1-2021

Informal institutions and comparative advantage of South-based MNEs: Theory and evidence

Pao-Li CHANG
Singapore Management University, plchang@smu.edu.sg

Yuting CHEN

Informal institutions and comparative advantage of South-based MNEs: Theory and evidence☆

Pao-Li Chang, School of Economics, Singapore Management University, 90 Stamford Road, Singapore 178903
Yuting Chen, School of Economics, Shanghai University of Finance and Economics, 111 Wuchuan Road, Shanghai, 200433, China

Published in Journal of Development Economics, January 2021, 48, Article No. 102566, pp 1-28.
https://doi.org/10.1016/j.jdeveco.2020.102566

Abstract

This paper builds a theory based on "informal institutions" to characterize the comparative advantage of South-based MNEs. MNEs headquartered in countries with poorer state institutions are shown to endogenously invest more in firm-specific institutional capital to compensate for the lack of state institutions, and as an optimal response, undertake FDI in countries with weaker institutions. We conduct an extensive test of the theory using worldwide firm-level greenfield FDI flows during 2009–2016, employing (among others) variations in the interaction of prevalence of informal institutions at home and state institutional qualities of host countries, as well as heterogeneity across sectors and firms in their sensitivity to institutional support.

Keywords: FDI location, Firm productivity, Firm R&D intensity, Informal institution

1. Introduction

Based on the World Bank's MIGA-EIU survey of foreign investment intentions, governmental interference and expropriation of foreign direct investment (FDI) are consistently cited by investors as one of their critical concerns (MIGA, 2011, p. 29). Informal mitigation through engagement with host governments, political leaders, or local communities remains the most prevalent approach used by foreign investors to mitigate expropriation (MIGA, 2011, p. 47). Fig. 1, reproduced from the report, serves to illustrate the importance of such "informal institutions" in the conduct of foreign investment.

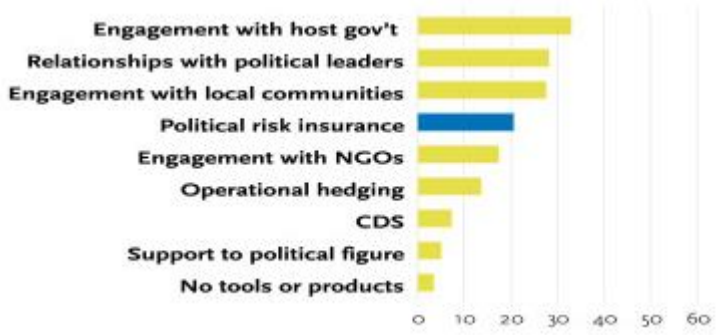


Fig. 1. Importance of informal institutions in foreign investment.
Source: World Bank MIGA-EIU Survey (MIGA, 2011, p. 47, Fig. 3.5). Tools used by MNEs to mitigate political risk in developing countries (percent of respondents). CDS: credit default swaps.

☆ We thank the editor Daniel Yi Xu and two anonymous referees for many thoughtful comments and suggestions, which helped improve the manuscript. We also wish to thank several colleagues who offered feedback on the paper at various seminars, workshops and conferences: Jonathan Vogel, Thomas Chaney, Andrei Levchenko, Chang-Tai Hsieh, Yi Lu, Kim Sau Chung, Chia-Hui Lu, Wen-Tai Hsu, Jiahua Che, Ping Wang, José de Sousa, Benjamin Faber, Andrés Rodríguez-Clare, among others. This study was supported by the Singapore Ministry of Education (MOE), Academic Research Fund (AcRF) Tier 1 grant (C244/MSS13E002). The *fDi* Markets dataset was kindly shared by Yue Lu of the University of International Business and Economics, Beijing, China.
☆ Corresponding author. E-mail addresses: plchang@smu.edu.sg (P.-L. Chang), yutingchen@mail.shufe.edu.cn (Y.Chen).

(UNCTAD, 2014). Equally important, the FDI flows from the South predominantly head toward the peer South. In 2001, 42% of FDI flows received by the South originated from the South, while 2.7% of FDI flows received by the North came from the South. This disproportionate pattern is observed throughout the period 2001–2012, as documented by Fig. 2. In the existing literature, multinational enterprises (MNEs) are often theoretically based in the North. This supposition, although understandable given the North MNEs' leadership in R&D and technology, is increasingly incongruent with the trend. It is thus important to develop a theoretical framework to formalize the comparative advantage of South-based MNEs.

In this paper, we propose a theoretical model to microfound the endogenous formation of firm-specific "informal institutions," which in turn affects the relative cost structures of MNEs in their choices of foreign market entry. In particular, we argue that weaker state institutions in the South breed heavier investment by firms in informal institutions as a self-remedy to counter the former's taxing effects on firm overhead costs. Such firm-specific informal institutions at home help reduce the fixed overhead of foreign market entry, more so in destinations with weaker state institutions, and even more so when serving the foreign market via FDI relative to exporting. This gives rise to a positive assortative matching in the state institutional qualities of FDI source and destination countries, and a comparative advantage of South-based MNEs in markets with weaker state institutions. We demonstrate the "existence" of the proposed theoretical channel based on a global firm-level dataset of greenfield FDI activities during 2009–2016, where the identification relies on, among others, directly measured informal institutions across countries, heterogeneity across industrial sectors in their demand for institutional support, variations across firms in their productivity levels and R&D intensity, and the interaction of these country/sector/firm characteristics with the destination's state institutional qualities, as predicted by the theory.

The term *informal institution* has been used in the literature to refer to many things, including customs, traditions, norms, religion, social capital, trust, reputation and culture.[1] We adopt the conception of Helmke and Levitsky (2004), who define informal institutions as socially shared rules, usually unwritten, that are created, communicated, and enforced outside of officially sanctioned channels. This distinguishes informal institutions from informal behavioral regularities, shared values and the broader concept of culture. Specifically, for the purpose of exposition, we can classify informal institutions as economic, legal, or political informal institutions. The relevance of such informal institutions is documented by many studies in various fields, although the literature may not have perceived or defined them as such. We point out below the pattern motivating our theoretical mechanism: the endogenous response of the private sector to the formal institutions the state provides.

First, where market-supporting institutions such as contract enforcement and bank credit are lacking, firms tend to fill the void with relational contracting and trade credit. These patterns are documented, for example, by McMillan and Woodruff (2002) for Russia, China, Poland and Vietnam. McMillan and Woodruff (1999a,b) provide detailed accounts of how these *informal economic institutions* work in Vietnam under reputation incentives and threat of community sanction. A similar argument was suggested by Acemoglu and Johnson (2005), that reputation-based mechanisms can, at least in part, alleviate the problems originating from weak contract enforcement institutions. Second, where the state legal institutions are weak, the private sector tends to turn to *informal legal institutions* such as private patrols, private protection agencies or informal courts to substitute for police protection and judicial systems (Hay and Shleifer, 1998). For example, Frye and Zhuravskaia (2000) found that higher levels of regulation and weak legal institutions are associated with a higher probability of contact with private protection organizations in Russia. Third (and perhaps the most controversial of the three, given its many faceted implications), where the state's bureaucratic system is inefficient and regulatory quality poor, firms tend to build political connections (Fisman, 2001; Faccio, 2006) with politicians and government officials, or directly participate in politics. Such political connections can help firms reduce regulatory burdens (e.g., fewer days to obtain business permits, fewer agencies to register with, or fewer on-site inspections), secure property rights (e.g., lower expropriation via taxes or fines) and enforce contracts.[2]

1.1. Contributions to the literature

The hypothesis that similarly poor governance endowments may be a source of comparative advantage for South-based MNEs when investing in developing countries was suggested by Morck et al. (2008) for Chinese outward FDI and by Dixit (2012) in a lecture, among others. In these studies, 'experiences', 'skills' and 'abilities' of firms based in the South 'to deal with burdensome regulations and to navigate around the opaque political constraints' and their 'familiarity' with the norms in the host country are often conjectured as potential explanations. In this paper, we develop a full structural model to account for the endogenous incentives of firms to invest in informal institutions and embed the endogenous fixed cost structure in a horizontal FDI model to characterize the decision of MNEs about foreign market entry and their choice of production locations. In particular, one of our key hypotheses implies that the profit differential of FDI relative to exporting to serve destination markets with poorer state institutions is larger for firms based in countries with poorer state institutions — hence implying an institutional complementarity effect on FDI. The theory and its propositions are shown to hold: (i) under the alternative setting of vertical FDI, and (ii) under generalization that allows informal institutions to affect marginal cost as well as fixed cost of production.

Several empirical studies based on country-level FDI data (Cezar and Escobar, 2015; Darby et al., 2010; Cuervo-Cazurra and Genc, 2008; Bénassy-Quéré et al., 2007; Habib and Zurawicki, 2002) have documented patterns, at least in part, consistent with the hypothesis. The firm-level study of China's inward FDI by Che et al. (2017) also provides evidence in line with the proposition. They found that foreign invested enterprises, at the extensive margin, are less likely to locate in Chinese regions whose institutional difference from their home countries is large. In this paper, we provide worldwide firm-level evidence of the theory's predictions. In particular, we use the worldwide *fDi Markets* database on firm-level greenfield FDI during 2009–2016, and the global Orbis financial dataset to obtain parent firms' key performance measures. Each unit of observation corresponds to an incident of greenfield foreign capital investment in a sector, destination and year by a firm from a source country reported by *fDi Markets*. We regress capital investment on the interaction of the institutional quality indicators of the home and host countries, on firm productivity and its interaction with destination institutional quality, and on firm R&D intensity and its

[1] See, for example, Williamson (2000), Seyoum (2011), and Chan et al. (2015).

[2] For example, Li et al. (2006) found that in China, the probability of entrepreneurs entering politics decreases by 8–20% when the institutional index in a region improves by one standard deviation. Chen, Li, Su, and Sun (2011) similarly showed that firms are more likely to establish political connections in regions in which the government has more discretion in allocating economic resources. Bai, Hsieh, and Song (2014) provided a vivid account of how in the aluminum and auto industries, Chinese local governments may have large leverage in providing public goods (such as land and capital) to their cronies and alter the terms of competition in the market. In general, firms may engage in all three types of informal institutional building (economic, legal and political). For example, Cai et al. (2011) inferred that the entertainment and travel expenditures of Chinese firms include grease money to obtain better government services, protection money to lower tax rates, and also business expenditures to build relational capital with suppliers and clients.

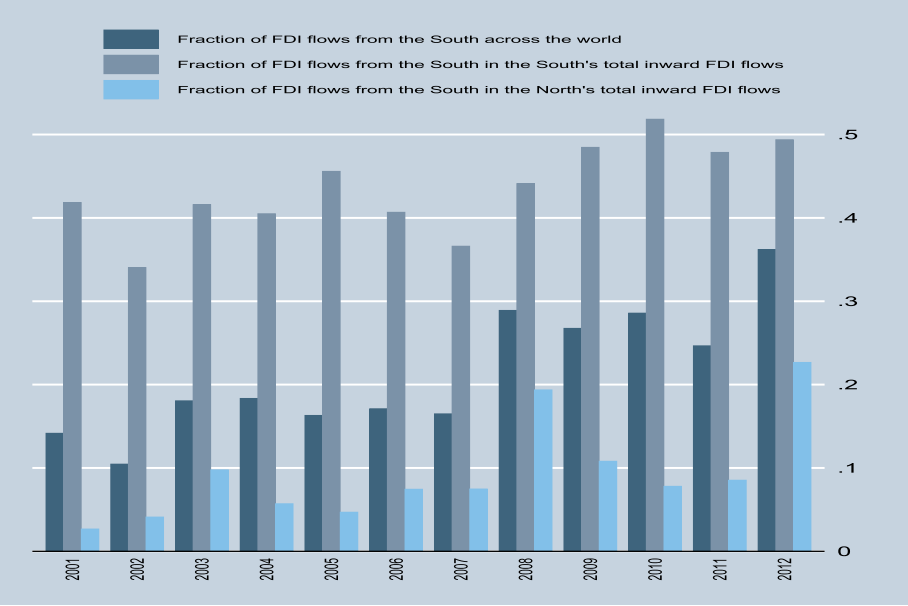


Fig. 2. Disproportionate FDI flows from the South to the South.
Source: Authors' calculations based on UNCTAD's Bilateral FDI Statistics (FDI inward flow series) for 219 economies during the period 2001–2012 (http://unctad.org/en/Pages/DIAE/FDI%20Statistics/FDI-Statistics-Bilateral.aspx). We define the South to be economies in transition and developing economies, and the North to be developed economies, using the UN country classifications (https://www.un.org/en/development/desa/policy/wesp/wesp_current/2014wesp_country_classification.pdf).

interaction with destination institutional quality. We also control for an extensive set of fixed effects (origin-year, destination-year, destination-sector) and FDI determinants at the country-pair level.

We find a positive and significant coefficient for the interaction term of the origin and destination institutional qualities, and such institutional complementarity effects are empirically stronger in sectors that are more contract intensive and hence more reliant on institutional support. We further replace the interaction of formal institutions with the interaction of home informal institutions—using four alternative proxies based on Faccio (2006)—and destination formal institutions. The sign of the coefficient of the new interaction term is found to be significantly negative across different measures of informal and formal institutions. This is consistent with the theoretical mechanism proposed in the paper: firms based in countries where formal institutions are lacking tend to build more informal institutions; in turn, these allow them to operate in destinations with poorer formal institutions. In support of the theoretical setup, we also find that the more productive firms tend to invest more in countries with poorer state institutions (since these firms with larger market shares have stronger incentives to locate production in countries with lower wages, and they are able to afford the higher fixed cost associated with larger investment in informal institutions in such countries). The key finding of an institutional complementarity effect on firm-level FDI is shown to be robust: (i) to the use of eight alternative measures of state institutional qualities, (ii) across the samples of South-based and North-based MNEs, (iii) to dropping sub-samples of conspicuous origins, destinations, sectors, or tax havens, (iv) to controlling for initial institutional qualities, and (v) to the use of alternative productivity measures.

The rest of the paper is organized as follows. Section 2 develops the theoretical model and propositions. Section 3 presents the firm-level empirical evidence for the propositions. Section 4 concludes. Appendix A provides the proofs of the propositions and develops the parallel propositions for the alternative setup of vertical FDI. Appendix B provides further documentation for the data used in the empirical analysis. The Online Appendix provides the theoretical generalizations in which informal institution affects marginal as well as fixed costs of production, additional summary statistics tables and estimation results.

2. Model

In this section, we develop the theoretical propositions in a framework of horizontal FDI. The proofs are provided in Appendix A.1. A parallel set of predictions under vertical FDI are provided in Appendix A.2. We discuss the generality of the proposed mechanisms and possible extensions in Section 2.3.

Suppose there is a continuum of countries indexed by $r \in R$, where r is an inverse measure of the quality of formal institutions. The larger r is, the poorer are the country's institutions. There is a continuum of sectors indexed by s producing differentiated goods, and one sector producing a homogeneous good (used as the numeraire). The only factor of production is labor, and the homogeneous good is produced with constant unit labor requirement. Labor endowment is assumed to be large enough in each country such that the homogeneous good is always produced. As a result, a country's labor productivity in the numeraire good determines its wage rate w. Countries with better formal institutions are assumed to have higher labor productivity in the numeraire good and hence a higher wage: $w = \omega(r)$ and $\omega'(r) \equiv d\omega(r)/dr < 0$.

Each variety of the differentiated goods requires a headquarters service component and an intermediate manufactured/service component using a Cobb-Doublas production function (à la Antràs and Helpman, 2004), where each component has a unit labor requirement equal to one. This implies a unit cost of production equal to $c = w_h^{\eta} w_d^{1-\eta}/\phi$, where ϕ indexes the productivity of the firm producing the variety, η denotes the headquarters intensity in the production, and w_h and w_d correspond to the wage rate of the country where the headquarters and the intermediate production facility of the firm are located, respectively.

The world is populated by consumers with identical preferences: $U = x_0 + \frac{1}{\mu}\int X_s^{\mu} ds$, $0 < \mu < 1$, where x_0 indicates the consumption of the numeraire good, and X_s a CES function over all available varieties $x_s(i)$ in sector s with an elasticity of substitution σ (> 1). We drop the sector index s to simplify the notation where there is no risk of confusion. Given monopolistic competition, the CES preferences imply the standard pricing and profit functions. Each firm charges a constant markup over its marginal cost of production $p(c) = \frac{\sigma}{\sigma-1}c$, sells a quantity of $x(p(c)) = X_s^{\sigma(\mu-1)+1} p(c)^{-\sigma}$ and earns a variable profit:

$$\begin{aligned}\pi &= (p(c) - c)x(p(c)) \\ &= Bc^{1-\sigma} \\ &= B\widetilde{\phi}\left(w_h^{\eta} w_d^{1-\eta}\right)^{1-\sigma}, \end{aligned} \tag{1}$$

where $B \equiv \frac{1}{\sigma} X_s^{\sigma(\mu-1)+1}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}$ can be taken as an index of the mar-

ket size for the sector (exogenous from the viewpoint of the individual firm), and $\widetilde{\phi} \equiv \phi^{\sigma-1}$ is a transformed index of the firm productivity level.

2.1. Choice of informal institutions

Each firm, given its productivity level, chooses whether to produce or not for the home market. If it chooses to produce for the home market, it incurs a fixed overhead cost $f^D(r_h, I_h)$, which depends on: i) the quality of the formal institutions r_h at home, and ii) the informal institutions I_h that the firm invests in. It is assumed that $f^D(r_h, I_h)$ strictly increases in r_h but strictly decreases in I_h: $\partial f^D(r_h, I_h)/\partial r_h > 0$ and $\partial f^D(r_h, I_h)/\partial I_h < 0$. That is, worse formal institutions increase the fixed overhead cost, but firm-specific informal institutions help reduce the fixed overhead cost. In addition, it is assumed that

$$\frac{\partial}{\partial r_h}\left(\frac{\partial f^D(r_h, I_h)}{\partial I_h}\right) < 0, \tag{2}$$

i.e., informal institutions are more effective in reducing the fixed overhead cost in environments with poorer formal institutions. Investing in informal institutions, however, costs the firm $k_h(I_h)$, which is assumed to be increasing and convex in I_h.

Investment in informal institutions is assumed to be sequential: firms first choose the optimal level of investment I_h^* to minimize the fixed cost of producing for the home market: $F^D(r_h, I_h) \equiv f^D(r_h, I_h) + k_h(I_h)$. Given entry into the home market, firms then choose whether or not to enter a foreign market (in addition to the home market) and whether to enter the foreign market via exporting or horizontal FDI. In the scenario of foreign market entry, it is assumed that firms make location-specific investments in informal institutions: I_d abroad in the destination d of foreign sales. Nonetheless, the level of informal institutions that a firm builds at home I_h^* still affects (to some extent) its fixed operating cost in the destination country. If a firm chooses to enter a foreign market by exporting, it needs to incur additional fixed cost of serving that market $F^E(r_d, I_h^*, I_d) \equiv f^E(r_d, I_h^*, I_d) + k_d(I_d)$, where $k_d(\cdot)$ is similarly increasing and convex. If the firm chooses to enter via FDI, the additional fixed cost of serving the foreign market is instead $F^{FDI}(r_d, I_h^*, I_d) \equiv f^E(r_d, I_h^*, I_d) + f^P(r_d, I_h^*, I_d) + k_d(I_d)$. We can interpret f^E as the fixed cost of maintaining the distribution network in the destination (which needs to be incurred in both cases of exporting and FDI), while f^P as the fixed cost of setting up an additional production plant/facility in a foreign country. Firms choose $I_d^{E,*}$ and $I_d^{FDI,*}$ to minimize the fixed cost of foreign market entry in the case of exporting and FDI, respectively.

The first-order conditions for I_h^*, $I_d^{E,*}$ and $I_d^{FDI,*}$ are, respectively:

$$\frac{\partial f^D(r_h, I_h^*)}{\partial I_h} + k_h'(I_h^*) = 0, \tag{3}$$

$$\frac{\partial f^E(r_d, I_h^*, I_d^{E,*})}{\partial I_d} + k_d'(I_d^{E,*}) = 0, \tag{4}$$

$$\frac{\partial f^E(r_d, I_h^*, I_d^{FDI,*})}{\partial I_d} + \frac{\partial f^P(r_d, I_h^*, I_d^{FDI,*})}{\partial I_d} + k_d'(I_d^{FDI,*}) = 0. \tag{5}$$

Define $F^{D,*}(r_h) \equiv F^D(r_h, I_h^*)$, $F^{E,*}(r_h, r_d) \equiv F^E(r_d, I_h^*, I_d^{E,*})$, and $F^{FDI,*}(r_h, r_d) \equiv F^{FDI}(r_d, I_h^*, I_d^{FDI,*})$; i.e., they are the respective minimal fixed costs of serving the home market, exporting and horizontal FDI. We make similar assumptions about $f^S(r_d, I_h, I_d)$ as for $f^D(r_h, I_h)$. That is, $f^S(r_d, I_h, I_d)$ strictly increases in r_d; strictly decreases in I_h and I_d; and

$$\frac{\partial}{\partial r_d}\left(\frac{\partial f^S(r_d, I_h, I_d)}{\partial I_h}\right) < 0; \quad \frac{\partial}{\partial r_d}\left(\frac{\partial f^S(r_d, I_h, I_d)}{\partial I_d}\right) < 0, \quad \text{for } S \in (E, P). \tag{6}$$

We assume the neutral scenario that

$$\frac{\partial^2 f^S(r_d, I_h, I_d)}{\partial I_h \partial I_d} = 0, \quad \text{for } S \in \{E, P\}, \tag{7}$$

so there are no reinforcing effects of r_h on the choice of I_d through I_h. We discuss the possible scenario of reinforcing effects at the end of Appendix A.1. Basically, the proposed mechanism is further strengthened.

