) RE (5)	ln(VAX) FE (6)	VAX/X RE (7)	VAX/X FE (8)
ln(VA) <sub>2000</sub>	0.573*** (0.203)		0.664** (0.259)		0.766*** (0.267)		0.030 (0.021)	
ln(HFDI)	0.431*** (0.151)	1.351*** (0.352)	0.685*** (0.226)	2.595*** (0.453)	0.735*** (0.223)	1.853*** (0.448)	0.018 (0.017)	-0.128** (0.064)
ln(HFDI)*ln(VA) <sub>2000</sub>	-0.034* (0.019)	-0.144*** (0.045)	-0.059** (0.027)	-0.281*** (0.057)	-0.065** (0.027)	-0.194*** (0.055)	-0.003 (0.002)	0.014* (0.008)
ln(BWFDIM)	0.073 (0.281)	-0.033 (1.011)	0.667* (0.398)	-0.319 (1.174)	0.664 (0.408)	-0.307 (1.212)	0.003 (0.036)	-0.105 (0.152)
ln(BWFDIM)*ln(VA) <sub>2000</sub>	-0.001 (0.033)	0.019 (0.129)	-0.083* (0.046)	0.023 (0.150)	-0.081* (0.047)	0.018 (0.154)	0.001 (0.004)	0.010 (0.019)
ln(FWFDIM)	0.731** (0.355)	2.813*** (0.799)	0.583 (0.462)	0.243 (1.106)	0.591 (0.477)	0.773 (1.107)	-0.036 (0.036)	0.095 (0.113)
ln(FWFDIM)*ln(VA) <sub>2000</sub>	-0.088** (0.043)	-0.368*** (1.04)	-0.069 (0.055)	-0.046 (0.142)	-0.073 (0.056)	-0.119 (0.142)	0.002 (0.004)	-0.014 (0.014)
ln(BWFDIS)	0.345 (0.423)	-0.738 (1.260)	-0.785 (0.583)	-2.710 (1.749)	-0.754 (0.605)	-2.185 (1.723)	-0.027 (0.063)	-0.014 (0.261)
ln(BWFDIS)*ln(VA) <sub>2000</sub>	-0.048 (0.052)	0.032 (0.166)	0.070 (0.069)	0.281 (0.234)	0.070 (0.072)	0.229 (0.228)	0.004 (0.007)	0.007 (0.033)
ln(FWFDIS)	-0.337 (0.491)	-4.157*** (1.176)	0.825 (0.582)	-1.653 (1.573)	0.152 (0.608)	-2.329 (1.559)	-0.137** (0.064)	0.031 (0.229)
ln(FWFDIS)*ln(VA) <sub>2000</sub>	0.057 (0.062)	0.568*** (0.153)	-0.070 (0.074)	0.249 (0.209)	0.025 (0.077)	0.335 (0.205)	0.018** (0.008)	-0.005 (0.031)
Number of observations	696	696	696	696	696	696	696	696

BWFDIM = manufacturing backward foreign direct investment linkages, BWFDIS = services backward foreign direct investment linkages, FE = fixed effects estimator, FWFDIM = manufacturing forward foreign direct investment linkages, FWFDIS = services forward foreign direct investment linkages, HFDI = intra-industry foreign direct investment, ln(VA)<sub>2000</sub> = log of value added per worker in the year 2000, RE = random effects estimator, TFP<sub>e</sub> = total factor productivity estimates, VA = value added per worker, VAX = direct domestic value added embodied in exports per worker, VAX/X = share of direct domestic value added in gross exports, X = gross exports per worker.

Notes: \*\*\* p-value < 0.01, \*\* p-value < 0.05, and \* p-value < 0.10. Cluster-robust standard errors are in parentheses. All regressions include a 5-year lagged dependent variable term and sector-specific time effects. The RE columns include country and sector fixed effects. The FE columns include country-sector fixed effects.

