

# Foreign Firm Characteristics, Absorptive Capacity and the Institutional Framework

The Role of Mediating Factors for FDI Spillovers  
in Low- and Middle-Income Countries

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## Abstract

Using a cross-section of more than 25,000 domestic manufacturing firms in 78 low and middle-income countries from the World Bank's Enterprise Surveys, this paper assesses how mediating factors influence intra-industry productivity spillovers to domestic firms from foreign direct investment. It identifies three types of mediating factors: (i) foreign direct investment spillover

potential, (ii) domestic firm absorptive capacity, and (iii) the host country's institutional framework. It finds that all three affect the extent and direction of foreign direct investment spillovers on domestic firm productivity. However, the impact of mediating factors depends significantly on the level of domestic firms' productivity and the structure of foreign ownership.

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# **Foreign Firm Characteristics, Absorptive Capacity and the Institutional Framework**

## **The Role of Mediating Factors for FDI Spillovers in Low- and Middle-Income Countries**

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# 1 Introduction

Most countries devote considerable attention and resources to attracting foreign direct investment (FDI). This is done in the hope not only of generating benefits like jobs, foreign exchange, and tax revenues, but perhaps more importantly in realizing dynamic benefits to the domestic economy through so-called “spillovers” from FDI. These “spillovers” generally refer to productivity improvements resulting from knowledge diffusion – both in the form of unintentional transmission or intentional transfer – from multinational affiliates to domestic firms, encompassing both technology and all forms of codified and ‘tacit knowledge’ related to production, including management and organizational practices. The existence of spillovers is based on the assumption that multinational firms enjoy technological and other advantages and have, therefore, higher levels of productivity (Hoekman and Javorcik 2006).

Spillovers can diffuse from foreign firms to local producers within the same industry (intra-industry or horizontal spillovers) or to another industry (inter-industry or vertical spillovers).<sup>3</sup> In the latter case, they can affect local input or services suppliers in upstream sectors (backward spillovers) and local customers in downstream sectors (forward spillovers). But clearly the firms, sectors, and countries involved in this process vary substantially, and therefore, the nature and scale of productivity spillovers should also be expected to vary in different contexts. In this paper, we are concerned with identifying and understanding the mediating factors that determine intra-industry productivity spillovers from FDI in low- and middle-income countries.

A vast set of empirical evidence has been amassed over the past decade on the existence and direction of FDI-generated horizontal and vertical spillovers (for a review of the literature, see for example Görg and Greenaway 2004; Lipsey and Sjöholm 2005; Smeets 2008; and Havranek and Irsova 2011). Overall, the results are mixed, and suggest that the postulated spillover effects often do not materialize automatically. As a result, more and more research has been devoted to understanding the various conditions that may explain these mixed results. Three major types of mediating factors have been identified, including (i) characteristics of foreign firms, which shape spillover potential; (ii) characteristics of domestic firms, which shape absorptive capacity to internalize spillovers; and (iii) differences in host country factors (Castellani and Zanfi 2003; Lipsey

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<sup>3</sup> The terms horizontal and vertical spillovers can be used analogously if sectors are narrowly defined. If sectors are defined at a more aggregated level, some intra-industry spillovers can, in reality, present vertical spillovers.

and Sjöholm 2005), which shape both domestic and foreign firm characteristics as well as the transmission channels for spillovers (Paus and Gallagher 2008).

Using a cross-section of more than 25,000 domestic manufacturing firms in 78 low- and middle-income countries from the World Bank's Enterprise Surveys Indicator Database, we assess how mediating factors influence intra-industry productivity spillovers to domestic firms from FDI. This paper contributes to the growing body of research on mediating factors for FDI spillovers in several ways:

First, most studies are limited to examining a single mediating factor, with the majority focusing on the absorptive capacity of domestic firms. Fewer studies analyze the role of foreign investors or host country characteristics and the institutional context for FDI-enhanced productivity spillovers. To our knowledge, only Havranek and Irsova (2011) control for all three types of mediating factor. Their meta-analysis uses the t-statistic of existing FDI spillover estimates from other studies as the dependent variable. In contrast, this study estimates the impact of FDI directly on productivity, and introduces all three types of mediating factors in the form of interaction terms with the FDI presence variable. While the methodological approach of this study is similar to Blalock and Gertler (2009), their study focuses only on a domestic firm's absorptive capacities.

Secondm related to the relatively low number of studies that take into account the characteristics of foreign investors is the fact that studies have neglected the specific dynamics within global value chains (GVCs). Global production networks are "led by large firms based typically in the industrialized countries, and relying often on complex networks of suppliers around the world" (Milberg and Winkler, forthcoming). The potential for FDI spillovers, however, is determined by the GVC in which foreign firms operate and by the specific GVC dynamics, including the FDI motive and sourcing strategy, among others (Paus and Gallagher 2008). This study addresses this gap in the literature by including two measures that proxy for foreign investors' FDI motive and sourcing behavior.

Third, most studies adding mediating factors focus on one or a few variables only. Even the meta-analysis by Meyer and Sinani (2009) covers only seven institutional variables<sup>4</sup>. This study takes a more comprehensive approach, focusing on four variables reflecting the FDI spillover

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<sup>4</sup> In addition, their study also differs in terms of methodology, as it uses the t-statistic of FDI spillover estimates from existing research as the dependent variable.

potential, six variables representing a domestic firm's absorptive capacity, and eleven variables covering national characteristics and the institutional framework.

Fourth, as mentioned above, most studies – with the exception of meta-analyses (e.g. Meyer and Sinani 2009; Havranek and Irsova 2011) – tend to focus on a specific country setting. While such studies have the advantage of examining a specific locational context, using a cross-section of 78 low and middle-income countries allows for the possibility of more generalizable results.

Fifth, it might be possible that mediating factors, such as firm size or exporting capabilities, are a reflection of heterogeneous firm-level productivity (Melitz 2003). Girma and Görg (2007, p. 220), for example, point out that “[i]n the presence of heterogeneous productivity processes, it is more appropriate (and arguably more interesting) to examine the dynamics of productivity at different points of the distribution rather than ‘average’ properties (i.e. conditional means).” Acknowledging the fact that firms are heterogeneous in terms of their productivity, we also examine if the role of mediating factors for FDI spillovers is a function of domestic firms' productivity.

And finally, studies have pointed to the higher spillover potential of foreign affiliates with partial foreign ownership (Javorcik 2004, Javorcik and Spatareanu 2008, Abraham, Konings, and Sloommaekers 2010, Havranek and Irsova 2011), confirming the view that the likelihood of technology leakages and knowledge spillovers are higher from foreign firms with local participation. To our knowledge, this paper is the first paper to show that foreign ownership structure not only matters for FDI spillovers, but also for the impact of other mediating factors.

This paper is structured as follows. In section 2, we identify the mediating factors we use in our empirical analysis and refer to other empirical studies that have used these variables. Section 3 introduces the data and econometric model. In section 4 we present our regression results, while section 5 concludes.

## **2 Mediating Factors**

Farole, Staritz, and Winkler (2012) develop a conceptual framework which depicts various mediating factors, as identified in the literature (see Appendix 1). At the foreign investor level, mediating factors include the FDI motive, sourcing strategy, degree of foreign ownership, and technology intensity, among others, which all can influence the FDI spillover potential. The role of these mediating factors is discussed in section 2.1. At the domestic firm level, studies identify, e.g., research and development (R&D), human capital, technology gap, firm size, export behavior, firm

location, and sectoral competition, as mediating factors, which we examine in section 2.2. These factors determine the local firm's absorptive capacity. Factors at the host-country and institutional level can influence foreign and domestic firm characteristics as well as the transmission channels through which knowledge diffuses from multinational to local firms. Such factors include a country's income per capita, learning and innovation infrastructure, trade policy, business and investment climate, access to finance, labor market regulations, among others. Their role is discussed in section 2.3.

## **2.1 Factors Influencing a Foreign Firm's Spillover Potential**

The degree of *foreign ownership* impacts on local firms' potential to absorb FDI spillovers. A higher share of foreign ownership, and, thus, larger control over management and lower potential for knowledge leakages, correlates positively with the parent firm's incentive to transfer knowledge, e.g., in the form of technology which has been confirmed by empirical studies for Greece (Dimelis and Louri 2002) and Indonesia (Taaki 2005). On the other hand, a larger domestic ownership share could also be beneficial for local firms, since the foreign investor's interests are less-well protected making technology leakages more likely (demonstration effect). A larger domestic participation might further increase the likelihood to rely on domestic suppliers (Crespo and Fontoura 2007). Toth and Semjen (1999) confirm that a larger domestic ownership share led to more inter-sectoral linkages (reported in Crespo and Fontoura 2007).

Empirical studies controlling for different *structures of foreign ownership* tend to support the the more positive spillover effects of joint ventures. Explanations include the possibility of more vertical linkages as well as stronger technology leakages for partially-owned foreign firms (Javorcik and Spatareanu 2008). For example, Havranek and Irsova (2011) find evidence for lower spillovers in fully-owned foreign affiliates, and Javorcik (2004) and Javorcik and Spatareanu (2008) find a positive vertical spillover effect on domestic firms in supplying industries from multinationals with partial foreign ownership, but not from multinationals with full foreign ownership. Abraham et al. (2010) find for a sample of Chinese manufacturing firms that foreign ownership in a domestic firm's sector only results in positive horizontal spillovers when foreign ownership is organized as a joint-venture. By contrast, the presence of fully-owned foreign firm is found to have a negative impact on local firms, due to technology intensity of multinationals crowding-out local producers within the same sectors (Abraham et al. 2010).

Different *motivations* for undertaking FDI – i.e. resource-seeking, efficiency-seeking and market-seeking – are likely to mediate spillover potential. The conventional wisdom is that resource-seeking FDI is that it has less potential for spillovers, due to its capital and technology intensity and limited time horizons, while FDI in manufacturing and services (especially retail) offer greater potential for spillovers. However, evidence remains ambiguous, suggesting that the situation may be context-specific.

Analogously, a multinational firm's *sourcing strategy* may affect the FDI spillover potential. If a multinational firm sources on a global scale, it may follow a co-sourcing strategy, resulting in an increased reliance on imported inputs from established suppliers abroad. Alternatively, a multinational firm might follow co-location strategies requiring an established foreign input supplier to also enter the host country. Both could render the entrance of new local suppliers more difficult. This is particularly common for multinationals in the clothing, footwear, electronics and automotive sector (Paus and Gallagher 2008).

FDI spillovers also depend on the *technology intensity* of the multinational's goods produced in the host country. More technology- or R&D-intensive products generally contain a greater element of knowledge and broader set of skills. However, the production of high-tech products might also involve low-tech processes which could offset this effect (Paus and Gallagher 2008). Focusing on FDI in technology-intensive industries, Buckley, Wang, and Clegg (2007) find positive spillovers on Chinese firms to be stronger if originated by Western-owned multinationals compared to affiliates from Taiwan, China; Hong Kong SAR, China; and Macau which they relate to the higher technology intensity in Western-owned affiliates. Analogously, Lin, Liub, and Zhanga (2009) the positive horizontal and vertical spillovers for FDI from other countries, while FDI from Taiwan, China; Hong Kong SAR, China; and Macao, results in positive forward FDI spillovers only, but in no backward spillovers and negative horizontal FDI spillovers. This is also explained with the more labor-intensive nature of foreign affiliates from Taiwan, China; Hong Kong SAR, China; and Macao (Lin et al. 2009).

## **2.2 Factors Influencing a Domestic Firm's Absorptive Capacity**

The *technology gap* between foreign and domestic firms has been identified as one the most important mediating factors for FDI spillovers (Kokko 1994; Kokko, Tansini, and Zejan 1996;



Grünfeld 2006)<sup>5</sup>. Views on the role of the technology gap for FDI spillovers conflict. Some studies find that a large technology gap is beneficial for local firms since their catching-up potential increases (Findlay 1978; Wang and Blomström 1992; Smeets 2008). Other studies argue that local firms might not be able to absorb positive FDI spillovers if the technology gap between the multinational and local producers is too big or too small (e.g. Blalock and Gertler 2009).

The literature suggests that there is solid evidence for the supportive role of *R&D* in local firms in high income countries, e.g. Spain (Barrios and Strobl 2002; Barrios, Dimelis, Louri, and Strobl 2004), the US (Keller and Yeaple 2009), Ireland (Barrios et al. 2004), and Sweden (Karpaty and Lundberg 2004), among others. There are also studies confirming the supportive role of *R&D* in domestic firms for developing or emerging countries, including the Czech Republic (Kinoshita 2001), India (Kanturia 2000, 2001, 2002), Hungary and Slovakia (Damijan, Knell, Majcen, and Rojec 2003), and Indonesia (Blalock and Gertler 2009), among others. One exception is Damijan et al. (2003) finding a negative role of firm-level *R&D* on FDI spillovers for Estonia and Latvia (reported in Crespo and Fontura 2007).

A domestic firm's ability to absorb foreign technology might also be positively related to its share of *skilled labor*. Blalock and Gertler (2009), for example, find that the proportion of employees with college degrees significantly increases domestic firms' productivity gains from FDI in Indonesian manufacturing. However, Girma and Wakelin (2007) only confirm such a finding for smaller firms in the U.K. – they find that FDI does not affect large firms with a high proportion of human capital, as these firms are probably the most similar to multinationals in terms of technology and market share. In contrast, Sinani and Meyer (2004) find for a sample of Estonian firms that a larger share of human capital reduces the positive spillover effects for domestic firms, but increases it for large firms. Their explanation for this contradicting result is that the competition effect might reduce workers' possibility to extract additional rents from local firms, since multinationals tend to pay better wages. The competition effect might also enable larger firms to keep skilled workers compared to smaller firms who might lose skilled workers to foreign firms.

*Firm size* has been positively related to a domestic firm's capacity to absorb FDI spillovers (e.g. Jordaan 2011b for Mexico). Larger firms may be better positioned to compete with multinationals and to imitate their tools (Crespo and Fontoura 2007). Analogously, larger firms may pay better

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<sup>5</sup> The technology gap is usually measured as a domestic firm's productivity level relative to a benchmark productivity level within the same sector – often of the leading firms (Griffith, Redding, and Simpson 2002; Girma 2005; Girma and Görg 2007) or of foreign firms (Castellini and Zanfei 2003).

wages and therefore find it easier to attract workers employed by multinational firms. Larger firms might also be more visible, e.g. organized in associations, and, thus, more likely selected as local suppliers by foreign firms. While Aitken and Harrison (1999) find negative spillovers from FDI on domestic plants in Venezuela, these effects are only significant for firms with less than 50 employees. This suggests that smaller firms are less competitive and less capable of absorbing positive spillover effects. In contrast, other studies find that small and medium-sized firms benefit more strongly from FDI spillovers, especially those firms with a higher proportion of skilled labor (e.g. Girma and Wakelin 2007; Sinani and Meyer 2004).

Several aspects of domestic firm *location* have shown to be important for the extent of productivity spillovers from FDI. Barrios, Luisito, and Strobl (2006) find evidence that foreign firms collocating (agglomeration) in the same sector and region significantly increase productivity and employment of local manufacturing firms in Ireland. Some studies contest the positive role of agglomeration for a firm's absorptive capacity. For example, while Sjöholm (1999) confirms positive spillover effects when FDI is measured at the country-sector level in Indonesia, he finds negative spillovers when foreign presence is measured at the region-sector level. Aitken and Harrison (1999) and Yudaeva, Kozlov, Malentieva, and Ponomareva (2003) find similar results for Russia.

Besides agglomerations, studies focused on other aspects of location. Firm location in special economic zones, for example, can have a negative impact on FDI spillovers if the zone focuses on export processing combined with a high percentage of imported inputs (Abraham et al. 2010). More regional development (e.g. Ponomareva 2000, Torlak 2004, Girma 2005, Girma and Wakelin 2007) and a domestic firm's geographical proximity to multinational firms (Girma and Wakelin 2007, Resmini and Nicolini 2007) seem to have a positive effect.

*Exporting* has been linked to a domestic firm's absorptive capacity for at least two reasons. First, local exporting firms are generally characterized by a higher productivity, be it via learning-by-exporting or self-selection into exporting, rendering them more competitive to bear up against negative rivalry effects created by multinationals (Crespo and Fontoura 2007). Second, the more a local firm exports, the lower will competitive pressures from multinational firms be felt (assuming that the multinational firm does not enter the same export market), hence, the incentive to improve, which lowers the extent of positive FDI spillovers. However, studies show no clear evidence whether exporting increases or lowers the productivity gains from FDI. While several studies find evidence for lower productivity gains for exporters (e.g. Blomström and Sjöholm 1999,

Ponomareva 2000, Sinai and Meyer 2004, Abraham et al. 2010, and Du, Harrison, and Jefferson 2011). In contrast, some studies find that the gains from FDI are larger for exporting firms (e.g. Barrios and Strobl 2002, Schoors and van der Tol 2002, Lin et al. 2009, Jordaan 2011b).