A firm incurs an iceberg trade cost factor $\tau_{hd}(>1)$ when exporting final or intermediate goods from home country h to the destination market d. In sum, the net profits of home market, exporting and FDI are, respectively:

$$\Pi^D \equiv \pi^D - F^{D,*}(r_h) = B_h \widetilde{\phi}(w_h)^{1-\sigma} - F^{D,*}(r_h), \tag{8}$$

$$\Pi^E \equiv \pi^E - F^{E,*}(r_h, r_d) = B_d \widetilde{\phi}(\tau_{hd} w_h)^{1-\sigma} - F^{E,*}(r_h, r_d), \tag{9}$$

$$\begin{aligned}\Pi^{FDI} &\equiv \pi^{FDI} - F^{FDI,*}(r_h, r_d) \\ &= B_d \widetilde{\phi}\left((\tau_{hd} w_h)^{\eta} w_d^{1-\eta}\right)^{1-\sigma} - F^{FDI,*}(r_h, r_d),\end{aligned} \tag{10}$$

where in the FDI mode, the headquarters input needs to be shipped to the foreign market (incurring trade cost) and combined with the intermediate manufactured/service component produced in the destination market. With trade cost, the market size B refers to that of a national market indexed by h or d. We characterize the choice and impacts of informal institutions as follows:

Proposition 1. *(i) The investment in destination informal institutions will be higher for firms engaging in horizontal FDI than for firms entering the same market by exporting*: $I_d^{FDI,*}(r_h, r_d) > I_d^{E,*}(r_h, r_d)$. *(ii) The total fixed cost of production will be higher for horizontal FDI than for exporting*: $F^{FDI,*}(r_h, r_d) > F^{E,*}(r_h, r_d)$. *(iii) The total fixed cost of horizontal FDI will be higher in FDI destinations with poorer institutions*: $dF^{FDI,*}/dr_d > 0$. *(iv) The total fixed cost of exporting will be higher in destinations with poorer institutions*: $dF^{E,*}/dr_d > 0$.

Proof. *See* Appendix A.1. ■

The predictions in Proposition 1 are derived under the endogenous choice of informal institutions by firms and yet they are consistent with typical assumptions (observations) often made in the FDI literature. First, note that firms will have a stronger incentive to invest in destination informal institutions when they engage in multinational production than when they serve the same market by exporting, because in the former case, the destination informal institutions can be used to help lower the overhead cost of not only the distribution network in the destination (which needs to be incurred in both cases of exporting and FDI), but also the fixed cost of additional production facilities in foreign countries. This prediction is in line with the fact that larger firms tend to be more politically connected or politically active (Hellman et al., 2003; Faccio, 2006; Li et al., 2006; Chen et al., 2011), since MNEs also tend to be larger than pure-exporting firms. Second, multinational production sets a higher threshold than exporting in terms of fixed costs. This helps explain the typical sorting of MNEs and pure-exporting firms in terms of productivity. Third, poor state institutions in a market discourage firms from entering the market via horizontal FDI or exports, by raising the total fixed cost ($dF^{FDI,*}/dr_d > 0$; $dF^{E,*}/dr_d > 0$). This is in spite of the fact that firms endogenously undertake heavier investment in informal institutions should they choose such locations. Thus, the direct effect of weak state institutions still dominates the countervailing effect of self-remedy.

Proposition 2. *(i) Firms based in countries with poorer institutions will invest more in home informal institutions*: $\frac{\partial I_h^{h,*}(r_h)}{\partial r_h} > 0$. *(ii) Firms exporting to countries with poorer institutions will invest more in destination informal institutions*: $\frac{\partial I_d^{E,*}(r_h, r_d)}{\partial r_d} > 0$. *(iii) Multinational firms undertaking horizontal FDI in countries with poorer institutions will invest more in destination informal institutions*: $\frac{\partial I_d^{FDI,*}(r_h, r_d)}{\partial r_d} > 0$. *(iv) As a corollary of (i), firms based in countries with poorer institutions and entering foreign markets will be*

more effective at reducing their fixed overhead in a given foreign market: $\frac{dF^E(r_d,I_h^*,I_d^{E,*})}{dr_h} < 0$ *and* $\frac{dF^{FDI}(r_d,I_h^*,I_d^{FDI,*})}{dr_h} < 0$.

Proof. *See* Appendix A.1. ■

To interpret Proposition 2, note that the marginal benefit of investing in informal institutions is higher for firms based in countries with poorer state institutions, because the firm-specific informal institutions reduce the fixed overhead cost of home operation more in such environments. Similar mechanisms induce firms that enter a foreign market with poorer state institutions to build more informal institutions at the destination. The heavier investment in home informal institutions, in turn, gives South-based firms an advantage over their peers from the North in dealing with inadequate state institutions in a given foreign market.

2.2. Optimal foreign market entry mode

For each foreign market, firms choose the entry mode by comparing the difference in profits from horizontal FDI and exporting. Let $\Pi^{\Delta} \equiv \Pi^{FDI} - \Pi^{E}$ denote the difference:

$$\Pi^{\Delta} = B_d\widetilde{\phi}((\tau_{hd}w_h)^{\eta(1-\sigma)}(w_d)^{(1-\eta)(1-\sigma)} - (\tau_{hd}w_h)^{1-\sigma}) - (F^{FDI,*} - F^{E,*}). \tag{11}$$

This difference varies with r_d according to:

$$\frac{\partial\Pi^{\Delta}}{\partial r_d} = (1-\eta)(1-\sigma)\frac{\pi^{FDI}}{w_d}\omega'(r_d) - \left[\frac{dF^{FDI,*}}{dr_d} - \frac{dF^{E,*}}{dr_d}\right], \tag{12}$$

where the first term is positive because in destinations with higher r_d, wages are lower, which reduces the marginal cost of intermediate components in the FDI mode but does not affect the variable profits from exporting. Thus, the difference in variable profits increases with r_d. The sign of the second term depends on the functional form assumptions about the importance of plant-level fixed cost f^P (incurred only under FDI) relative to distribution fixed cost f^E (incurred in both entry modes). We discuss this further below. The cross derivative of the profit differential with respect to r_h and r_d is then:

$$\frac{\partial^2\Pi^{\Delta}}{\partial r_h\partial r_d} = \eta(1-\eta)(1-\sigma)^2\frac{\pi^{FDI}}{w_h w_d}\omega'(r_h)\omega'(r_d) - \left[\frac{\partial^2F^{FDI,*}}{\partial r_h\partial r_d} - \frac{\partial^2F^{E,*}}{\partial r_h\partial r_d}\right], \tag{13}$$

where the first term is positive. Thus, the variable profit differential between FDI and exporting in destinations with higher r_d is larger for firms based in countries with higher r_h. This is mainly due to the complementarity between headquarters and intermediate components implied by the Cobb-Douglas production function. More importantly, using (20) and (21) in Appendix A.1, we obtain, under scenario (7):

$$\frac{\partial^2F^{FDI,*}}{\partial r_h\partial r_d} - \frac{\partial^2F^{E,*}}{\partial r_h\partial r_d} = \frac{\partial^2f^E(r_d,I_h^*,I_d^{FDI,*})}{\partial r_d\,\partial I_h^*}\frac{\partial I_h^*}{\partial r_h} + \frac{\partial^2f^P(r_d,I_h^*,I_d^{FDI,*})}{\partial r_d\,\partial I_h^*}\frac{\partial I_h^*}{\partial r_h} - \frac{\partial^2f^E(r_d,I_h^*,I_d^{E,*})}{\partial r_d\,\partial I_h^*}\frac{\partial I_h^*}{\partial r_h} < 0, \tag{14}$$

where the first and third terms are independent of I_d (since there is no interaction between I_h and I_d in the fixed cost function of exporting by assumption (7)), and hence cancel each other. This leaves the second term, which is negative because of assumption (6) and Proposition 2(i). The result in (14) reinforces the complementarity of r_h and r_d in variable profit difference between FDI and exporting in (13). Thus, we reach the key proposition of the paper, as follows:

Proposition 3. *(i)* ***(Complementarity of Institutional Qualities in Firm-level Horizontal FDI)*** *All else being equal, a firm will more likely choose to undertake horizontal FDI instead of exporting to serve a foreign market with poorer institutional qualities, the poorer the institutional quality at home is:* $\frac{\partial^2\Pi^{\Delta}}{\partial r_h\partial r_d} > 0$. *(ii) All else being equal, a firm will more likely choose to undertake horizontal FDI instead of exporting to serve a foreign market with poorer institutional qualities, the more productive the firm is:* $\frac{\partial^2\Pi^{\Delta}}{\partial\widetilde{\phi}\partial r_d} > 0$. *(iii) All else being equal, a firm will more likely choose to undertake horizontal FDI instead of exporting to serve a foreign market with poorer institutional qualities, the larger the destination market demand is:* $\frac{\partial^2\Pi^{\Delta}}{\partial B_d\partial r_d} > 0$. *(iv) All else being equal, a firm will more likely choose to undertake horizontal FDI instead of exporting to serve a foreign market with poorer institutional qualities, the less headquarters-intensive the sector is:* $\frac{\partial^2\Pi^{\Delta}}{\partial\eta\partial r_d} < 0$.

Proof. (*i*) *This follows from the derivations above, where in* (13) *the first term is positive and the second term is negative by* (14). (*ii*)–(*iv*) *See* Appendix A.1. ■

To reiterate, institutional complementarity in firm-level horizontal FDI arises for two reasons. First, firms based in countries with poorer institutional qualities tend to be more heavily endowed with firm-specific informal institutions, which gives them a comparative advantage in conducting FDI (relative to exporting) in destinations having poorer institutional qualities (since the adverse effect of weak institutions at the destination on fixed cost is reduced by the firm-specific home institutional investment, more so in destinations with poorer institutions, and even more so in the FDI entry mode). This is the key mechanism proposed here. In addition, given the supermodularity between the headquarters and the intermediate component implied by the Cobb-Douglas production function, foreign destinations with higher r_d (lower-wage and lower-cost intermediate manufactured/service component) increases FDI's variable profits relative to exporting, and more so for firms based in countries with higher r_h (lower-wage and lower-cost headquarters input). This second mechanism reinforces the main mechanism and strengthens the institutional complementarity effect on FDI.

A larger $\widetilde{\phi}$ (or B) increases FDI's marginal benefit (relative to exporting) of producing the intermediate component in a location with lower wages w_d, since the market share of the firm at stake (or the size of the destination market demand) is larger. In contrast, when a sector is more headquarters intensive, the cost of the intermediate component becomes less important, which weakens the incentive of firms to locate FDI in countries with weaker institutional support.

We now propose possible functional-form assumptions about f^E and f^P that satisfy our assumptions:

$$f^E = r_d\exp(-\Upsilon I_h) + r_d\exp(-I_d), \quad \Upsilon > 0, \tag{15}$$

$$f^P = \Xi r_d\exp(-\Upsilon I_h) + \Xi r_d\exp(-I_d), \quad \Xi > 0, \tag{16}$$

where both f^E and f^P increase with r_d, decrease with I_h and I_d, and satisfy assumption (6). The fixed-cost functions are also separable in the home and destination informal institutions, and thus satisfy assumption (7). The parameter Υ denotes the transnationality of informal institutions at home in reducing destination fixed cost, while Ξ denotes the size of plant-level fixed cost relative to distribution fixed cost. Given this, we have

$$\frac{dF^{FDI,*}}{dr_d} - \frac{dF^{E,*}}{dr_d} = \Xi\exp(-\Upsilon I_h^*) + (\Xi+1)\exp(-I_d^{FDI,*}) - \exp(-I_d^{E,*}), \tag{17}$$

$$\frac{\partial^2F^{FDI,*}}{\partial r_h\partial r_d} - \frac{\partial^2F^{E,*}}{\partial r_h\partial r_d} = -\Upsilon\Xi\exp(-\Upsilon I_h^*)\frac{\partial I_h^*}{\partial r_h} < 0, \tag{18}$$

where the sign of (17) depends on the parameters Ξ and Υ, so the first-order difference in fixed costs of FDI and exporting can increase

or decrease with r_d. Nonetheless, the cross derivative of the fixed-cost difference with respect to r_h and r_d in (18) is negative, consistent with the general derivation in (14). Thus, whatever the fixed-cost difference between FDI and exporting, the difference is smaller for firms based in countries having higher r_h when the foreign destination has higher r_d.

2.3. Discussion of the model

We discuss several possible extensions of the model. First, we have implicitly assumed that labor productivity is the same across countries in the production of headquarters or intermediate components for differentiated goods. We can relax this assumption without affecting the result if the wage rate adjusted for labor productivity remains lower in countries with poorer institutional qualities.

Second, the benchmark model is developed under the horizontal-FDI framework. In Appendix A.2, we develop the parallel propositions for a vertical-FDI framework. We show that the same institutional complementarity effect at the firm level continues to apply in this alternative setting. All else being equal, a firm will choose to undertake FDI in countries with poorer institutional qualities, the poorer the institutional quality at home is.

Third, in the benchmark model, we assume that informal institutions affect only fixed costs. In Online Appendix A.3, we extend the model by allowing informal institutions to affect both variable and fixed costs. A firm's productivity is assumed to be determined by both an exogenous component ϕ and an endogenous part that increases with the firm's investment in informal institutions. That is, informal institutions help to facilitate production processes and enhance a firm's productivity. Firms now choose the level of investment in informal institutions I_h^* that maximizes net profit Π^D for home production, and $I_d^{E,*}$ and $I_d^{FDI,*}$ that maximizes Π^E and Π^{FDI}, respectively, in the case of entering a foreign market. We show that the propositions continue to hold with this generalization. Online Appendix A.4 provides the parallel generalization for the vertical-FDI model.

Fourth, the prediction of Proposition 3(ii) is derived from pure horizontal-FDI incentives. In Appendix A.2 and Online Appendix A.3–A.4, we show that the positive correlation between firm productivity and r_d continues to hold in the alternative setting with vertical FDI or where informal institutions affect both fixed and variable costs. There are some potential factors outside the model that can moderate this stark prediction. One possible moderating factor is quality-control risk. Firms that use more sophisticated production technologies may tend to be more productive but also face higher risk of quality-control failure, which creates disincentives for such firms to locate production in countries with poorer institutions (Chang and Lu, 2012). In the empirical analysis, we control for both firm productivity and firm R&D intensity, and their interactions with destination institutional qualities, to distinguish these two potentially distinctive mechanisms—the market-share incentive to locate production in countries with lower wages by more productive firms and the quality-control risk consideration to locate production in countries with better state institutions by firms with higher technological sophistication.

3. Empirical evidence: FDI activities at the firm level

In this section, we propose empirical specifications and measures to test the theoretical predictions of Proposition 3. We start with baseline specifications and present evidence consistent with the theoretical predictions. We then provide extensive robustness checks to verify that the effects we identify are indeed driven by the (formal and informal) institutional mechanism we propose. In view of the theory, we specify that the firm-level FDI activities depend on institutions and other key variables as follows:

$$\begin{aligned}\ln(FDI_{fshdt}) = {} & \boldsymbol{\beta_1}(\boldsymbol{G_{h,t-1}} * \boldsymbol{G_{d,t-1}}) \\ & + \beta_2 \ln(prod_{f,t-1}) + \boldsymbol{\beta_3}(\ln(\boldsymbol{prod_{f,t-1}}) * \boldsymbol{G_{d,t-1}}) \\ & + \beta_4 RD_{f,t-1} + \boldsymbol{\beta_5}(\boldsymbol{RD_{f,t-1}} * \boldsymbol{G_{d,t-1}}) \\ & + \beta_6 |\ln(gdppc_{h,t-1}) - \ln(gdppc_{d,t-1})| + \gamma' X_{hd,t-1} \\ & + \chi_{ht} + \zeta_{dt} + \kappa_{ds} + \epsilon_{fshdt} \end{aligned} \quad (19)$$

where FDI_{fshdt} measures the FDI activity in sector s by firm f of origin h in destination d in year t, $G_{c,t-1}$ is country c's institutional quality in year $t-1$, $prod_{f,t-1}$ denotes firm f's productivity in year $t-1$, and $RD_{f,t-1}$ is firm f's R&D intensity in year $t-1$. The three sets of indicator variables, $\{\chi_{ht}, \zeta_{dt}, \kappa_{ds}\}$, control for origin-year, destination-year, and destination-sector fixed effects.

Proposition 3(i) implies that firms from countries with better institutions tend to carry out more FDI in destinations with better institutions (relative to another firm with similar characteristics other than country of origin) and vice versa. A finding of $\beta_1 > 0$ in (19) will provide empirical support for this hypothesis of an institutional complementarity effect on FDI. The next two terms in (19) test the prediction of Proposition 3(ii). It suggests that more productive firms, due to larger market shares, have stronger incentives to locate production of intermediate components in cheaper locations (i.e., poorer institutions in the current framework), and implies $\beta_3 < 0$. To distinguish this effect of productivity on FDI from that of quality-control risk as suggested by Chang and Lu (2012), we include R&D intensity to proxy for a parent firm's technological sophistication. The theory of Chang and Lu (2012) suggests that firms with more complicated production technology have weaker incentives to engage in FDI because of higher risk of quality-control failure ($\beta_4 < 0$), but such disincentive is moderated in destinations with better institutional support ($\beta_5 > 0$). Including both the firm-level productivity and R&D intensity, together with their interactions with destination institutional quality, helps us isolate these two potential, countervailing, mechanisms. Last, the effects of sector market size and headquarters intensity on the choice of FDI location, as suggested by Proposition 3(iii)–(iv), would be absorbed by the destination-sector FEs.

The Linder hypothesis of FDI, proposed by Fajgelbaum et al. (2015), suggests that MNEs will tend to invest in countries having similar income per capita because of non-homothetic preferences and proximity-versus-concentration tradeoff of serving foreign markets. We control for this mechanism by including the absolute difference in log income per capita between two countries $|\ln(gdppc_{h,t-1}) - \ln(gdppc_{d,t-1})|$ as in their study, and expect to find $\beta_6 < 0$ accordingly. The specification in (19) also includes a long list of country-pair covariates $X_{hd,t-1}$ to help control for trade costs and the transaction barriers of FDI. Note that all right-hand-side variables are lagged by one period in the estimation to reduce any potential simultaneity bias.

3.1. Data and measurement

We construct a panel of firm-level FDI data for the period 2009–2016 by combining the *fDi Markets* database (which tracks greenfield FDI activities) and the Orbis dataset (which provides firm-level financial information). The study period is dictated by the availability of the Orbis firm-level data.

3.1.1. Firm-level FDI data

The *fDi Markets* database is a service offered by the Financial Times. The database is the most comprehensive source of firm-level information on cross-border greenfield investment available, covering all countries and sectors worldwide. It provides real-time monitoring of investment projects, capital investments and job creation. Data are collated through daily searches of Financial Times newswires and internal information sources, thousands of media sources, project data received from over 2,000 industry organizations and investment agencies, and data purchased from market research and publication companies. Each

Table 1
Composition of the firm-level FDI data before and after merging.

(2009–2016)	Before	After
FDI transactions	93,823	32,403
Unique firms	35,039	9278
Source countries	168	88
Destination countries	200	187
FDI sector	39	39

Note: The column 'Before' refers to the *fDi Markets* dataset and the column 'After' refers to the dataset matched with the *Orbis* firm-level financial information.

project identified is cross-referenced against multiple sources, with primary focus on direct company sources.[3] This dataset is used as the primary source of greenfield FDI information by various organizations, such as UNCTAD and World Bank. It is also increasingly used in FDI studies. For example, Desbordes and Wei (2017) used this dataset to examine the effect of financial constraints on FDI activities; Chan and Zheng, 2017 and Paniagua et al. (2017) studied the effect of networks on outward FDI; and Castellani and Lavoratori (2017) exploited the information on the type of project to study the co-location and agglomeration of FDI.

For every project initiated overseas, this dataset records the date when a project is carried out, the parent firm initiating it, the location of the parent firm (country-state-city), the industry sector of FDI, the host country (and city), the capital investment of the project (in million USD), and the number of jobs created. We collapse the firm-level capital investment (originally reported by date and at the city level) into year and destination country basis. Thus, the measure of FDI is at the level of firm, sector, origin country, destination country, and year. As indicated by Table 1, for the period 2009–2016, there are 35,039 unique firms from 168 origin countries that carried out 93,823 greenfield FDI transactions in 200 destination countries and in 39 sectors.

The *fDi Markets* data do have some caveats. These include, first, the restriction to greenfield FDI announcements appearing in news sources. In particular, this database tracks cross-border investment in a new physical project or expansion of an existing investment that creates new jobs and capital investment. Joint ventures (JV) are only included when they lead to a new physical operation. Mergers and acquisitions (M&A) and other equity investments are not tracked. Thus, it does not cover M&A (and some JV) FDI flows. This, however, may not be a significant drawback for our study. We can argue that the importance of informal institutions is more pronounced in the case of greenfield FDI than M&A (or JV), since in the latter case, the local partner's informal institutions available in the host country may relax the institutional constraints faced by foreign investors. Greenfield FDI flow thus is an ideal subject for testing our hypothesis.

Since the *fDi Markets* data are collected primarily from publicly available sources, and since companies do not always release information on investment amounts, one may expect measurement errors in the FDI variable, despite efforts made by the data provider to cross-reference each news report against multiple sources. This will translate into larger standard errors in the coefficient estimates and less significant results. Finally, Fig. 3(a) and (c) and 4 indicate that the *fDi Markets* data are skewed toward the US parent firms, the US destination, and three service sectors for the period of our study. We discuss below the robustness checks performed to address potential concerns about sample compositions.

[3] https://www.fdimarkets.com/faqs/.

3.1.2. Firm-level characteristics

Firm-level financial data (lagged one year) were retrieved from Orbis (compiled by Bureau van Dijk, BvD). This dataset provides comprehensive information on private companies worldwide. In particular, we use the information on operating revenues, number of employees, total assets, material costs, and research and development (R&D) expenses. Data were downloaded in US dollars. The Orbis dataset includes over 280 million companies around the world, so it is infeasible to download all observations. We downloaded the subset of firms satisfying the following criteria during 2008–2016: (i) firms with observations in at least one year on operating revenues, number of employees, and total assets, and (ii) also with observations in at least one year on material costs (or alternatively, costs of goods sold and costs of employees), since these variables are required for the estimation of firm productivity.[4]

The financial and balance-sheet data in Orbis come from business registries collected by national chambers of commerce to fulfill legal and administrative requirements and are relayed to BvD by over 40 different information providers. See Table A1 in Kalemli-Ozcan et al. (2015) for a list of the information providers of BvD. Coverage of small firms and balance sheet variables change from country to country given the filing requirements by business registries in each country. Although most countries require limited liability companies to register once they are formed, requirements in terms of who reports (above certain firm size) and what to report from the balance sheet items vary across countries. In most European countries, it is a regulatory requirement to file most of the balance sheet variables for firms of all sizes. Thus, the Orbis coverage tends to be biased toward large firms and regions where the filing requirements are more stringent. Fig. 3(e) indicates that the Orbis data we downloaded indeed have better coverage of firm-level data for European countries.

