Greenfield or Brownfield?
FDI Entry Mode and Intangible Capital

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Abstract

When a multinational firm invests abroad, it can either establish a new facility (greenfield investment, GF) or purchase a local firm (cross-border merger and acquisition, M&A). Using a novel US firm-level dataset, I provide the first evidence that multinationals with higher levels of intangible capital systematically invest through GF rather than through M&A. Motivated by this empirical result, I develop a general equilibrium search model of a multinational firm's choice between M&A and GF. The model implies that equilibrium FDI patterns can be suboptimal. In particular, since the gap between the productivities of multinationals and local firms is larger in less developed countries, policymakers there can increase welfare by incentivizing FDI through M&A. By allowing highly productive multinationals to use local intangible capital, this policy increases aggregate productivity more than the laissez-faire outcome.

Keywords: FDI, Cross-border M&A, Greenfield FDI, Intangible capital

JEL Classification: F14, F21, F23

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1 Introduction

Multinationals and their foreign affiliates generated one-third of global GDP and accounted for two-thirds of international trade.[1] In light of their economic importance, governments have offered subsidies and tax incentives to attract multinationals' foreign direct investment (FDI). Host countries can receive two types of FDI—one is *greenfield investment* (the development of new facilities by foreign multinationals), and the other is *brownfield investment*, also called *cross-border mergers and acquisitions* (the purchase of local firms by foreign multinationals). In recent years, there have been over twice as many greenfield investments (GF) as cross-border mergers and acquisitions (M&A), whereas the total values of these transactions are virtually the same (UNCTAD, 2019). Although both modes of investment are economically important, policymakers assume that new facilities create more jobs than acquisitions of existing facilities, and therefore almost all investment promotion agencies encourage GF rather than M&A (Caves, 2007).[2] Given that FDI policies focus on promoting GF investment, it is of first-order policy importance to understand how multinational firms decide whether to pursue a GF or M&A investment. Moreover, the current literature does not provide a rigorous framework to analyze this choice and its welfare consequences for host countries. To fill this gap, I examine the determinants of FDI mode (i.e., GF or M&A) and the policy implications of these decisions. In particular, I investigate two related questions: (1) how do firms choose between the two FDI entry modes, and (2) how does the firm's choice of FDI mode affect the local economy?

I start with the premise that the key difference between GF and M&A is the role of intangible capital, such as a firm's brand name, intellectual property, and supplier network. One of the defining characteristics of intangible capital is its non-rivalry in use (Crouzet et al., 2022). That is, unlike physical capital, intangible capital can be used in multiple locations simultaneously. Because of this characteristic, intangible capital plays an important role in FDI (Markusen, 1995; Burstein and Monge-Naranjo, 2009; McGrattan and Prescott, 2009, 2010). If investing firms intensively use their own intangible capital, they are also likely to use those intangibles in foreign markets, thus relying less on M&A and more on GF. For example, multinational firms such as Walmart with established global brands—a type of

[1] This information comes from the OECD analytical AMNE database in 2016. I refer to the VOX EU CEPR column, "Multinational enterprises in the global economy: Heavily discussed, hardly measured," published on September 25, 2019.

[2] For example, in the survey for the OECD and Latin America and the Caribbean countries, around 80% of agencies target GF, while around 5% of them target M&A (Inter-American Development Bank, 2019). In the survey for the OECD countries, none of the countries target M&A (OECD, 2018)

intangible capital—will likely pursue GF investments (DePamphilis, 2019). Firms that do not have well-known brands or reputations will seek instead to acquire local brands.

To test this hypothesis, I empirically analyze how the amount of intangible capital affects a firm's choice of FDI mode. I construct a novel US firm-level dataset using financial information on US publicly listed firms (Compustat), data on GF projects (fDi Market), and the universe of M&A deals (SDC Platinum). I measure the amount of firm's intangible capital following Peters and Taylor (2017) and Ewens et al. (2020). Although my data focus only on publicly listed firms, this new dataset covers approximately 60% of US multinational firms.