## **2.3 Host Country Characteristics and Institutional Framework**

*Labor market regulations* can influence the effect of FDI on domestic firms via various channels, including the amount and type of FDI being attracted in the first place, the domestic firm's absorptive capabilities, and the frequency of labor turnover as a transmission channel of spillovers. Using firm-level data for 19 Western and Eastern European countries between 1998 and 2001 Javorcik and Spatareanu (2005), for instance, find that higher absolute and relative labor market flexibility compared with the foreign investor's home country has a positive impact on the likelihood of foreign investment. Besides the amount of FDI, labor market regulations also affect domestic firm's absorptive capacities. In a recent study, Hale and Long (2011) conclude that labor market regulations in general, and wage constraints in particular, affect the level of skills in a firm and, thus, their absorptive capacity. Labor market regulations directly affect the frequency of labor turnover and, thus, the transmission channel. Overly rigid labor markets can reduce the possibility for labor turnover and FDI spillovers. However, overly flexible labor markets may result in frequent labor turnover, lowering the possibility of domestic workers to acquire skills and knowledge in foreign firms.

A few studies stress the role of *financial markets* in developing countries as a mediating factor for the absorption of spillovers (Alfaro, Chanda, Kalemli-Ozcan, and Sayek 2010; Havranek and Irsova 2011). Multinationals can have an ambivalent impact on access to finance for local firms. They might ease access to finance by bringing in scarce capital to developing countries, but if multinationals borrow from local financial institutions, they might increase local firms' financing constraints (Harrison, Love and McMillan, 2004). This, in turn, can influence a local firm's absorptive capacity and, thus, actual FDI spillovers. Harrison et al. (2004) find evidence for the second effect using firm-level data for a cross-section of 38 high- and low-income countries.

Other studies look explicitly at the role of financial development – representing access to finance – for FDI spillovers. Studies find that well-developed financial markets may facilitate a domestic firm's absorptive capacity linkages. Agarwal, Milner, and Riaño (2011), for instance, find that FDI spillovers are lower or even negative for Chinese manufacturing firms that are credit-constrained. Javorcik and Spatareanu (2009) find that less liquidity-constrained firms are more

likely to self-select into supplying multinationals. Havranek and Isrova (2011), in contrast, find evidence for lower FDI spillovers in more developed financial systems. This implies that while access to finance in general should be easier for local suppliers, competition with foreign investors for limited financial resources might also increase with financial development, reducing local firms' absorptive capacity (second effect above).

The share of human capital at the firm-level is influenced by the *local innovation and learning infrastructure*. Meyer and Sinani (2009), for instance, include three measures of a country's availability of human capital and show evidence that the share of workers with tertiary education, the R&D intensity in the private sector, and the number of patents per billion US dollars granted to host country residents significantly affect FDI spillovers. This relationship takes a U-shaped form, i.e. only below or above certain threshold levels of human capital does the extent of spillovers increase (Meyer and Sinani 2009). Tytell and Yudaeva (2007) find evidence for Romania that productivity spillovers from FDI in manufacturing are significantly lower in regions with a low share of education.

Most countries have established special policies to attract FDI, including the establishment of *investment promotion* agencies and a wide range of fiscal incentives. Du et al. (2011) find for China that foreign firms enjoying investment subsidies generate positive backward spillovers, whereas foreign firms not enjoying such subsidies actually generate negative spillovers. In addition, this study finds that foreign firms enjoying tax exemption from value added taxes generate higher forward spillovers than foreign firms that are not exempt from these taxes.

A country's *trade policy* shapes the amount and type of foreign investment and, thus, influences the potential of FDI spillovers. Open trade regimes may be more likely to attract foreign investors than inward-oriented regimes, since they are less constrained by the size and efficiency of the local market in the first case (Crespo and Fontoura 2007). Foreign investors might also be more export-oriented in an open setting, increasing chances for local suppliers to become exporters, too. Moreover, foreign investors in an open trade setting are globally more integrated and therefore adopt the newest technologies (Meyer and Sinani 2009). Others, however, argue that foreign investors in an outward-oriented trade setting might focus more strongly on international distribution and marketing, while foreign firms in an inward-oriented policy regime might bring newer technologies to the host countries (Crespo and Fontoura 2007).

Trade policy also affects domestic firms. Local firms in an open trade regime are more exposed to competitive pressures through international trade competition which will prepare them to better

absorb FDI spillovers. Overall, studies confirm that FDI spillovers are larger in countries that are more open towards trade (Meyer and Sinani 2009; Du et al. 2011, Havranek and Irsova 2011).

Weak *institutions* – including corruption, red tape, or intellectual property rights – are linked to protectionism with regard to local firms, network-driven business practices, and inefficient markets. Foreign investors may, in such cases, be constrained from exploiting fully their competitive advantages. This may influence the type of FDI attracted in the first place, as well as the domestic firms' absorptive capacities. Empirical evidence is mixed. Using firm-level data for 17 emerging countries over the period 2002-2005, Gorodnichenko, Svejnar, and Terrell (2007) find no evidence that the extent of FDI spillovers is affected by the degree of corruption (measured as bribes) or red tape (measured as manager's time spent with officials). Measuring transparency with a corruption perception index, Meyer and Sinani (2009) find evidence that a country's level of transparency has a U-shaped effect on FDI spillovers, i.e. countries with a medium level of transparency benefit the least from FDI, while countries with a low and high level of transparency benefit show stronger FDI spillovers.

Finally, competitive pressures from multinational firms might be lower if the local firm already faces a high level of *competition* at the sectoral level. As in the case of exports, local firms in competitive sectors might have a lower incentive to improve, resulting in lower benefits from FDI spillovers. Sinani and Meyer (2004) confirm that more sectoral competition both of foreign firms and of domestic firms have a positive impact on the growth of sales of local firms in Estonia, but do not control for the interaction of competition with FDI. On the other hand, local firms could be better equipped to benefit from positive demonstration effects. Barrios and Strobl (2002) find that less sectoral competition, captured by a higher Hirschman-Herfindahl index (HHI), increases the productivity gains from FDI for Spain, pointing towards a lower incentive to improve.

### 3 Empirical Model

#### 3.1 Econometric Model and Estimation Strategy

Following Blalock and Gertler (2009), we define the following equation:

$$\ln prod_{irst} = \alpha_0 + \beta FDI_{sct} + \gamma FDI_{sct} * MF + D_r + D_s + D_t + \varepsilon_{irst} \quad (1)$$

where subscript  $i$  stands for firm,  $r$  for (sub-national) region,  $s$  for sector,  $c$  for country, and  $t$  for year.  $\alpha_0$  designates the constant,  $D_r$  region fixed effects,  $D_s$  sector fixed effects,  $D_t$  year fixed effects, and  $\varepsilon_{irst}$  the idiosyncratic error term.  $\ln prod$  is a measure of productivity in logarithms,  $FDI$  a measure of FDI presence at the sectoral level in a country, and  $FDI_s * MF$  the interaction term of FDI with a mediating factor MF. The total effect of FDI on productivity is given by  $\beta + \gamma MF$ . Our coefficient of interest is  $\gamma$ . The total effect of FDI on productivity will be larger (smaller resp.) than  $\beta$  if the coefficient of the interaction term is positive (negative resp.), i.e.  $\gamma > 0$  ( $\gamma < 0$  resp.).

Following the literature, we use the share of foreign output as percentage total output at the sectoral level as our measure of intra-industry FDI presence.<sup>6</sup>

$$FDI_{sct}^Y = \frac{\sum_{i \in sct} Y_i^{for}}{\sum_{i \in sct} Y_i} \quad (2)$$

where  $i \in sc$  indicates a firm in a given sector  $s$  of country  $c$ ,  $Y_i$  is firm-level output in a given sector of country  $c$ , and  $Y_i^{for}$  is output if the firm is foreign. As common in the literature on FDI, we only consider firms as foreign with a foreign ownership of 10 percent or higher.

The foreign output share variable in the strict sense captures only horizontal spillovers. However, since sectors are defined at a broad level (see Appendix 3), the foreign output share variable is likely to capture some vertical spillovers. For example, ‘auto and auto components’ includes both final automotive producers and suppliers of automotive components – thus, FDI in this sector could impact on both domestic final producers of cars as well as domestic suppliers of

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<sup>6</sup> Blalock and Gertler (2009) calculate FDI spillovers at the region-sector level due to the geographical specificities of Indonesia (i.e. many islands). We follow the majority of studies that calculate FDI at the sectoral level.

auto components. Similar situations are also likely in sectors such as food, electronics, and chemicals and pharmaceuticals.

To capture firm-level productivity, we use labor productivity, LP, defined as value added per worker. LP measures are only available for manufacturing sectors.<sup>7</sup> Since labor productivity is mainly determined by capital intensity, we add firm-level capital intensity, defined as capital stock<sup>8</sup> per worker, in logarithms as an explanatory variable to each specification in order to avoid an omitted variable bias. This yields the following estimation equation:

$$\ln lp_{irst} = \alpha_0 + \beta FDI_{sct}^Y + \gamma FDI_{sct}^Y * MF + \ln capint_{irst} + D_r + D_s + D_t + \varepsilon_{irst} \quad (3)$$

Since we are only interested in spillovers from foreign to domestic firms, we run the regressions across domestic firms only. In a first step, we run the baseline regressions as specified in equation (3) using ordinary least squares (OLS).

The cross-sectional nature of our dataset (see section 3.2), however, renders the identification of a causal relationship between foreign output share and domestic firm productivity difficult. Foreign firms may be attracted into a specific sector in a country because of some unobserved characteristics that are correlated with domestic firm productivity. Aitken and Harrison (1999) find that controlling for such unobservable effects at the country-sector level leads to negative spillovers, while not controlling for fixed country-specific sector effects reserves the impact.

To control for such effects adequately, we would need to include fixed country-sector effects, which is not possible using cross-sectional data, as those would be perfectly correlated with the spillovers variable. One alternative approach to address this issue is to instrument for foreign output share. Only few studies to date have used instruments to address the potential endogeneity between FDI presence and domestic firm productivity. Haskel et al. (2007) instrument their sectoral FDI presence variable for the UK with sectoral inward FDI data from the US. Similarly, in his study on Mexican manufacturing firms, Jordaan (2011a) uses the US sectoral foreign employment share as instrument for his sectoral FDI spillover measure. In their study on FDI spillovers in the US, Keller and Yeaple (2009) use contemporaneous changes in shipping costs and tariffs and lagged levels of the real exchange rate interacted with industry dummies to instrument

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<sup>7</sup> Our cross-sectional dataset is not suited to calculate total factor productivity using the standard methodologies that control for the endogeneity of input demand (e.g. Olley-Pakes 1996 or Levinsohn-Petrin 2003).

<sup>8</sup> Capital stock is defined as the replacement value of machinery, vehicles, and equipment. Information on the replacement value of buildings and land was very incomplete and was, thus, not included.

for sectoral FDI presence and imports. In a second step, we estimate the regressions using an instrumental variables two-stage least squares (IV 2SLS) approach.

### 3.2 Data and Instruments

The World Bank Enterprise Analysis Unit recently published the Enterprise Surveys Indicator Database.<sup>9</sup> This publication covers 215 enterprise surveys for 126 countries over the period 2006 to 2010. Enterprise surveys represent a comprehensive source of firm-level data in emerging markets and developing economies. One major advantage of the enterprise surveys is that the survey questions are the same across all countries. Moreover, the Enterprise Surveys represent a stratified random sample of firms using three levels of stratification: sector, firm size, and region. Sectors are based on the ISIC Rev. 3.1 classification, but in some cases are further aggregated.

The Enterprise Surveys Indicator Database covers a wide range of indicators on firm characteristics, the business environment, innovation and technology, and workforce and skills among others. We merged this dataset with data on firm-level output, value added, and capital stock obtained from the Enterprise Analysis Unit of the World Bank.<sup>10</sup> All local currencies have been converted into US dollars and deflated using a GDP deflator in USD (base year 2000). Exchange rates and GDP deflators have been obtained from the World Development Indicators.

We apply the following rules to the dataset: (i) We include only the most recent Enterprise Surveys for each country; (ii) We include only countries that cover foreign firms in the surveys<sup>11</sup>; (iii) We drop high-income countries to cover only emerging or developing countries<sup>12</sup>; and (iv) We drop countries for which we cannot calculate foreign output share due to unavailable output data. We focus only on the effects of productivity spillovers on domestic manufacturing firms, since productivity measures were unavailable for services firms.

The procedure above results in more than 25,000 domestic firms and 3,400 foreign firms in 78 countries covering eleven manufacturing sectors. The list of countries, year of most recent survey and number of domestic and foreign manufacturing firms by country can be found in Appendix 2.

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<sup>9</sup> See <http://www.enterprisesurveys.org/~media/FPDKM/EnterpriseSurveys/Documents/Misc/Indicator-Descriptions.pdf> for a description of the indicators. Our analysis is based on the October 2011 release of the Enterprise Surveys Indicator Database.

<sup>10</sup> We thank Federica Saliola and Murat Seker for making these data available to us.

<sup>11</sup> Only Kosovo did not fulfill this criterion.

<sup>12</sup> We drop these, as the database only included eleven high-income countries which were not representative of high-income countries (some OECD countries, some non-OECD countries, and one oil exporter).



We combine these firm-level data with country-level data to control for national characteristics, including a country's institutional framework. The data source for each variable is indicated in section 3.5. Data for the national variables are aligned with the survey year of a country's enterprise survey (see Appendix 2 for information on survey years). In a few cases where national data were unavailable for the specific survey year, we choose the observation of the nearest available year.

We include three different instruments for foreign output share. The selection of these instruments is based on the assumption that the instruments are correlated with the foreign output share variable, but not with domestic firm productivity in the country of interest. First, we take advantage of the fact that for many countries the Enterprise Surveys Indicator Database publishes surveys for more than one year. Based on the previous survey year for such countries, we are able to calculate the foreign output share variable as defined in equation 2 to be used as an instrument. For some countries we have to rely on the previous version of the Enterprise Surveys Indicator Database which covers the period 2002-2005.<sup>13</sup> In most cases, the time lag between the original and lagged foreign output share variables covers between two and four years. Therefore, it is safe to assume that the instrument is correlated with the foreign output share variable in  $t$ , but not correlated with domestic firm productivity in  $t$ .

Second, we add a sectoral measure of sector targeting by investment promotion agencies.<sup>14</sup> The measure equals 1 if a sector has been targeted by a country's investment promotion agency in a certain year and 0 if not. As foreign output share rather reflects longer-term FDI presence, we aggregate the dummies over the period 2000 to 2004 to obtain a measure of total length of sector targeting in the early 2000s. The sum can range from 0 (no targeting over this period) to 5 (continuous targeting over this period). To control for non-linearities, we use the measure in natural logarithms, i.e.  $\ln(\text{total sector targeting} + 1)$ . We believe that total sector targeting is well-suited as an instrument, as it is correlated with the foreign output share variable, but not with domestic firm productivity – especially since there is a time lag between these two measures.

Finally, following Keller and Yeaple (2009), we include sectoral tariffs obtained from the World Bank WITS Database. The data are based on the WTO NAMA method (effectively applied rates).

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<sup>13</sup> We thank Minh Cong Nguyen for making an older version of the Enterprise Surveys Indicator Database available to us.

<sup>14</sup> The authors are grateful to Torfinn Harding, Beata Javorcik and Daniel Lederman for making this dataset available to us. For more information on the dataset, see Harding and Javorcik (2011).

Since some of our sectors are more aggregated than the original ISIC Rev. 3.1 classification, we aggregate tariffs up using import shares as weights. Tariff data are aligned with the survey year of a country's enterprise survey. In a few cases where tariff data are unavailable for the specific survey year, we choose the observation of the nearest available year before the survey year.

### 3.3 Measures of Foreign Spillover Potential

We now turn to the mediating factors MF. In a first step we present measures of FDI spillover potential at the sectoral level based on available data in the Enterprise Surveys Indicator Database. All of the following variables are averages across all foreign firms within a specific sector of a country.

- *own* = a sector's average percentage of foreign ownership in a country;
- *market* = a sector's average percentage of FDI sales to the domestic market in a country. This measure serves as a proxy for a sector's average FDI motive in a country, whereby a higher share is associated with market-oriented FDI;
- *inp* = a sector's average percentage of domestic input purchases of FDI firms in a country. This measure captures a sector's average sourcing strategy of foreign firms in a country, whereby a higher share is associated with more local sourcing;
- *tech* = *iso* + *tech\_for* + *website* + *email* with  $0 \leq tech \leq 4$ , where *iso* = 1 if firm owns internationally-recognized quality certification and 0 otherwise, *tech\_for* = 1 if firm uses technology licensed from foreign firms and 0 otherwise, *website* = 1 if firm uses own website to communicate with clients or suppliers, *email* = 1 if firm uses email to communicate with clients or suppliers. The technology indicator serves as a proxy for a sector's average FDI technology intensity in a country.

### 3.4 Measures of Absorptive Capacity

In a second step, we include the following measures of absorptive capacity that were available in the Enterprise Surveys Indicator Database.

- *gap* = domestic firm's LP relative to median LP of multinational firms in sector in natural logarithms;

- *tech* = domestic firm's technology indicator as defined in previous section, where *tech*  $\in \{0, 1, 2, 3, 4\}$ . The technology indicator serves as a proxy for R&D intensity which is unavailable;
- *skills* = domestic firm's share of high-skilled labor in firm's total labor force;
- *size* = domestic firm's total number of permanent and temporary employees in natural logarithms;
- *aggl* = region's total number of manufacturing and services firms as percentage of a country's total number of manufacturing and services firms. This measure is a proxy for urbanization economies (locational advantages) and covers both domestic and foreign firms<sup>15</sup>;
- *exp* = domestic firm's share of direct or indirect exports in firm sales.

### 3.5 Measures of National Characteristics and Institutions

In a third step, we turn to mediating factors at the national level. We include the following country-level variables into the model.