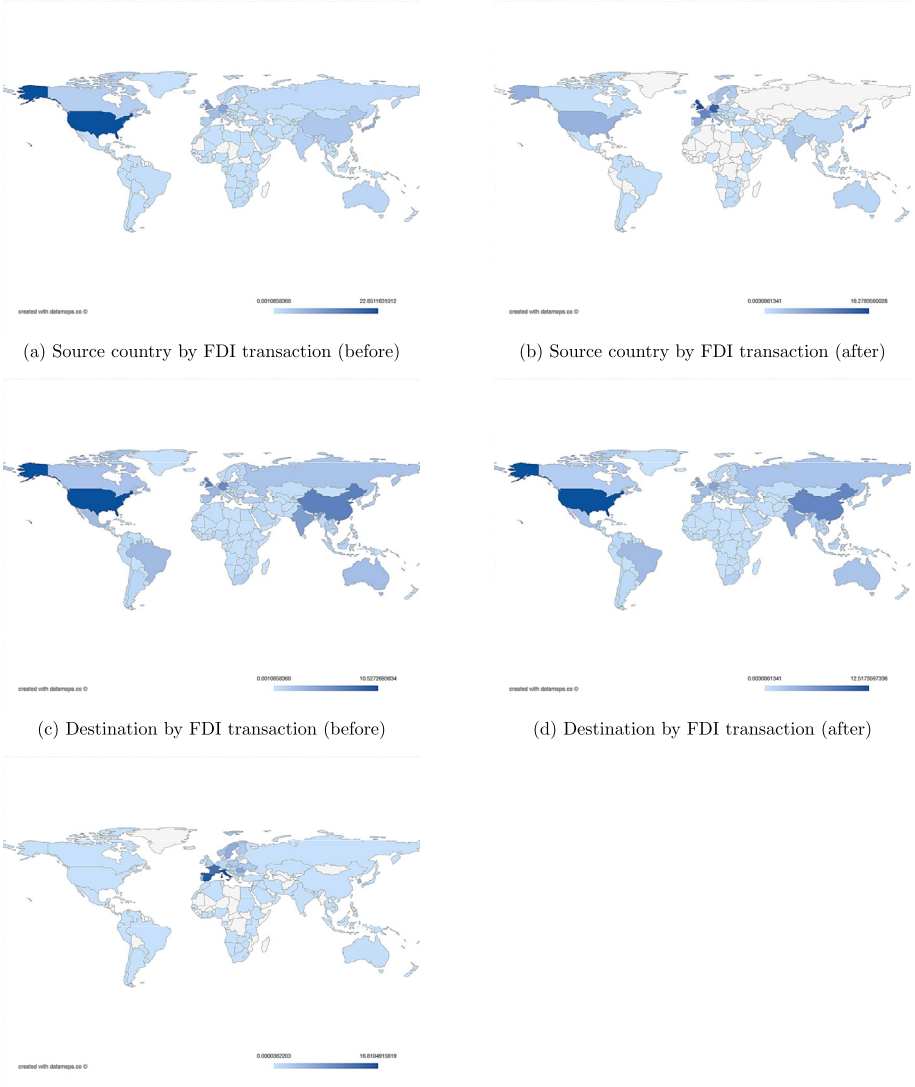
We then merge the firms in the *fDi Markets* dataset with the firms in Orbis to obtain the parent firms' annual financial data for the period 2008–2016. The merging process relies on matching of two key identifiers — firm name and home country — from both datasets, based on fuzzy matching programs and manual inspection.[5]

As indicated by Table 1, about 35% of FDI observations (at annual, bilateral country, level) in the *fDi Markets* dataset are successfully matched to firms from Orbis. The corresponding figure is 26% by count of unique firms. As discussed above, the *fDi Markets* dataset is dominated by the US parent firms (cf. Fig. 3(a)), while Orbis has better coverage of firm-level data for European countries (cf. Fig. 3(e)). As a result, as indicated by Fig. 3(b), the frequency of the US as the source of FDI transactions decreases after the matching, while that of European countries increases.[6] Table 1 also indicates that 80 out of 168 source countries of parent firms in *fDi Markets* are not matched in Orbis. The list of these countries is given in Online Appendix Table B1. They are mainly African or small island countries. This, as indicated by Fig. 3(e), is partly due to Orbis' limited coverage of these countries. On the other hand, Fig. 3(c)–(d) indicate that the compositions of destination countries before and after the merging are similar, despite the attrition of

[4] When the information on material costs is missing, it is proxied by the difference between the costs of goods sold and the costs of employees.

[5] Stata provides a fuzzy matching program, reclink2. It is an algorithm for probabilistic record linkage. In particular, it compares strings to determine whether records are 'similar' and provides similarity scores. The package also provides an algorithm, stnd_compname, to pre-process (standardize) company names. We standardize each firm's name in both datasets before applying the matching program. Because reclink2 is a fuzzy matching algorithm, manual checking is done to improve accuracy. We inspect each record of matched pairs and verify whether they are indeed the same company. Matched pairs found by reclink2 but manually determined to have different (core) standardized names are dropped.

[6] The pattern is very similar if the analysis is based on counts of unique firms instead of FDI transactions.



(a) Source country by FDI transaction (before)

(b) Source country by FDI transaction (after)

(c) Destination by FDI transaction (before)

(d) Destination by FDI transaction (after)

(e) Orbis country by firm count

Fig. 3. Country composition of the firm-level FDI data before and after merging.

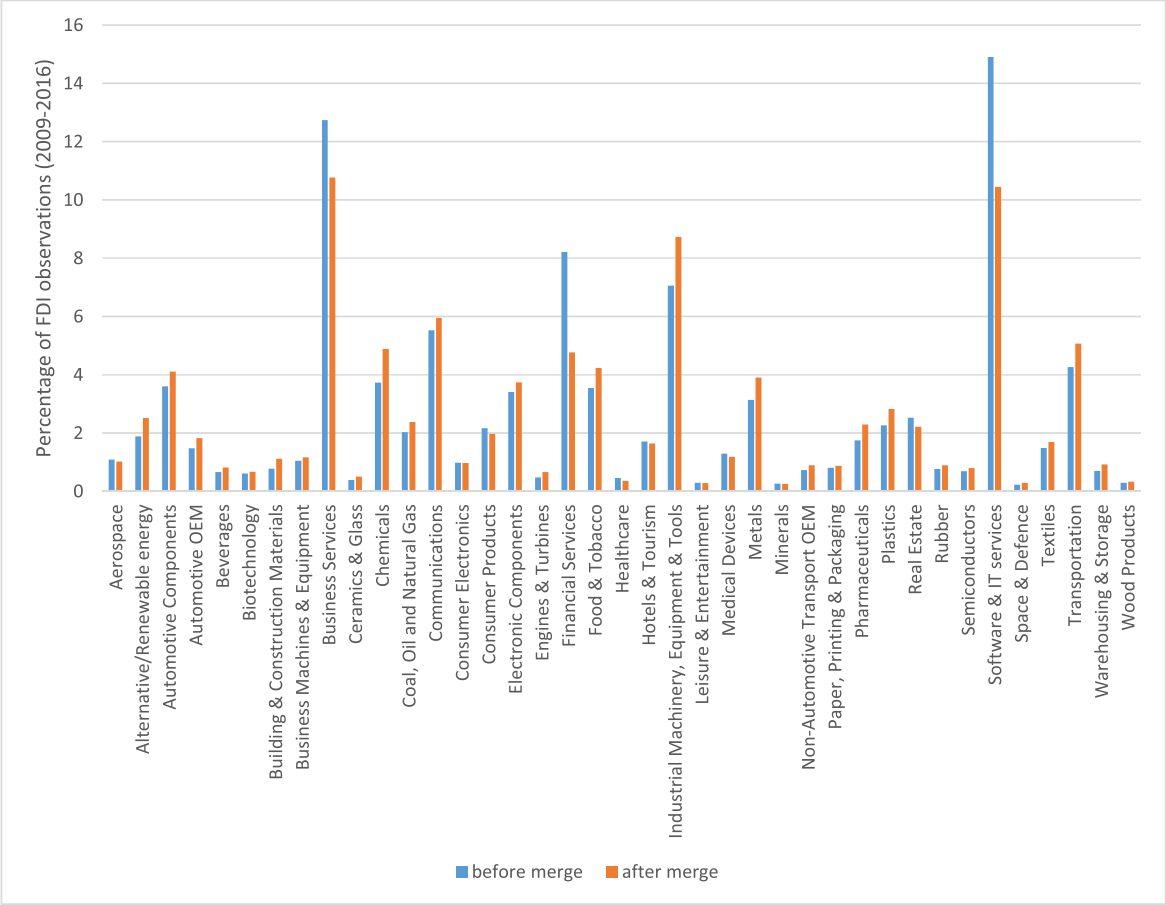
parent firms that are not matched across the two datasets. Fig. 4 suggests that sector compositions are also relatively similar before and after the matching process.

Given the set of parent firms with financial data, we first construct the R&D intensity as the ratio of R&D expenses to operating revenues. We then estimate firm productivity by four alternative methods proposed in the literature: the methods of Levinsohn and Petrin (2003) (LP), Ackerberg et al. (2015) (ACF), Wooldridge (2009) (WRDG), and Rovigatti and Mollisi (2018) (RM).[7] In the estimations, we allow the production functions to differ across sectors, where the sector is defined according to the industry sector of FDI reported for the firm by the *fDi Markets* dataset. This estimation process provides a panel of productivity estimates for each firm across years according to its sector of FDI.

Van Beveren (2012) provides a detailed discussion of alternative productivity estimation methods, and Rovigatti and Mollisi (2018) provide Monte Carlo simulation comparing the four methods we use here. In particular, the LP method estimates the labor coefficient in the first stage and the capital and material coefficients in the second stage. The ACF method argues that the labor variable and the nonparametric function in the first stage may be collinear if there are no variations in labor choice independent of materials, which implies that the labor coefficient may not be identifiable in the first stage. The ACF method proposes to obtain all input coefficients in the second stage, where the first stage only serves to net out the error component in the production function. Wooldridge (2009) suggested that the two-step semiparametric estimators of LP and ACF can be implemented by a one-step GMM approach. The RM method further extends the WRDG method by using dynamic panel instruments.

The Monte Carlo simulation comparison of the four methods conducted by Rovigatti and Mollisi (2018) suggests that the ACF estimator performs better than LP in terms of bias and MSE. The ACF estimator, however, is shown to be often trapped in local maxima. On the other hand, the WRDG and RM estimators are shown to have relatively small bias and MSE. The WRDG method also offers a number of advantages. First, unlike the semiparametric estimators, which require bootstrapping methods to obtain standard errors for the input coefficients,

[7] One possible alternative is the method proposed by Olley and Pakes (1996) (OP). We do not pursue this method here because it relies on investment as a proxy (for unobserved productivity), whose level depends on the depreciation rate assumed and may not be positive. In contrast, the four methods above use intermediate inputs as a proxy for unobserved productivity. It is common for firms to report positive use of materials, so we can preserve as many observations as possible.



Note: Count by FDI transaction.

Fig. 4. Sector composition of the firm-level FDI data before and after merging. Note: Count by FDI transaction.

the WRDG method uses the standard robust variance estimator (allowing for serial correlation or heteroskedasticity). Second, it is also more efficient than the two-step semiparametric estimators, since the latter ignore the potential correlation between the errors in the two steps. In view of the above discussion and the relatively straightforward estimation structure, we thus use the WRDG estimator as the benchmark, and report the results of the other methods in robustness checks.

Some caveats regarding the productivity measures are in order. First of all, the measure could reflect markup since the estimation is revenue based and firm-level deflators are not available. In the presence of imperfect competition, we may overestimate the productivity of firms that charge higher markups than average and vice versa. Relatedly, given the lack of industry-level deflators at the level of FDI sectors or firm-level deflators, we use country-level deflators to convert revenues and input expenditures into 2008 PPP dollars (see Appendix B for more details). This introduces measurement errors and bias in the productivity estimates if there are systematic correlations in firm-level price difference (relative to the country-level price) and input choice. See Van Beveren (2012) for further discussion. Third, firms in Orbis may report consolidated or unconsolidated financial statements. In the former case, the headquarters of a group aggregates all companies belonging to the group, and its productivity measure can be influenced by its investment overseas. We verify that there are no duplicate firms in our dataset reporting both consolidated and unconsolidated accounts to avoid double-counting in our exercises.[8] As with other control variables, we lag the productivity measure by one year in estimation equation (19), so it is not affected by the current year's investment overseas, to avoid simultaneity bias. Overall, these caveats are admittedly difficult to address and applicable to many other studies.

Table 2 provides the summary statistics of the firm-level variables. For the period 2009–2016, the minimum positive FDI value is 8 thousand USD, while the maximum is 18.5 billion USD, with mean of approximately 35.9 million USD. This indicates extensive heterogeneities in FDI capital investment across years and across firms. There are also substantial variations in productivities and R&D intensities across firms.

3.1.3. *Institutional quality and other country-pair characteristics*

We measure a country's institutional quality based on the Worldwide Governance Indicators (WGI) in six dimensions: voice and accountability (VA); political stability and absence of violence (PV); government effectiveness (GE); regulatory quality (RQ); rule of law (RL); and control of corruption (CC).[9] Kaufmann et al. (2010) provide details of the construction of these indicators. Since these indicators are highly correlated with one another, we include them one at a time in the estimation of (19). For each governance indicator, a country receives a

[8] The consolidated account includes larger amounts of inputs but also larger amounts of outputs across the entities belonging to a group. It does not necessarily bias the productivity estimate up or down, compared with the alternative scenario if the headquarters reports an unconsolidated account.

[9] http://info.worldbank.org/governance/wgi.

Table 2
Summary statistics of firms undertaking FDI in 2009–2016.

	Obs.	Mean	Std. Dev.	Min.	Max.
2009–2016:					
FDI capital investment (in million USD)	32,403	35.90	302.19	0	18,500
Lagged (2008–2015):					
Productivity (in log), WRDG method	19,278	3.77	1.64	−11.53	12.92
Productivity (in log), RM method	19,278	4.03	1.83	−11.86	12.21
Productivity (in log), LP method	19,278	2.96	1.41	−11.61	9.80
Productivity (in log), ACF method	19,278	1.72	2.03	−20.08	7.65
R&D Intensity (= R&D expenses/Operating revenues)	13,621	0.10	3.40	0	259.34
Operating revenues (in log, thousand USD), real	27,369	12.80	3.43	−4.43	19.67
No. of employees (in log)	24,247	7.27	3.24	0	13.78
Total assets (in log, thousand USD), real	28,062	12.77	3.64	−6.55	20.11
Material costs (in log, thousand USD), real	22,077	11.75	3.89	−6.65	19.59

Note: The current values of operating revenues, total assets, and material costs are deflated to 2008 PPP dollars before being used in the productivity estimations.

point estimate ranging from approximately −2.5 (weak) to 2.5 (strong). The higher the index, the better the institutional quality.

In addition to the WGI indicator, we consider two additional institutional quality measures. These are: (i) contract enforcement (CE), from World Bank Doing Business,[10] and (ii) legal system and security of property rights (LS), from Economic Freedom, Fraser Institute.[11] These choices follow Nunn (2007), who used RL from WGI, CE sub-indicators from Doing Business, and LS in his study of contract enforcement. The CE indicator is a summary index of three sub-indicators in terms of time (days), cost (% of claim), and quality of judicial processes, to enforce a contract.[12] The LS indicator, on the other hand, is a broad concept that covers many aspects of the judicial system.[13] The CE indicator is on a scale of 0–100 while the LS indicator has a scale of 0–10. As with the WGI, the higher the index, the better the institutional quality.

Table 3 provides the summary statistics of the institutional quality of home and destination countries of FDI in terms of these indicators. It is evident that FDI origins on average have better institutional qualities, consistent with the well-documented dominance of North-based MNEs. The table also indicates that the FDI recipient countries are more dispersed than origins in terms of institutional qualities (standard deviations are larger while means are lower for FDI recipient countries).

The list of bilateral trade cost proxies (and FDI barriers) $X_{hd,t-1}$ includes distance, contiguity, common language, colonial relationship, regional trade agreement (RTA), and common currency indicators. To this list we add bilateral investment treaty (BIT), which indicates whether two countries have a BIT that offers protection for the other country's foreign investments and access to investor-state dispute settlement. In addition, we also include religion similarity, industrial structure similarity, and endowment difference in capital-labor ratio. This is to reduce concerns that the interaction of institutional quality indicators may be systematically correlated with similarity in country characteristics (in terms of culture, industrial structure, or endowment). Details on the source and measurement of these country-pair variables are documented in Appendix B. Table 4 provides their summary statistics.

In sum, the sample of observations used in the analysis refers to an incident of greenfield foreign capital investment in a sector and year by a firm reported by *fDi Markets* and the corresponding characteristics of the investing firm, origin and destination countries (lagged by one year). Thus, effectively, the observations use variations in FDI during 2009–2016 and those of firm/country characteristics during 2008–2015. We use the PPML estimator, because zero FDI values exist where the firm does not reveal the amount of capital investment.[14]

3.2. Baseline results

3.2.1. Interactions between home and destination formal institutions

Table 5 reports the PPML estimation results of equation (19) with the basic set of country-pair controls. As shown by the table, the coefficient of $(G_{h,t-1}{}^{*}G_{d,t-1})$ is positive and significant across all the six WGI governance indicators and the legal-system indicator. This provides support for our theoretical prediction of an institutional complementarity effect on firm-level FDI activities. The estimate of the institutional complementarity effect increases in magnitude across the board in Table 6 if we further include extra country-pair controls (endowment difference and similarity in industrial structure and religion). The coefficient of $(G_{h,t-1}{}^{*}G_{d,t-1})$ in the case of contract enforcement is now also precisely estimated and positive.

Recall that the WGI indicators are on a scale of −2.5 to 2.5, the CE indicator on a scale of 0–100 and the LS indicator on a scale of 0–10. Thus, to compare across indicators, we need to scale up the coefficient for the CE interaction term by 400 $(= (100/5)^2)$ and that for the LS interaction term by 4 $(= (10/5)^2)$. The results in Table 6 indicate that the institutional complementarity effects have similar orders of magnitude, with stronger effects in terms of the legal system (LS), rule of law (RL), and government effectiveness (GE), but weaker effects in terms of voice and accountability (VA), control of corruption (CC), and contract enforcement (CE).

Furthermore, Tables 5 and 6 indicate that firm productivity has a positive effect on FDI, and the coefficient of $(\ln(prod_{f,t-1})^{*}G_{d,t-1})$ is negative, consistent with the prediction of Proposition 3(ii). As argued by the theory, more productive firms, given their larger market shares, have stronger incentives to undertake FDI in destinations with lower wages. At the same time, their heavier investment in informal institutions allows them to operate in such destinations with poorer institutions. The exercise also finds support for the theory of Chang and Lu (2012): the coefficient of $RD_{f,t-1}$ is significantly negative but that of $(RD_{f,t-1}{}^{*}G_{d,t-1})$ is positive. Thus, firms that are R&D intensive tend to

[10] https://www.doingbusiness.org/en/data.
[11] https://www.fraserinstitute.org/studies/economic-freedom.
[12] https://www.doingbusiness.org/content/dam/doingBusiness/media/Annual-Reports/English/DB19-Chapters/DB19-Score-and-DBRankings.pdf.
[13] https://www.fraserinstitute.org/sites/default/files/human-freedom-index-2018.pdf. The index reflects: i. judicial independence, ii. impartial courts, iii. protection of property rights, iv. military interference in rule of law and politics, v. integrity of the legal system, vi. legal enforcement of contracts, vii. regulatory restrictions on the sale of real property, viii. reliability of police, and ix. business costs of crime.

[14] Because the universe of FDI relations (nil or active) across all firm-sector-origin-destination-year combinations is too large for typical computing capacity to handle, it is infeasible to conduct analysis of the extensive margin of FDI using Probit or Logit estimations.

Table 3
Institutional quality of home and destination countries (firm-level FDI in 2009–2016).

	Obs.	Mean	Std. Dev.	Min.	Max.
Home country					
VA (Voice and Accountability)	32,392	1.14	0.50	−1.88	1.74
PV (Political Stability and Absence of Violence)	32,403	0.60	0.55	−2.81	1.55
GE (Government Effectiveness)	32,403	1.40	0.52	−1.53	2.44
RQ (Regulatory Quality)	32,403	1.32	0.53	−2.14	2.26
RL (Rule of Law)	32,403	1.41	0.57	−2.03	2.10
CC (Control of Corruption)	32,403	1.40	0.71	−1.40	2.45
CE (Contract Enforcement)	32,362	69.11	11.00	20.82	93.36
LS (Legal System & Security of Property Rights)	32,340	7.38	0.93	2.03	8.91
Destination country					
VA (Voice and Accountability)	32,397	0.37	1.02	−2.26	1.74
PV (Political Stability and Absence of Violence)	32,398	0.16	0.81	−3.08	1.55
GE (Government Effectiveness)	32,389	0.79	0.86	−2.20	2.44
RQ (Regulatory Quality)	32,389	0.72	0.87	−2.45	2.26
RL (Rule of Law)	32,396	0.67	0.98	−2.42	2.10
CC (Control of Corruption)	32,390	0.61	1.04	−1.77	2.45
CE (Contract Enforcement)	32,210	65.29	13.68	2.08	93.36
LS (Legal System & Security of Property Rights)	31,991	6.37	1.33	1.43	8.91

Note: Statistics refer to institutional quality lagged by one year before the year of FDI.

Table 4
Summary statistics of control variables (firm-level FDI in 2009–2016).