Sources: International Trade Centre. Investment Map. <http://www.investmentmap.org/>; Organisation for Economic Co-operation and Development. 2015. Trade in Value Added Database. <https://stats.oecd.org/index.aspx?queryid=66237>; and World Bank. 2000–2014. World Input-Output Tables. <http://www.wiod.org/home>.

## VII. Conclusions

In this paper, we have investigated how intra- and inter-industry FDI influences the average productivity of a sample of emerging market economies. Overall, we find a large positive effect of intra-industry FDI on total and export-related labor productivity. The fact that this effect is much harder to detect, in economic and statistical terms, when we examine the determinants of TFP suggests that foreign firms raise the performance of their host economies through a compositional effect. Foreign firms tend to be larger than domestic firms; they make more intensive use of (possibly better) physical capital, human capital, and intermediates; and they have greater access to foreign markets. Hence, their greater prevalence in a given sector mechanically increases average labor productivity and export performance.

As stressed by Lipsey (2004) and Navaretti and Venables (2005), this FDI-induced composition effect can be crucial for host countries' economic development. It should not be discounted in favor of potential foreign externalities for which we have not found robust evidence and whose existence is often conditional on domestic absorptive capacities.

In addition to improving their FDI attractiveness, governments should also ensure that they adopt policies that increase the quantity, quality, and technological level of local producers. This will leverage the benefits of FDI and sustain long-run economic development. These considerations led the Government of the PRC to introduce in 2006 and 2015, respectively, the Indigenous Innovation and Made in China 2025 policy packages to upgrade domestic manufacturing.

Finally, it should be acknowledged that our results need to be interpreted with caution. Our estimates are likely to be affected by an endogeneity bias that is related, at the very least, to measurement error. We nevertheless believe that our findings complement those based either on cross-country evidence or single-country, firm-level studies.

## References

- Barro, Robert J., and Xavier Sala-i-Martin. 1997. "Technological Diffusion, Convergence, and Growth." *Journal of Economic Growth* 2 (1): 1–27.
- Blundell, Richard, and Stephen Bond. 1998. "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models." *Journal of Econometrics* 87 (1): 115–43.
- Carkovic, Maria, and Ross Levine. 2005. "Does Foreign Direct Investment Accelerate Economic Growth?" In *Does Foreign Direct Investment Promote Development?*, edited by Theodore H. Moran, Edward M. Graham, and Magnus Blomström, 195–220. Washington, DC: Institute for International Economics.
- Caves, Richard E. 2007. *Multinational Enterprises and Economic Analysis, Third Edition*. Cambridge: Cambridge University Press.
- Crisuolo, Chiara. 2006. "Foreign Affiliates in OECD Economies." *OECD Economic Studies* 2006 (2): 109–39.