- *labor* = measure of labor freedom in natural logarithms from the Heritage Foundation and captures labor market institutions. The variable ranges from 0 to 100 (highest labor freedom) and includes various aspects of the legal and regulatory framework of a country's labor market, such as minimum wages; laws inhibiting layoffs; severance requirements; and measurable regulatory burdens on hiring, hours, etc. The measure is mainly based on data from the World Bank's Doing Business study;
- *finance* = measure of financial freedom in natural logarithms from the Heritage Foundation. The variable measures banking efficiency as well as a measure of independence from government control and interference in the financial sector with scores ranging from 0 to 100 (highest financial freedom). This measure relies on various underlying data sources, including (in order of priority) the Economist Intelligence Unit, the International Monetary Fund, the Organisation for Economic Co-

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<sup>15</sup> We included services and foreign firms in this measure as urbanization economies refer to spillovers due to the proximity of firms from all types of sectors and ownership.

operation and Development, and official government publications of each country, among others;

- *educ1* = government spending on education as percentage of GDP from the WDI database;
- *educ2* = people with completed secondary and tertiary education as percentage of population aged 15 and over from Barro and Lee (2010);
- *rd* = a country's expenditures on research and development as percentage of GDP from the WDI database;
- *investment* = measure of investment freedom in natural logarithms from the Heritage Foundation and serves as a proxy for investment promotion. The score ranges from 0 to 100 (highest investment freedom) and measures the ability of individuals and firms to move their resources in and out of specific activities both internally and across the country's borders. This variable is mainly based on official government publications of each country on capital flows and foreign investment;
- *trade1* = a country's share of exports of goods and services as percentage of GDP from the WDI database;
- *trade2* = measure of trade freedom in logarithms from the Heritage Foundation, which is a composite measure of the trade-weighted average applied tariff rate and non-tariff barriers with scores ranging from 0 to 100 (highest trade freedom), reflecting the absence of trade protectionism. The measure is based on various underlying sources including data from World Bank, the World Trade Organization, and the Economist Intelligence Unit, among others;
- *business* = measure of business freedom in natural logarithms from the Heritage Foundation as an outcome-based indicator of a country's institutional development. It is a measure reflecting the ability to start, operate, and close a business with scores ranging from 0 to 100 (highest business freedom). The measure mainly relies on the World Bank's Doing Business study;
- *hhi* = HHI of sector concentration to capture competition in a domestic firm's sector. The HHI of sector concentration is defined as the sum of squares of firm's output share by sector. If only one firm operates in a sector, the HHI would be 1. A lower HHI reflects a higher sectoral diversity. This measure includes both domestic and foreign firms;

- *income* = a country's per capita GDP (USD at 2000 prices) in natural logarithms from the World Bank's World Development Indicators (WDI) database. It captures national competition, but also other aspects of the national and institutional environment.

## 4 Regression Results

### 4.1 FDI Spillover Potential

#### *Overall Results*

In the following, we apply OLS and IV 2SLS regressions. All regression results follow equation (3) and include sector, subnational region, and year fixed effects. Standard errors are robust to heteroscedasticity and clustered at the country-sector level.<sup>16</sup> Foreign output share is defined as in equation (2). The summary statistics are reported in Appendix 4. Our data sample only includes domestic manufacturing firms, i.e. all firms with a foreign ownership share of less than 10 percent (see Appendix 2). Table 1 shows how the FDI spillover potential influences domestic firm productivity. Columns 1 to 4 report the OLS regression results, while columns 5 to 10 report the IV 2SLS regression results<sup>17</sup>. Foreign firm characteristics are averages across all foreign firms within a specific sector of a country. To rule out the possibility that the impact of a foreign firm characteristic on FDI spillovers which we observe is not the result of another foreign firm characteristic for which we do not simultaneously control, we assess the correlation of foreign firm characteristics with each other. The correlation matrix (available upon request) reassures us that foreign firm characteristics show a very low correlation of at most 0.26.

As could be expected, capital intensity shows a positive and significant effect on labor productivity. More importantly for this paper, intra-industry foreign output share mostly shows a negative effect on labor productivity of domestic firms, although in Table 1 the impact is only significant in column 2. What may explain the negative FDI spillovers? In the short term, local firms might face losses in their market share due to increased competition (competition effect). Loss of market share, in turn, requires them to produce at higher average unit-costs, as a declining amount

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<sup>16</sup> We partial out fixed sector, subnational region and year effects in the IV 2SLS regressions to avoid that the covariance matrix of orthogonality conditions is not of full rank, which is common when using the cluster option. This also allows us to perform overidentification tests.

<sup>17</sup> The number of observations is lower in the IV 2SLS regressions since not all instruments are available for all countries (see summary statistics in Appendix 4).

of output shifts them left on the economies-of-scale curve (Harrison 1994; Aitken and Harrison 1999; Crespo and Fontoura 2007). It is also more likely in the short term that foreign firms bid away high quality labor from domestic firms by offering higher wages and benefits (labor turnover effect), resulting in a potentially negative spillover effect (Sinani and Meyer 2004; Hoekman and Javorcik 2006; Crespo and Fontoura 2007).

Both effects can reverse in the medium to long term, if domestic firms become more productive due to increased competition and start to absorb skilled workers from multinationals. Given that our data sample only allows us to control for short-term effects, the negative coefficients on the foreign output share variable are not surprising. Moreover, they are in line with other studies rejecting the existence of positive intra-industry FDI spillovers (Havranek and Irsova 2011) or studies that find negative intra-industry spillovers (e.g. Aitken and Harrison 1999; Djankov and Hoekman 2000; Konings 2001, among others).<sup>18</sup>

A sector's average share of foreign ownership in a country (*own*) shows a positive coefficient sign, but is insignificant (columns 1 and 5). The interaction terms with a sector's average percentage of FDI sales to the domestic market in a country (*market*) has a significantly positive effect on domestic firms' productivity in the OLS regressions (column 2), confirming the hypothesis that market-seeking FDI is more likely not only to provide a higher spillover potential, but also to translate into more positive actual spillovers.

Since the *market* variable might be influenced by the productivity of domestic competitors, we additionally instrument for the interaction term of foreign output share with the *market* variable in column 7. We choose the sectoral average number of days to clear direct exports through customs in a country (in natural logarithms) from the Enterprise Surveys Indicator Database as an inverse instrument. One could argue that longer waiting times at customs motivate foreign firms to rely more strongly on the host market for sales. The coefficient signs in the IV 2SLS regressions are also positive, but insignificant (columns 6 and 7). However, the Hansen J-test of over-identifying restrictions implies that the instruments are not accepted in these specifications.

Analogously, a sector's average percentage of domestic input purchases of FDI firms in a country (*inp*) might be endogenous, as the sectoral share of inputs purchased locally might be

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<sup>18</sup> Görg and Strobl (2001) and Görg and Greenaway (2004), however, argue that studies using cross-sectional data tend to find positive FDI spillovers, which they relate to potential time-invariant effects across units (firms or sectors) that are correlated with the FDI presence variable without being caused by it. Interestingly, we find negative FDI spillover effects regardless of whether we control for this potential endogeneity (IV 2SLS) or not (OLS).

influenced by domestic firm productivity. We therefore additionally instrument for the interaction term of foreign output share with the *inp* variable in column 9, using the sectoral average number of days to clear imports through customs in a country (in natural logarithms) from the Enterprise Surveys Indicator Database as an inverse instrument. The argument for this choice of instrument would be that longer waiting times at customs may motivate foreign firms to source more inputs from the domestic market. The IV 2SLS regressions show that the interaction term with *inp* has a positive coefficient sign (columns 8 and 9), while it is negative in the OLS regression (column 3). Both interaction terms are insignificant. The interaction term with sectoral FDI technology intensity in a country (*tech*) has a negative but insignificant impact in both regressions (columns 4 and 10), rejecting the findings of a positive impact (e.g. Buckley et al. 2007; Lin et al. 2009).

Unfortunately, many results fall short of the thresholds of statistical significance, which could be related to heterogeneous productivity levels of domestic firms (Girma and Görg 2007). We therefore examine the dynamics of productivity at different points of the distribution in a next step.

### ***The Role of Domestic Firm Productivity***

We split our sample into three productivity groups: LP  $\leq$  33.33 percentile (low-productivity firms); 33.33 percentile < LP  $\leq$  66.67 percentile (medium-productivity firms); and LP > 66.67 percentile (high-productivity firms). The IV 2SLS regression results by productivity level are shown in Appendices 5 to 7. We detect clear differences across the three types of domestic firms. The foreign output share variable mostly shows negative coefficient signs for all types of firms, but is rarely significant. However, the coefficients decline with firm productivity, suggesting that higher productivity reduces negative FDI spillovers. Capital intensity shows a constantly positive effect on labor productivity, but the impact is strongest for high-productivity firms, followed by low-productivity firms and medium-productivity firms.

The interaction term with foreign ownership share (*for*) is insignificant for all types of firms (column 1). The interaction term with FDI sales to the domestic market is positive and significant for both low- and medium-productivity firms, but more so for low-productivity firms (columns 2 and 3). While market-seeking FDI provides a higher spillover potential, the underlying transmission channels, however, seem to be different for both types of firms. It is more likely that medium-productivity firms benefit from competition and demonstration effects, while low-productivity firms may rather benefit from potential integration in supply chains and labor turnover.

**Table 1: FDI Spillover Potential, FDI Spillovers, All Domestic Firms**

| Dependent variable: $\ln p_{irst}$ |                        |                      |                      |                      |                                                |                      |                      |                      |                      |                      |
|------------------------------------|------------------------|----------------------|----------------------|----------------------|------------------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                    | Ordinary Least Squares |                      |                      |                      | Instrumental Variables Two-Stage Least Squares |                      |                      |                      |                      |                      |
|                                    | (1)                    | (2)                  | (3)                  | (4)                  | (5)                                            | (6)                  | (7)                  | (8)                  | (9)                  | (10)                 |
| $FDI_{sct}^Y$                      | -0.3300<br>(0.134)     | -0.3243**<br>(0.012) | -0.0341<br>(0.790)   | 0.1777<br>(0.360)    | -0.5360<br>(0.680)                             | -0.6277<br>(0.201)   | -1.4594<br>(0.112)   | -0.7505<br>(0.129)   | -2.2952<br>(0.187)   | 0.2180<br>(0.643)    |
| $FDI_{sct}^Y * own_{sct}$          | 0.3158<br>(0.228)      |                      |                      |                      | 0.5961<br>(0.680)                              |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * market_{sct}$       |                        | 0.3979**<br>(0.028)  |                      |                      |                                                | 0.8586<br>(0.141)    | 2.1830<br>(0.123)    |                      |                      |                      |
| $FDI_{sct}^Y * inp_{sct}$          |                        |                      | -0.0844<br>(0.700)   |                      |                                                |                      |                      | 1.1346<br>(0.114)    | 4.0729<br>(0.198)    |                      |
| $FDI_{sct}^Y * tech_{sct}$         |                        |                      |                      | -0.1050<br>(0.147)   |                                                |                      |                      |                      |                      | -0.1177<br>(0.479)   |
| $\ln capint_{irst}$                | 0.2726***<br>(0.000)   | 0.2727***<br>(0.000) | 0.2734***<br>(0.000) | 0.2728***<br>(0.000) | 0.2664***<br>(0.000)                           | 0.2661***<br>(0.000) | 0.2665***<br>(0.000) | 0.2660***<br>(0.000) | 0.2643***<br>(0.000) | 0.2665***<br>(0.000) |
| Observations                       | 15,137                 | 15,137               | 15,106               | 15,137               | 5,193                                          | 5,193                | 5,152                | 5,193                | 5,162                | 5,193                |
| R-squared                          | 0.62                   | 0.62                 | 0.62                 | 0.62                 | 0.14                                           | 0.14                 | 0.13                 | 0.13                 | 0.11                 | 0.14                 |
| Endog. var.                        |                        |                      |                      |                      | 1                                              | 1                    | 2                    | 1                    | 2                    | 1                    |
| Instruments                        |                        |                      |                      |                      | 3                                              | 3                    | 4                    | 3                    | 4                    | 3                    |
| F-stat. FDI                        |                        |                      |                      |                      | 2.81                                           | 4.81                 | 19.62                | 5.35                 | 17.28                | 4.99                 |
| F-stat. market_int                 |                        |                      |                      |                      |                                                |                      | 13.89                |                      |                      |                      |
| F-stat. inp_int                    |                        |                      |                      |                      |                                                |                      |                      |                      | 10.82                |                      |
| Hansen p-val.                      |                        |                      |                      |                      | 0.1133                                         | 0.0805               | 0.0967               | 0.3629               | 0.8662               | 0.1458               |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects. Standard errors are clustered at the country-sector level.



A sector's average percentage of domestic input purchases of FDI firms in a country (*inp*) also shows a positive and significant impact for low- and medium-productivity firms (column 4). Our results suggest that more local sourcing is associated with more positive FDI spillovers to domestic firms. Various transmission channels between foreign firms and domestic suppliers are plausible, e.g. the demand and assistance effect, diffusion effect, availability and quality effect as shown in Appendix 1 (see Farole et al. 2012 for more details). Again, the effects are stronger for low-productivity firms which may be the result of their higher catching-up potential.

The interaction term with foreign technology intensity (*tech*) is negative, but insignificant for all types of firms (column 6). However, the p-value is lower for high-productivity firms, implying that a smaller technology gap between high-productivity domestic firms and foreign firms renders it more difficult for the former to absorb foreign technology.

In sum, the results show that low- and medium-productivity firms benefit more positively from foreign presence than high-productivity firms.

### ***The Role of Foreign Ownership Structure***

In a next step, we also assess whether the results depend on the structure of foreign ownership, as discussed in section 2.1. We therefore calculate two variants of the foreign output share variable in equation two: (i) foreign output share based on firms with full-foreign ownership, defined as a foreign participation of 100 percent, and (ii) foreign output share based on firms with partial foreign ownership, defined as foreign participation of at least 10 percent but less than 100 percent. Appendix 3 shows the number of foreign firms by structure of foreign ownership. It is worth noting that in all countries of our data sample but one (Yemen) there exists a mix of both fully and partially foreign-owned firms, suggesting that there is no substantial impact of investment policy (i.e. requirements for local participation) on foreign ownership structure<sup>19</sup>.

Analogously, we also calculate the average foreign firm characteristics in a sector and country, as described in section 3.3, based on fully-owned and partially-owned foreign firms only. Appendix 8 shows the results for full foreign ownership (columns 1 to 6) and partial foreign ownerships (columns 7 to 12). While foreign firms in a country's sector sell on average 67.5 percent to the domestic market (*market*), this share is 69 percent for partial FDI versus 65 percent for fully-owned

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<sup>19</sup> This may be explained by the fact that this analysis focuses on the manufacturing sector, where restrictions on full foreign ownership are much less common than in services sectors.

FDI. Similarly, average purchases from local sources in a country's sector (*inp*) are 57 percent for all foreign firms, but the split sample shows it is almost 60 percent for partially-owned FDI and only 55 percent for fully-owned FDI (see summary statistics in Appendix 4). All differences are statistically significant at the 1 percentage level. These summary statistics alone suggest that partially-owned foreign firms are more integrated into domestic markets than fully foreign-owned firms, and may indicate a higher spillover potential for partially-owned foreign firms.

Appendix 8 shows the regression results by foreign ownership structure. Note that the model dropped the sectoral foreign ownership variable (*own*) for fully-owned FDI, as the value, by definition, is 100 percent for every sector. The interaction term with foreign firms' sales to the domestic market (*market*) is positive but only significant for fully foreign-owned FDI (column 3), implying that spillovers from market-oriented FDI are more beneficial from foreign firms with full ownership, possibly due to their higher willingness to transfer technology (Dimelis and Louri 2002, Taaki 2005).

The interaction term with foreign firms' share of local inputs (*inp*) is positive and significant for partially foreign-owned FDI (column 10), suggesting that local sourcing increases the productivity spillovers from foreign firms with local participation, possibly due to the existence of more vertical linkages (Javorcik and Spatareanu 2008). On the other hand, more local sourcing reduces the spillovers from fully-owned FDI which is insignificant.

Overall, the results cannot give a clear answer whether full or partial foreign ownership translates into higher FDI spillovers, since the latter also depend on the foreign firm's FDI motive and sourcing strategy.

## 4.2 Absorptive Capacity

### ***Overall Results***

Table 2 shows the regression results for domestic firms' absorptive capacities. Columns 1 to 6 report the estimates using OLS, while columns 7 to 12 show the results using IV 2SLS. Again, we need to rule out the possibility that the observed impact of a firm's absorptive capacity on FDI spillovers does not pick up another absorptive capacity for which we do not simultaneously control. The correlation matrix (available upon request) shows that in almost all cases absorptive capacities have a correlation which is lower than 0.33. Only firm size and technology intensity show a correlation of 0.52, which still lies within an acceptable range.

Foreign output share shows a negative and often significant impact on labor productivity, except for columns 1 and 7. Interestingly, the results clearly indicate that FDI spillovers in the OLS estimates are upward biased compared to the IV 2SLS estimates, confirming the results by Aitken and Harrison (1999) who find that foreign firms might be attracted to more productive industries which OLS estimates using cross-sectional data cannot adequately control for. Capital intensity has a positive and significant effect in all specifications.