	Obs.	Mean	Std. Dev.	Min.	Max.
$\lvert\ln(gdppc_{h,t-1}) - \ln(gdppc_{d,t-1})\rvert$	32,354	1.18	1.11	0.000152	5.51
$\ln(distance_{hd})$	32,088	8.18	1.12	4.09	9.90
$contig_{hd}$	32,088	0.10	0.29	0	1
$comlang_{hd}$	32,088	0.20	0.40	0	1
$colony_{hd}$	32,088	0.17	0.37	0	1
$comcol_{hd}$	32,088	0.02	0.13	0	1
$smctry_{hd}$	32,088	0.02	0.13	0	1
$rta_{hd,t-1}$	32,333	0.42	0.49	0	1
$comcur_{hd,t-1}$	32,389	0.08	0.28	0	1
$bit_{hd,t-1}$	32,403	0.43	0.50	0	1
$\lvert(K/L)_{h,t-1} - (K/L)_{d,t-1}\rvert$	32,260	0.18	0.13	0.000035	0.67
$indsim_{hd,t-1}$	30,996	0.95	0.03	0.78	0.9986
$relsim_{hd,t-1}$	31,376	0.90	0.09	0.65	0.9996
CI_s	19,097	0.67	0.20	0.34	0.89

engage in less FDI, but such disincentive is moderated by better institutions in the destination. Based on Table 6, if we adjust the difference in scales of CE and LS (by 20 times and 2 times relative to the six WGI indicators), the coefficients of $(\ln(prod_{f,t-1})^* G_{d,t-1})$ and $(RD_{f,t-1}{}^* G_{d,t-1})$ in terms of CE and LS, respectively, are in orders of magnitude similar to the case of the WGI indicators.

The findings for the other country-pair variables are sometimes sensitive to the inclusion of extra pair controls, in contrast with the robust institutional complementarity effect. For example, the coefficient of bilateral distance is negative in Table 5 with the basic set of controls, but becomes positive in Table 6 with the extended set of controls. In the latter case, similarities in industrial structure and religion composition both increase FDI volume, while the difference in capital-labor ratios has no significant effects on FDI. This indicates that for the sample under study, distance tends to be negatively correlated with similarity in industrial structure and religion. There are different theoretical arguments in the literature for a positive or negative effect of distance on FDI, and which of these mechanisms dominates may depend on the sample under study.

Also noteworthy is the positive sign of the difference in GDP per capita, which is quite robust throughout most of our analyses. This may not be a clear rejection of the Linder hypothesis of Fajgelbaum et al. (2015), since their theory is driven by horizontal FDI motives, while our sample pools both vertical and horizontal FDI. Because vertical FDI is motivated by cost-saving considerations, larger differences in incomes between origins and destinations can promote FDI flows. Unfortunately, there is no satisfactory way to disentangle the two modes of FDI in this exercise (following methods such as in Alfaro and Charlton, 2009), because the *fDi Markets* dataset reports the type of FDI activity in very broad categories. Lastly, contiguity, common language, and common currency all tend to promote FDI, as expected, and are robust to the extra pair controls.

In the subsequent analysis, we use the extensive list of country-pair controls (with endowment difference, and similarity in industrial structure and religion composition), but present only the main coefficients of interest in the tables. The full list of coefficient estimates is available upon request.

3.2.2. Interactions between home informal institutions and destination formal institutions

In this section, we utilize direct measures of informal institutions to test the hypotheses. Although there are country-specific studies related to "informal institutions" such as McMillan and Woodruff (2002) and McMillan and Woodruff (1999a,b) on "informal economic institutions"; Hay and Shleifer (1998) and Frye and Zhuravskaia (2000) on "informal legal institutions"; and Fisman (2001), Li et al. (2006), Chen et al. (2011), Bai et al. (2014), and Cai et al. (2011) on "informal political institutions," there are rare systematic cross-country studies of infor-

Table 5
Firm-level FDI dependence on institutional quality.

FDI capital investment	VA	PV	GE	RQ	RL	CC	CE	LS
$\boldsymbol{G_{h,t-1}{}^{*}G_{d,t-1}}$	**0.607*****	**0.742*****	**0.571*****	**0.631*****	**0.775*****	**0.536*****	**0.0411**	**0.189*****
	(0.0825)	**(0.127)**	**(0.144)**	**(0.152)**	**(0.120)**	**(0.0958)**	**(0.0338)**	**(0.0566)**
$\ln(prod_{f,t-1})$	0.383***	0.383**	0.774***	0.659***	0.625***	0.577***	1.444***	1.285***
	(0.133)	(0.169)	(0.204)	(0.196)	(0.176)	(0.159)	(0.482)	(0.450)
$\boldsymbol{ln(prod_{f,t-1})^{*}G_{d,t-1}}$	**−0.377*****	**−0.313****	**−0.543*****	**−0.495*****	**−0.443*****	**−0.474*****	**−0.154****	**−0.143****
	(0.0902)	**(0.122)**	**(0.118)**	**(0.117)**	**(0.0974)**	**(0.0936)**	**(0.0699)**	**(0.0671)**
$RD_{f,t-1}$	−4.081***	−4.669***	−9.191***	−7.436***	−6.072***	−5.333***	−36.34***	−16.27***
	(0.859)	(0.821)	(1.120)	(0.961)	(0.939)	(0.911)	(4.331)	(5.541)
$\boldsymbol{RD_{f,t-1}{}^{*}G_{d,t-1}}$	**1.818****	**5.482*****	**6.235*****	**4.926*****	**3.639*****	**2.647*****	**4.445*****	**1.815****
	(0.740)	**(1.131)**	**(0.928)**	**(0.816)**	**(0.818)**	**(0.885)**	**(0.619)**	**(0.863)**
$\lvert\ln(gdppc_{h,t-1}) - \ln(gdppc_{d,t-1})\rvert$	0.793***	0.875***	0.865***	0.966***	1.175***	1.045***	0.650***	0.865***
	(0.152)	(0.148)	(0.157)	(0.164)	(0.162)	(0.171)	(0.153)	(0.161)
$\ln(distance_{hd})$	−0.193*	−0.116	−0.181**	−0.177**	−0.159*	−0.150*	−0.0328	−0.0340
	(0.0990)	(0.0895)	(0.0859)	(0.0875)	(0.0861)	(0.0860)	(0.0905)	(0.0861)
$contig_{hd}$	0.429**	0.426*	0.623***	0.583***	0.609***	0.693***	0.624***	0.675***
	(0.209)	(0.222)	(0.222)	(0.219)	(0.208)	(0.217)	(0.229)	(0.225)
$comlang_{hd}$	0.558***	0.743***	0.879***	0.873***	0.826***	0.810***	0.838***	0.786***
	(0.184)	(0.166)	(0.172)	(0.172)	(0.173)	(0.170)	(0.175)	(0.172)
$colony_{hd}$	−0.245	−0.193	−0.510**	−0.489**	−0.557***	−0.496**	−0.350	−0.361*
	(0.212)	(0.206)	(0.204)	(0.209)	(0.206)	(0.197)	(0.213)	(0.213)
$comcol_{hd}$	0.235	0.273	0.0199	−0.0545	−0.0745	0.0663	−0.0810	0.122
	(0.578)	(0.436)	(0.406)	(0.414)	(0.428)	(0.399)	(0.458)	(0.433)
$smctry_{hd}$	−0.0679	0.0154	−0.150	−0.0354	0.0555	−0.0419	−0.160	0.0407
	(0.301)	(0.306)	(0.291)	(0.288)	(0.296)	(0.301)	(0.302)	(0.311)
$rta_{hd,t-1}$	−0.220	0.0566	−0.173	−0.111	−0.216	−0.0802	0.0542	0.0733
	(0.232)	(0.225)	(0.240)	(0.230)	(0.245)	(0.244)	(0.238)	(0.218)
$comcur_{hd,t-1}$	0.564**	0.482**	0.477**	0.520**	0.495**	0.449*	0.424*	0.479**
	(0.246)	(0.242)	(0.236)	(0.236)	(0.232)	(0.232)	(0.246)	(0.238)
$bit_{hd,t-1}$	−0.574***	−0.762***	−0.608***	−0.574***	−0.514***	−0.480***	−0.693***	−0.664***
	(0.209)	(0.190)	(0.180)	(0.182)	(0.186)	(0.184)	(0.195)	(0.196)
constant	−24.77***	−27.99***	−42.11***	−30.00***	−25.45***	−24.76***	−26.07***	−5.312*
	(2.064)	(2.899)	(2.848)	(2.896)	(2.025)	(1.929)	(2.017)	(2.951)
# Observations	7686	7686	7686	7686	7686	7686	7670	7652
R^2	0.774	0.768	0.777	0.777	0.777	0.778	0.765	0.761
origin-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-sector FE	Y	Y	Y	Y	Y	Y	Y	Y

Note: PPML estimation of equation (19). Robust standard errors clustered by country pairs are reported in parentheses. Productivity estimates based on the WRDG method and operating revenues. The entries ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively.

mal institutions.[15] The closest to this is the study by Faccio (2006), which provides measures of the prevalence of politically connected firms across countries: (1) percentage of firms in a country that is connected with a minister or a member of parliament (MP); (2) percentage of firms in a country connected with a minister or MP, or a close relationship; (3) percentage of top 50 firms connected; and (4) percentage of market capitalization of connected firms. We use these four measures as alternative proxies for informal institutions prevalent in a country. The summary statistics for these four measures of informal institutions are provided in Table 7.

In this set of analysis, we replace the interaction term of home and destination formal institutions ($G_{h,t-1}{}^{*}G_{d,t-1}$) with the interaction of informal institutions at home and formal institutions of the FDI destination ($I_h{}^{*}G_{d,t-1}$). The analysis is repeated for each of the four alternative proxies of informal institutions. Tables 8–11 show that the sign of the coefficient of the new interaction term is significantly negative across different measures of informal and formal institutions. This is consistent with the theoretical mechanism proposed in the paper: when firms are based in a country where formal institutions are lacking, they tend to build more informal institutions; in turn, these allow them to conduct FDI in destinations with poorer formal institutions. The results for the other coefficients of interest remain robust.

The measures of Faccio (2006) are unfortunately time-invariant (constructed based on data pertaining to the period 1997–2001). Thus, the measures do not provide more time variations (than formal institutions), as would be the ideal case. The measures of Faccio (2006) are also limited in terms of country coverage (47 countries), although the set of countries includes both developed and developing nations

[15] The double quotations are used around informal institutions in the above statements because they are not referred to as such by the original papers but are categorized by us.

Table 6
Firm-level FDI dependence on institutional quality — *extra country-pair controls*.

FDI capital investment	VA	PV	GE	RQ	RL	CC	CE	LS
$G_{h,t-1}{}^{*}G_{d,t-1}$	**0.631*****	**1.028*****	**1.049*****	**1.016*****	**1.108*****	**0.671*****	**0.00118*****	**0.417*****
	(0.0921)	**(0.130)**	**(0.158)**	**(0.164)**	**(0.132)**	**(0.104)**	**(0.000313)**	**(0.0575)**
$\ln(prod_{f,t-1})$	0.212	0.0884	0.454**	0.429**	0.363**	0.334**	0.893**	1.173**
	(0.148)	(0.129)	(0.196)	(0.202)	(0.173)	(0.157)	(0.369)	(0.519)
$ln(prod_{f,t-1})^{*}G_{d,t-1}$	**−0.356*****	**−0.269*****	**−0.447*****	**−0.487*****	**−0.392*****	**−0.414*****	**−0.0119****	**−0.178****
	(0.107)	**(0.104)**	**(0.117)**	**(0.128)**	**(0.101)**	**(0.0957)**	**(0.00486)**	**(0.0715)**
$RD_{f,t-1}$	−5.032***	−5.143***	−12.57***	−10.84***	−8.573***	−7.081***	−48.55***	−32.53***
	(1.168)	(1.084)	(1.515)	(1.400)	(1.424)	(1.322)	(4.530)	(6.213)
$RD_{f,t-1}{}^{*}G_{d,t-1}$	**3.366*****	**9.618*****	**9.086*****	**8.254*****	**5.909*****	**5.341*****	**0.631*****	**4.556*****
	(0.959)	**(1.268)**	**(0.961)**	**(0.950)**	**(0.913)**	**(0.945)**	**(0.0610)**	**(0.859)**
$\lvert\ln(gdppc_{h,t-1}) - \ln(gdppc_{d,t-1})\rvert$	1.010***	1.414***	1.834***	1.827***	2.144***	1.797***	1.121***	1.862***
	(0.174)	(0.185)	(0.211)	(0.202)	(0.192)	(0.212)	(0.192)	(0.194)
$\ln(distance_{hd})$	0.308***	0.454***	0.488***	0.460***	0.554***	0.486***	0.488***	0.615***
	(0.116)	(0.0931)	(0.102)	(0.105)	(0.0992)	(0.101)	(0.0998)	(0.0956)
$contig_{hd}$	1.192***	1.258***	1.512***	1.380***	1.483***	1.485***	1.520***	1.716***
	(0.202)	(0.200)	(0.197)	(0.199)	(0.191)	(0.196)	(0.207)	(0.206)
$comlang_{hd}$	0.447**	0.496***	0.705***	0.759***	0.737***	0.684***	0.645***	0.516***
	(0.181)	(0.167)	(0.174)	(0.174)	(0.171)	(0.171)	(0.170)	(0.168)
$colony_{hd}$	−0.522***	−0.389**	−0.880***	−0.884***	−1.003***	−0.796***	−0.660***	−0.726***
	(0.185)	(0.175)	(0.178)	(0.180)	(0.173)	(0.170)	(0.178)	(0.177)
$comcol_{hd}$	−0.661	0.293	0.434	0.145	−0.323	0.112	0.261	0.104
	(1.034)	(0.627)	(0.606)	(0.621)	(0.721)	(0.661)	(0.751)	(0.676)
$smctry_{hd}$	−1.271*	−1.472**	−1.252*	−1.240*	−0.371	−0.945	−2.814***	−1.351*
	(0.747)	(0.696)	(0.758)	(0.725)	(0.721)	(0.709)	(0.886)	(0.712)
$rta_{hd,t-1}$	−0.251	0.0820	−0.251	−0.238	−0.280	−0.118	−0.000252	0.107
	(0.259)	(0.233)	(0.285)	(0.273)	(0.267)	(0.269)	(0.253)	(0.227)
$comcur_{hd,t-1}$	0.607**	0.486**	0.557**	0.648***	0.541**	0.491**	0.508**	0.600**
	(0.260)	(0.241)	(0.242)	(0.246)	(0.243)	(0.245)	(0.258)	(0.246)
$bit_{hd,t-1}$	−0.323	−0.498**	−0.285	−0.124	−0.179	−0.217	−0.426*	−0.370
	(0.241)	(0.210)	(0.213)	(0.215)	(0.214)	(0.222)	(0.226)	(0.232)
$\lvert(K/L)_{h,t-1} - (K/L)_{d,t-1}\rvert$	1.729	0.596	−0.692	−0.791	−0.793	−0.633	0.418	−0.163
	(1.153)	(1.083)	(1.008)	(1.033)	(0.977)	(1.024)	(1.114)	(1.048)
$indsim_{hd,t-1}$	20.87***	22.05***	22.11***	21.29***	23.38***	20.68***	22.17***	24.89***
	(4.222)	(3.822)	(4.087)	(4.304)	(4.146)	(4.091)	(3.814)	(4.286)
$relsim_{hd,t-1}$	4.428***	4.744***	7.664***	6.827***	7.556***	6.705***	5.062***	7.007***
	(1.542)	(1.459)	(1.648)	(1.512)	(1.605)	(1.574)	(1.576)	(1.483)
constant	−53.67***	−57.73***	−54.81***	−50.60***	−55.97***	−23.29***	−60.63***	−79.98***
	(5.035)	(5.201)	(4.636)	(5.114)	(4.558)	(5.083)	(5.728)	(6.579)
# Observations	7056	7056	7056	7056	7056	7056	7044	7025
R^2	0.825	0.827	0.833	0.832	0.834	0.831	0.825	0.828
origin-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-sector FE	Y	Y	Y	Y	Y	Y	Y	Y

Note: PPML estimation of equation (19). Robust standard errors clustered by country pairs are reported in parentheses. Productivity estimates based on the WRDG method and operating revenues. The entries ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively.

(see Table 2 therein). Thus, the sample size is reduced in this specification, but the spectrum of home countries is not skewed to developed or developing countries.

3.2.3. Variations in contract intensity across sectors

In this section, we explore potential heterogeneity in institutional complementarity effects across sectors. For this purpose, we use sectoral contract intensity, which measures the importance of relationship-specific inputs used in the production of a sector. The larger the measure, the more important are contract enforcement and related institutions that alleviate the under-investment inefficiency associated with incomplete contracts. We use the contract intensity measure of Nunn (2007), whose concordance with the *fDi Markets* sectors is provided in Desbordes and Wei (2017, Table A1). Table B2 of the Online Appendix lists the contract intensity for each of the FDI sectors. Note that the measure is available mainly for manufacturing sectors.

We classify sectors into those that are contract intensive (with contract intensity higher than the median of the sample) and otherwise (with contract intensity lower than the median), with a corresponding indicator, CI_s, which takes value one in the former case and zero in the latter case. In addition to the institutional interaction term ($G_{h,t-1}{}^{*}G_{d,t-1}$) in the benchmark specification (19), we add a triple

Table 7
Informal institutions of home countries (firm-level FDI in 2009–2016).

	Obs.	Mean	Std. Dev.	Min.	Max.
Informal Institution					
(i) % of firms connected with a minister or MP	31,156	2.87	2.80	0	10.30
(ii) % of firms connected with a minister, MP, or a close relationship	31,156	3.12	3.00	0	22.08
(iii) % of top 50 firms connected	31,156	11.64	16.20	0	46.00
(iv) % of market capitalization of connected firms	31,156	10.09	13.92	0	41.62

Note: Measures are based on the study of Faccio (2006).

Table 8
Firm-level FDI dependence on institutional quality — *informal institutions (i)*.

FDI capital investment	**VA**	**PV**	**GE**	**RQ**	**RL**	**CC**	**CE**	**LS**
$\boldsymbol{I_h{}^*G_{d,t-1}}$	**−0.0384***	**−0.157*****	**−0.175*****	**−0.173*****	**−0.139*****	**−0.113*****	**−0.00937*****	**−0.125*****
	(0.0197)	**(0.0228)**	**(0.0233)**	**(0.0217)**	**(0.0207)**	**(0.0192)**	**(0.00126)**	**(0.0153)**
$\ln(prod_{f,t-1})$	0.260*	0.160	0.642***	0.610***	0.497***	0.401**	1.441***	1.299**
	(0.157)	(0.150)	(0.215)	(0.229)	(0.189)	(0.167)	(0.438)	(0.555)
$\boldsymbol{ln(prod_{f,t-1})^*G_{d,t-1}}$	**−0.312*****	**−0.216***	**−0.536*****	**−0.562*****	**−0.416*****	**−0.376*****	**−0.0184*****	**−0.177****
	(0.112)	**(0.115)**	**(0.128)**	**(0.146)**	**(0.107)**	**(0.0999)**	**(0.00586)**	**(0.0776)**
$RD_{f,t-1}$	−4.614***	−4.200***	−9.962***	−8.620***	−7.221***	−6.134***	−33.09***	−22.00***
	(1.167)	(1.032)	(1.423)	(1.247)	(1.321)	(1.290)	(4.262)	(5.489)
$\boldsymbol{RD_{f,t-1}{}^*G_{d,t-1}}$	**2.202****	**5.840*****	**6.743*****	**5.959*****	**4.516*****	**3.747*****	**0.426*****	**2.894*****
	(0.957)	**(1.199)**	**(0.931)**	**(0.842)**	**(0.888)**	**(0.948)**	**(0.0572)**	**(0.776)**
# Observations	6762	6762	6762	6762	6762	6762	6750	6739
R^2	0.827	0.833	0.838	0.842	0.837	0.833	0.834	0.834
origin-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-sector FE	Y	Y	Y	Y	Y	Y	Y	Y
extra country-pair controls	Y	Y	Y	Y	Y	Y	Y	Y

Note: PPML estimation of equation (19) with ($G_{h,t-1}{}^*G_{d,t-1}$) replaced by ($I_h{}^*G_{d,t-1}$). Refer to Table 7 for the definition of the informal institution measure (i). Robust standard errors clustered by country pairs are reported in parentheses. Productivity estimates based on the WRDG method and operating revenues. The entries ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively.

Table 9
Firm-level FDI dependence on institutional quality — *informal institutions (ii)*.

FDI capital investment	**VA**	**PV**	**GE**	**RQ**	**RL**	**CC**	**CE**	**LS**
$\boldsymbol{I_h{}^*G_{d,t-1}}$	**−0.0511*****	**−0.154*****	**−0.170*****	**−0.177*****	**−0.143*****	**−0.115*****	**−0.00779*****	**−0.115*****
	(0.0183)	**(0.0217)**	**(0.0223)**	**(0.0199)**	**(0.0197)**	**(0.0181)**	**(0.00135)**	**(0.0146)**
$\ln(prod_{f,t-1})$	0.262*	0.160	0.652***	0.617***	0.496***	0.402**	1.538***	1.344**
	(0.157)	(0.149)	(0.216)	(0.230)	(0.188)	(0.167)	(0.439)	(0.561)
$\boldsymbol{ln(prod_{f,t-1})^*G_{d,t-1}}$	**−0.313*****	**−0.217***	**−0.547*****	**−0.571*****	**−0.417*****	**−0.380*****	**−0.0198*****	**−0.184****
	(0.112)	**(0.114)**	**(0.129)**	**(0.147)**	**(0.106)**	**(0.100)**	**(0.00584)**	**(0.0784)**
$RD_{f,t-1}$	−4.479***	−4.258***	−10.05***	−8.610***	−7.121***	−6.124***	−37.25***	−23.34***
	(1.191)	(1.030)	(1.427)	(1.246)	(1.322)	(1.291)	(4.342)	(5.497)
$\boldsymbol{RD_{f,t-1}{}^*G_{d,t-1}}$	**1.885***	**5.831*****	**6.802*****	**5.937*****	**4.404*****	**3.738*****	**0.484*****	**3.093*****
	(0.979)	**(1.187)**	**(0.930)**	**(0.840)**	**(0.888)**	**(0.947)**	**(0.0581)**	**(0.774)**
# Observations	6762	6762	6762	6762	6762	6762	6750	6739
R^2	0.827	0.832	0.838	0.842	0.836	0.833	0.833	0.833
origin-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-sector FE	Y	Y	Y	Y	Y	Y	Y	Y
extra country-pair controls	Y	Y	Y	Y	Y	Y	Y	Y

Note: PPML estimation of equation (19) with ($G_{h,t-1}{}^*G_{d,t-1}$) replaced by ($I_h{}^*G_{d,t-1}$). Refer to Table 7 for the definition of the informal institution measure (ii). Robust standard errors clustered by country pairs are reported in parentheses. Productivity estimates based on the WRDG method and operating revenues. The entries ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively.

interaction term ($CI_s{}^*G_{h,t-1}{}^*G_{d,t-1}$) of the above with the FDI sector's contract intensity indicator. As shown in Table 12, the signs of the coefficients of the main institutional interaction term and the triple interaction term are positive when precisely estimated. This indicates that the institutional complementarity effect is positive, and is stronger in sectors that are contract intensive. This in a way is consistent with our proposed mechanism: although not explicitly modeled in theory, the effect of institutions on fixed costs (and variable costs in the extended model provided in Online Appendix A.3–A.4) is likely to be more significant in sectors that depend more on the quality of institutions. The results in

Table 10
Firm-level FDI dependence on institutional quality — *informal institutions (iii)*.