Using the data, I show that firms with less intangible capital are more likely to choose M&A rather than GF. This result is consistent with the above hypothesis: Firms with low pre-FDI stocks of intangible capital benefit more from the extra intangible capital gained through M&A. My data also reveal the fact that firm heterogeneity matters most in firms' FDI mode decisions, compared to country and industry variation. Further, I find that firms are less likely to make M&A investments if geographic, linguistic, or institutional barriers are larger (i.e., if a host country is more distant, has a different language, or is has tighter FDI restrictions). This can reflect the fact that barriers to searching for local partners matter when multinationals make M&A.

Motivated by these empirical facts, I develop a general equilibrium search model of a firm's FDI mode choice, building on Nocke and Yeaple (2007, 2008). Expanding on prior studies of domestic M&A markets (Rhodes-Kropf and Robinson, 2008; David, 2021), I develop a model in which a multinational's intangible assets play a key role in determining whether the firm pursues M&A or GF, while search frictions can deter multinationals from searching for an M&A partner.

In my model, a multinational firm searches for a partner and chooses M&A if it matches with a local target firm; otherwise, it invests via GF. A multinational's production technology in the host country has two components: its productivity (TFP) and intangible capital. Both components of the production technology are transferable across countries, and the complementarity between these two technologies generates a trade-off in the multinational's M&A decision. In particular, if a multinational firm invests via M&A, it cannot use all of its own intangible capital at its new foreign affiliate, but obtains additional intangible capital from the acquired local firm and upgrades the acquired firm's intangibles by leveraging its higher productivity. The investing firm's optimal search effort depends on the attractiveness of M&A. The attractiveness of M&A, in turn, depends on the expected return from acquiring intangible capital, which is decreasing in the firm's own intangible capital stock.

I assume that multinationals are heterogeneous in intangible capital but have a uniform productivity, which exceeds the productivity of local firms. Because of this Melitz-type (2003) structure, there is a cutoff level of intangible capital below which multinationals prefer to invest via M&A. The model implies that multinationals with higher levels of intangible capital are more likely to invest through GF, consistent with my empirical results. The model also implies that multinationals are more likely to choose M&A if there are more firms (i.e., potential M&A partners) in the host country and if local firms have more intangible capital on average. My data on US multinationals support these predictions.

I also investigate if the market equilibrium is efficient by considering the social planner's constrained problem. I find that the equilibrium FDI pattern (i.e., the amount of M&A or GF investment that a local economy receives) can be suboptimal because of search externalities. Therefore, there could be room for the local government to improve welfare using FDI policies that incentivize one entry type over the other. To examine this possibility, I calibrate the parameters of the model and conduct counterfactual experiments. The optimal policy response differs between developed (i.e., the North) and developing countries (i.e., the South). Welfare in the North benefits more from GF than M&A, while the South would benefit from more M&A investment than they receive in equilibrium. Since the gap between the productivities of multinationals and local firms is larger in the South, policymakers there can increase welfare by incentivizing FDI through M&A. By allowing highly productive multinationals to use local intangible capital, this policy increases aggregate productivity more than the laissez-faire outcome. In counterfactual analyses, I evaluate the effect of subsidies on GF investments in the North and the effect of a tax on the profits of GF multinationals in the South. My findings suggest that if policymakers in the South seek to increase local welfare, they should restrict GF investments. By contrast, in the North, local welfare increases as a result of promoting GF investments.

Related Literature This paper is primarily related to the literature on foreign market entry. For example, Helpman et al. (2004) develop a model with heterogeneous firms that self-select into exporting or investing abroad. Recent literature such as Ramondo and Rodríguez-Clare (2013) and Tintelnot (2017), extends Helpman's framework and allows foreign affiliates to export. Unlike these studies, which consider firms' exporting and FDI decisions, my research focuses on the firm's FDI mode choice—i.e., whether a multinational chooses GF or cross-border M&A when it makes FDI. While there are fewer studies on FDI mode choice compared with the extensive literature on FDI and exporting, the studies most relevant to my research are by Nocke and Yeaple (2007, 2008). They extend Helpman et al. (2004) by incorporating cross-border M&A and show that firm do not perceive two modes of FDI as perfect substitute. My paper contributes to this literature in three ways. First, I provide a comprehensive empirical analysis with a larger and more up-to-date dataset than Nocke and Yeaple (2008). Second, I construct an equilibrium search model of mergers that is consistent with salient empirical features from the data. And third, I quantitatively assess the model to analyze the welfare implications of equilibrium FDI patterns for host countries. This allows me to showcase a potential inefficiency in the laissez-faire equilibrium and propose a policy to address it.