Absorptive capacities are measured at the domestic firm level and interacted with our FDI measure. The results show that absorptive capacity influences FDI spillovers, regardless of the type of estimator being used. In particular, the interaction term with productivity gap (*gap*) shows a significantly positive impact (columns 1 and 7)<sup>20</sup>. This argues against the findings of other studies claiming that a large technology gap is beneficial for local firms, since their catching-up potential increases (Findlay 1978; Wang and Blomström 1992; Smeets 2008), and instead supports the idea that too large a gap hinders absorption potential (Blalock and Gertler 2009).

The interaction with a domestic firm's technology (*tech*) has a significantly positive effect on domestic labor productivity (columns 2 and 8). This confirms the high number of studies pointing towards a positive effect of R&D (see section 2.2). The interaction term with skills, however, does not influence domestic labor productivity (column 3). Firm size, measured by number of employees (*size*), shows a positive interaction with foreign output share which is significant (columns 4 and 10). Our results confirm the majority of studies which positively relate firm size to a domestic firm's capacity to absorb FDI spillovers.

The proximity to other firms in a subnational region (*aggl*) also shows a positive productivity effect in interaction with foreign output share (columns 5 and 11), which is in line with Barrios et al.'s (2006) findings. Finally, the interaction with exports, measured as export share (*exp*), also shows a significantly positive productivity effect (columns 6 and 12) which is in line with other empirical studies (e.g. Barrios and Strobl 2002, Schoors and van der Tol 2002, Lin et al. 2009, Jordaan 2011b) supporting the hypothesis that exporting renders domestic firms more competitive to bear up against negative rivalry effects created by multinationals (Crespo and Fontoura 2007).

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<sup>20</sup> Recall that our variable *gap* measures the ratio of domestic firm productivity to the median foreign firm productivity, so a higher number indicates a lower gap.

**Table 2: Absorptive Capacity, FDI Spillovers, All Domestic Firms**

| Dependent variable: $\ln p_{irst}$ |                        |                       |                      |                       |                      |                      |                                                |                      |                      |                       |                      |                      |
|------------------------------------|------------------------|-----------------------|----------------------|-----------------------|----------------------|----------------------|------------------------------------------------|----------------------|----------------------|-----------------------|----------------------|----------------------|
|                                    | Ordinary Least Squares |                       |                      |                       |                      |                      | Instrumental Variables Two-Stage Least Squares |                      |                      |                       |                      |                      |
|                                    | (1)                    | (2)                   | (3)                  | (4)                   | (5)                  | (6)                  | (7)                                            | (8)                  | (9)                  | (10)                  | (11)                 | (12)                 |
| $FDI_{sct}^Y$                      | 1.3735***<br>(0.000)   | -0.6764***<br>(0.000) | -0.0375<br>(0.674)   | -1.0001***<br>(0.000) | -0.2646**<br>(0.018) | -0.1391*<br>(0.052)  | 0.8201***<br>(0.005)                           | -0.4614**<br>(0.015) | -0.1304<br>(0.565)   | -1.0139***<br>(0.001) | -0.5029<br>(0.120)   | -0.1528<br>(0.367)   |
| $FDI_{sct}^Y * gap_{isct}$         | 1.6451***<br>(0.000)   |                       |                      |                       |                      |                      | 1.7388***<br>(0.000)                           |                      |                      |                       |                      |                      |
| $FDI_{sct}^Y * tech_{irst}$        |                        | 0.4660***<br>(0.000)  |                      |                       |                      |                      |                                                | 0.4674***<br>(0.000) |                      |                       |                      |                      |
| $FDI_{sct}^Y * skills_{irst}$      |                        |                       | -0.0178<br>(0.840)   |                       |                      |                      |                                                |                      | 0.1205<br>(0.425)    |                       |                      |                      |
| $FDI_{sct}^Y * size_{irst}$        |                        |                       |                      | 0.2758***<br>(0.000)  |                      |                      |                                                |                      |                      | 0.3184***<br>(0.000)  |                      |                      |
| $FDI_{sct}^Y * aggl_{rct}$         |                        |                       |                      |                       | 0.5346**<br>(0.046)  |                      |                                                |                      |                      |                       | 1.0066*<br>(0.054)   |                      |
| $FDI_{sct}^Y * exp_{irst}$         |                        |                       |                      |                       |                      | 0.6344***<br>(0.000) |                                                |                      |                      |                       |                      | 0.9274***<br>(0.000) |
| $\ln capint_{irst}$                | 0.1524***<br>(0.000)   | 0.2578***<br>(0.000)  | 0.2683***<br>(0.000) | 0.2665***<br>(0.000)  | 0.2701***<br>(0.000) | 0.2701***<br>(0.000) | 0.1310***<br>(0.000)                           | 0.2495***<br>(0.000) | 0.2607***<br>(0.000) | 0.2585***<br>(0.000)  | 0.2636***<br>(0.000) | 0.2626***<br>(0.000) |
| Observations                       | 13,994                 | 15,936                | 15,753               | 15,936                | 15,936               | 15,878               | 4,763                                          | 5,307                | 5,256                | 5,307                 | 5,307                | 5,304                |
| R-squared                          | 0.79                   | 0.63                  | 0.62                 | 0.63                  | 0.62                 | 0.62                 | 0.56                                           | 0.16                 | 0.13                 | 0.15                  | 0.14                 | 0.14                 |
| Endog. var.                        |                        |                       |                      |                       |                      |                      | 1                                              | 1                    | 1                    | 1                     | 1                    | 1                    |
| Instruments                        |                        |                       |                      |                       |                      |                      | 3                                              | 3                    | 3                    | 3                     | 3                    | 3                    |
| F-stat. FDI                        |                        |                       |                      |                       |                      |                      | 22.90                                          | 22.76                | 13.60                | 15.77                 | 8.20                 | 21.98                |
| p-val.                             |                        |                       |                      |                       |                      |                      | 0.6221                                         | 0.5144               | 0.3824               | 0.5017                | 0.1800               | 0.5526               |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects. Standard errors are clustered at the country-sector level.

Overall, the coefficients of the interaction terms are larger for the IV 2SLS estimates compared to the OLS regressions. In other words, absorptive capacities seem to have a bigger impact on FDI spillovers when the potential endogeneity between foreign output share and domestic firm productivity is controlled for.

### ***The Role of Domestic Firm Productivity***

In a next step, we evaluate the role of domestic firm-level productivity for their absorptive capacity. Appendices 9 to 11 show the IV 2SLS regression results for domestic firms by productivity level. FDI spillovers are negative in most specifications across all firms, but only rarely significant. The coefficient sizes, however, seem to be larger for low-productivity firms, suggesting that negative FDI spillover effects are smaller for more productive firms. Capital intensity again is significant and positive across all types of firms. The positive interaction term with technology gap (*gap*) is most important for firms with a low productivity level, almost equally high for high-productivity firms, whereas firms with a medium-productivity level benefit less from a lower technology gap (column 1). The positive interaction terms with technology (*tech*) are only significant for low-productivity firms (column 2), while medium- and high-productivity firms fall short of the 10 percent significance level. The interaction term with skills (*skills*) is also positive and narrowly misses the 10 percent significance level for low-productivity firms (column 3).

The interaction term with firm size (*size*) is positive and significant for low-productivity firms (column 4). Similarly, agglomeration (*aggl*) shows a significant and positive effect for low-productivity firms only (column 5). This may reflect firm size and the fact that smaller firms tend to benefit more from urbanization externalities, while larger firms are more self-sufficient (Jacobs 1961). While the interaction terms with export share (*exp*) are insignificant across all types of firms (column 6), the p-values and coefficient sizes reveal that export behavior matters more for highly productive firms, confirming that exporters are more productive (Bernard and Jensen 1999). Note that the effects on all domestic firms were significant (see Table 2).

In sum, the results tend to suggest that absorptive capacities are more important for low-productivity firms than for medium- and high-productivity firms, in terms of both statistical significance and in most cases also coefficient size. The results imply that firm productivity is a major mediating factor of FDI spillovers, as negative spillover effects tend to be smaller for more productive firms (although they are not significant). Once domestic firms reach a certain productivity level, other firm characteristics become less important as mediating factors. The high

statistical significance of the technology gap variable across the three types of firms confirms the importance of domestic firm productivity for FDI spillovers, not only relative to other domestic firms, but also relative to foreign firms.

### ***The Role of Foreign Ownership Structure***

In this section, we examine if foreign ownership structure influences the role of absorptive capacities of domestic firms in facilitating spillovers. Appendix 12 shows the IV 2SLS regression results for FDI from fully-owned firms (columns 1 to 6) and partially-owned firms (columns 7 to 12). Interestingly, FDI spillovers tend to be negative and significant for partial foreign ownership, while the foreign output share variable often shows positive coefficient signs for full foreign ownership which are mostly insignificant. Capital intensity shows a positive and significant effect across both types of foreign ownership structure.

The results indicate clearly that absorptive capacities more strongly influence spillovers from FDI with local participation (partial FDI). A domestic firm's lower technology gap (*gap*, columns 1 and 7), technology level (*tech*, columns 2 and 8), size (*size*, columns 4 and 10), and export share (*exp*, columns 6 and 12) have a significantly stronger beneficial impact on productivity spillovers from partial FDI compared to full FDI. Proximity to other firms (*aggl*) shows a significantly positive productivity effect from partial FDI, whereas there is no effect from agglomeration in the presence of fully-owned FDI (column 5).

The findings suggest that FDI that includes partial domestic ownership participation better facilitates firms with absorptive capacity to reap the benefits of productivity spillovers, perhaps because partial-FDI firms offer greater opportunities for technology diffusion.

## **4.3 National Characteristics and Institutions**

### ***Overall Results***

Finally, we focus on the role of host country characteristics and institutions. The OLS regression results are shown in Table 3, while the IV 2SLS estimates are presented in Table 4. To rule out the possibility that the impact of an institutional factor on FDI spillovers does not pick up another institutional characteristic for which we do not simultaneously control, we assess the cross-correlation of all national characteristics. Reassuringly, the correlation matrix (available upon request) shows that in all cases institutional factors have a correlation lower than 0.50. Moreover, only in three cases does the correlation exceed 0.40.

FDI spillovers mostly have a negative effect on labor productivity which is rarely significant, while capital intensity shows a consistently positive impact. The interaction of FDI with financial freedom (*finance*) shows a significantly positive effect on domestic firm productivity in the OLS regression (column 2). This supports studies finding that well-developed financial markets might ease the domestic firm's absorptive capacity and facilitate linkages (Agarwal et al. 2011, Javorcik and Spatareanu 2009).

The interaction of our FDI measure with a country's government spending on education as percentage of GDP (*educ1*) has a strongly positive and significant productivity effect (column 3) in the OLS and IV 2SLS regressions, confirming the positive role of the local innovation infrastructure for FDI spillovers (e.g. Meyer and Sinani 2009; Tytell and Yudaeva 2007).

Both trade indicators, namely a country's export share (*trade1*), and the absence of trade protectionism (*trade2*), are significant and interact positively with foreign output share (columns 7 and 8). This supports the view that FDI spillovers are larger in countries that are more open towards trade (Meyer and Sinani 2009; Havranek and Irsova 2011; Du et al. 2011). However, the interaction terms with the trade indicators are only significant in the OLS regressions.

While all other variables have no impact in the overall sample, the effect varies depending on the level of productivity of domestic firms as well as on the foreign ownership structure, as we show in the next two sections.

### ***The Role of Domestic Firm Productivity***

Appendices 13 to 15 show the IV 2SLS regression results by type of domestic firm productivity. The impact of FDI spillovers is insignificant across all specifications. The positive impact of capital intensity matters most for firms with a high- and low-productivity level, followed by medium-productivity firms.

The interaction term with a country's government spending on education as percentage of GDP (*educ1*) has a significantly positive productivity effect only for low-productivity firms (column 3). It is also interesting to take a look at the coefficient sizes and p-values across the three types of firms, suggesting that skilled labor becomes more important the less productive domestic firms are.

**Table 3: National Characteristics, FDI Spillovers, All Domestic Firms, OLS**

| Dependent variable: $\ln l_{p_{irst}}$ |                      |                      |                       |                      |                      |                      |                      |                      |                      |                      |                      |
|----------------------------------------|----------------------|----------------------|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                        | (1)                  | (2)                  | (3)                   | (4)                  | (5)                  | (6)                  | (7)                  | (8)                  | (9)                  | (10)                 | (11)                 |
| $FDI_{sct}^Y$                          | -0.0927<br>(0.929)   | -1.7358*<br>(0.072)  | -0.8046***<br>(0.003) | -0.0069<br>(0.961)   | -0.0178<br>(0.893)   | 0.9202<br>(0.175)    | -0.2461**<br>(0.027) | -2.7521**<br>(0.026) | 1.1780<br>(0.411)    | -0.1221<br>(0.172)   | -0.1388<br>(0.749)   |
| $FDI_{sct}^Y * labor_{ct}$             | 0.0087<br>(0.972)    |                      |                       |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * finance_{ct}$           |                      | 0.4316*<br>(0.080)   |                       |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * educ1_{ct}$             |                      |                      | 3.9472**<br>(0.013)   |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * educ2_{ct}$             |                      |                      |                       | -0.1922<br>(0.680)   |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * rd_{ct}$                |                      |                      |                       |                      | -35.1017<br>(0.141)  |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * investm_{ct}$           |                      |                      |                       |                      |                      | -0.2561<br>(0.140)   |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * trade1_{ct}$            |                      |                      |                       |                      |                      |                      | 0.5713**<br>(0.031)  |                      |                      |                      |                      |
| $FDI_{sct}^Y * trade2_{ct}$            |                      |                      |                       |                      |                      |                      |                      | 0.6309**<br>(0.029)  |                      |                      |                      |
| $FDI_{sct}^Y * business_{ct}$          |                      |                      |                       |                      |                      |                      |                      |                      | -0.3019<br>(0.384)   |                      |                      |
| $FDI_{sct}^Y * hhi_{sct}$              |                      |                      |                       |                      |                      |                      |                      |                      |                      | 0.2488<br>(0.316)    |                      |
| $FDI_{sct}^Y * income_{ct}$            |                      |                      |                       |                      |                      |                      |                      |                      |                      |                      | 0.0113<br>(0.848)    |
| $\ln capint_{irst}$                    | 0.2707***<br>(0.000) | 0.2709***<br>(0.000) | 0.2772***<br>(0.000)  | 0.2754***<br>(0.000) | 0.2717***<br>(0.000) | 0.2706***<br>(0.000) | 0.2706***<br>(0.000) | 0.2705***<br>(0.000) | 0.2706***<br>(0.000) | 0.2701***<br>(0.000) | 0.2707***<br>(0.000) |
| Observations                           | 15,884               | 15,884               | 11,696                | 14,330               | 10,356               | 15,884               | 15,788               | 15,884               | 15,884               | 15,936               | 15,884               |
| R-squared                              | 0.62                 | 0.62                 | 0.49                  | 0.61                 | 0.46                 | 0.62                 | 0.62                 | 0.62                 | 0.62                 | 0.62                 | 0.62                 |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects. Standard errors are clustered at the country-sector level.



**Table 4: National Characteristics, FDI Spillovers, All Domestic Firms, IV 2SLS**

| Dependent variable: $\ln l_{p_{irst}}$ |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
|----------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                        | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  | (7)                  | (8)                  | (9)                  | (10)                 | (11)                 |
| $FDI_{sct}^Y$                          | 3.5634<br>(0.466)    | 3.5825<br>(0.584)    | -2.2114*<br>(0.095)  | 0.0837<br>(0.787)    | 0.0570<br>(0.949)    | 0.3838<br>(0.913)    | -0.8501<br>(0.260)   | -2.7243<br>(0.665)   | -5.9113<br>(0.642)   | -0.1886<br>(0.415)   | -0.3773<br>(0.720)   |
| $FDI_{sct}^Y * labor_{ct}$             | -0.8772<br>(0.465)   |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * finance_{ct}$           |                      | -0.8907<br>(0.585)   |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * educ1_{ct}$             |                      |                      | 12.3485*<br>(0.087)  |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * educ2_{ct}$             |                      |                      |                      | -0.6653<br>(0.544)   |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * rd_{ct}$                |                      |                      |                      |                      | -53.2774<br>(0.691)  |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * investm_{ct}$           |                      |                      |                      |                      |                      | -0.0952<br>(0.913)   |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * trade1_{ct}$            |                      |                      |                      |                      |                      |                      | 2.6208<br>(0.205)    |                      |                      |                      |                      |
| $FDI_{sct}^Y * trade2_{ct}$            |                      |                      |                      |                      |                      |                      |                      | 0.6313<br>(0.664)    |                      |                      |                      |
| $FDI_{sct}^Y * business_{ct}$          |                      |                      |                      |                      |                      |                      |                      |                      | 1.4287<br>(0.642)    |                      |                      |
| $FDI_{sct}^Y * hhi_{sct}$              |                      |                      |                      |                      |                      |                      |                      |                      |                      | 0.5884<br>(0.293)    |                      |
| $FDI_{sct}^Y * income_{ct}$            |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      | 0.0468<br>(0.736)    |
| $\ln capint_{irst}$                    | 0.2629***<br>(0.000) | 0.2632***<br>(0.000) | 0.2498***<br>(0.000) | 0.2664***<br>(0.000) | 0.2502***<br>(0.000) | 0.2638***<br>(0.000) | 0.2646***<br>(0.000) | 0.2638***<br>(0.000) | 0.2644***<br>(0.000) | 0.2641***<br>(0.000) | 0.2639***<br>(0.000) |
| Observations                           | 5,307                | 5,307                | 4,329                | 5,098                | 3,326                | 5,307                | 5,271                | 5,307                | 5,307                | 5,307                | 5,307                |
| R-squared                              | 0.13                 | 0.13                 | 0.13                 | 0.14                 | 0.14                 | 0.13                 | 0.14                 | 0.13                 | 0.13                 | 0.13                 | 0.13                 |
| Endog. var.                            | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    |
| Instruments                            | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    |
| F-stat. FDI                            | 4.05                 | 1.48                 | 3.27                 | 11.75                | 0.40                 | 6.31                 | 3.06                 | 12.35                | 1.54                 | 14.99                | 8.39                 |
| Hansen p-val.                          | 0.4752               | 0.3871               | 0.5092               | 0.3384               | 0.2747               | 0.3281               | 0.2774               | 0.3527               | 0.4370               | 0.3905               | 0.3898               |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects. Standard errors are clustered at the country-sector level.