FDI capital investment	VA	PV	GE	RQ	RL	CC	CE	LS
$\boldsymbol{I_h{}^*G_{d,t-1}}$	**−0.00720**	**−0.0190*****	**−0.0283*****	**−0.0269*****	**−0.0242*****	**−0.0171*****	**−0.000898*****	**−0.0169*****
	(0.00457)	**(0.00424)**	**(0.00433)**	**(0.00430)**	**(0.00383)**	**(0.00362)**	**(0.000237)**	**(0.00287)**
$\ln(prod_{f,t-1})$	0.259*	0.175	0.655***	0.611***	0.507***	0.394**	1.441***	1.315**
	(0.157)	(0.149)	(0.211)	(0.227)	(0.188)	(0.165)	(0.421)	(0.551)
$\boldsymbol{\ln(prod_{f,t-1})^*G_{d,t-1}}$	**−0.313*****	**−0.227****	**−0.546*****	**−0.563*****	**−0.426*****	**−0.371*****	**−0.0183*****	**−0.177****
	(0.112)	**(0.113)**	**(0.127)**	**(0.145)**	**(0.108)**	**(0.0996)**	**(0.00565)**	**(0.0779)**
$RD_{f,t-1}$	−4.735***	−5.013***	−11.64***	−10.14***	−8.001***	−6.631***	−48.34***	−32.89***
	(1.153)	(1.068)	(1.500)	(1.305)	(1.381)	(1.317)	(4.670)	(6.167)
$\boldsymbol{RD_{f,t-1}{}^*G_{d,t-1}}$	**2.621*****	**8.726*****	**8.363*****	**7.434*****	**5.463*****	**4.593*****	**0.635*****	**4.547*****
	(0.966)	**(1.266)**	**(0.972)**	**(0.883)**	**(0.923)**	**(0.954)**	**(0.0623)**	**(0.856)**
# Observations	6762	6762	6762	6762	6762	6762	6750	6739
R^2	0.826	0.828	0.832	0.835	0.831	0.828	0.828	0.827
origin-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-sector FE	Y	Y	Y	Y	Y	Y	Y	Y
extra country-pair controls	Y	Y	Y	Y	Y	Y	Y	Y

Note: PPML estimation of equation (19) with ($G_{h,t-1}{}^*G_{d,t-1}$) replaced by ($I_h{}^*G_{d,t-1}$). Refer to Table 7 for the definition of the informal institution measure (iii). Robust standard errors clustered by country pairs are reported in parentheses. Productivity estimates based on the WRDG method and operating revenues. The entries ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively.

Table 11
Firm-level FDI dependence on institutional quality — *informal institutions (iv)*.

FDI capital investment	VA	PV	GE	RQ	RL	CC	CE	LS
$\boldsymbol{I_h{}^*G_{d,t-1}}$	**−0.00863***	**−0.0229*****	**−0.0335*****	**−0.0305*****	**−0.0285*****	**−0.0208*****	**−0.00110*****	**−0.0207*****
	(0.00512)	**(0.00483)**	**(0.00506)**	**(0.00502)**	**(0.00441)**	**(0.00416)**	**(0.000276)**	**(0.00335)**
$\ln(prod_{f,t-1})$	0.263*	0.181	0.698***	0.631***	0.533***	0.410**	1.568***	1.426***
	(0.157)	(0.146)	(0.215)	(0.229)	(0.190)	(0.164)	(0.410)	(0.551)
$\boldsymbol{\ln(prod_{f,t-1})^*G_{d,t-1}}$	**−0.322*****	**−0.259****	**−0.589*****	**−0.588*****	**−0.454*****	**−0.393*****	**−0.0201*****	**−0.193****
	(0.113)	**(0.111)**	**(0.129)**	**(0.146)**	**(0.108)**	**(0.0993)**	**(0.00544)**	**(0.0777)**
$RD_{f,t-1}$	−4.740***	−5.005***	−11.72***	−10.14***	−7.981***	−6.581***	−47.31***	−31.95***
	(1.154)	(1.072)	(1.512)	(1.310)	(1.390)	(1.324)	(4.681)	(6.191)
$\boldsymbol{RD_{f,t-1}{}^*G_{d,t-1}}$	**2.595*****	**8.578*****	**8.426*****	**7.375*****	**5.384*****	**4.481*****	**0.620*****	**4.406*****
	(0.967)	**(1.277)**	**(0.983)**	**(0.887)**	**(0.933)**	**(0.962)**	**(0.0625)**	**(0.860)**
# Observations	6762	6762	6762	6762	6762	6762	6750	6739
R^2	0.826	0.828	0.832	0.834	0.831	0.828	0.828	0.826
origin-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-sector FE	Y	Y	Y	Y	Y	Y	Y	Y
extra country-pair controls	Y	Y	Y	Y	Y	Y	Y	Y

Note: PPML estimation of equation (19) with ($G_{h,t-1}{}^*G_{d,t-1}$) replaced by ($I_h{}^*G_{d,t-1}$). Refer to Table 7 for the definition of the informal institution measure (iv). Robust standard errors clustered by country pairs are reported in parentheses. Productivity estimates based on the WRDG method and operating revenues. The entries ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively.

this section thus strengthen the validity of the theoretical mechanism proposed in the paper. The findings for the other coefficients of interest remain robust.

3.2.4. South-based versus north-based MNEs

In this section, we allow the coefficients of the interaction terms in the main specification to differ depending on the level of development of the home country of the MNE. We follow the UN country classifications and define the home country of MNEs as the South ($SMNE = 1$) if the country is in the group of economies in transition or developing economies, and as the North if the country is in the group of developed economies ($SMNE = 0$).[16] This exercise aims to verify that the institutional complementarity effects identified above are indeed applicable to the South-based MNEs that motivate our study and theory.

We add additional triple interaction terms ($SMNE_h{}^*G_{h,t-1}{}^*G_{d,t-1}$, $SMNE_h{}^*\ln(prod_{f,t-1})^*G_{d,t-1}$, and $SMNE_h{}^*RD_{f,t-1}{}^*G_{d,t-1}$) to the main specification in (19). The coefficients of the double interaction terms represent the baseline effects common to both South-based and North-based MNEs, and the coefficients of the triple interaction terms correspond to the additional effects on the South-based MNEs. Table 13 indicates that the overall institutional complementarity effect remains positive, with the effects on South-based MNEs stronger than on North-

[16] https://www.un.org/en/development/desa/policy/wesp/wesp_current/2014wesp_country_classification.pdf. In particular, the group of developed economies includes 28 EU member states, Iceland, Norway, Switzerland, Australia, Canada, Japan, New Zealand, and the US.

Table 12
Firm-level FDI dependence on institutional quality — *sectoral contract intensity*.

FDI capital investment	VA	PV	GE	RQ	RL	CC	CE	LS
$G_{h,t-1}{}^{*}G_{d,t-1}$	**0.137**	**0.297****	**0.510*****	**−0.0119**	**0.510*****	**0.0639**	**0.000548**	**0.269*****
	(0.112)	**(0.151)**	**(0.186)**	**(0.213)**	**(0.147)**	**(0.114)**	**(0.000398)**	**(0.0644)**
$CI_s{}^{*}G_{h,t-1}{}^{*}G_{d,t-1}$	**0.802*****	**1.150*****	**0.462*****	**0.974*****	**0.935*****	**0.622*****	**0.000996*****	**−0.0232**
	(0.185)	**(0.276)**	**(0.165)**	**(0.159)**	**(0.156)**	**(0.140)**	**(0.000131)**	**(0.0243)**
$\ln(prod_{f,t-1})$	0.411**	0.335*	0.728***	0.617**	0.611***	0.545***	1.057**	1.456**
	(0.188)	(0.187)	(0.258)	(0.266)	(0.217)	(0.203)	(0.461)	(0.726)
$ln(prod_{f,t-1})^{*}G_{d,t-1}$	**−0.358*****	**−0.348*****	**−0.486*****	**−0.423****	**−0.392*****	**−0.394*****	**−0.0112***	**−0.180***
	(0.133)	**(0.127)**	**(0.146)**	**(0.170)**	**(0.120)**	**(0.117)**	**(0.00628)**	**(0.104)**
$RD_{f,t-1}$	−4.617***	−4.718***	−10.06***	−8.397***	−6.719***	−6.102***	−36.57***	−25.37***
	(1.507)	(1.180)	(1.742)	(1.493)	(1.586)	(1.507)	(4.295)	(7.712)
$RD_{f,t-1}{}^{*}G_{d,t-1}$	**0.733**	**5.450*****	**6.271*****	**4.896*****	**3.524*****	**3.117*****	**0.449*****	**3.314*****
	(1.233)	**(1.444)**	**(1.184)**	**(1.065)**	**(1.139)**	**(1.182)**	**(0.0577)**	**(1.100)**
# Observations	5289	5289	5289	5289	5289	5289	5278	5268
R^2	0.705	0.705	0.707	0.707	0.709	0.708	0.703	0.701
origin-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-sector FE	Y	Y	Y	Y	Y	Y	Y	Y
extra country-pair controls	Y	Y	Y	Y	Y	Y	Y	Y

Note: PPML estimation of equation (19) with an additional term: $CI_s{}^{*}G_{h,t-1}{}^{*}G_{d,t-1}$. Refer to Table B2 of the Online Appendix for the degree of contract intensity across sectors. Robust standard errors clustered by country pairs are reported in parentheses. Productivity estimates based on the WRDG method and operating revenues. The entries ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively.

based MNEs, when the WGI indicators are used. In the case of CE and LS, the coefficient of the triple interaction term $SMNE_h{}^{*}G_{h,t-1}{}^{*}G_{d,t-1}$ is insignificant or negative, but in an order of magnitude much smaller than the coefficient of $G_{h,t-1}{}^{*}G_{d,t-1}$; thus, the total effect of the institutional interaction terms is positive for South-based MNEs.

The coefficient of the interaction of firm productivity and destination institutional quality continues to be significant and negative, and more negative for South-based MNEs, suggesting that more productive MNEs based in the South are less inhibited by poor institutions in the destination than their North peers, all else being equal. Finally, the benchmark conclusion regarding R&D intensity and its interaction with destination institutional quality still holds for the North-based MNEs, although less robustly so for the South-based MNEs. This is understandable given that the quality-control risk mechanism proposed by Chang and Lu (2012) is modeled for North-based MNEs whose technological complexity exceeds the technology frontier of potential FDI destinations. In the case of South-based MNEs, this constraint might not be binding across all firms and hence the relationship identified is likely subject to more idiosyncrasies.

3.3. Robustness checks

3.3.1. Dropping US or top service sectors

As discussed in Section 3.1.1, the *fDi Markets* data are skewed toward US parent firms, the US destination, and three service sectors for the period of our study. After merging with the Orbis data, the dominance of the US parent firms decreases, but the destination and sector compositions remain similar (cf. Figs. 3 and 4 again). This may raise concern about the representativeness of the merged sample and the robustness of the results to the conspicuous destinations and sectors.

To alleviate such concerns, we first drop the US parent firms. As indicated by Table B3 of the Online Appendix, the results for all coefficients of interest are qualitatively similar to the benchmark in Table 6. Thus, the findings are not driven by the US parent firms alone, and as a result, the attrition of US parent firms due to the merging process may pose less of a threat to the conclusion. Next, we drop the FDI observations where the destination is the US. Again, the results are fairly robust to this variation. Last, we drop the three top service sectors in terms of FDI activities: Software & IT Services, Business Services, and Financial Services. In fact, the coefficient estimates of the institutional interaction term are very similar to the benchmark. Thus, the findings apply to the manufacturing as well as service sectors.

3.3.2. Dropping tax havens

Next, we drop jurisdictions that are considered to be tax havens, as origins or destinations. We consider two alternative lists of tax havens. The first list, following Investopedia, consists of Andorra, Bahamas, Belize, Bermuda, British Virgin Islands, Cayman Islands, Channel Islands, Cook Islands, Hong Kong, Isle of Man, Liechtenstein, Mauritius, Monaco, Panama, Switzerland and St. Kitts and Nevis.[17] The second list, published by the EU on June 17, 2015 (which is relevant for our period of study), includes 30 jurisdictions: Andorra, Anguilla, Antigua and Barbuda, Bahamas, Barbados, Belize, Bermuda, British Virgin Islands, Brunei, Cayman Islands, Cook Islands, Grenada, Guernsey, Hong Kong, Liberia, Liechtenstein, Maldives, Nauru, Niue, Marshall Islands, Mauritius, Monaco, Montserrat, Panama, St Kitts and Nevis, St Vincent and the Grenadines, Seychelles, Turks and Caicos, US Virgin Islands, and Vanuatu.[18]

As Table B4 of the Online Appendix indicates, the institutional complementarity effects remain similar in magnitudes to the benchmark in Table 6 for all institutional indicators. The findings are also similar for the other coefficients of interest.

3.3.3. Informal institution robustness checks

In this section, we repeat the analysis in Sections 3.2.3–3.3.2, replacing the home formal institutions with informal institutions as introduced in Section 3.2.2. The results based on measure (iv)—% of market capitalization of connected firms—are summarized in Table 14. Note the caveats discussed above associated with the measures of informal institutions (time invariant and limited country coverage relative to the formal institution measures). We choose measure (iv) for the robustness checks, as it incorporates both extensive margins (firm count) and intensive margins (firm size) in gauging the influence of informal institutions in an economy.

[17] http://www.investopedia.com/terms/t/taxhaven.asp.
[18] http://www.eubusiness.com/news-eu/economy-politics.120n.

Table 13
Firm-level FDI dependence on institutional quality — *South versus North-based MNEs*.

FDI capital investment	VA	PV	GE	RQ	RL	CC	CE	LS
$G_{h,t-1}{}^{*}G_{d,t-1}$	−0.0398	0.799***	0.858***	0.639***	0.886***	0.465***	0.00124***	0.340***
	(0.188)	(0.167)	(0.178)	(0.195)	(0.150)	(0.116)	(0.000344)	(0.0590)
$SMNE_h{}^{*}G_{h,t-1}{}^{*}G_{d,t-1}$	0.901***	0.698**	0.303	0.960***	0.315	0.614***	−0.000157	−0.0532*
	(0.233)	(0.326)	(0.220)	(0.229)	(0.235)	(0.206)	(0.000188)	(0.0287)
$\ln(prod_{f,t-1})$	0.154	0.0972	0.499**	0.392*	0.383**	0.354**	1.501***	1.934***
	(0.162)	(0.119)	(0.212)	(0.226)	(0.185)	(0.163)	(0.431)	(0.548)
$ln(prod_{f,t-1})^{*}G_{d,t-1}$	−0.259**	−0.400***	−0.506***	−0.449***	−0.427***	−0.461***	−0.0208***	−0.292***
	(0.129)	(0.114)	(0.135)	(0.150)	(0.112)	(0.103)	(0.00604)	(0.0777)
$SMNE_h{}^{*}\ ln(prod_{f,t-1})^{*}G_{d,t-1}$	−0.238***	−0.434***	−0.346***	−0.423***	−0.351***	−0.383***	−0.00828***	−0.0884***
	(0.0868)	(0.0845)	(0.0597)	(0.0615)	(0.0560)	(0.0581)	(0.00140)	(0.0134)
$RD_{f,t-1}$	−5.521***	−5.382***	−12.82***	−12.16***	−8.621***	−7.668***	−39.01***	−27.54***
	(1.163)	(1.123)	(1.561)	(1.450)	(1.508)	(1.395)	(4.485)	(6.193)
$RD_{f,t-1}{}^{*}G_{d,t-1}$	3.796***	9.009***	8.666***	8.813***	5.198***	5.216***	0.499***	3.768***
	(0.904)	(1.324)	(0.969)	(0.943)	(0.975)	(0.962)	(0.0593)	(0.861)
$SMNE_h{}^{*}RD_{f,t-1}{}^{*}G_{d,t-1}$	1.989	1.385	−8.464***	−10.03***	5.729**	−1.361	−0.0851	−1.082*
	(3.820)	(5.819)	(2.777)	(2.653)	(2.753)	(3.210)	(0.0567)	(0.569)
# Observations	7056	7056	7056	7056	7056	7056	7044	7025
R^2	0.833	0.838	0.844	0.846	0.846	0.846	0.843	0.844
origin-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-sector FE	Y	Y	Y	Y	Y	Y	Y	Y
extra country-pair controls	Y	Y	Y	Y	Y	Y	Y	Y

Note: PPML estimation of equation (19) with additional interaction terms: $SMNE_h{}^{*}(G_{h,t-1}{}^{*}G_{d,t-1})$, $SMNE_h{}^{*}(\ln(prod_{f,t-1})^{*}G_{d,t-1})$ and $SMNE_h{}^{*}(RD_{f,t-1}{}^{*}G_{d,t-1})$, where $SMNE_h$ equals one if the firm making the FDI is based in the South and zero otherwise. Refer to the main text for the definition of the South. Robust standard errors clustered by country pairs are reported in parentheses. Productivity estimates based on the WRDG method and operating revenues. The entries ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively.

The overall conclusions are consistent with those based on the formal institutions of source countries. MNEs based in countries characterized as having higher levels of informal institutions tend to make more FDI in destinations with poorer formal institutions. The identified relationship tends to be stronger for contract-intensive sectors; applies to both South-based and North-based MNEs overall; and is robust to variations in the sample (by dropping the US MNEs, the US as a FDI destination, the top three service sectors, or the tax havens). The coefficient estimates for firm characteristics and their interaction with destination institutional quality, although not reported, are similar to those in Tables 12 and 13 and Tables B3–B.4 of the Online Appendix.

3.3.4. Controlling for initial institutional qualities

In this section, we consider controlling for interaction of initial institutional qualities, to address concerns about omitted variables. Note that it is not practical to incorporate country-pair fixed effects in the current exercise, for two reasons. First, the formal institutional qualities are a slow-moving process, so including country-pair fixed effects removes most of informative variations from the measure. Second, the greenfield FDI activities at the firm level are not a frequent event within the majority of country pairs; it is demanding for the identification to rely on within-country-pair variations. If the key variable we use — the interaction of institutional variables — are picking up effects of some invariant (and omitted) country-pair characteristics, inclusion of the variable's initial value might help absorb such effects to certain extents.

To this end, we add $G_{h,0}{}^{*}G_{d,0}$ to the list of baseline controls used in Table 6, where the initial value used ($G_{h,0}{}^{*}G_{d,0}$) refers to the institutional qualities of year 2007, given that the period of FDI activities studied is 2009–2016 and the control variables used are lagged by one year (2008–2015). We also repeat the same analysis based on $I_h{}^{*}G_{d,t-1}$, and consider variations in contract intensity across sectors in both scenarios ($CI_s{}^{*}G_{h,t-1}{}^{*}G_{d,t-1}$ or $CI_s{}^{*}I_h{}^{*}G_{d,t-1}$), with the initial value $G_{h,0}{}^{*}G_{d,0}$ controlled for. The four sets of results are summarized in Table B5 of the Online Appendix. The coefficients of $G_{h,t-1}{}^{*}G_{d,t-1}$ are overall positive when precisely estimated, and more positive in sectors that are contract-intensive. Exceptions arise in the case of control of corruption (CC) and contract enforcement (CE), but such irregularity disappears once we rely on the specification based on informal institutions ($I_h{}^{*}G_{d,t-1}$). The coefficient estimates of $I_h{}^{*}G_{d,t-1}$ are negative, and more negative in contract-intensive sectors, across measures of institutional qualities. The findings are very similar if we use the institutional qualities of year 2006 instead of 2007 as the initial values.

3.3.5. Single versus multiple FDI destinations

In the remaining two robustness checks, we focus on the effects of firm characteristics on FDI activities. In addition to the institutional complementarity effect documented, there is a regular pattern in the coefficients of productivity, R&D intensity, and their interactions with destination institutional quality. In particular, the coefficient of the interaction between productivity and destination institutional quality is negative. Some may argue that this finding is due to a pecking order in the sorting of multinational firms across countries, where more productive multinational firms invest in more countries compared to less productive firms, and as a result its set of FDI destinations is more likely to include both countries with good institutional quality and those with poor institutional quality. This is in contrast with our theory that more productive firms tend to undertake FDI in countries with poorer institutions rather than in countries having better institutions, due to market share considerations.