- Dunning, John H., and Sarianna M. Lundan. 2008. *Multinational Enterprises and the Global Economy*. Cheltenham: Edward Elgar.
- Fernandes, Ana M., and Caroline Paunov. 2012. "Foreign Direct Investment in Services and Manufacturing Productivity: Evidence for Chile." *Journal of Development Economics* 97 (2): 305–21.
- Fox, Jeremy T., and Valérie Smeets. 2011. "Does Input Quality Drive Measured Differences in Firm Productivity?" *International Economic Review* 52 (4): 961–89.
- Gerschenkron, Alexander. 1962. *Economic Backwardness in Historical Perspective: A Book of Essays*. Cambridge: The Belknap Press of Harvard University Press.
- Griffith, Rachel. 1999. "Using the ARD Establishment Level Data to Look at Foreign Ownership and Productivity in the United Kingdom." *The Economic Journal* 109 (456): 416–42.
- Havránek, Tomáš, and Zuzana Iršová. 2011. "Estimating Vertical Spillovers from FDI: Why Results Vary and What the True Effect Is." *Journal of International Economics* 85 (2): 234–44.
- Herzer, Dierk, Stephan Klasen, and Felicitas Nowak-Lehmann. 2008. "In Search of FDI-Led Growth in Developing Countries: The Way Forward." *Economic Modelling* 25 (5): 793–810.
- Iamsriraj, Sasi, and Mehmet Ali Ulubasoglu. 2015. "Foreign Direct Investment and Economic Growth: A Real Relationship or Wishful Thinking?" *Economic Modelling* 51: 200–13.
- International Trade Centre. Investment Map. <http://www.investmentmap.org/>.
- Iršová, Zuzana, and Tomáš Havránek. 2013. "Determinants of Horizontal Spillovers from FDI: Evidence from a Large Meta-Analysis." *World Development* 42: 1–15.
- Javorcik, Beata. 2004. "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages." *American Economic Review* 94 (3): 605–27.
- Judson, Ruth A., and Ann L. Owen. 1999. "Estimating Dynamic Panel Data Models: A Guide for Macroeconomists." *Economics Letters* 65 (1): 9–15.
- Lipsey, Robert E. 2004. "Home- and Host-Country Effects of Foreign Direct Investment." In *Challenges to Globalization: Analyzing the Economics*, edited by Richard E. Baldwin and Alan L. Winters, 333–82. Chicago and London: University of Chicago Press.
- Navaretti, Giorio Barba, and Anthony J. Venables. 2005. *Multinational Firms in the World Economy*. Princeton: Princeton University Press.
- Organisation for Economic Co-operation and Development. 2015. Trade in Value Added Database. <https://stats.oecd.org/index.aspx?queryid=66237>.
- Roodman, David. 2009. "A Note on the Theme of Too Many Instruments." *Oxford Bulletin of Economics and Statistics* 71 (1): 135–58.
- Solow, Robert M. 1956. "A Contribution to the Theory of Economic Growth." *Quarterly Journal of Economics* 70 (1): 65–94.
- Swan, Trevor S. 1956. "Economic Growth and Capital Accumulation." *Economic Record* 32 (2): 334–61.
- Van Beveren, Ilke. 2012. "Total Factor Productivity Estimation: A Practical Review." *Journal of Economic Surveys* 26 (1): 98–128.
- Wittgenstein Centre for Demography and Global Human Capital. 2015. Wittgenstein Centre Data Explorer Version 1.2. <http://witt.null2.net/shiny/wic/>.
- World Bank. 2000–2014. World Input–Output Tables. <http://www.wiod.org/home>.

## Appendix. Descriptive Summary Statistics

Table A1. List of Emerging Market Economies in the Database

Central and Eastern Europe	Latin America	Asia
Bulgaria	Brazil	India
Czech Republic	Mexico	Indonesia
Hungary		People's Republic of China
Latvia		
Lithuania		
Poland		
Romania		
Russian Federation		
Slovakia		
Turkey		

Source: Authors' compilation.

Table A2. Manufacturing and Service Sectors in the Database

Broad Industry	ISIC rev 3.1	Sector Name	Median HFDI 2000 (%)	Median HFDI 2008 (%)
M	D15t16	Food, beverages, and tobacco	8	8
M	D17t19	Textiles, leather, and footwear	6	10
M	D20	Wood, of wood, and cork	5	12
M	D21t22	Pulp, paper, printing, and publishing	6	8
M	D23	Coke, refined petroleum, and nuclear fuel	25	46
M	D24	Chemicals and chemical products	14	29
M	D25	Rubber and plastics	15	14
M	D26	Other nonmetallic minerals	8	13
M	D27t28	Basic metals and fabricated metals	9	21
M	D29	Machinery, nec	20	42
M	D30t33	Electrical and optical equipment	41	57
M	D34t35	Transport equipment	30	42
M	D36t37	Manufacturing nec; recycling	18	17
S	E	Electricity, gas, and water supply	1	4
S	F	Construction	1	2
S	G	Wholesale and retail trade; repair of goods	6	7
S	H	Hotels and restaurants	4	6
S	I	Transport, storage and communications	5	5
S	J	Financial intermediation	28	42
S	K	Real estate, renting, and business activities	11	10
S	L	Public administration and defense	0	0
S	M	Education	0	0
S	N	Health and social work	0	0
S	O	Other community, social, and personal service activities	4	6

HFDI = intra-industry foreign direct investment, ISIC = International Standard Industrial Classification, M = manufacturing, nec = not elsewhere classified, S = services.