A country's export share (*trade1*) positively interacts with foreign output share for low-productivity firms (column 7). While the effect is statistically insignificant for medium- and high-productivity firms, the coefficient sizes and p-values across the three types of firms suggest that an open trade regime is less important for more productive firms. The interaction term with the absence of trade protectionism (or openness to imports) (*trade2*) also shows a positive effect for low-productivity firms, but narrowly misses the 10 percent significance level (column 8).

Finally, the interaction term with sector concentration (*hhi*) shows a positive and significant impact on labor productivity for firms with low productivity levels (column 10). Our findings confirm the results of Barrios and Strobl (2002) showing that higher concentration of sectoral activity has positive productivity effects that are stronger for low-productivity firms. The interaction term with income per capita (*income*) is positive, but falls short of the threshold levels of statistical significance for low-productivity firms (column 11).

In sum, the interaction terms are only significant for low-productivity firms, confirming the previous finding that mediating factors matter more for lower-productivity firms. Among the various institutional variables we test, only a country's education spending, trade openness and sector concentration seem to mediate the spillover effects from FDI.

### ***The Role of Foreign Ownership Structure***

Finally, we focus on the role of foreign ownership structure for national characteristics. Appendices 16 and 17 report the IV 2SLS regression results for FDI spillovers from fully-owned versus partially-owned firms. The results show that national mediating factors influence FDI spillovers differently, depending on the type of foreign ownership.

More flexible labor markets (*labor*) positively affect them from partially-owned firms, but negatively influence productivity spillovers from fully-owned firms (column 1). Both effects, however, fall short of the threshold levels of statistical significance. Fully-foreign owned firms might be more constrained to transfer technology in a flexible labor market due to the risk of technology diffusion. Foreign firms with domestic participation, in contrast, tend to be characterized by more supply-linkages with the host country. In a flexible labor market, this could be beneficial to knowledge and productivity spillovers due to higher labor turnover.

A country's financial market openness (*finance*) positively and significantly mediates the productivity effect from partially-owned FDI, but has no effect on the productivity effect generated by fully-owned FDI (column 2). It is possible that partially-owned foreign firms bring in scarce

capital to developing countries (Harrison et al. 2004), which seems to be facilitated by more open financial markets. This would ease access to finance for local firms and strengthen their absorptive capacities.

Government spending on education (*educ1*) significantly increases the productivity effect from partial foreign ownership, while there is no effect from fully-owned FDI (column 3). This supports earlier findings that absorptive capacities contribute to greater productivity spillovers in the presence of partially foreign-owned firms than fully foreign-owned firms. A higher share of people with completed secondary and tertiary education as percentage of population (*educ2*) also interacts positively with spillovers from partially-owned foreign firms, although the effect is not statistically significant (column 4). Both interaction effects suggest that economies with higher skill availability benefit more strongly from partially-owned FDI, possibly due to more labor turnover of skilled labor to domestic firms.

Interestingly, higher skill availability in a country (*educ2*) significantly lowers the spillovers from fully-owned foreign firms. It may be possible that economies with a higher share of skilled people attract more fully-foreign owned firms whose higher technology intensity could crowd-out domestic producers, supporting the findings of Abraham et al. (2010). Such firms could also bid away high quality labor from domestic firms, resulting in negative spillover effects.

A country's openness to investment (*investm*) positively and significantly interacts with the output share of partially-owned foreign firms, while the effect from fully-owned foreign firms is negative but narrowly misses the 10 percent level of significance (column 6). More investment openness could attract more partially-owned FDI and thus increase the spillover potential due to technology leakages and more linkages to the host country. At the same time, it could also contribute to greater 'footloose' fully foreign-owned firms, with fewer linkages to the local economy and crowding-out potential.

Interestingly, a country's export share in GDP (*trade1*) significantly increases the spillover impact from partial foreign ownership, while the effect from full foreign ownership is negative but insignificant (column 7). Analogously, trade freedom (*trade2*) – reflecting the absence of trade protectionism including imports – positively moderates the productivity impact from partial foreign ownership, while the effect from fully-owned FDI is negative but again insignificant (column 8). Partially-owned foreign firms have a higher spillover potential because they are more integrated into their host countries in terms of sales and local sourcing (see Appendix 4). Nevertheless, they may still depend on exports or imported inputs, hence, trade openness and freedom positively

interact with the sectoral output share of such firms. Fully-owned FDI, in contrast, is more likely to be an export-platform with fewer local linkages and technology leakages.

Finally, income per capita (*income*) positively mediates the FDI spillover effect on domestic labor productivity from partially-owned FDI, while there is no effect for fully-owned FDI (column 11). This reflects the importance of national competitiveness and development, given the possibility of more local linkages for partially-owned foreign firms.

Overall, the results clearly indicate that spillovers from partially-owned FDI are positively mediated by various national and institutional factors. In contrast, national and institutional characteristics exert no or even a negative effect on spillovers from fully-owned FDI.

## 5 Conclusions

In this paper, we use a cross-section of more than 25,000 manufacturing firms in 78 low- and middle-income countries from the World Bank's Enterprise Surveys Indicator Database to identify the mediating factors that determine intra-industry productivity spillovers. Besides OLS, this paper also applies an instrumental variables approach to address the potential endogeneity between FDI spillovers and domestic firm productivity. We differentiate between major types of mediating factors, namely the FDI spillover potential, domestic firms' absorptive capacity, and differences in host country factors and institutions. This is the first study to our knowledge that interacts FDI with all three types of mediating factors against productivity outcomes.

We find evidence for negative FDI spillovers overall, which we relate to increased competition in the short term for market share (both domestic and export) and skilled labor. Regarding the FDI spillover potential, we find a positive and significant impact in the overall sample for market orientation in the OLS regressions – the higher the share of FDI output sold domestically, the greater productivity spillovers to domestic firms. Splitting the sample into three productivity groups, we find that larger output share sold to the domestic market and larger share of local inputs contributes to higher spillovers for low- and medium-productivity firms.

Regarding a domestic firm's absorptive capacity, almost all variables show the expected coefficient signs, suggesting that a lower technology gap, firm technology, firm size, proximity to other firms, and export behavior interact positively with foreign output share, although results vary by type of firm. In sum, the mediating factors are more significant for low-productivity firms. The results imply that firm productivity is a major mediating factor of FDI spillovers, as negative

spillover effects tend to be smaller for more productive firms (although they are not significant). Once domestic firms reach a certain productivity level, other firm characteristics become less important as mediating factors. The high statistical significance of the technology gap variable across the three types of firms confirms the importance of domestic firm productivity for FDI spillovers, not only relative to other domestic firms, but also relative to foreign firms.

The overall results for national and institutional mediating factors suggest that a country's spending on education as well as trade openness and openness in financial markets (the latter two can only be confirmed in the OLS regressions) matter most. However, again the results vary significantly depending on the productivity levels of domestic firms. The positive interaction with education spending and trade is only significant for low-productivity firms and tends to fall with higher firm-level productivity. Splitting the sample into three productivity levels reveals that a country's institutional framework only seems to benefit low-productivity firms. A country's spending on education, export share, and sector concentration significantly increase FDI spillovers.

In sum, all three types of mediating factors have an influence on domestic firms, although the actual effect is clearly related to domestic firm productivity. Low-productivity firms tend to benefit from FDI spillover potential and the institutional framework and also exhibit the highest absorptive capacity. The mediating factors might help them counterbalance some of the negative spillover effects from FDI despite their productivity disadvantage. Medium-productivity firms seem to be disadvantaged in terms of the institutional framework and also show lower benefits from FDI spillover potential and absorptive capacity. High-productivity firms only benefit from absorptive capacities – in particular a low productivity gap – while the FDI spillover potential and the institutional framework have a negative or no influence on FDI spillovers for those firms.

We also assess whether the results depend on the structure of foreign ownership. Across all three types of mediating factors, we find strong evidence that partial foreign ownership shows more positive FDI spillovers on domestic firm productivity. While we have no specific information on investment policy in our sample, our data sample suggests that the majority of partially-owned firms have the legal status of a joint venture. However, joint venture participation seems to be overwhelmingly driven by market considerations rather than policies which require local participation. Regarding the FDI spillover potential, the spillovers from partially-owned foreign firms are larger the higher the share of local sourcing is, which does not hold for fully-owned firms. On the other hand, foreign firms' sales to the domestic market exert a positive effect on FDI spillovers which is only significant for fully foreign-owned firms.

Our results also show clearly that a domestic firm's absorptive capacities, in particular a smaller technology gap, higher technology level, larger size, more agglomeration and higher export share, more strongly influence spillovers from FDI in the presence of FDI that includes local partners (partial foreign-owned) than they do in the presence fully foreign-owned FDI.

Finally, the role of local participation for the moderating effects of national characteristics is clearly positive. Government spending on education, openness in trade, investment, and financial markets, trade integration, and income level interact positively with FDI from partially-owned firms. In contrast, national and institutional characteristics exert no or even a negative effect on spillovers from fully-owned FDI, suggesting that fully foreign-owned firms may operate largely as enclaves in their host countries.

Overall, these findings suggest that policies designed to promote greater spillovers from foreign investment need to take into account not only these three important mediating factors – FDI spillover potential, absorptive capacity of domestic firms, and the host country environment – but also, critically, heterogeneity of firms in the host country. The effectiveness of interventions is likely to vary significantly depending on the characteristics of domestic firms, as well as the form of foreign investment.

While there has been substantial empirical work in the field of FDI spillovers over the past decade, much promising ground for research remains. Our findings suggest three areas in particular. First, this paper highlights the importance of firm heterogeneity in mediating spillover potential, both from the perspective of domestic firms and FDI. Improving our understanding of the mechanics of FDI spillovers, including positive knowledge diffusion and also negative competition effects, can help identify the impact of heterogeneity in domestic firm productivity and foreign ownership structure on spillovers. This will help guide policies designed to attract FDI and perhaps encourage domestic participation as well as policies intending explicitly to promote spillovers, including the increasingly popular supplier linkage programs.

Second, and related to the previous point, our findings on the importance of the structure of foreign investment – specifically on the positive impact of local participation– suggest a need to understand better the specific mechanisms within firms and supply chains which lead to this result. In particular, researchers should examine the role of spillovers from joint ventures versus other forms of partial ownership. Moreover, there is a need to understand what, if any policies can play a positive role in facilitating conducive local participation.

Finally, research on mediating factors should focus more on understanding better FDI spillover potential, particularly in the context of global value chain dynamics. Upstream of the form of FDI, a multinational's global production strategy can influence the FDI spillover potential. If production is highly internalized, e.g., because a large share of value added is considered a core competency, the multinational firm may have little interest in local sourcing beyond non-tradable services and standardized inputs like packaging. If production of inputs requires a high degree of technological sophistication, a multinational firm may opt to purchase inputs from existing global suppliers with whom it already has developed long-standing relationships. In both cases, the opportunity for positive local spillovers from FDI will be limited from the start. Given the increasing importance of global production chains and export platform FDI, understanding how spillover potential differs in this growing category of FDI is likely to become an important policy priority, particularly for small and low-income countries that rely increasingly on this type of investment.

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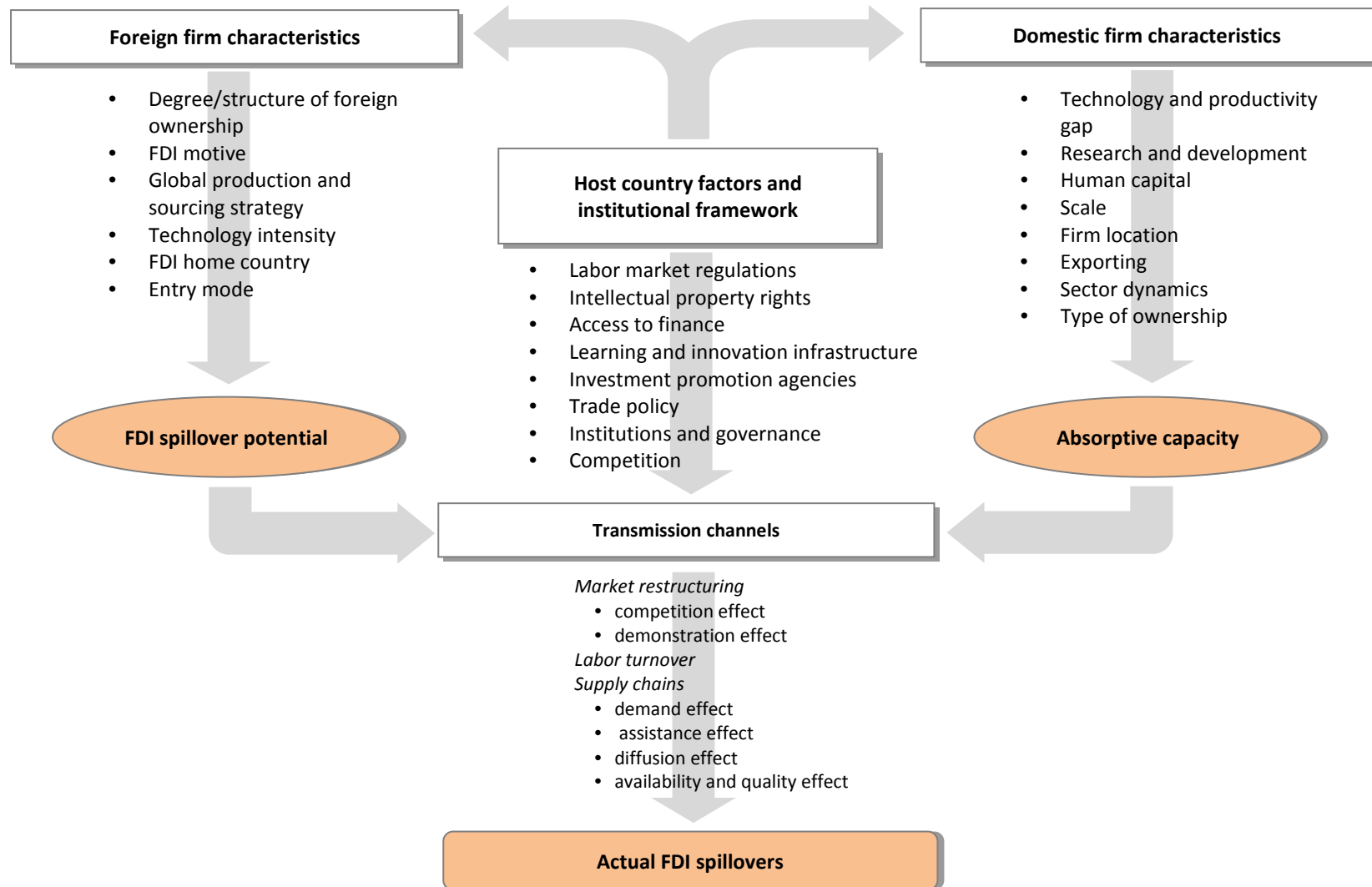


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## Appendix 1: The role of mediating factors for FDI spillovers – a conceptual framework



Source: Farole, Staritz, and Winkler (2012).