To distinguish these two competing hypotheses, we create a dummy to indicate whether a firm invests in multiple foreign countries in a year and a sector (*multidest_dum* = 1) or in a single foreign country (*multidest_dum* = 0). We add a triple interaction term between this indicator, productivity and destination institutional quality. The results in Table 15 indicate that the coefficient of the interaction between productivity and destination institutional quality is negative, and the coef-

Table 14
Firm-level FDI dependence on institutional quality — *robustness checks based on informal institutions.*

	VA	PV	GE	RQ	RL	CC	CE	LS
1. Sectoral contract intensity								
$I_h{}^*G_{d,t-1}$	0.00238	−0.0168***	−0.0210***	−0.0201***	−0.0178***	−0.0128**	−0.000863***	−0.0204***
	(0.00593)	(0.00617)	(0.00548)	(0.00558)	(0.00496)	(0.00505)	(0.000293)	(0.00338)
$CI_s{}^*I_h{}^*G_{d,t-1}$	−0.0120***	0.00269	−0.0184***	−0.0131**	−0.0161***	−0.0164***	−0.000561***	−0.00726***
	(0.00463)	(0.00877)	(0.00502)	(0.00589)	(0.00466)	(0.00528)	(0.000100)	(0.00101)
2. South versus North-based MNEs								
$I_h{}^*G_{d,t-1}$	−0.00761	−0.0274***	−0.0364***	−0.0320***	−0.0289***	−0.0229***	−0.00122***	−0.0215***
	(0.00479)	(0.00477)	(0.00499)	(0.00496)	(0.00431)	(0.00415)	(0.000258)	(0.00322)
$SMNE_h{}^*I_h{}^*G_{d,t-1}$	−0.0211	0.0468	0.0450*	0.0206	−0.0146	0.0177	0.000295	−0.0109
	(0.0206)	(0.0347)	(0.0273)	(0.0245)	(0.0247)	(0.0237)	(0.00136)	(0.0222)
3. Dropping US firms								
$I_h{}^*G_{d,t-1}$	−0.00682	−0.0211***	−0.0312***	−0.0284***	−0.0269***	−0.0193***	−0.00101***	−0.0197***
	(0.00521)	(0.00499)	(0.00515)	(0.00514)	(0.00447)	(0.00420)	(0.000287)	(0.00341)
4. Dropping US as destination								
$I_h{}^*G_{d,t-1}$	−0.00144	−0.0144***	−0.0229***	−0.0217***	−0.0189***	−0.0126***	−0.000685***	−0.0147***
	(0.00430)	(0.00424)	(0.00480)	(0.00462)	(0.00415)	(0.00367)	(0.000249)	(0.00297)
5. Dropping top service sectors								
$I_h{}^*G_{d,t-1}$	−0.00766	−0.0209***	−0.0316***	−0.0288***	−0.0272***	−0.0192***	−0.00100***	−0.0199***
	(0.00507)	(0.00507)	(0.00527)	(0.00530)	(0.00455)	(0.00434)	(0.000284)	(0.00357)
6. Dropping tax havens (List I)								
$I_h{}^*G_{d,t-1}$	−0.00755	−0.0232***	−0.0331***	−0.0301***	−0.0276***	−0.0200***	−0.00119***	−0.0202***
	(0.00528)	(0.00502)	(0.00526)	(0.00520)	(0.00467)	(0.00434)	(0.000281)	(0.00347)
7. Dropping tax havens (List II)								
$I_h{}^*G_{d,t-1}$	−0.00856*	−0.0228***	−0.0335***	−0.0305***	−0.0284***	−0.0208***	−0.00110***	−0.0207***
	(0.00514)	(0.00484)	(0.00507)	(0.00504)	(0.00442)	(0.00416)	(0.000277)	(0.00334)
origin-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-sector FE	Y	Y	Y	Y	Y	Y	Y	Y
extra country-pair controls	Y	Y	Y	Y	Y	Y	Y	Y

Note: PPML estimation of equation (19), with variations in the specifications as explained in the footnote of Tables 12 and 13 of the paper and Tables B3–B4 of the Online Appendix. Informal institutions are based on measure (iv): % of market capitalization of connected firms. Robust standard errors clustered by country pairs are reported in parentheses. Productivity estimates based on the WRDG method and operating revenues. The entries ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively.

ficient of the triple interaction is positive when significant (but with much smaller magnitudes), such that the two coefficients' sum is still negative. This suggests that more productive firms invest in countries with poorer institutions, and as they invest in more destinations, they move up the 'institutional quality ladder'. Thus, the conclusion is in favor of our proposed hypothesis.

As an extra robustness check, we define the dummy instead according to whether a firm invests in multiple foreign countries in a sector *during the period of study* (*multidest_dum* = 1) or in a single foreign country (*multidest_dum* = 0). The results, as shown in the lower panel of Table 15, are similar. At the same time, the findings on institutional complementarity and R&D intensity remain robust.

3.3.6. Alternative productivity measures

In this set of robustness checks, we adopt alternative productivity measures based on the estimators of Rovigatti and Mollisi (2018) (RM), Levinsohn and Petrin (2003) (LP), and Ackerberg et al. (2015) (ACF). See Section 3.1.2 for a summary of these estimators and their potential caveats. As discussed, in view of potential drawbacks of LP and ACF, we used the WRDG estimator in the main analysis above.

The results are summarized in Table 16. The institutional complementarity effect remains robust to the use of alternative productivity measures. The interaction of R&D intensity and destination institutions also remains positive and robust. The interaction of productivity and destination institutions continues to be negative in the case of RM, negative but not as precisely estimated in the case of LP, and negative overall with the exception of CE in the case of ACF.

We also repeat the other analysis presented above with the alternative productivity estimators (unreported in tables). The general observation is that the institutional complementarity pattern is very robust to the choice of productivity estimators. The signs of the coefficients of R&D intensity and its interaction term with destination institutional quality are also fairly robust. The choice of productivity estimators mainly affects the coefficient of productivity and its interaction with destination institutional quality. The sign of the coefficient of productivity is positive and the interaction term negative (as the theory suggests) in the case of WRDG and RM, and not as robustly so in the case of LP. When based on ACF, the sign of the coefficient of productivity tends to be negative instead (contrary to ex ante expectation), while the sign of the coefficient of the interaction between productivity and destination institutional quality still tends to be negative. In general, the signs of the coefficients are more regular and precisely estimated based

Table 15
Firm-level FDI dependence on institutional quality — *firms undertaking FDI in single vs. multiple destinations*.

	VA	PV	GE	RQ	RL	CC	CE	LS
I. multiple destinations per year								
$G_{h,t-1}{}^{*}G_{d,t-1}$	**0.643*****	**1.014*****	**1.066*****	**1.030*****	**1.098*****	**0.679*****	**0.00127*****	**0.425*****
	(0.0882)	**(0.131)**	**(0.158)**	**(0.164)**	**(0.130)**	**(0.104)**	**(0.000320)**	**(0.0581)**
$\ln(prod_{f,t-1})$	0.206	0.0954	0.462**	0.437**	0.380**	0.358**	0.898**	1.241**
	(0.145)	(0.128)	(0.197)	(0.206)	(0.178)	(0.160)	(0.359)	(0.492)
$ln(prod_{f,t-1})^{*}G_{d,t-1}$	**−0.323*****	**−0.315*****	**−0.539*****	**−0.552*****	**−0.463*****	**−0.473*****	**−0.0141*****	**−0.209*****
	(0.122)	**(0.104)**	**(0.120)**	**(0.139)**	**(0.107)**	**(0.105)**	**(0.00466)**	**(0.0670)**
$multidest\_dum_{f,t}{}^{*}\ ln(prod_{f,t-1})^{*}G_{d,t-1}$	**−0.0364**	**0.0461**	**0.101*****	**0.0718****	**0.0733*****	**0.0486***	**0.00213*****	**0.0215*****
	(0.0396)	**(0.0394)**	**(0.0227)**	**(0.0292)**	**(0.0254)**	**(0.0267)**	**(0.000467)**	**(0.00460)**
$RD_{f,t-1}$	−5.088***	−5.051***	−12.61***	−10.78***	−8.435***	−7.119***	−50.97***	−32.35***
	(1.178)	(1.079)	(1.488)	(1.366)	(1.401)	(1.314)	(4.495)	(6.207)
$RD_{f,t-1}{}^{*}G_{d,t-1}$	**3.488*****	**9.395*****	**9.070*****	**8.127*****	**5.788*****	**5.302*****	**0.655*****	**4.443*****
	(0.950)	**(1.260)**	**(0.934)**	**(0.922)**	**(0.902)**	**(0.937)**	**(0.0601)**	**(0.855)**
# Observations	7056	7056	7056	7056	7056	7056	7044	7025
R^2	0.825	0.829	0.837	0.834	0.837	0.832	0.829	0.831
II. multiple destinations during the period of study								
$G_{h,t-1}{}^{*}G_{d,t-1}$	**0.660*****	**1.028*****	**1.029*****	**0.983*****	**1.093*****	**0.654*****	**0.00122*****	**0.401*****
	(0.0884)	**(0.131)**	**(0.157)**	**(0.165)**	**(0.131)**	**(0.103)**	**(0.000315)**	**(0.0582)**
$\ln(prod_{f,t-1})$	0.232*	0.0981	0.448**	0.422**	0.361**	0.330**	0.947***	1.287***
	(0.129)	(0.133)	(0.195)	(0.202)	(0.175)	(0.159)	(0.362)	(0.481)
$ln(prod_{f,t-1})^{*}G_{d,t-1}$	**−0.282***	**−0.405*****	**−0.568*****	**−0.545*****	**−0.454*****	**−0.492*****	**−0.0158*****	**−0.228*****
	(0.148)	**(0.137)**	**(0.128)**	**(0.154)**	**(0.119)**	**(0.121)**	**(0.00483)**	**(0.0652)**
$multidest\_dum_{f,t}{}^{*}\ ln(prod_{f,t-1})^{*}G_{d,t-1}$	**−0.0772**	**0.109**	**0.102*****	**0.0538**	**0.0521**	**0.0692**	**0.00277*****	**0.0291*****
	(0.0685)	**(0.0745)**	**(0.0387)**	**(0.0457)**	**(0.0405)**	**(0.0460)**	**(0.000981)**	**(0.00938)**
$RD_{f,t-1}$	−5.300***	−4.836***	−12.15***	−10.71***	−8.384***	−6.836***	−48.59***	−34.49***
	(1.177)	(1.077)	(1.486)	(1.370)	(1.406)	(1.307)	(4.558)	(6.172)
$RD_{f,t-1}{}^{*}G_{d,t-1}$	**3.228*****	**9.545*****	**9.289*****	**8.414*****	**6.095*****	**5.480*****	**0.637*****	**4.911*****
	(0.987)	**(1.272)**	**(0.958)**	**(0.956)**	**(0.915)**	**(0.934)**	**(0.0619)**	**(0.847)**
# Observations	7056	7056	7056	7056	7056	7056	7044	7025
R^2	0.828	0.830	0.835	0.832	0.835	0.832	0.828	0.831
origin-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-sector FE	Y	Y	Y	Y	Y	Y	Y	Y
extra country-pair controls	Y	Y	Y	Y	Y	Y	Y	Y

Note: PPML estimation of equation (19) with an additional term $multidest\_dum_{f,t}{}^{*}\ln(prod_{f,t-1})^{*}G_{d,t-1}$. I. The indicator *multidest_dum* equals one if a firm invests in multiple foreign countries in a year and a sector (*multidest_dum* = 1); and zero if a firm invests in a single foreign country (*multidest_dum* = 0). II. The indicator *multidest_dum* equals one if a firm invests in multiple foreign countries in a sector during the period of study (*multidest_dum* = 1); and zero if a firm invests in a single foreign country (*multidest_dum* = 0). Robust standard errors clustered by country pairs are reported in parentheses. Productivity estimates based on the WRDG method and operating revenues. The entries ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively.

on WRDG and RM, while they are more irregular across institutional indicators in the case of ACF, with the results based on LP somewhere in between.[19]

Given the potential issues of productivity estimations highlighted in Section 3.1.2, we might need to take the results pertaining to productivity (and productivity interacted with destination institutions) with a grain of salt. Nonetheless, the various variations in specifications and robustness checks conducted in Sections 3.2–3.3 demonstrate consistent empirical support for the proposed institutional complementarity effect and its theoretical mechanism.

4. Conclusion

In this paper, we propose a theoretical framework to underpin at the micro level the endogenous formation of firm-specific informal institutions; such that South-based MNEs have a comparative advantage in dealing with the inefficiency associated with weak formal institutions and to maneuver in relationship-based investment environments, relative to their peers from the North. The theory predicts complementarity of institutional qualities of the home and destination countries in bilateral FDI flows at the firm level. This helps explain the greater presence of South-based MNEs in countries having relatively poorer institutions. In addition, our theoretical framework also suggests interesting testable

[19] It is also possible to implement the productivity estimations by value added instead of revenues. The former takes the difference between revenues and intermediate inputs such as materials, before estimating a value-added function in labor and capital, while the latter estimates the production function in all inputs. In fact, the ACF method was proposed by means of a value-added function. We choose to take the revenue-function approach, as the value-added approach requires a stronger functional form assumption about the production structure. In particular, it assumes that the production function is a Leontief function in value added and intermediate inputs. See Gandhi et al. (2017) for further discussion.

Table 16
Firm-level FDI dependence on institutional quality — *alternative productivity estimates*.

	VA	PV	GE	RQ	RL	CC	CE	LS
I. RM method								
$\mathbf{G_{h,t-1}{}^{*}G_{d,t-1}}$	**0.566*****	**1.021*****	**1.036*****	**1.036*****	**1.091*****	**0.671*****	**0.00114*****	**0.414*****
	(0.0891)	**(0.130)**	**(0.157)**	**(0.163)**	**(0.130)**	**(0.100)**	**(0.000315)**	**(0.0568)**
$\ln(prod_{f,t-1})$	0.0930	0.0636	0.370**	0.360**	0.279**	0.260**	1.044***	0.929**
	(0.101)	(0.107)	(0.149)	(0.148)	(0.128)	(0.124)	(0.302)	(0.401)
$\mathbf{ln(prod_{f,t-1})^{*}G_{d,t-1}}$	**−0.263*****	**−0.253****	**−0.382*****	**−0.439*****	**−0.333*****	**−0.361*****	**−0.0143*****	**−0.144****
	(0.0816)	**(0.106)**	**(0.0915)**	**(0.0991)**	**(0.0790)**	**(0.0815)**	**(0.00392)**	**(0.0578)**
$RD_{f,t-1}$	−4.446***	−4.959***	−12.20***	−10.41***	−8.073***	−6.726***	−49.17***	−31.19***
	(1.139)	(1.087)	(1.500)	(1.395)	(1.402)	(1.301)	(4.494)	(6.179)
$\mathbf{RD_{f,t-1}{}^{*}G_{d,t-1}}$	**2.682*****	**9.294*****	**8.758*****	**7.817*****	**5.480*****	**5.011*****	**0.640*****	**4.358*****
	(0.923)	**(1.268)**	**(0.954)**	**(0.940)**	**(0.904)**	**(0.943)**	**(0.0603)**	**(0.858)**
# Observations	7056	7056	7056	7056	7056	7056	7044	7025
R^2	0.826	0.828	0.833	0.833	0.835	0.831	0.825	0.828
II. LP method								
$\mathbf{G_{h,t-1}{}^{*}G_{d,t-1}}$	**0.541*****	**0.994*****	**1.072*****	**0.972*****	**1.097*****	**0.594*****	**0.00130*****	**0.404*****
	(0.0867)	**(0.130)**	**(0.158)**	**(0.165)**	**(0.133)**	**(0.104)**	**(0.000302)**	**(0.0546)**
$\ln(prod_{f,t-1})$	−0.0441	−0.162	0.127	0.126	0.0544	0.0368	0.286	0.547
	(0.134)	(0.118)	(0.180)	(0.179)	(0.166)	(0.147)	(0.449)	(0.595)
$\mathbf{ln(prod_{f,t-1})^{*}G_{d,t-1}}$	**−0.339*****	**−0.146**	**−0.394*****	**−0.446*****	**−0.346*****	**−0.347*****	**−0.00656**	**−0.122**
	(0.112)	**(0.140)**	**(0.129)**	**(0.129)**	**(0.116)**	**(0.108)**	**(0.00627)**	**(0.0846)**
$RD_{f,t-1}$	−4.508***	−4.725***	−10.83***	−9.410***	−7.275***	−6.109***	−42.71***	−29.06***
	(1.189)	(1.101)	(1.525)	(1.405)	(1.430)	(1.336)	(4.531)	(6.269)
$\mathbf{RD_{f,t-1}{}^{*}G_{d,t-1}}$	**2.507****	**8.656*****	**7.794*****	**7.139*****	**5.014*****	**4.373*****	**0.553*****	**4.076*****
	(0.979)	**(1.308)**	**(0.995)**	**(0.958)**	**(0.948)**	**(0.958)**	**(0.0610)**	**(0.870)**
# Observations	7056	7056	7056	7056	7056	7056	7044	7025
R^2	0.826	0.831	0.835	0.832	0.836	0.831	0.827	0.831
III. ACF method								
$\mathbf{G_{h,t-1}{}^{*}G_{d,t-1}}$	**0.546*****	**0.977*****	**1.135*****	**0.982*****	**1.117*****	**0.583*****	**0.00141*****	**0.397*****
	(0.0892)	**(0.128)**	**(0.158)**	**(0.163)**	**(0.129)**	**(0.103)**	**(0.000299)**	**(0.0534)**
$\ln(prod_{f,t-1})$	−0.311***	−0.385***	−0.0474	−0.223*	−0.160	−0.202	−2.200***	−0.294
	(0.114)	(0.125)	(0.112)	(0.123)	(0.138)	(0.123)	(0.608)	(0.571)
$\mathbf{ln(prod_{f,t-1})^{*}G_{d,t-1}}$	**−0.294*****	**−0.106**	**−0.485*****	**−0.319*****	**−0.353*****	**−0.337*****	**0.0258*****	**−0.0255**
	(0.0883)	**(0.155)**	**(0.0928)**	**(0.0929)**	**(0.103)**	**(0.103)**	**(0.00867)**	**(0.0835)**
$RD_{f,t-1}$	−3.921***	−4.464***	−9.836***	−8.184***	−6.465***	−5.512***	−36.96***	−26.76***
	(1.193)	(1.098)	(1.517)	(1.385)	(1.420)	(1.315)	(4.527)	(6.262)
$\mathbf{RD_{f,t-1}{}^{*}G_{d,t-1}}$	**1.686***	**8.277*****	**7.417*****	**6.471*****	**4.756*****	**3.927*****	**0.474*****	**3.763*****
	(0.978)	**(1.318)**	**(1.025)**	**(0.972)**	**(0.972)**	**(0.972)**	**(0.0612)**	**(0.873)**
# Observations	7056	7056	7056	7056	7056	7056	7044	7025
R^2	0.828	0.834	0.838	0.834	0.839	0.835	0.832	0.833
origin-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-year FE	Y	Y	Y	Y	Y	Y	Y	Y
destination-sector FE	Y	Y	Y	Y	Y	Y	Y	Y
extra country-pair controls	Y	Y	Y	Y	Y	Y	Y	Y

Note: PPML estimation of equation (19). Productivity estimates based on the RM, LP, and ACF methods, respectively, and operating revenues. Robust standard errors clustered by country pairs are reported in parentheses. The entries ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively.

predictions about the interaction of firm characteristics and destination institutional qualities. In particular, a more productive firm will choose to engage in FDI in countries with poorer institutional qualities, all else being equal.

We conduct extensive tests of the theory using worldwide firm-level FDI activities during the period 2009–2016. An interaction term of institutional qualities of home and destination countries is embedded in a comprehensive gravity estimation equation controlling for firm-level characteristics (and their interactions with destination institutional qualities), origin-year, destination-year, and destination-sector fixed effects, proxies for bilateral barriers to FDI, the difference in GDP per capita, and extra country-pair controls. The results indicate a statistically significant complementarity effect of institutional qualities. The findings are robust across eight alternative institutional quality indicators, stronger in sectors that rely more on institutions (to enforce contracts), not driven by particular origin, destination, or sectors, robust to dropping tax havens, and robust to the use of alternative productivity measures. We also verify that the findings are consistent with the proposed theoretical mechanism by replacing the

interaction of formal institutions with that of informal institutions at home and formal institutions in the FDI destination. We find that firms based in countries with more prevalent informal institutions tend to engage in more FDI in destinations with poorer formal institutions. The result is robust to alternative proxies of informal institutions and across the various specifications discussed above.

Informal institutions are modeled in this paper in a rather summary manner. In reality, the concept likely embodies many facets of firm-specific capacities growing out of a society's political structure and social conditions. The rich fabric and informal nature of these human, social, and political investments by firms are difficult to quantify. But they present an interesting avenue to understand the incentives and constraints of firms based in developing countries, and their comparative advantages when venturing abroad. To this end, future research that constructs standardized proxies of these informal institutions across countries and across time would be beneficial.

A. Theory Appendix

A.1. Proofs for the benchmark model of horizontal FDI

Proof of Proposition 1. (i) Note that:

$$\left.\frac{\partial F^{FDI}(r_d, I_h^*, I_d)}{\partial I_d}\right|_{I_d = I_d^{E,*}} = \frac{\partial f^E(r_d, I_h^*, I_d^{E,*})}{\partial I_d} + \frac{\partial f^P(r_d, I_h^*, I_d^{E,*})}{\partial I_d} + k_d'(I_d^{E,*})$$
$$= \frac{\partial f^P(r_d, I_h^*, I_d^{E,*})}{\partial I_d} < 0,$$

where the second equality follows from the FOC for $I_d^{E,*}$: $\frac{\partial f^E(r_d, I_h^*, I_d^{E,*})}{\partial I_d} + k_d'(I_d^{E,*}) = 0$, and the sign follows from the assumption that $f^P(r_d, I_h, I_d)$ strictly decreases in I_d. The sign implies that $I_d^{E,*} < I_d^{FDI,*}$.

(ii) We can write:

$$F^{FDI,*} - F^{E,*} = \left\{F^{FDI,*} - F^E\left(r_d, I_h^*, I_d^{FDI,*}\right)\right\} + \left\{F^E\left(r_d, I_h^*, I_d^{FDI,*}\right) - F^{E,*}\right\}$$
$$= f^P\left(r_d, I_h^*, I_d^{FDI,*}\right) + \left\{F^E\left(r_d, I_h^*, I_d^{FDI,*}\right) - F^{E,*}\right\} > 0,$$

where the second equality follows from the definition of F^E and F^{FDI}, and $\left\{F^E(r_d, I_h^*, I_d^{FDI,*}) - F^{E,*}\right\} > 0$ follows from the definition of $F^{E,*}$ and the fact that $I_d^{FDI,*} \neq I_d^{E,*}$.