Source: Authors' compilation.



Table A3. Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.	Obs.
Value added (\$) per worker (VA)	8,980.15	14,377.95	12.5	183,240.38	702
Real gross exports (\$) per worker (X)	10,062.6	35,841.95	0	547,825.31	686
Real direct domestic VA (\$) in gross exports (VAX)	2,542.46	6,247.34	0	72,482.41	684
Domestic use coefficient ( $\delta$ )	0.61	0.17	0.17	0.97	702
Domestic supply coefficient ( $\gamma$ )	0.31	0.2	0	0.92	702
Domestic use coefficient from manufacturing sectors	0.18	0.13	0	0.71	702
Domestic supply coefficient to manufacturing sectors	0.11	0.1	0	0.51	698
Domestic use coefficient from service sectors	0.36	0.16	0.06	0.83	702
Domestic supply coefficient to service sectors	0.18	0.14	0	0.78	701
Share of foreign persons employed (HFDI)	19.89	25.29	1	101	702
HFDI in manufacturing sectors	27.78	18.01	2.8	67.23	702
HFDI in service sectors	10.28	6.15	2.24	22.56	702
Backward FDI linkages (BWFDI)	5.45	5.33	1	37.97	702
BWFDI from manufacturing sectors (BWFDIM)	4.09	4.54	1	35.29	702
BWFDI from service sectors (BWFDIS)	2.25	1.52	1	11.7	702
Forward FDI linkages (FWFDI)	9.75	7.72	1.38	56.23	702
FWFDI to manufacturing sectors (FWFDIM)	5.83	5.75	1.05	47.84	702
FWFDI to service sectors (FWFDIS)	4.56	3.54	1.15	35.43	702

Notes: Use (supply) coefficients are calculated as the share of inputs supplied by upstream (to downstream) industries. Foreign direct investment (FDI) variables have been transformed using  $FDI * 100 + 1$ . BWFDI (FWFDI) variables are the product of the supply coefficient  $\gamma$  (use coefficient  $\delta$ ) and HFDI in the downstream (upstream) sector.

Sources: Authors' calculations and International Trade Centre, Investment Map. <http://www.investmentmap.org/>; Organisation for Economic Co-operation and Development, 2015. Trade in Value Added Database. <https://stats.oecd.org/index.aspx?queryid=66237>; and World Bank, 2000–2014. World Input–Output Tables. <http://www.wiod.org/home>.

Table A4. Skill Proxies

Region	Schooling (Years)	Broad Industry	Share of Skilled Workers
Latin America	7.2	Manufacturing	0.57
		Services	0.65
Asia	6.4	Manufacturing	0.44
		Services	0.63
Central and Eastern Europe	10.8	Manufacturing	0.68
		Services	0.78

Notes: The share of skilled workers equals the share in total hours worked by high- and medium-skilled workers. Schooling represents the median of average years of schooling per country over the period 2000–2010.

Sources: International Trade Centre, Investment Map. <http://www.investmentmap.org/>; Organisation for Economic Co-operation and Development, 2015. Trade in Value Added Database. <https://stats.oecd.org/index.aspx?queryid=66237>; Wittgenstein Centre for Demography and Global Human Capital, 2015. Wittgenstein Centre Data Explorer Version 1.2. <http://witt.null2.net/shiny/wic/>; and World Bank, 2000–2014. World Input–Output Tables. <http://www.wiod.org/home>.

Table A5. **Region-Specific Labor Productivity, 2000**

<b>Region</b>	<b>Value Added per Worker (\$, <math>V_{2000}</math>)</b>
Latin America	11,652.87
Asia	4,007.16
Central and Eastern Europe	5,144.67

Source: International Trade Centre. Investment Map. <http://www.investmentmap.org/>.