## Appendix 2: Survey Year and Number of Domestic and Foreign Manufacturing Firms by Country

| Country          | Survey year | Dom. mfg. firms | For. mfg. firms | Country             | Survey year | Dom. mfg. firms | For. mfg. firms |
|------------------|-------------|-----------------|-----------------|---------------------|-------------|-----------------|-----------------|
| Albania          | 2007        | 87              | 23              | Malaysia            | 2007        | 773             | 321             |
| Algeria          | 2007        | 374             | 10              | Mauritania          | 2006        | 112             | 16              |
| Argentina        | 2010        | 681             | 111             | Mauritius           | 2009        | 157             | 18              |
| Armenia          | 2009        | 102             | 12              | Mexico              | 2010        | 1,046           | 110             |
| Azerbaijan       | 2009        | 95              | 23              | Moldova             | 2009        | 86              | 22              |
| Belarus          | 2008        | 86              | 13              | Mongolia            | 2009        | 115             | 15              |
| Bosnia Herzeg.   | 2009        | 113             | 10              | Morocco             | 2007        | 354             | 103             |
| Bolivia          | 2010        | 118             | 22              | Mozambique          | 2007        | 284             | 56              |
| Brazil           | 2009        | 851             | 59              | Namibia             | 2006        | 114             | 37              |
| Burkina Faso     | 2009        | 81              | 16              | Nepal               | 2009        | 124             | 4               |
| Burundi          | 2006        | 110             | 28              | Nicaragua           | 2010        | 115             | 10              |
| Cameroon         | 2009        | 87              | 29              | Nigeria             | 2007        | 938             | 10              |
| Chile            | 2010        | 673             | 102             | Pakistan            | 2007        | 763             | 20              |
| Colombia         | 2010        | 641             | 65              | Panama              | 2010        | 101             | 14              |
| Costa Rica       | 2010        | 272             | 53              | Paraguay            | 2010        | 108             | 17              |
| Cote d'Ivoire    | 2009        | 144             | 49              | Peru                | 2010        | 673             | 87              |
| Croatia          | 2007        | 364             | 47              | Philippines         | 2009        | 692             | 262             |
| Ecuador          | 2010        | 97              | 22              | Poland              | 2009        | 137             | 14              |
| Egypt            | 2008        | 1,103           | 36              | Romania             | 2009        | 143             | 36              |
| El Salvador      | 2010        | 104             | 20              | Russia              | 2009        | 660             | 39              |
| Ethiopia         | 2006        | 337             | 22              | Rwanda              | 2006        | 54              | 14              |
| Form. Yugoslavia | 2009        | 98              | 23              | Senegal             | 2007        | 243             | 16              |
| Georgia          | 2008        | 109             | 14              | Serbia              | 2009        | 117             | 19              |
| Ghana            | 2007        | 271             | 19              | South Africa        | 2007        | 579             | 101             |
| Guatemala        | 2010        | 315             | 40              | St. Vincent & Gr.   | 2010        | 124             | 24              |
| Guinea           | 2006        | 122             | 15              | Swaziland           | 2006        | 68              | 38              |
| Guinea-Bissau    | 2006        | 72              | 9               | Tajikistan          | 2008        | 98              | 15              |
| Honduras         | 2010        | 130             | 18              | Tanzania            | 2006        | 247             | 39              |
| India            | 2006        | 2,134           | 37              | Thailand            | 2006        | 800             | 230             |
| Indonesia        | 2009        | 1,067           | 89              | Turkey              | 2008        | 866             | 29              |
| Jamaica          | 2010        | 103             | 16              | Uganda              | 2006        | 276             | 58              |
| Jordan           | 2006        | 305             | 48              | Ukraine             | 2008        | 523             | 46              |
| Kazakhstan       | 2009        | 169             | 14              | Uruguay             | 2010        | 327             | 32              |
| Kenya            | 2007        | 331             | 65              | Uzbekistan          | 2008        | 87              | 34              |
| Kyrgyzstan       | 2009        | 80              | 16              | Venezuela           | 2010        | 71              | 14              |
| Latvia           | 2009        | 65              | 24              | Vietnam             | 2009        | 649             | 130             |
| Lithuania        | 2009        | 85              | 19              | Yemen               | 2010        | 238             | 5               |
| Madagascar       | 2009        | 125             | 79              | Zambia              | 2007        | 236             | 68              |
| <b>SUM</b>       |             |                 |                 | <b>25,199 3,440</b> |             |                 |                 |

### Appendix 3: Number of Domestic and Foreign Manufacturing Firms by Sector

| Sector                             | Domestic firms |               | Foreign firms |               |                               |               |                                  |               |
|------------------------------------|----------------|---------------|---------------|---------------|-------------------------------|---------------|----------------------------------|---------------|
|                                    | <i>All</i>     |               | <i>All</i>    |               | <i>Full foreign ownership</i> |               | <i>Partial foreign ownership</i> |               |
|                                    | No.            | %             | No.           | %             | No.                           | %             | No.                              | %             |
| <b>Manufacturing</b>               | <b>25,199</b>  | <b>100.0%</b> | <b>3,440</b>  | <b>100.0%</b> | <b>1,789</b>                  | <b>100.0%</b> | <b>1,651</b>                     | <b>100.0%</b> |
| Textiles                           | 2,051          | 8.1%          | 194           | 5.6%          | 106                           | 5.9%          | 88                               | 5.3%          |
| Leather                            | 275            | 1.1%          | 42            | 1.2%          | 25                            | 1.4%          | 17                               | 1.0%          |
| Garments                           | 3,439          | 13.6%         | 373           | 10.8%         | 217                           | 12.1%         | 156                              | 9.4%          |
| Food                               | 5,098          | 20.2%         | 632           | 18.4%         | 309                           | 17.3%         | 323                              | 19.6%         |
| Metals and machinery               | 3,878          | 15.4%         | 534           | 15.5%         | 286                           | 16.0%         | 248                              | 15.0%         |
| Electronics                        | 697            | 2.8%          | 188           | 5.5%          | 103                           | 5.8%          | 85                               | 5.1%          |
| Chemicals and pharmaceuticals      | 1,986          | 7.9%          | 391           | 11.4%         | 198                           | 11.1%         | 193                              | 11.7%         |
| Wood and furniture                 | 715            | 2.8%          | 46            | 1.3%          | 16                            | 0.9%          | 30                               | 1.8%          |
| Non-metallic and plastic materials | 2,653          | 10.5%         | 446           | 13.0%         | 218                           | 12.2%         | 228                              | 13.8%         |
| Auto and auto components           | 370            | 1.5%          | 75            | 2.2%          | 37                            | 2.1%          | 38                               | 2.3%          |
| Other manufacturing                | 4,037          | 16.0%         | 519           | 15.1%         | 274                           | 15.3%         | 245                              | 14.8%         |

NB: Full foreign ownership: foreign participation = 100 percent.

Partial foreign ownership: 10 percent >= foreign participation < 100 percent.

#### Appendix 4: Summary Statistics

| Variable                                                           | Obs    | Mean    | Std. Dev. | Min      | Max     |
|--------------------------------------------------------------------|--------|---------|-----------|----------|---------|
| $\ln l_{first}$                                                    | 18,287 | 8.4083  | 1.7609    | -11.4958 | 20.4382 |
| $FDI_{sct}$                                                        | 25,660 | 0.2648  | 0.2381    | 0.0000   | 1.0000  |
| $FDI_{sct,full}$                                                   | 25,660 | 0.1406  | 0.1863    | 0.0000   | 0.9927  |
| $FDI_{sct,partial}$                                                | 25,660 | 0.1243  | 0.1556    | 0.0000   | 1.0000  |
| $\ln cap_{int_{first}}$                                            | 18,807 | 7.7379  | 2.1370    | -4.0956  | 19.7083 |
| <b><u>FDI spillover potential</u></b>                              |        |         |           |          |         |
| $own_{sct}$                                                        | 24,433 | 0.7251  | 0.1865    | 0.1000   | 1.0000  |
| $own_{sct,full}$                                                   | 21,002 | 1.0000  | 0.0000    | 1.0000   | 1.0000  |
| $own_{sct,partial}$                                                | 22,995 | 0.5232  | 0.1731    | 0.1000   | 0.9900  |
| $market_{sct}$                                                     | 24,433 | 0.6745  | 0.2695    | 0.0000   | 1.0000  |
| $market_{sct,full}$                                                | 20,720 | 0.6480  | 0.3118    | 0.0000   | 1.0000  |
| $market_{sct,partial}$                                             | 22,923 | 0.6935  | 0.2704    | 0.0000   | 1.0000  |
| $inp_{sct}$                                                        | 24,330 | 0.5695  | 0.2393    | 0.0000   | 1.0000  |
| $inp_{sct,full}$                                                   | 20,680 | 0.5506  | 0.2892    | 0.0000   | 1.0000  |
| $inp_{sct,partial}$                                                | 22,500 | 0.5968  | 0.2455    | 0.0000   | 1.0000  |
| $tech_{sct}$                                                       | 24,433 | 2.4402  | 0.7434    | 0.0000   | 4.0000  |
| $tech_{sct,full}$                                                  | 20,863 | 2.3593  | 0.8844    | 0.0000   | 4.0000  |
| $tech_{sct,partial}$                                               | 22,995 | 2.5152  | 0.7710    | 0.0000   | 4.0000  |
| <b><u>Absorptive capacity</u></b>                                  |        |         |           |          |         |
| $gap_{isct}$                                                       | 16,145 | -0.6668 | 1.5280    | -19.0525 | 7.4185  |
| $tech_{first}$                                                     | 29,770 | 1.3461  | 1.1575    | 0.0000   | 4.0000  |
| $skills_{first}$                                                   | 24,782 | 0.6381  | 0.3283    | 0.0000   | 1.0000  |
| $size_{first}$                                                     | 29,383 | 3.5342  | 1.3551    | 0.0000   | 8.6995  |
| $aggl_{rct}$                                                       | 29,770 | 0.3451  | 0.2797    | 0.0017   | 1.0000  |
| $exp_{first}$                                                      | 29,471 | 0.1278  | 0.2825    | 0.0000   | 1.0000  |
| <b><u>National characteristics and institutional framework</u></b> |        |         |           |          |         |
| $labor_{ct}$                                                       | 28,992 | 4.0926  | 0.2236    | 3.2619   | 4.6052  |
| $finance_{ct}$                                                     | 28,992 | 3.7619  | 0.3497    | 2.3026   | 4.3820  |
| $educ1_{ct}$                                                       | 21,091 | 0.1701  | 0.0424    | 0.0441   | 0.2746  |
| $educ2_{ct}$                                                       | 26,205 | 0.2579  | 0.1445    | 0.0120   | 0.7200  |
| $rd_{ct}$                                                          | 16,743 | 0.0058  | 0.0031    | 0.0003   | 0.0110  |
| $investment_{ct}$                                                  | 28,992 | 3.7998  | 0.3424    | 1.6094   | 4.4427  |
| $trade1_{ct}$                                                      | 28,830 | 0.3361  | 0.1963    | 0.0453   | 1.1002  |
| $trade2_{ct}$                                                      | 28,992 | 4.1718  | 0.3322    | 3.1781   | 4.4773  |
| $business_{ct}$                                                    | 28,992 | 4.0884  | 0.2022    | 2.9069   | 4.4998  |
| $hhi_{sct}$                                                        | 25,804 | 0.1526  | 0.1587    | 0.0153   | 1.0000  |
| $income_{ct}$                                                      | 29,238 | 7.3396  | 1.1107    | 4.5344   | 9.6946  |
| <b><u>Instruments</u></b>                                          |        |         |           |          |         |
| $FDI_{sc,lag}$                                                     | 17,962 | 0.2730  | 0.2391    | 0.0000   | 0.9928  |
| $FDI_{sc,lag,full}$                                                | 17,962 | 0.1424  | 0.1872    | 0.0000   | 0.9927  |
| $FDI_{sc,lag,partial}$                                             | 17,962 | 0.1306  | 0.1615    | 0.0000   | 0.9740  |
| $\ln ipa\_length_{sc,2000-2004}$                                   | 12,839 | 0.4321  | 0.7122    | 0.0000   | 1.7918  |
| $\ln tariff_{sct}$                                                 | 25,808 | 2.0668  | 0.8026    | 0.0000   | 4.2277  |
| $\ln exp\_customs_{sct}$                                           | 24,863 | 1.6805  | 0.7733    | 0.0000   | 5.1930  |
| $\ln imp\_customs_{sct}$                                           | 25,456 | 2.2423  | 0.6483    | 0.0000   | 4.1972  |

## Appendix 5: FDI Spillover Potential, FDI Spillovers, Domestic Low Productivity Firms, IV 2SLS

| Dependent variable: $\ln p_{irst}$ |                      |                      |                      |                      |                      |                      |
|------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                    | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  |
| $FDI_{sct}^Y$                      | -0.9337<br>(0.594)   | -1.1489<br>(0.103)   | -3.2765**<br>(0.046) | -1.1940<br>(0.101)   | -3.5573<br>(0.168)   | 0.3386<br>(0.649)    |
| $FDI_{sct}^Y * own_{sct}$          | 1.4043<br>(0.469)    |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * market_{sct}$       |                      | 1.9283**<br>(0.018)  | 5.2864**<br>(0.035)  |                      |                      |                      |
| $FDI_{sct}^Y * inp_{sct}$          |                      |                      |                      | 2.2108**<br>(0.038)  | 6.7001<br>(0.152)    |                      |
| $FDI_{sct}^Y * tech_{sct}$         |                      |                      |                      |                      |                      | -0.0793<br>(0.750)   |
| $ln capint_{irst}$                 | 0.0862***<br>(0.000) | 0.0848***<br>(0.000) | 0.0798***<br>(0.001) | 0.0846***<br>(0.000) | 0.0770***<br>(0.001) | 0.0865***<br>(0.000) |
| Observations                       | 1,789                | 1,789                | 1,772                | 1,789                | 1,776                | 1,789                |
| R-squared                          | 0.02                 | 0.02                 | -0.06                | 0.01                 | -0.11                | 0.03                 |
| Endog. var.                        | 1                    | 1                    | 2                    | 1                    | 2                    | 1                    |
| Instruments                        | 3                    | 3                    | 4                    | 3                    | 4                    | 3                    |
| F-stat. FDI                        | 3.04                 | 4.83                 | 19.61                | 5.49                 | 17.07                | 4.75                 |
| F-stat. market_int                 |                      |                      | 14.29                |                      |                      |                      |
| F-stat. inp_int                    |                      |                      |                      |                      | 10.20                |                      |
| Hansen p-val.                      | 0.0662               | 0.1335               | 0.0800               | 0.4404               | 0.3427               | 0.1421               |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects. Standard errors are clustered at the country-sector level.  
Low productivity:  $LP \leq 33.33$  percentile.

## Appendix 6: FDI Spillover Potential, FDI Spillovers, Domestic Medium Productivity Firms, IV 2SLS

| Dependent variable: $\ln p_{irst}$ |                      |                      |                      |                      |                      |                      |
|------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                    | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  |
| $FDI_{sct}^Y$                      | 0.7886<br>(0.593)    | -0.9243<br>(0.136)   | -3.2378**<br>(0.037) | -0.8447<br>(0.114)   | -2.5559<br>(0.171)   | 0.1298<br>(0.825)    |
| $FDI_{sct}^Y * own_{sct}$          | -0.8388<br>(0.601)   |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * market_{sct}$       |                      | 1.2940*<br>(0.078)   | 5.0172**<br>(0.025)  |                      |                      |                      |
| $FDI_{sct}^Y * inp_{sct}$          |                      |                      |                      | 1.3829*<br>(0.070)   | 4.7339<br>(0.171)    |                      |
| $FDI_{sct}^Y * tech_{sct}$         |                      |                      |                      |                      |                      | -0.0700<br>(0.728)   |
| $ln capint_{irst}$                 | 0.0367***<br>(0.000) | 0.0371***<br>(0.000) | 0.0333***<br>(0.000) | 0.0373***<br>(0.000) | 0.0341***<br>(0.000) | 0.0367***<br>(0.000) |
| Observations                       | 1,772                | 1,772                | 1,757                | 1,772                | 1,761                | 1,772                |
| R-squared                          | 0.01                 | 0.03                 | -0.39                | 0.03                 | -0.25                | 0.03                 |
| Endog. var.                        | 1                    | 1                    | 2                    | 1                    | 2                    | 1                    |
| Instruments                        | 3                    | 3                    | 4                    | 3                    | 4                    | 3                    |
| F-stat. FDI                        | 2.55                 | 4.72                 | 17.65                | 5.50                 | 14.10                | 4.45                 |
| F-stat. market_int                 |                      |                      | 12.81                |                      |                      |                      |
| F-stat. inp_int                    |                      |                      |                      |                      | 8.85                 |                      |
| Hansen p-val.                      | 0.2266               | 0.2529               | 0.1372               | 0.3833               | 0.3441               | 0.2242               |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects. Standard errors are clustered at the country-sector level.  
Medium productivity:  $33.33 \text{ percentile} < LP \leq 66.67 \text{ percentile}$ .



## Appendix 7: FDI Spillover Potential, FDI Spillovers, Domestic High Productivity Firms, IV 2SLS

| Dependent variable: $\ln l_{p_{rst}}$ |                      |                      |                      |                      |                      |                      |
|---------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                       | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  |
| $FDI_{sct}^Y$                         | -0.1559<br>(0.937)   | -0.1603<br>(0.857)   | -0.5486<br>(0.644)   | -0.5291<br>(0.454)   | -1.1922<br>(0.586)   | 0.1884<br>(0.793)    |
| $FDI_{sct}^Y * own_{sct}$             | -0.1703<br>(0.938)   |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * market_{sct}$          |                      | -0.1809<br>(0.868)   | 0.5402<br>(0.760)    |                      |                      |                      |
| $FDI_{sct}^Y * inp_{sct}$             |                      |                      |                      | 0.4191<br>(0.677)    | 1.7521<br>(0.657)    |                      |
| $FDI_{sct}^Y * tech_{sct}$            |                      |                      |                      |                      |                      | -0.2219<br>(0.385)   |
| $ln cap_{int_{rst}}$                  | 0.1067***<br>(0.000) | 0.1069***<br>(0.000) | 0.1073***<br>(0.000) | 0.1061***<br>(0.000) | 0.1050***<br>(0.000) | 0.1064***<br>(0.000) |
| Observations                          | 1,621                | 1,621                | 1,612                | 1,621                | 1,614                | 1,621                |
| R-squared                             | 0.06                 | 0.06                 | 0.06                 | 0.06                 | 0.06                 | 0.06                 |
| Endog. var.                           | 1                    | 1                    | 2                    | 1                    | 2                    | 1                    |
| Instruments                           | 3                    | 3                    | 4                    | 3                    | 4                    | 3                    |
| F-stat. FDI                           | 2.05                 | 3.94                 | 17.06                | 4.04                 | 15.89                | 4.09                 |
| F-stat. market_int                    |                      |                      | 12.67                |                      |                      |                      |
| F-stat. inp_int                       |                      |                      |                      |                      | 10.38                |                      |
| Hansen p-val.                         | 0.9437               | 0.9482               | 0.7816               | 0.9814               | 0.9514               | 0.9582               |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects. Standard errors are clustered at the country-sector level.  
High productivity: LP > 66.67 percentile.