(iii) Note that:

$$\frac{dF^{FDI,*}}{dr_d} = \frac{\partial f^E(r_d, I_h^*, I_d^{FDI,*})}{\partial r_d} + \frac{\partial f^P(r_d, I_h^*, I_d^{FDI,*})}{\partial r_d} + \frac{\partial F^{FDI}(r_d, I_h^*, I_d^{FDI,*})}{\partial I_d}\frac{\partial I_d^{FDI,*}}{\partial r_d} > 0, \tag{20}$$

where the sign follows from the assumption that $f^S(r_d, I_h, I_d)$ strictly increases in r_d for $S \in \{E, P\}$, and from the FOC for $I_d^{FDI,*}$ such that $\partial F^{FDI}(r_d, I_h^*, I_d^{FDI,*})/\partial I_d = 0$.

(iv) The Proof is similar to (iii). We have:

$$\frac{dF^{E,*}}{dr_d} = \frac{\partial f^E(r_d, I_h^*, I_d^{E,*})}{\partial r_d} + \frac{\partial F^E(r_d, I_h^*, I_d^{E,*})}{\partial I_d}\frac{\partial I_d^{E,*}}{\partial r_d} > 0, \tag{21}$$

where the sign follows from the assumption that $f^E(r_d, I_h, I_d)$ strictly increases in r_d and from the FOC for $I_d^{E,*}$ such that $\partial F^E(r_d, I_h^*, I_d^{E,*})/\partial I_d = 0$. ■

Proof of Proposition 2. (i) By total differentiation of (3) with respect to r_h and I_h^*, we have:

$$\frac{\partial I_h^*}{\partial r_h} = -\frac{\frac{\partial^2 f^D(r_h, I_h^*)}{\partial r_h \partial I_h}}{\frac{\partial^2 F^D}{\partial I_h^2}} > 0,$$

since the numerator is negative by the assumption in (2) and since $\frac{\partial^2 F^D}{\partial I_h^2} > 0$ by the SOC for I_h^*.

(ii) By total differentiation of (4) with respect to r_d and $I_d^{E,*}$, we have:

$$\frac{\partial I_d^{E,*}}{\partial r_d} = -\frac{\frac{\partial^2 f^E(r_d, I_h^*, I_d^{E,*})}{\partial r_d \partial I_d}}{\frac{\partial^2 F^E}{\partial I_d^2}} > 0,$$

by the assumption in (6) and by the SOC for $I_d^{E,*}$.

(iii) By total differentiation of (5) with respect to r_d and $I_d^{FDI,*}$, we have:

$$\frac{\partial I_d^{FDI,*}}{\partial r_d} = -\frac{\frac{\partial^2 f^E(r_d, I_h^*, I_d^{FDI,*})}{\partial r_d \partial I_d} + \frac{\partial^2 f^P(r_d, I_h^*, I_d^{FDI,*})}{\partial r_d \partial I_d}}{\frac{\partial^2 F^{FDI}}{\partial I_d^2}} > 0,$$

by the assumption in (6) and by the SOC for $I_d^{FDI,*}$.

(iv) As a corollary,

$$\frac{dF^E(r_d, I_h^*, I_d^{E,*})}{dr_h} = \frac{\partial f^E(r_d, I_h^*, I_d^{E,*})}{\partial I_h^*}\frac{\partial I_h^*}{\partial r_h} < 0,$$

$$\frac{dF^{FDI}(r_d, I_h^*, I_d^{FDI,*})}{dr_h} = \frac{\partial f^E(r_d, I_h^*, I_d^{FDI,*})}{\partial I_h^*}\frac{\partial I_h^*}{\partial r_h} + \frac{\partial f^P(r_d, I_h^*, I_d^{FDI,*})}{\partial I_h^*}\frac{\partial I_h^*}{\partial r_h} < 0,$$

by the assumption that $f^S(r_d, I_h, I_d)$ strictly decreases in I_h for $S \in \{E, P\}$, and by Proposition 2(i). ■

Proof of Proposition 3. (ii) By total differentiation of (12) with respect to $\widetilde{\phi}$, we have:

$$\frac{\partial^2 \Pi^\Delta}{\partial \widetilde{\phi} \partial r_d} = (1-\eta)(1-\sigma)\frac{\pi^{FDI}}{\widetilde{\phi} w_d}\omega'(r_d) > 0, \tag{22}$$

because $\sigma > 1$ and $\omega'(r) < 0$.

(iii) It is straightforward to see that B_d has an analogous (positive) effect on $\frac{\partial \Pi^\Delta}{\partial r_d}$ as $\widetilde{\phi}$, because B_d and $\widetilde{\phi}$ enter the profit function multiplicatively.

(iv) Finally, we have:

$$\frac{\partial^2 \Pi^\Delta}{\partial \eta \partial r_d} = (1-\sigma)\left[(1-\eta)(1-\sigma)\ln\frac{\tau_{hd} w_h}{w_d} - 1\right](\pi^{FDI}/w_d)\omega'(r_d) < 0, \tag{23}$$

for $\left(\frac{\tau_{hd} w_h}{w_d}\right)^{(1-\eta)(1-\sigma)} < 1$, which is necessary if FDI is the chosen entry mode instead of exporting (because the FDI variable profit must be larger than exporting to compensate for the higher FDI fixed costs as shown in Proposition 1(ii)). In other words, for firms based in a country with a sufficiently high wage (relative to the FDI destination, $\tau_{hd} w_h > w_d$, after adjusting for trade cost), the wage saving of FDI relative to exporting (by producing the intermediate component in destinations with higher r_d and thus lower w_d) becomes smaller when the headquarters intensity η is higher. ■

We now discuss the implications if I_h and I_d are complementary in lowering fixed costs of exporting or FDI at the destination. Instead of (7), suppose that:

$$\frac{\partial^2 f^S(I_h, I_d)}{\partial I_h \partial I_d} < 0, \quad \frac{\partial^3 f^S(r_d, I_h, I_d)}{\partial r_d \partial I_h \partial I_d} < 0, \quad \text{for } S \in (E, P). \tag{24}$$

In this case, all the propositions continue to hold in the direction predicted and with the effects reinforced. The proofs remain the same except with the following modifications. First, in addition to Proposition 2(ii)–(iii), we establish the parallel derivative of $I_d^{E,*}$ and $I_d^{FDI,*}$ with respect to r_h.

Proposition 2(ii'). By total differentiation of (4) with respect to r_h and $I_d^{E,*}$, we have:

$$\frac{\partial I_d^{E,*}}{\partial r_h} = -\frac{\frac{\partial^2 f^E(r_d, I_h^*, I_d^{E,*})}{\partial I_h^* \partial I_d}\frac{\partial I_h^*}{\partial r_h}}{\frac{\partial^2 F^E}{\partial I_d^2}} > 0,$$

by the assumption in (24), Proposition 2(i), and the SOC for $I_d^{E,*}$.

Proposition 2(iii'). By total differentiation of (5) with respect to r_h and $I_d^{FDI,*}$, we have:

$$\frac{\partial I_d^{FDI,*}}{\partial r_h} = -\frac{\frac{\partial^2 f^E(r_d, I_h^*, I_d^{FDI,*})}{\partial I_h^* \partial I_d}\frac{\partial I_h^*}{\partial r_h} + \frac{\partial^2 f^P(r_d, I_h^*, I_d^{FDI,*})}{\partial I_h^* \partial I_d}\frac{\partial I_h^*}{\partial r_h}}{\frac{\partial^2 F^{FDI}}{\partial I_d^2}} > 0,$$

by the assumption in (24), Proposition 2(i), and the SOC for $I_d^{FDI,*}$.

Proposition 2(iv) is modified as a result:

$$\frac{dF^E(r_d, I_h^*, I_d^{E,*})}{dr_h} = \frac{\partial f^E(r_d, I_h^*, I_d^{E,*})}{\partial I_h^*}\frac{\partial I_h^*}{\partial r_h} + \frac{\partial f^E(r_d, I_h^*, I_d^{E,*})}{\partial I_d^{E,*}}\frac{\partial I_d^{E,*}}{\partial r_h} < 0,$$

$$\frac{dF^{FDI}(r_d, I_h^*, I_d^{FDI,*})}{dr_h} = \frac{\partial f^E(r_d, I_h^*, I_d^{FDI,*})}{\partial I_h^*}\frac{\partial I_h^*}{\partial r_h} + \frac{\partial f^E(r_d, I_h^*, I_d^{FDI,*})}{\partial I_d^{FDI,*}}\frac{\partial I_d^{FDI,*}}{\partial r_h}$$
$$+\frac{\partial f^P(r_d, I_h^*, I_d^{FDI,*})}{\partial I_h^*}\frac{\partial I_h^*}{\partial r_h} + \frac{\partial f^P(r_d, I_h^*, I_d^{FDI,*})}{\partial I_d^{FDI,*}}\frac{\partial I_d^{FDI,*}}{\partial r_h} < 0,$$

by the assumption that $f^S(r_d, I_h, I_d)$ strictly decreases in I_h and I_d for $S \in \{E, P\}$, and by the result from Propositions 2(i), 2(ii') and 2(iii'). Thus, the fixed costs are further reduced by higher $I_d^{E,*}$ or $I_d^{FDI,*}$ as a result of larger r_h.

Proposition 3(i). Given the assumption in (24), it follows that in (14):

$$\frac{\partial^2 f^E(r_d, I_h^*, I_d^{FDI,*})}{\partial r_d\, \partial I_h^*}\frac{\partial I_h^*}{\partial r_h} - \frac{\partial^2 f^E(r_d, I_h^*, I_d^{E,*})}{\partial r_d\, \partial I_h^*}\frac{\partial I_h^*}{\partial r_h} < 0$$

since $I_d^{FDI,*} > I_d^{E,*}$ by Proposition 1(i). As a result, $\frac{\partial^2 \Pi^\Delta}{\partial r_h \partial r_d} > 0$ in (13) continues to hold and with larger effects.

A.2. The case of vertical FDI

In this alternative setup, we develop the parallel propositions for the case of vertical FDI. The baseline structure remains the same, with the following modifications. First, we abstract away from any kind of trade frictions (and thus the incentives of horizontal FDI driven by market access). This implies there is a single world market for goods, with size indexed by B. A firm, given its productivity level, chooses whether to produce or not. If it chooses to produce both headquarters and intermediate components at home (to serve the world market), it incurs a fixed overhead cost $f^D(r_h, I_h)$. If it chooses to produce the intermediate component in a country different from where it is headquartered, it incurs an *additional* overhead cost $f^{FDI}(r_d, I_h, I_d)$, where the level of informal institutions that a firm builds at home affects (to some extent) its fixed operating cost in the host country. Firms choose $I_h^{D,*}$ to minimize the fixed cost of local production: $F^D(r_h, I_h) \equiv f^D(r_h, I_h) + k_h(I_h)$, and alternatively $I_h^{FDI,*}$ and $I_d^{FDI,*}$ to minimize the fixed cost of multinational production: $F^{FDI}(r_h, r_d, I_h, I_d) \equiv f^D(r_h, I_h) + f^{FDI}(r_d, I_h, I_d) + k_h(I_h) + k_d(I_d)$.

The first order conditions for $I_h^{FDI,*}$ and $I_d^{FDI,*}$ are, respectively:

$$\frac{\partial f^D(r_h, I_h^{FDI,*})}{\partial I_h} + \frac{\partial f^{FDI}(r_d, I_h^{FDI,*}, I_d^{FDI,*})}{\partial I_h} + k_h'(I_h^{FDI,*}) = 0, \tag{25}$$

$$\frac{\partial f^{FDI}(r_d, I_h^{FDI,*}, I_d^{FDI,*})}{\partial I_d} + k_d'(I_d^{FDI,*}) = 0. \tag{26}$$

Define $F^{D,*}(r_h)$ and $F^{FDI,*}(r_h, r_d)$ as the respective minimal fixed costs of local production and FDI. We make the same assumptions about $f^D(r_h, I_h)$ as in the benchmark model. Furthermore, assume that $f^{FDI}(r_d, I_h, I_d)$ strictly increases in r_d; strictly decreases in I_h and I_d; and

$$\frac{\partial}{\partial r_d}\left(\frac{\partial f^{FDI}(r_d, I_h, I_d)}{\partial I_h}\right) < 0; \quad \frac{\partial}{\partial r_d}\left(\frac{\partial f^{FDI}(r_d, I_h, I_d)}{\partial I_d}\right) < 0. \tag{27}$$

We also start the analysis by assuming the neutral scenario that

$$\frac{\partial^2 f^{FDI}(r_d, I_h, I_d)}{\partial I_h \partial I_d} = 0, \tag{28}$$

so there are no reinforcing effects of r_h on the choice of I_d through I_h. We discuss the possible scenario of reinforcing effects at the end of this section. Basically, the proposed mechanism is further strengthened.

Proposition A.2.1. *(i) The investment in informal institutions at home will be higher for firms engaging in multinational production than for firms engaging only in local production: $I_h^{FDI,*}(r_h, r_d) > I_h^{D,*}(r_h)$. (ii) The total fixed cost of production will be higher for multinational production than for local production: $F^{FDI,*}(r_h, r_d) > F^{D,*}(r_h)$. (iii) The total fixed cost of multinational production will be higher in FDI destinations with poorer institutions: $dF^{FDI,*}/dr_d > 0$. (iv) For a given FDI destination, the total fixed cost of multinational production will be higher for MNEs based in countries with poorer institutions: $dF^{FDI,*}/dr_h > 0$.*

Proof. (*i*) *Note that*:

$$\left.\frac{\partial F^{FDI}}{\partial I_h}\right|_{I_h = I_h^{D,*}} = \frac{\partial f^D(r_h, I_h^{D,*})}{\partial I_h} + \frac{\partial f^{FDI}(r_d, I_h^{D,*}, I_d)}{\partial I_h} + k_h'(I_h^{D,*})$$
$$= \frac{\partial f^{FDI}(r_d, I_h^{D,*}, I_d)}{\partial I_h} < 0,$$

where the second equality follows from the FOC condition for $I_h^{D,*}$: $\frac{\partial f^D(r_h, I_h^{D,*})}{\partial I_h} + k_h'(I_h^{D,*}) = 0$, and the sign follows from the assumption that $f^{FDI}(r_d, I_h, I_d)$ strictly decreases in I_h. The sign implies that $I_h^{D,*} < I_h^{FDI,*}$.

(ii) *We can write the difference in the fixed costs as*:

$$
\begin{aligned}
F^{FDI,*} - F^{D,*} &= \{F^{FDI,*} - F^{D}(r_h, I_h^{FDI,*})\} + \{F^{D}(r_h, I_h^{FDI,*}) - F^{D,*}\} \\
&= \{f^{FDI}(r_d, I_h^{FDI,*}, I_d^{FDI,*}) + k_d(I_d^{FDI,*})\} + \{F^{D}(r_h, I_h^{FDI,*}) - F^{D,*}\} \\
&> 0,
\end{aligned}
$$

where the second equality follows from the definition of F^D *and* F^{FDI}*, and* $\left\{F^{D}(r_h, I_h^{FDI,*}) - F^{D,*}\right\} > 0$ *follows from the definition of* $F^{D,*}$ *and the fact that* $I_h^{FDI,*} \neq I_h^{D,*}$.

(iii) *Taking the derivative of* $F^{FDI,*}$ *with respect to* r_d*, we have*:

$$
\begin{aligned}
\frac{dF^{FDI,*}}{dr_d} &= \frac{\partial f^{FDI}(r_d, I_h^{FDI,*}, I_d^{FDI,*})}{\partial r_d} \\
&\quad + \frac{\partial F^{FDI}(r_h, r_d, I_h^{FDI,*}, I_d^{FDI,*})}{\partial I_h} \frac{\partial I_h^{FDI,*}}{\partial r_d} + \frac{\partial F^{FDI}(r_h, r_d, I_h^{FDI,*}, I_d^{FDI,*})}{\partial I_d} \frac{\partial I_d^{FDI,*}}{\partial r_d}, \\
&= \frac{\partial f^{FDI}(r_d, I_h^{FDI,*}, I_d^{FDI,*})}{\partial r_d} > 0,
\end{aligned} \tag{29}
$$

where the second equality follows from the FOCs for $I_h^{FDI,*}$ *and* $I_d^{FDI,*}$ *in* (25) and (26)*, and the sign follows from the assumption that* $f^{FDI}(r_d, I_h, I_d)$ *strictly increases in* r_d.

(iv) *Similarly, we have*:

$$
\begin{aligned}
\frac{dF^{FDI,*}}{dr_h} &= \frac{\partial f^{D}(r_h, I_h^{FDI,*})}{\partial r_h} + \frac{\partial F^{FDI}(r_h, r_d, I_h^{FDI,*}, I_d^{FDI,*})}{\partial I_h} \frac{\partial I_h^{FDI,*}}{\partial r_h}, \\
&= \frac{\partial f^{D}(r_h, I_h^{FDI,*})}{\partial r_h} > 0,
\end{aligned} \tag{30}
$$

by the FOC for $I_h^{FDI,*}$ *in* (25) *and by the assumption that* $f^D(r_h, I_h)$ *strictly increases in* r_h. ■

First, note that firms will have a stronger incentive to invest in informal institutions when they engage in multinational production than when they produce only locally, because in the former case, the informal institutions can be used to help lower the overhead cost of both the headquarters operation at home and the production abroad. Second, multinational production sets a higher threshold than local production in terms of fixed costs. This helps explain the typical sorting of MNEs and local firms in terms of productivity. Third, poor state institutions discourage inward FDI by raising the total fixed cost of multinational production ($dF^{FDI,*}/dr_d > 0$). This is in spite of the fact that firms endogenously undertake heavier investment in informal institutions should they choose such locations. Finally, poor state institutions also impose an absolute disadvantage on firms based in the South; they incur a higher total fixed cost of multinational production than firms based in the North given the same choice of FDI destination ($dF^{FDI,*}/dr_h > 0$). This helps explain in part the dominance of MNEs from the North.

Proposition A.2.2. *(i) Multinational firms headquartered in countries with poorer institutions will invest more in informal institutions at home:* $\frac{\partial I_h^{FDI,*}(r_h, r_d)}{\partial r_h} > 0$. *As a corollary, multinational firms headquartered in countries with poorer institutions will be more effective at reducing their fixed overhead in a given FDI destination:* $\frac{df^{FDI}(r_d, I_h^{FDI,*}, I_d^{FDI,*})}{dr_h} < 0$. *(ii) Multinational firms undertaking FDI in countries with poorer institutions will also invest more in informal institutions:* $\frac{\partial I_h^{FDI,*}(r_h, r_d)}{\partial r_d} > 0$ *and* $\frac{\partial I_d^{FDI,*}(r_h, r_d)}{\partial r_d} > 0$.

Proof. (*i*) *By total differentiation of* (25) *with respect to* r_h *and* $I_h^{FDI,*}$*, we have*:

$$
\frac{\partial I_h^{FDI,*}}{\partial r_h} = -\frac{\frac{\partial^2 f^D(r_h, I_h^{FDI,*})}{\partial r_h \partial I_h}}{\frac{\partial^2 F^{FDI}}{\partial I_h^2}} > 0.
$$

The inequality follows because the numerator is negative by the assumption in (2); *and* $\frac{\partial^2 F^{FDI}}{\partial I_h^2} > 0$ *by the SOC for* $I_h^{FDI,*}$*. As a corollary,*

$$
\frac{df^{FDI}(r_d, I_h^{FDI,*}, I_d^{FDI,*})}{dr_h} = \frac{\partial f^{FDI}(r_d, I_h^{FDI,*}, I_d^{FDI,*})}{\partial I_h} \frac{\partial I_h^{FDI,*}}{\partial r_h} < 0
$$

by the assumption that $f^{FDI}(r_d, I_h, I_d)$ *decreases in* I_h *and the previous result* $\frac{\partial I_h^{FDI,*}}{\partial r_h} > 0$.

(ii) *By total differentiation of* (25) *with respect to* r_d *and* $I_h^{FDI,*}$*, we have*:

$$\frac{\partial I_h^{FDI,*}}{\partial r_d} = -\frac{\frac{\partial^2 f^{FDI}(r_d, I_h^{FDI,*}, I_d^{FDI,*})}{\partial r_d \partial I_h}}{\frac{\partial^2 F^{FDI}}{\partial I_h^2}} > 0.$$

The inequality follows because the numerator is negative by the assumption in (27); *and* $\frac{\partial^2 F^{FDI}}{\partial I_h^2} > 0$ *by the SOC for* $I_h^{FDI,*}$. *Similarly, by total differentiation of* (26) *with respect to* r_d *and* $I_d^{FDI,*}$, *we have*:

$$\frac{\partial I_d^{FDI,*}}{\partial r_d} = -\frac{\frac{\partial^2 f^{FDI}(r_d, I_h^{FDI,*}, I_d^{FDI,*})}{\partial r_d \partial I_d}}{\frac{\partial^2 F^{FDI}}{\partial I_d^2}} > 0.$$

The inequality follows because the numerator is negative by the assumption in (27); *and* $\frac{\partial^2 F^{FDI}}{\partial I_d^2} > 0$ *by the SOC for* $I_d^{FDI,*}$. ■

A firm's net profit from local production given the optimal choice of $I_h^{D,*}$ and net profit from FDI given the optimal choice of $I_h^{FDI,*}$ and $I_d^{FDI,*}$ are, respectively:

$$\Pi^{D,*} \equiv \pi^D - F^{D,*}(r_h) = B\widetilde{\phi}(w_h)^{1-\sigma} - F^{D,*}(r_h), \tag{31}$$

$$\Pi^{FDI,*} \equiv \pi^{FDI} - F^{FDI,*}(r_h, r_d) = B\widetilde{\phi}\left(w_h^{\eta} w_d^{1-\eta}\right)^{1-\sigma} - F^{FDI,*}(r_h, r_d). \tag{32}$$

Among possible destinations of FDI, firms take into account the lower wages but higher fixed costs associated with poorer institutions, and choose r_d that maximizes (32). The FOC for the optimal choice r_d^* requires that at r_d^*:

$$\frac{\partial \pi^{FDI}}{\partial w_d}\omega'(r_d) - \frac{\partial f^{FDI}(r_d, I_h^{FDI,*}, I_d^{FDI,*})}{\partial r_d} = 0, \tag{33}$$

where $\partial F^{FDI,*}(r_h, r_d)/\partial r_d = \partial f^{FDI}(r_d, I_h^{FDI,*}, I_d^{FDI,*})/\partial r_d$ by the envelope theorem.