# Appendix 8: FDI Spillover Potential, FDI Spillovers by Type of Foreign Ownership, All Domestic Firms, IV 2SLS

| Dependent variable: $\ln p_{irst}$ |                                                       |                      |                      |                      |                      |                      |                                                          |                      |                      |                      |                      |                      |
|------------------------------------|-------------------------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                    | FDI spillovers from firms with full foreign ownership |                      |                      |                      |                      |                      | FDI spillovers from firms with partial foreign ownership |                      |                      |                      |                      |                      |
|                                    | (1)                                                   | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  | (7)                                                      | (8)                  | (9)                  | (10)                 | (11)                 | (12)                 |
| $FDI_{sct}^V$                      | -0.0155<br>(0.908)                                    | -2.6314<br>(0.388)   | -4.8399<br>(0.111)   | 0.1259<br>(0.829)    | 0.2271<br>(0.804)    | 0.3878<br>(0.327)    | -0.0965<br>(0.934)                                       | -0.7897<br>(0.284)   | -0.9031<br>(0.461)   | -1.5220*<br>(0.053)  | -1.1513<br>(0.219)   | 0.5652<br>(0.769)    |
| $FDI_{sct}^V * own_{sct}$          |                                                       |                      |                      |                      |                      |                      | 0.1544<br>(0.938)                                        |                      |                      |                      |                      |                      |
| $FDI_{sct}^V * market_{sct}$       |                                                       | 3.6360<br>(0.363)    | 7.0625*<br>(0.098)   |                      |                      |                      |                                                          | 0.8028<br>(0.321)    | 1.2382<br>(0.494)    |                      |                      |                      |
| $FDI_{sct}^V * inp_{sct}$          |                                                       |                      |                      | -0.1213<br>(0.889)   | -0.3045<br>(0.852)   |                      |                                                          |                      |                      | 2.3147**<br>(0.039)  | 1.5365<br>(0.339)    |                      |
| $FDI_{sct}^V * tech_{sct}$         |                                                       |                      |                      |                      |                      | -0.1679<br>(0.212)   |                                                          |                      |                      |                      |                      | -0.2242<br>(0.721)   |
| $\ln capint_{irst}$                | 0.2579***<br>(0.000)                                  | 0.2572***<br>(0.000) | 0.2560***<br>(0.000) | 0.2581***<br>(0.000) | 0.2593***<br>(0.000) | 0.2585***<br>(0.000) | 0.2638***<br>(0.000)                                     | 0.2637***<br>(0.000) | 0.2634***<br>(0.000) | 0.2641***<br>(0.000) | 0.2638***<br>(0.000) | 0.2635***<br>(0.000) |
| Observations                       | 4,493                                                 | 4,493                | 4,463                | 4,493                | 4,470                | 4,493                | 4,876                                                    | 4,876                | 4,865                | 4,876                | 4,868                | 4,876                |
| R-squared                          | 0.13                                                  | 0.12                 | 0.07                 | 0.13                 | 0.13                 | 0.13                 | 0.13                                                     | 0.13                 | 0.13                 | 0.13                 | 0.13                 | 0.13                 |
| Endog. var.                        | 1                                                     | 1                    | 2                    | 1                    | 2                    | 1                    | 1                                                        | 1                    | 2                    | 1                    | 2                    | 1                    |
| Instruments                        | 3                                                     | 3                    | 4                    | 3                    | 4                    | 3                    | 3                                                        | 3                    | 4                    | 3                    | 4                    | 3                    |
| F-stat. FDI                        | .                                                     | 0.26                 | 16.96                | 6.49                 | 16.61                | 9.13                 | 3.30                                                     | 6.15                 | 11.44                | 2.36                 | 10.75                | 1.88                 |
| F-stat. market_int                 |                                                       |                      | 16.56                |                      |                      |                      |                                                          |                      | 7.01                 |                      |                      |                      |
| F-stat. inp_int                    |                                                       |                      |                      |                      | 8.94                 |                      |                                                          |                      |                      |                      | 5.84                 |                      |
| Hansen p-val.                      | 0.2633                                                | 0.4526               | 0.6866               | 0.1685               | 0.1711               | 0.1525               | 0.0355                                                   | 0.1483               | 0.0599               | 0.2933               | 0.3562               | 0.0927               |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects.

Standard errors are clustered at the country-sector level.

Full foreign ownership: foreign participation = 100 percent. Partial foreign ownership: 10 percent  $\geq$  foreign participation < 100 percent.

### Appendix 9: Absorptive Capacity, FDI Spillovers, Domestic Low Productivity Firms, IV 2SLS

| Dependent variable: $\ln p_{first}$ |                      |                      |                      |                      |                      |                      |
|-------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                     | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  |
| $FDI_{sct}^{IV}$                    | 2.7091***<br>(0.000) | -0.1444<br>(0.638)   | -0.3374<br>(0.397)   | -0.5568<br>(0.272)   | -1.0811**<br>(0.016) | -0.0379<br>(0.894)   |
| $FDI_{sct}^{IV} * gap_{isct}$       | 1.6787***<br>(0.000) |                      |                      |                      |                      |                      |
| $FDI_{sct}^{IV} * tech_{first}$     |                      | 0.1749**<br>(0.013)  |                      |                      |                      |                      |
| $FDI_{sct}^{IV} * skills_{first}$   |                      |                      | 0.4030<br>(0.143)    |                      |                      |                      |
| $FDI_{sct}^{IV} * size_{first}$     |                      |                      |                      | 0.1814**<br>(0.047)  |                      |                      |
| $FDI_{sct}^{IV} * aggl_{rct}$       |                      |                      |                      |                      | 2.3566***<br>(0.001) |                      |
| $FDI_{sct}^{IV} * exp_{first}$      |                      |                      |                      |                      |                      | 0.0457<br>(0.841)    |
| $\ln capint_{first}$                | 0.0243<br>(0.351)    | 0.0897***<br>(0.000) | 0.0935***<br>(0.000) | 0.0933***<br>(0.000) | 0.0905***<br>(0.000) | 0.0929***<br>(0.000) |
| Observations                        | 1,632                | 1,833                | 1,819                | 1,833                | 1,833                | 1,832                |
| R-squared                           | 0.45                 | 0.03                 | 0.02                 | 0.02                 | 0.03                 | 0.02                 |
| Endog. var.                         | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    |
| Instruments                         | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    |
| F-stat. FDI                         | 15.34                | 23.80                | 11.74                | 11.92                | 9.40                 | 23.39                |
| Hansen p-val.                       | 0.4271               | 0.2567               | 0.3145               | 0.2469               | 0.1144               | 0.3030               |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects. Standard errors are clustered at the country-sector level.  
Low productivity:  $LP \leq 33.33$  percentile.

### Appendix 10: Absorptive Capacity, FDI Spillovers, Domestic Medium Productivity Firms, IV 2SLS

| Dependent variable: $\ln p_{first}$ |                      |                      |                      |                      |                      |                      |
|-------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                     | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  |
| $FDI_{sct}^{IV}$                    | 0.4113*<br>(0.058)   | -0.1045<br>(0.628)   | -0.1400<br>(0.600)   | -0.2378<br>(0.497)   | -0.4241<br>(0.330)   | -0.0337<br>(0.865)   |
| $FDI_{sct}^{IV} * gap_{isct}$       | 0.7863***<br>(0.000) |                      |                      |                      |                      |                      |
| $FDI_{sct}^{IV} * tech_{first}$     |                      | 0.0702<br>(0.101)    |                      |                      |                      |                      |
| $FDI_{sct}^{IV} * skills_{first}$   |                      |                      | 0.1375<br>(0.375)    |                      |                      |                      |
| $FDI_{sct}^{IV} * size_{first}$     |                      |                      |                      | 0.0625<br>(0.299)    |                      |                      |
| $FDI_{sct}^{IV} * aggl_{rct}$       |                      |                      |                      |                      | 0.8166<br>(0.178)    |                      |
| $FDI_{sct}^{IV} * exp_{first}$      |                      |                      |                      |                      |                      | -0.1106<br>(0.388)   |
| $\ln capint_{first}$                | 0.0243***<br>(0.000) | 0.0357***<br>(0.000) | 0.0368***<br>(0.000) | 0.0368***<br>(0.000) | 0.0365***<br>(0.000) | 0.0364***<br>(0.000) |
| Observations                        | 1,620                | 1,814                | 1,804                | 1,814                | 1,814                | 1,812                |
| R-squared                           | 0.28                 | 0.03                 | 0.02                 | 0.02                 | 0.04                 | 0.02                 |
| Endog. var.                         | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    |
| Instruments                         | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    |
| F-stat. FDI                         | 18.31                | 19.24                | 11.49                | 13.97                | 6.47                 | 18.49                |
| Hansen p-val.                       | 0.3242               | 0.5179               | 0.5161               | 0.5130               | 0.3908               | 0.4727               |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects. Standard errors are clustered at the country-sector level.  
Medium productivity:  $33.33 \text{ percentile} < LP \leq 66.67 \text{ percentile}$ .

# Appendix 11: Absorptive Capacity, FDI Spillovers, Domestic High Productivity Firms, IV 2SLS

| Dependent variable: $\ln p_{first}$ |                       |                      |                      |                      |                      |                      |
|-------------------------------------|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                     | (1)                   | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  |
| $FDI_{sct}^{IV}$                    | -1.1134***<br>(0.001) | -0.2980<br>(0.237)   | -0.2113<br>(0.468)   | -0.1641<br>(0.662)   | -0.3685<br>(0.535)   | -0.2222<br>(0.298)   |
| $FDI_{sct}^{IV} * gap_{sct}$        | 1.5133***<br>(0.000)  |                      |                      |                      |                      |                      |
| $FDI_{sct}^{IV} * tech_{first}$     |                       | 0.0869<br>(0.148)    |                      |                      |                      |                      |
| $FDI_{sct}^{IV} * skills_{first}$   |                       |                      | 0.0655<br>(0.732)    |                      |                      |                      |
| $FDI_{sct}^{IV} * size_{first}$     |                       |                      |                      | -0.0109<br>(0.865)   |                      |                      |
| $FDI_{sct}^{IV} * aggl_{sct}$       |                       |                      |                      |                      | 0.3288<br>(0.702)    |                      |
| $FDI_{sct}^{IV} * exp_{first}$      |                       |                      |                      |                      |                      | 0.1904<br>(0.286)    |
| $\ln cap_{int_{first}}$             | 0.0729***<br>(0.000)  | 0.1026***<br>(0.000) | 0.0982***<br>(0.000) | 0.1045***<br>(0.000) | 0.1044***<br>(0.000) | 0.1039***<br>(0.000) |
| Observations                        | 1,500                 | 1,649                | 1,623                | 1,649                | 1,649                | 1,649                |
| R-squared                           | 0.45                  | 0.06                 | 0.05                 | 0.05                 | 0.06                 | 0.06                 |
| Endog. var.                         | 1                     | 1                    | 1                    | 1                    | 1                    | 1                    |
| Instruments                         | 3                     | 3                    | 3                    | 3                    | 3                    | 3                    |
| F-stat. FDI                         | 18.63                 | 19.06                | 12.94                | 15.05                | 5.95                 | 17.75                |
| Hansen p-val.                       | 0.5736                | 0.9349               | 0.9187               | 0.9570               | 0.9612               | 0.9453               |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects. Standard errors are clustered at the country-sector level.

High productivity: LP > 66.67 percentile.

### Appendix 12: Absorptive Capacity, FDI Spillovers by Type of Foreign Ownership, All Domestic Firms, IV 2SLS

| Dependent variable: $\ln p_{irst}$ |                                                       |                      |                      |                      |                      |                      |                                                          |                       |                      |                       |                      |                      |
|------------------------------------|-------------------------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------------------------------------------|-----------------------|----------------------|-----------------------|----------------------|----------------------|
|                                    | FDI spillovers from firms with full foreign ownership |                      |                      |                      |                      |                      | FDI spillovers from firms with partial foreign ownership |                       |                      |                       |                      |                      |
|                                    | (1)                                                   | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  | (7)                                                      | (8)                   | (9)                  | (10)                  | (11)                 | (12)                 |
| $FDI_{sct}^Y$                      | 0.5679**<br>(0.022)                                   | -0.3110<br>(0.238)   | 0.2305<br>(0.477)    | -0.6730<br>(0.140)   | 0.1505<br>(0.785)    | 0.0169<br>(0.932)    | 3.2370***<br>(0.000)                                     | -1.1048***<br>(0.000) | -0.7602<br>(0.122)   | -2.4945***<br>(0.000) | -0.9759**<br>(0.015) | -0.4183*<br>(0.083)  |
| $FDI_{sct}^Y * gap_{isct}$         | 2.1221***<br>(0.000)                                  |                      |                      |                      |                      |                      | 2.8656***<br>(0.000)                                     |                       |                      |                       |                      |                      |
| $FDI_{sct}^Y * tech_{irst}$        |                                                       | 0.4432***<br>(0.000) |                      |                      |                      |                      |                                                          | 0.8403***<br>(0.000)  |                      |                       |                      |                      |
| $FDI_{sct}^Y * skills_{irst}$      |                                                       |                      | -0.1315<br>(0.626)   |                      |                      |                      |                                                          |                       | 0.6816<br>(0.131)    |                       |                      |                      |
| $FDI_{sct}^Y * size_{irst}$        |                                                       |                      |                      | 0.2635**<br>(0.011)  |                      |                      |                                                          |                       |                      | 0.7147***<br>(0.000)  |                      |                      |
| $FDI_{sct}^Y * aggl_{rct}$         |                                                       |                      |                      |                      | -0.0537<br>(0.950)   |                      |                                                          |                       |                      |                       | 1.8956***<br>(0.008) |                      |
| $FDI_{sct}^Y * exp_{irst}$         |                                                       |                      |                      |                      |                      | 0.9621***<br>(0.001) |                                                          |                       |                      |                       |                      | 1.8191***<br>(0.000) |
| $\ln capint_{irst}$                | 0.1735***<br>(0.000)                                  | 0.2568***<br>(0.000) | 0.2605***<br>(0.000) | 0.2615***<br>(0.000) | 0.2641***<br>(0.000) | 0.2631***<br>(0.000) | 0.1677***<br>(0.000)                                     | 0.2521***<br>(0.000)  | 0.2610***<br>(0.000) | 0.2590***<br>(0.000)  | 0.2635***<br>(0.000) | 0.2636***<br>(0.000) |
| Observations                       | 4,763                                                 | 5,307                | 5,256                | 5,307                | 5,307                | 5,304                | 4,763                                                    | 5,307                 | 5,256                | 5,307                 | 5,307                | 5,304                |
| R-squared                          | 0.46                                                  | 0.15                 | 0.13                 | 0.15                 | 0.13                 | 0.14                 | 0.37                                                     | 0.15                  | 0.13                 | 0.15                  | 0.14                 | 0.14                 |
| Endog. var.                        | 1                                                     | 1                    | 1                    | 1                    | 1                    | 1                    | 1                                                        | 1                     | 1                    | 1                     | 1                    | 1                    |
| Instruments                        | 3                                                     | 3                    | 3                    | 3                    | 3                    | 3                    | 3                                                        | 3                     | 3                    | 3                     | 3                    | 3                    |
| F-stat. FDI                        | 33.37                                                 | 23.91                | 13.17                | 15.28                | 6.08                 | 27.12                | 5.94                                                     | 10.65                 | 5.29                 | 6.72                  | 6.44                 | 13.11                |
| Hansen p-val.                      | 0.8953                                                | 0.4200               | 0.2998               | 0.3618               | 0.3364               | 0.4162               | 0.3706                                                   | 0.6914                | 0.3186               | 0.5514                | 0.1804               | 0.4056               |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects.

Standard errors are clustered at the country-sector level.

Full foreign ownership: foreign participation = 100 percent. Partial foreign ownership: 10 percent  $\geq$  foreign participation < 100 percent.