Proposition A.2.3. *(i)* ***(Complementarity of Institutional Qualities in Firm-level Vertical FDI)*** *All else being equal, a firm will choose to undertake FDI in countries with poorer institutional qualities, the poorer the institutional quality at home is*: $\frac{\partial r_d^*}{\partial r_h} > 0$. *(ii) All else being equal, a firm will choose to undertake FDI in countries with poorer institutional qualities, the more productive the firm is*: $\frac{\partial r_d^*}{\partial \widetilde{\phi}} > 0$. *(iii) All else being equal, a firm will choose to undertake FDI in countries with poorer institutional qualities, the larger the world demand for the sector is*: $\frac{\partial r_d^*}{\partial B} > 0$. *(iv) All else being equal, a firm will choose to undertake FDI in countries with poorer institutional qualities, the less headquarters-intensive the sector is*: $\frac{\partial r_d^*}{\partial \eta} < 0$.

Proof. (*i*) *By totally differentiating* (33) *with respect to* r_d^* *and* r_h, *we obtain*:

$$\frac{\partial r_d^*}{\partial r_h} = -\frac{\frac{\partial^2 \pi^{FDI}}{\partial w_h \partial w_d}\omega'(r_h)\omega'(r_d) - \frac{\partial^2 f^{FDI}}{\partial r_d \partial I_h}\frac{\partial I_h^{FDI,*}(r_h, r_d)}{\partial r_h}}{\frac{\partial^2 \Pi^{FDI,*}}{\partial r_d^2}} > 0. \tag{34}$$

The inequality holds because: $\frac{\partial^2 \pi^{FDI}}{\partial w_h \partial w_d} > 0$ *by the Cobb-Douglas functional form of* π^{FDI}; $\frac{\partial^2 f^{FDI}}{\partial r_d \partial I_h} < 0$ *by the assumption in* (27); *and* $\frac{\partial^2 \Pi^{FDI,*}}{\partial r_d^2} < 0$ *by the SOC for* r_d^*.

(ii) *Similarly, by total differentiation of* (33) *with respect to* r_d^* *and* $\widetilde{\phi}$, *we have*:

$$\frac{\partial r_d^*}{\partial \widetilde{\phi}} = -\frac{\frac{\partial^2 \pi^{FDI}}{\partial \widetilde{\phi} \partial w_d}\omega'(r_d)}{\frac{\partial^2 \Pi^{FDI,*}}{\partial r_d^2}} > 0, \tag{35}$$

because $\frac{\partial^2 \pi^{FDI}}{\partial \widetilde{\phi} \partial w_d} = (1-\eta)(1-\sigma)\pi^{FDI}/(\widetilde{\phi} w_d) < 0$ *and* $\omega'(r) < 0$.

(iii) *It is straightforward to see that B has an analogous (positive) effect as* $\widetilde{\phi}$ *on* r_d^*, *because B and* $\widetilde{\phi}$ *enter* π^{FDI} *multiplicatively*.

(iv) *Finally, by similar derivations, we have*:

$$\frac{\partial r_d^*}{\partial \eta} = -\frac{\frac{\partial^2 \pi^{FDI}}{\partial \eta \partial w_d}\omega'(r_d)}{\frac{\partial^2 \Pi^{FDI,*}}{\partial r_d^2}} < 0,$$

where $\frac{\partial^2 \pi^{FDI}}{\partial \eta \partial w_d} = (1-\sigma)\left[(1-\eta)(1-\sigma)\ln\frac{w_h}{w_d} - 1\right]\pi^{FDI}/w_d > 0$, *since* $w_h > w_d$ *holds at the optimal choice of FDI destination (lower wages at the FDI destination are necessary to compensate for the higher fixed cost of FDI)*. ■

Institutional complementarity at the firm level in vertical FDI arises for two reasons. First, firms based in countries with poorer institutional qualities tend to be more heavily endowed with firm-specific informal institutions, which gives them a comparative advantage in conducting FDI

in destinations having poorer institutional qualities (since the adverse effect of weak institutions at the destination on fixed cost is reduced by the firm-specific institutional investment, and more so in destinations with poorer institutions). This is the key mechanism proposed by the paper. In addition, given the supermodularity between the headquarters and the intermediate component implied by the Cobb-Douglas production function, a lower wage at home (a lower-cost headquarters input) also increases the marginal benefit (increments in variable profits) of securing a lower-cost intermediate component. This second mechanism reinforces the main mechanism and strengthens the institutional complementarity effect on FDI location choice. The interpretations of (ii)–(iv) are similar to the benchmark model.

In the remaining part of this section, we discuss the implications if I_h and I_d are complementary in lowering fixed costs of FDI at the destination. In other words, suppose that:

$$\frac{\partial^2 f^{FDI}(r_d, I_h, I_d)}{\partial I_h \partial I_d} < 0. \tag{36}$$

In this case, $I_d^{FDI,*}$ is not determined by (26) alone, but is jointly determined with $I_h^{FDI,*}$ by (25) and (26). By total differentiation of (25) and (26) with respect to r_h, $I_h^{FDI,*}$, and $I_d^{FDI,*}$, we have:

$$\frac{\partial^2 f^{D}}{\partial r_h \partial I_h} dr_h + \frac{\partial^2 F^{FDI}}{\partial I_h^2} dI_h^{FDI,*} + \frac{\partial^2 f^{FDI}}{\partial I_d \partial I_h} dI_d^{FDI,*} = 0, \tag{37}$$

$$\frac{\partial^2 f^{FDI}}{\partial I_h \partial I_d} dI_h^{FDI,*} + \frac{\partial^2 F^{FDI}}{\partial I_d^2} dI_d^{FDI,*} = 0. \tag{38}$$

Substituting (38) in (37) and collecting terms, we obtain

$$\frac{\partial I_h^{FDI,*}}{\partial r_h} = -\frac{\frac{\partial^2 f^{D}}{\partial r_h \partial I_h}}{\frac{\partial^2 F^{FDI}}{\partial I_h^2} - \left(\frac{\partial^2 f^{FDI}}{\partial I_h \partial I_d}\right)^2 / \frac{\partial^2 F^{FDI}}{\partial I_d^2}} > 0, \tag{39}$$

which holds if the denominator is positive. In other words, it requires that

$$\left(\frac{\partial^2 f^{FDI}}{\partial I_h \partial I_d}\right)^2 < \frac{\partial^2 F^{FDI}}{\partial I_h^2} \frac{\partial^2 F^{FDI}}{\partial I_d^2}. \tag{40}$$

This is basically a stability condition on the system that the complementarity effect between I_h and I_d on f^{FDI} be sufficiently weak to ensure that the solutions to I_h and I_d are not explosive. As a corollary, we have:

$$\frac{\partial I_d^{FDI,*}}{\partial r_h} = \left\{ -\frac{\partial^2 f^{FDI}}{\partial I_h \partial I_d} / \frac{\partial^2 F^{FDI}}{\partial I_d^2} \right\} \frac{\partial I_h^{FDI,*}}{\partial r_h} > 0. \tag{41}$$

It follows that:

$$\frac{df^{FDI}(r_d, I_h^{FDI,*}, I_d^{FDI,*})}{dr_h} = \frac{\partial f^{FDI}(r_d, I_h^{FDI,*}, I_d^{FDI,*})}{\partial I_h} \frac{\partial I_h^{FDI,*}}{\partial r_h} + \frac{\partial f^{FDI}(r_d, I_h^{FDI,*}, I_d^{FDI,*})}{\partial I_d} \frac{\partial I_d^{FDI,*}}{\partial r_h} < 0.$$

In parallel to the analysis above, if we totally differentiate (25) and (26) with respect to r_d, $I_h^{FDI,*}$, and $I_d^{FDI,*}$, we have:

$$\frac{\partial^2 f^{FDI}}{\partial r_d \partial I_h} dr_d + \frac{\partial^2 F^{FDI}}{\partial I_h^2} dI_h^{FDI,*} + \frac{\partial^2 f^{FDI}}{\partial I_d \partial I_h} dI_d^{FDI,*} = 0, \tag{42}$$

$$\frac{\partial^2 f^{FDI}}{\partial r_d \partial I_d} dr_d + \frac{\partial^2 f^{FDI}}{\partial I_h \partial I_d} dI_h^{FDI,*} + \frac{\partial^2 F^{FDI}}{\partial I_d^2} dI_d^{FDI,*} = 0. \tag{43}$$

Substituting (43) in (42) and collecting terms, we obtain

$$\frac{\partial I_h^{FDI,*}}{\partial r_d} = -\frac{\frac{\partial^2 f^{FDI}}{\partial r_d \partial I_h} - \left(\frac{\partial^2 f^{FDI}}{\partial r_d \partial I_d} / \frac{\partial^2 F^{FDI}}{\partial I_d^2}\right) \frac{\partial^2 f^{FDI}}{\partial I_h \partial I_d}}{\frac{\partial^2 F^{FDI}}{\partial I_h^2} - \left(\frac{\partial^2 f^{FDI}}{\partial I_h \partial I_d} / \frac{\partial^2 F^{FDI}}{\partial I_d^2}\right) \frac{\partial^2 f^{FDI}}{\partial I_h \partial I_d}} > 0, \tag{44}$$

and

$$\frac{\partial I_d^{FDI,*}}{\partial r_d} = -\frac{\frac{\partial^2 f^{FDI}}{\partial r_d \partial I_h} - \left(\frac{\partial^2 f^{FDI}}{\partial r_d \partial I_d} / \frac{\partial^2 f^{FDI}}{\partial I_h \partial I_d}\right) \frac{\partial^2 F^{FDI}}{\partial I_h^2}}{\frac{\partial^2 f^{FDI}}{\partial I_h \partial I_d} - \left(\frac{\partial^2 F^{FDI}}{\partial I_d^2} / \frac{\partial^2 f^{FDI}}{\partial I_h \partial I_d}\right) \frac{\partial^2 F^{FDI}}{\partial I_h^2}} > 0, \tag{45}$$

where the signs hold under conditions (27), (36), and (40). Thus, Proposition A.2.2 continues to hold, with the effects reinforced in scenario (36).

Proposition A.2.3 continues to hold, with modifications to the Proof in part (i) such that:

$$\frac{\partial r_d^*}{\partial r_h} = -\frac{\frac{\partial^2 \pi^{FDI}}{\partial w_h \partial w_d} \omega'(r_h)\omega'(r_d) - \left\{ \frac{\partial^2 f^{FDI}}{\partial r_d \partial I_h} \frac{\partial I_h^{FDI,*}(r_h, r_d)}{\partial r_h} + \frac{\partial^2 f^{FDI}}{\partial r_d \partial I_d} \frac{\partial I_d^{FDI,*}(r_h, r_d)}{\partial r_h} \right\}}{\frac{\partial^2 \Pi^{FDI,*}}{\partial r_d^2}} > 0. \tag{46}$$

In summary, the overall mechanism is reinforced in scenario (36).

B. Data Appendix

B.1. Deflator used in the productivity estimation

Let $E_{c,t}$ indicate the exchange rate of country c in year t (in terms of local currency/USD), and let $deflator_{c,t} \equiv P_{c,t}/P_{c,2008}$ denote country c's local deflator relative to year 2008. The current values of revenues and other input expenditures (in USD) are converted to 2008 PPP dollars by $deflator\_2008\_ppp_{c,t} \equiv deflator_{c,t}/(E_{c,t}/E_{c,2008})$.

The local GDP deflators are retrieved from the World Bank World Development Indicators.[20] The exchange rates are based on Penn World Table version 9.1.[21] The deflator for Taiwan is separately sourced from its government website.[22]

B.2. Country-pair controls

The data on GDP per capita (in current US dollars) are also retrieved from the World Development Indicators. The GDP for Taiwan (in local currency) is sourced from the same government website as the deflator. The population of Taiwan is similarly sourced from its Statistical Bureau website.[23] The GDP for Taiwan is converted from local currency to US dollars (using the exchange rate from Penn World Table version 9.1 as noted above) and divided by its population to derive its GDP per capita (in current US dollars).

The bilateral trade cost proxies (and FDI barriers) $X_{hd,t-1}$ are compiled from several sources. The CEPII website provides the data on bilateral distance, and whether two countries are contiguous (*contig*), share a common language (*comlang*), have ever had a colonial link (*colony*), have had a common colonizer after 1945 (*comcol*), are currently in a colonial relationship (*curcol*) or were/are the same country (*smctry*). See Mayer and Zignago (2011) for further details.[24] The data on whether two countries are currently in a regional trade agreement (*rta*), and whether they use a common currency (*comcur*) are available from de Sousa's website (de Sousa, 2012).[25] Furthermore, the data on bilateral investment treaties are obtained from UNCTAD.[26] We construct a dummy variable that equals one if a BIT is currently in force between a country pair and zero otherwise, according to the date a BIT enters into force. We set the cutoff date to be July 1st of the current year in defining the year-varying dummy *bit*.

The capital-labor ratio is constructed as the ratio of capital stock at current PPP (in million 2011 USD) and employment (in millions), both of which are obtained from Penn World Table version 9.1.

The index of industrial structure similarity between two countries is constructed as $indsim_{hdt} = 1 - \sqrt{\sum_{j=1}^{J}(va_{ht,j} - va_{dt,j})^2}/J$, where $va_{ht,j}$ is the value added of sector j in year t, as a percentage of GDP of country h, and similarly defined for $va_{dt,j}$. Data on industrial value added are obtained from the World Development Indicators, and are available for four distinct sectors: agriculture (ISIC divisions 1–5); manufacturing industry (ISIC divisions 15–37); non-manufacturing industry (ISIC divisions 10–14 and 38–45, including mining, construction, electricity, water, and gas); and services (ISIC divisions 50–99).

The religion similarity index is constructed based on the religion dataset of Maoz and Henderson (2013). The index follows Maoz and Henderson (2013) and measures the similarity of religious compositions between two countries as $relsim_{hdt} = 1 - \sqrt{\sum_{r=1}^{R}(ra_{ht,r} - ra_{dt,r})^2}/R$, where $ra_{ht,r}$ is the proportion of population in country h in year t adhering to religion r and similarly defined for $ra_{dt,r}$. We use the top four religion categories: Christianity, Judaism, Islam and Buddhism in calculating the index. The data are available for the period 1945–2010 in five-year intervals. We use the 2005 data for years 2005–2009, and the 2010 data for years 2010–2015.

C. Online Appendix

The Online Appendix to this article can be found online at https://doi.org/10.1016/j.jdeveco.2020.102566.

References

Acemoglu, D., Johnson, S., 2005. Unbundling institutions. J. Polit. Econ. 113, 949–995.

Ackerberg, D.A., Caves, K., Frazer, G., 2015. Identification properties of recent production function estimators. Econometrica 83 (6), 2411–2451.

Alfaro, L., Charlton, A., 2009. Intra-industry foreign direct investment. Am. Econ. Rev. 99 (5), 2096–2119.

Antràs, P., Helpman, E., 2004. Global sourcing. J. Polit. Econ. 112 (3), 552–580.

Bai, C.-E., Hsieh, C.-T., Song, Z.M., , 2014. Crony capitalism with Chinese characteristics. Tsinghua University and University of Chicago.

Bénassy-Quéré, A., Coupet, M., Mayer, T., 2007. Institutional determinants of foreign direct investment. World Econ. 30 (5), 764–782.

Cai, H., Fang, H., Xu, L.C., 2011. Eat, drink, firms, government: an investigation of corruption from the entertainment and travel costs of Chinese firms. J. Law Econ. 54, 55–78.

Castellani, D., Lavoratori, K., 2017. Location of R&D abroad: An analysis on global cities. John H Dunning Centre for International Business Discussion Papers jhd-dp2017-03, Henley Business School, Reading University.

Cezar, R., Escobar, O., 2015. Institutional distance and foreign direct investment. Rev. World Econ. 151 (4), 713–733.

Chan, K.S., Xu, X., Gao, Y., 2015. The China growth miracle: the role of the formal and the informal institutions. World Econ. 38, 63–90.

Chan, J.M., Zheng, H., 2017. Migrant networks, greenfield FDI, and cross-border mergers and acquisitions. (manuscript).

Chang, P.-L., Lu, C.-H., 2012. Risk and the technology content of FDI: a dynamic model. J. Int. Econ. 86, 306–317.

Che, Y., Du, J., Lu, Y., Tao, Z., 2017. Institutional difference and FDI location choice: Evidence from China. MPRA Paper No. 77158.

Chen, C.J., Li, Z., Su, X., Sun, Z., 2011. Rent-seeking incentives, corporate political connections, and the control structure of private firms: Chinese evidence. J. Corp. Finance 17, 229–243.

Cuervo-Cazurra, A., Genc, M., 2008. Transforming disadvantages into advantages: developing-country MNEs in the least developed countries. J. Int. Bus. Stud. 39 (6), 957–979.

Darby, J., Desbordes, R., Wooton, I., 2010. Does public governance always matter? How experience of poor institutional quality influences FDI to the South. Cesifo Working Paper No. 3290.

[20] http://data.worldbank.org/data-catalog/world-development-indicators.

[21] https://www.rug.nl/ggdc/productivity/pwt/.

[22] https://eng.stat.gov.tw/ct.asp?xItem=37408&CtNode=5347&mp=5.

[23] https://www1.stat.gov.tw/ct.asp?xItem=15408&CtNode=4692&mp=3.

[24] http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=6.

[25] http://jdesousa.univ.free.fr/data.htm.

[26] https://investmentpolicy.unctad.org/international-investment-agreements.

de Sousa, J., 2012. The currency union effect on trade is decreasing over time. Econ. Lett. 117, 917–920.
Desbordes, R., Wei, S.-J., 2017. The effects of financial development on foreign direct investment. J. Dev. Econ. 127, 153–168.
Dixit, A., 2012. Governance, Development, and Foreign Direct Investment. Max Weber Lecture Series 2012/01.
Faccio, M., 2006. Politically connected firms. Am. Econ. Rev. 96 (1), 369–386.
Fajgelbaum, P., Grossman, G.M., Helpman, E., 2015. A Linder hypothesis for foreign direct investment. Rev. Econ. Stud. 82, 83–121.
Fisman, R., 2001. Estimating the value of political connections. Am. Econ. Rev. 91 (4), 1095–1102.
Frye, T., Zhuravskaia, E., 2000. Rackets, regulations and the rule of law. J. Law Econ. Organ. 16, 478–502.
Gandhi, A., Navarro, S., Rivers, D., 2017. How heterogeneous is productivity? A comparison of gross output and value added. University of Pennsylvania.
Habib, M., Zurawicki, L., 2002. Corruption and foreign direct investment. J. Int. Bus. Stud. 33 (2), 291–307.
Hay, J.R., Shleifer, A., 1998. Private enforcement of public laws: a theory of legal reform. Am. Econ. Rev. 88 (2), 398–403.
Hellman, J.S., Jones, G., Kaufmann, D., 2003. Seize the state, seize the day: state capture and influence in transition economies. J. Comp. Econ. 31, 751–773.
Helmke, G., Levitsky, S., 2004. Informal institutions and comparative politics: a research agenda. Perspect. Polit. 2 (4), 725–740.
Kalemli-Ozcan, S., Sorensen, B., Villegas-Sanchez, C., Volosovych, V., Yesiltas, S., 2015. How to construct nationally representative firm level data from the ORBIS global database. NBER Working Paper No. 21558.
Kaufmann, D., Kraay, A., Mastruzzi, M., 2010. The worldwide governance indicators: Methodology and analytical issues. The World Bank Policy Research Working Paper 5430.
Levinsohn, J., Petrin, A., 2003. Estimating production functions using inputs to control for unobservables. Rev. Econ. Stud. 70 (2), 317–341.
Li, H., Meng, L., Zhang, J., 2006. Why do entrepreneurs enter politics? Evidence from China. Econ. Inq. 44 (3), 559–578.
Maoz, Z., Henderson, E.A., 2013. The world religion dataset, 1945–2010: logic, estimates, and trends. Int. Interact. 39 (3), 265–291.
Mayer, T., Zignago, S., 2011. Notes on CEPII's distances measures: The GeoDist database. CEPII Working Paper 2011-25.
McMillan, J., Woodruff, C., 1999a. Disputes prevention without courts in Vietnam. J. Law Econ. Organ. 15 (3), 637–658.
McMillan, J., Woodruff, C., 1999b. Interfirm relationships and informal credit in Vietnam. Q. J. Econ. 114 (4), 1285–1320.
McMillan, J., Woodruff, C., 2002. The central role of entrepreneurs in transition economies. J. Econ. Perspect. 16, 153–170.
MIGA, 2011. World Investment and Political Risk. The World Bank, Washington DC.
Morck, R., Yeung, B., Zhao, M., 2008. Perspectives on China's outward foreign direct investment. J. Int. Bus. Stud. 39, 337–350.
Nunn, N., 2007. Relationship-specificity, incomplete contracts, and the pattern of trade. Q. J. Econ. 122 (2), 569–600.
Olley, G.S., Pakes, A., 1996. The dynamics of productivity in the telecommunications equipment industry. Econometrica 64 (6), 1263–1297.
Paniagua, J., Korzynski, P., Mas-Tur, A., 2017. Crossing borders with social media: online social networking and FDI. Eur. Manag. J. 35 (3), 314–326.
Rovigatti, G., Mollisi, V., 2018. Theory and practice of total-factor productivity estimation: the control function approach using Stata. STATA J. 18 (3), 618–662.
Seyoum, B., 2011. Informal institutions and foreign direct investment. J. Econ. Issues 45 (4), 917–940.
UNCTAD, 2014. World Investment Report 2014: Investing in the SDGs: an Action Plan. United Nations, New York and Geneva.
Van Beveren, I., 2012. Total factor productivity estimation: a practical review. J. Econ. Surv. 26 (1), 98–128.
Williamson, O.E., 2000. The new institutional economics: Taking stock, looking ahead. J. Econ. Lit. 38 (3), 595–613.
Wooldridge, J.M., 2009. On estimating firm-level production functions using proxy variables to control for unobservables. Econ. Lett. 104 (3), 112–114.