**Appendix 13: National Characteristics, FDI Spillovers, Domestic Low Productivity Firms, IV 2SLS**

| Dependent variable: $\ln lp_{irst}$ |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
|-------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                     | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  | (7)                  | (8)                  | (9)                  | (10)                 | (11)                 |
| $FDI_{sct}^Y$                       | 1.3192<br>(0.850)    | -0.4678<br>(0.956)   | -4.3143*<br>(0.097)  | 0.0624<br>(0.906)    | 0.7216<br>(0.657)    | -3.7942<br>(0.463)   | -2.2549*<br>(0.062)  | -13.9303<br>(0.142)  | -13.3786<br>(0.565)  | -0.4258<br>(0.266)   | -1.9672<br>(0.250)   |
| $FDI_{sct}^Y * labor_{ct}$          | -0.2702<br>(0.874)   |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * finance_{ct}$        |                      | 0.1801<br>(0.931)    |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * educ1_{ct}$          |                      |                      | 24.7543*<br>(0.078)  |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * educ2_{ct}$          |                      |                      |                      | 0.1000<br>(0.953)    |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * rd_{ct}$             |                      |                      |                      |                      | -141.2323<br>(0.549) |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * investm_{ct}$        |                      |                      |                      |                      |                      | 0.9992<br>(0.429)    |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * trade1_{ct}$         |                      |                      |                      |                      |                      |                      | 7.2220**<br>(0.026)  |                      |                      |                      |                      |
| $FDI_{sct}^Y * trade2_{ct}$         |                      |                      |                      |                      |                      |                      |                      | 3.2760<br>(0.133)    |                      |                      |                      |
| $FDI_{sct}^Y * business_{ct}$       |                      |                      |                      |                      |                      |                      |                      |                      | 3.2913<br>(0.560)    |                      |                      |
| $FDI_{sct}^Y * hhi_{sct}$           |                      |                      |                      |                      |                      |                      |                      |                      |                      | 1.5837**<br>(0.038)  |                      |
| $FDI_{sct}^Y * income_{ct}$         |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      | 0.2871<br>(0.196)    |
| $\ln capint_{irst}$                 | 0.0921***<br>(0.000) | 0.0928***<br>(0.000) | 0.0622***<br>(0.005) | 0.0920***<br>(0.000) | 0.0874***<br>(0.000) | 0.0934***<br>(0.000) | 0.0962***<br>(0.000) | 0.0922***<br>(0.000) | 0.0956***<br>(0.000) | 0.0919***<br>(0.000) | 0.0938***<br>(0.000) |
| Observations                        | 1,833                | 1,833                | 1,485                | 1,757                | 1,152                | 1,833                | 1,822                | 1,833                | 1,833                | 1,833                | 1,833                |
| R-squared                           | 0.03                 | 0.03                 | 0.02                 | 0.03                 | 0.03                 | 0.02                 | 0.02                 | 0.02                 | -0.02                | 0.02                 | 0.01                 |
| Endog. var.                         | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    |
| Instruments                         | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    |
| F-stat. FDI                         | 3.92                 | 1.33                 | 3.25                 | 12.07                | 0.39                 | 6.03                 | 3.25                 | 12.19                | 1.13                 | 13.61                | 8.65                 |
| Hansen p-val.                       | 0.0904               | 0.0567               | 0.1934               | 0.2176               | 0.3544               | 0.0988               | 0.2051               | 0.2085               | 0.2057               | 0.4278               | 0.3528               |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects. Standard errors are clustered at the country-sector level. Low productivity:  $LP \leq 33.33$  percentile.

**Appendix 14: National Characteristics, FDI Spillovers, Domestic Medium Productivity Firms, IV 2SLS**

| Dependent variable: $\ln l_{irst}$ |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
|------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                    | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  | (7)                  | (8)                  | (9)                  | (10)                 | (11)                 |
| $FDI_{sct}^Y$                      | 4.6217<br>(0.481)    | 3.1890<br>(0.712)    | -2.0509<br>(0.138)   | 0.1474<br>(0.699)    | 0.7821<br>(0.583)    | 0.3670<br>(0.931)    | -0.9205<br>(0.270)   | -2.4525<br>(0.723)   | 2.8917<br>(0.808)    | -0.1564<br>(0.593)   | -0.2367<br>(0.836)   |
| $FDI_{sct}^Y * labor_{ct}$         | -1.1407<br>(0.479)   |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * finance_{ct}$       |                      | -0.7939<br>(0.713)   |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * educ1_{ct}$         |                      |                      | 11.9357<br>(0.110)   |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * educ2_{ct}$         |                      |                      |                      | -1.1456<br>(0.381)   |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * rd_{ct}$            |                      |                      |                      |                      | -126.9857<br>(0.541) |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * investm_{ct}$       |                      |                      |                      |                      |                      | -0.0908<br>(0.930)   |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * trade1_{ct}$        |                      |                      |                      |                      |                      |                      | 2.9364<br>(0.196)    |                      |                      |                      |                      |
| $FDI_{sct}^Y * trade2_{ct}$        |                      |                      |                      |                      |                      |                      |                      | 0.5712<br>(0.720)    |                      |                      |                      |
| $FDI_{sct}^Y * business_{ct}$      |                      |                      |                      |                      |                      |                      |                      |                      | -0.7000<br>(0.808)   |                      |                      |
| $FDI_{sct}^Y * hhi_{sct}$          |                      |                      |                      |                      |                      |                      |                      |                      |                      | 0.5752<br>(0.417)    |                      |
| $FDI_{sct}^Y * income_{ct}$        |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      | 0.0298<br>(0.841)    |
| $\ln capint_{irst}$                | 0.0344***<br>(0.000) | 0.0362***<br>(0.000) | 0.0305***<br>(0.000) | 0.0373***<br>(0.000) | 0.0338***<br>(0.000) | 0.0364***<br>(0.000) | 0.0358***<br>(0.000) | 0.0363***<br>(0.000) | 0.0362***<br>(0.000) | 0.0368***<br>(0.000) | 0.0364***<br>(0.000) |
| Observations                       | 1,814                | 1,814                | 1,475                | 1,741                | 1,135                | 1,814                | 1,800                | 1,814                | 1,814                | 1,814                | 1,814                |
| R-squared                          | 0.06                 | 0.01                 | 0.09                 | 0.04                 | -0.04                | 0.03                 | 0.05                 | 0.02                 | 0.04                 | 0.02                 | 0.02                 |
| Endog. var.                        | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    |
| Instruments                        | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    |
| F-stat. FDI                        | 3.40                 | 1.34                 | 3.32                 | 10.22                | 0.32                 | 5.78                 | 2.81                 | 11.90                | 1.77                 | 14.24                | 7.30                 |
| Hansen p-val.                      | 0.4630               | 0.3752               | 0.5422               | 0.4605               | 0.2824               | 0.4389               | 0.4437               | 0.4845               | 0.4302               | 0.4845               | 0.4960               |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects.

Standard errors are clustered at the country-sector level. Medium productivity: 33.33 percentile < LP ≤ 66.67 percentile.

# Appendix 15: National Characteristics, FDI Spillovers, Domestic High Productivity Firms, IV 2SLS

| Dependent variable: $\ln lp_{irst}$ |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
|-------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                     | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  | (7)                  | (8)                  | (9)                  | (10)                 | (11)                 |
| $FDI_{sct}^Y$                       | 1.4855<br>(0.833)    | 0.8961<br>(0.922)    | -1.3108<br>(0.408)   | -0.0027<br>(0.995)   | 0.2877<br>(0.847)    | 1.7890<br>(0.709)    | -0.3449<br>(0.765)   | 5.1011<br>(0.551)    | -0.0480<br>(0.998)   | -0.1529<br>(0.643)   | 0.8588<br>(0.551)    |
| $FDI_{sct}^Y * labor_{ct}$          | -0.4435<br>(0.797)   |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * finance_{ct}$        |                      | -0.2961<br>(0.896)   |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * educ1_{ct}$          |                      |                      | 6.0911<br>(0.466)    |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * educ2_{ct}$          |                      |                      |                      | -1.6284<br>(0.314)   |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * rd_{ct}$             |                      |                      |                      |                      | -135.8625<br>(0.548) |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * investm_{ct}$        |                      |                      |                      |                      |                      | -0.5215<br>(0.662)   |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * trade1_{ct}$         |                      |                      |                      |                      |                      |                      | 0.4347<br>(0.890)    |                      |                      |                      |                      |
| $FDI_{sct}^Y * trade2_{ct}$         |                      |                      |                      |                      |                      |                      |                      | -1.2510<br>(0.527)   |                      |                      |                      |
| $FDI_{sct}^Y * business_{ct}$       |                      |                      |                      |                      |                      |                      |                      |                      | -0.0656<br>(0.987)   |                      |                      |
| $FDI_{sct}^Y * hhi_{sct}$           |                      |                      |                      |                      |                      |                      |                      |                      |                      | -0.2433<br>(0.793)   |                      |
| $FDI_{sct}^Y * income_{ct}$         |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      | -0.1582<br>(0.402)   |
| $\ln capint_{irst}$                 | 0.1041***<br>(0.000) | 0.1040***<br>(0.000) | 0.1083***<br>(0.000) | 0.1050***<br>(0.000) | 0.0920***<br>(0.000) | 0.1043***<br>(0.000) | 0.1048***<br>(0.000) | 0.1042***<br>(0.000) | 0.1044***<br>(0.000) | 0.1042***<br>(0.000) | 0.1045***<br>(0.000) |
| Observations                        | 1,649                | 1,649                | 1,359                | 1,589                | 1,036                | 1,649                | 1,638                | 1,649                | 1,649                | 1,649                | 1,649                |
| R-squared                           | 0.06                 | 0.05                 | 0.07                 | 0.06                 | 0.05                 | 0.05                 | 0.06                 | 0.05                 | 0.06                 | 0.05                 | 0.06                 |
| Endog. var.                         | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    |
| Instruments                         | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    |
| F-stat. FDI                         | 4.62                 | 1.47                 | 2.21                 | 11.37                | 0.44                 | 6.71                 | 3.06                 | 12.34                | 1.48                 | 12.49                | 7.58                 |
| Hansen p-val.                       | 0.7204               | 0.8060               | 0.9950               | 0.8839               | 0.8712               | 0.8508               | 0.9585               | 0.9252               | 0.6768               | 0.9535               | 0.9403               |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects. Standard errors are clustered at the country-sector level. High productivity: LP > 66.67 percentile.



# Appendix 16: National Characteristics, FDI Spillovers from Full Foreign Ownership, All Domestic Firms, IV 2SLS

| Dependent variable: $\ln p_{irst}$ |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
|------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                                    | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  | (7)                  | (8)                  | (9)                  | (10)                 | (11)                 |
| $FDI_{sct}^Y$                      | 10.3481<br>(0.119)   | 11.3934<br>(0.285)   | -1.6032<br>(0.581)   | 0.5108<br>(0.155)    | 1.0172<br>(0.552)    | 4.8833<br>(0.122)    | 1.3942<br>(0.500)    | 9.4646<br>(0.221)    | 3.7632<br>(0.791)    | 0.0055<br>(0.984)    | 1.6173<br>(0.232)    |
| $FDI_{sct}^Y * labor_{ct}$         | -2.5070<br>(0.118)   |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * finance_{ct}$       |                      | -2.8224<br>(0.285)   |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * educ1_{ct}$         |                      |                      | 8.8373<br>(0.567)    |                      |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * educ2_{ct}$         |                      |                      |                      | -2.0013*<br>(0.099)  |                      |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * rd_{ct}$            |                      |                      |                      |                      | -216.5904<br>(0.442) |                      |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * investm_{ct}$       |                      |                      |                      |                      |                      | -1.2063<br>(0.120)   |                      |                      |                      |                      |                      |
| $FDI_{sct}^Y * trade1_{ct}$        |                      |                      |                      |                      |                      |                      | -3.5995<br>(0.514)   |                      |                      |                      |                      |
| $FDI_{sct}^Y * trade2_{ct}$        |                      |                      |                      |                      |                      |                      |                      | -2.1743<br>(0.220)   |                      |                      |                      |
| $FDI_{sct}^Y * business_{ct}$      |                      |                      |                      |                      |                      |                      |                      |                      | -0.9114<br>(0.791)   |                      |                      |
| $FDI_{sct}^Y * hhi_{sct}$          |                      |                      |                      |                      |                      |                      |                      |                      |                      | 0.3176<br>(0.708)    |                      |
| $FDI_{sct}^Y * income_{ct}$        |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      | -0.2099<br>(0.216)   |
| $\ln capint_{irst}$                | 0.2628***<br>(0.000) | 0.2624***<br>(0.000) | 0.2507***<br>(0.000) | 0.2665***<br>(0.000) | 0.2497***<br>(0.000) | 0.2633***<br>(0.000) | 0.2643***<br>(0.000) | 0.2635***<br>(0.000) | 0.2638***<br>(0.000) | 0.2641***<br>(0.000) | 0.2637***<br>(0.000) |
| Observations                       | 5,307                | 5,307                | 4,329                | 5,098                | 3,326                | 5,307                | 5,271                | 5,307                | 5,307                | 5,307                | 5,307                |
| R-squared                          | 0.13                 | 0.12                 | 0.13                 | 0.14                 | 0.13                 | 0.13                 | 0.13                 | 0.13                 | 0.14                 | 0.13                 | 0.14                 |
| Endog. var.                        | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    |
| Instruments                        | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    |
| F-stat. FDI                        | 4.01                 | 1.22                 | 0.69                 | 15.28                | 0.59                 | 5.82                 | 1.45                 | 7.68                 | 2.08                 | 8.75                 | 6.06                 |
| Hansen p-val.                      | 0.9426               | 0.9884               | 0.2804               | 0.4084               | 0.6840               | 0.7950               | 0.4378               | 0.4229               | 0.2188               | 0.3205               | 0.3051               |

Note:  $p^* < 0.1$ ,  $p^{**} < 0.05$ ,  $p^{***} < 0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects.

Standard errors are clustered at the country-sector level. Full foreign ownership: foreign participation = 100 percent.

# **Appendix 17: National Characteristics, FDI Spillovers from Partial Foreign Ownership, All Domestic Firms, IV 2SLS**

| Dependent variable: $\ln l_{irst}$ |                      |                      |                      |                      |                      |                       |                       |                      |                      |                      |                      |
|------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|-----------------------|----------------------|----------------------|----------------------|----------------------|
|                                    | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                   | (7)                   | (8)                  | (9)                  | (10)                 | (11)                 |
| $FDI_{sct}$                        | -18.9813<br>(0.122)  | -30.3412*<br>(0.066) | -5.8866**<br>(0.042) | -0.7804<br>(0.234)   | -2.8057<br>(0.628)   | -13.6193**<br>(0.030) | -3.1069***<br>(0.007) | -17.8079*<br>(0.069) | 19.4574<br>(0.383)   | -0.4316<br>(0.254)   | -4.1389**<br>(0.042) |
| $FDI_{sct}^{*}labor_{ct}$          | 4.7343<br>(0.117)    |                      |                      |                      |                      |                       |                       |                      |                      |                      |                      |
| $FDI_{sct}^{*}finance_{ct}$        |                      | 7.7047*<br>(0.065)   |                      |                      |                      |                       |                       |                      |                      |                      |                      |
| $FDI_{sct}^{*}educ1_{ct}$          |                      |                      | 35.4614**<br>(0.041) |                      |                      |                       |                       |                      |                      |                      |                      |
| $FDI_{sct}^{*}educ2_{ct}$          |                      |                      |                      | 2.6142<br>(0.257)    |                      |                       |                       |                      |                      |                      |                      |
| $FDI_{sct}^{*}rd_{ct}$             |                      |                      |                      |                      | 367.1298<br>(0.655)  |                       |                       |                      |                      |                      |                      |
| $FDI_{sct}^{*}investm_{ct}$        |                      |                      |                      |                      |                      | 3.3987**<br>(0.029)   |                       |                      |                      |                      |                      |
| $FDI_{sct}^{*}trade1_{ct}$         |                      |                      |                      |                      |                      |                       | 10.3784***<br>(0.004) |                      |                      |                      |                      |
| $FDI_{sct}^{*}trade2_{ct}$         |                      |                      |                      |                      |                      |                       |                       | 4.1490*<br>(0.070)   |                      |                      |                      |
| $FDI_{sct}^{*}business_{ct}$       |                      |                      |                      |                      |                      |                       |                       |                      | -4.7106<br>(0.381)   |                      |                      |
| $FDI_{sct}^{*}hhi_{sct}$           |                      |                      |                      |                      |                      |                       |                       |                      |                      | 0.8914<br>(0.276)    |                      |
| $FDI_{sct}^{*}income_{ct}$         |                      |                      |                      |                      |                      |                       |                       |                      |                      |                      | 0.5708**<br>(0.036)  |
| $\ln capint_{irst}$                | 0.2663***<br>(0.000) | 0.2647***<br>(0.000) | 0.2484***<br>(0.000) | 0.2678***<br>(0.000) | 0.2516***<br>(0.000) | 0.2633***<br>(0.000)  | 0.2649***<br>(0.000)  | 0.2627***<br>(0.000) | 0.2625***<br>(0.000) | 0.2642***<br>(0.000) | 0.2639***<br>(0.000) |
| Observations                       | 5,307                | 5,307                | 4,329                | 5,098                | 3,326                | 5,307                 | 5,271                 | 5,307                | 5,307                | 5,307                | 5,307                |
| R-squared                          | 0.12                 | 0.12                 | 0.12                 | 0.13                 | 0.11                 | 0.13                  | 0.13                  | 0.13                 | 0.14                 | 0.13                 | 0.13                 |
| Endog. var.                        | 1                    | 1                    | 1                    | 1                    | 1                    | 1                     | 1                     | 1                    | 1                    | 1                    | 1                    |
| Instruments                        | 3                    | 3                    | 3                    | 3                    | 3                    | 3                     | 3                     | 3                    | 3                    | 3                    | 3                    |
| F-stat. FDI                        | 1.73                 | 1.06                 | 3.40                 | 4.55                 | 0.17                 | 5.25                  | 2.03                  | 5.78                 | 0.77                 | 5.88                 | 7.22                 |
| Hansen p-val.                      | 0.4391               | 0.7750               | 0.4592               | 0.3266               | 0.6192               | 0.6694                | 0.4852                | 0.4546               | 0.1213               | 0.2003               | 0.5893               |

Note:  $p^{*}<0.1$ ,  $p^{**}<0.05$ ,  $p^{***}<0.01$  (p-values in parentheses). All regressions include sector, subnational region, and year fixed effects. . Standard errors are clustered at the country-sector level. Partial foreign ownership: 10 percent  $\geq$  foreign participation < 100 percent.