This paper also relates to other studies on firm FDI mode choice. For example, Davies et al. (2018) use global transaction-level data and show that geographical and cultural barriers affect firms' FDI mode decisions. Díez and Spearot (2014) focus on the matching of core competencies between acquirer and target firms, and Chan and Zheng (2019) consider the effect of migrant networks on firms' investment decisions. Unlike these studies, my dataset incorporates US firm financial data, which allows me to explore how firm-level heterogeneity drives FDI mode decisions.[3] Similarly, my research builds on a theoretical literature that aims to predict how FDI mode choice affects welfare (Norbäck and Persson, 2007; Kim, 2009; Bertrand et al., 2012). This paper complements those studies by focusing on intangible capital stock as a key determinant of FDI modes.

In terms of the role of intangible capital in FDI, this paper relates to a broader literature that examines knowledge transfer and firm boundaries. Firm's knowledge and technology (i.e., intangible capital in this paper) can be shared across countries through FDI (Teece 1977; Dunning, 1981; Burstein and Monge-Naranjo, 2009; McGrattan and Prescott, 2010; Bloom et al., 2012; Arkolakis et al., 2018; Bilir and Morales, 2020). In particular, Burstein and Monge-Naranjo (2009) study knowledge transfer from developed to developing countries via FDI and quantify the potential welfare gains by loosening foreign ownership restrictions. I contribute to this research by considering the differences between FDI modes, and find that M&A can increase welfare in developing countries because multinationals can improve local firms' productivity through M&As. Another relevant study is by Ramondo et al. (2016), who show that few foreign affiliates engaged in trade with their parent firms.[4] This empirical study supports the fact that multinational firms transfer intangible capital to their affiliates

[3] Other studies on firm's FDI mode choice focus on two GF ownership choices, whole ownership or a joint venture (Raff et al., 2012); vertical and horizontal FDI (Ramondo, 2016); and the impact of the FDI mode on total factor productivity in developed and developing countries (Ashraf et al., 2016).

[4] Atalay et al. (2014) also demonstrate that firms engage in intangible capital transfer rather than intra-firm trade using data on US multi-plant firms.

rather than tangible goods.

Finally, this paper contributes to the corporate finance and macroeconomic literature on intangible capital. Researchers have documented that firms have become more intangible capital-intensive in recent years, especially in developed economies. For example, since 1992, US firms have invested more in intangible capital than they have in physical capital (Corrado and Hulten, 2010). Following Peter and Taylor (2017) and Ewens et al. (2020), I use the Compustat database to measure the amount of intangible capital of US firms. To my best knowledge, this is the first empirical analysis of the relationship between firms' FDI and intangible capital. I show that intangible capital is one of the important factors for firm's FDI mode choice, which provides additional insights into intangible capital.

The outline of the paper is as follows. I describe the data I use in Section 2, report the empirical evidence in Section 3, and present the model in Section 4. I test model implications in Section 5 and present counterfactual analyses using calibrated parameters in Section 6. I conclude in Section 7.

2 Data

I construct a novel dataset that links US firms' FDI deals and their financial characteristics between 2003 and 2018. I use three data sources: greenfield investment projects (fDi Market), cross-border M&A deals (SDC Platinum), and US firms' financial information (Compustat). I also employ data that describe host country characteristics such as distance and GDP per capita. In this section, I introduce each of the data sources and provide a brief explanation of how to merge these three data sources. I then show how I organize the merged data for subsequent regression analyses. Appendix A provides further details of the data.

2.1 Data Sources

(i) Greenfield Investment Projects: The greenfield investment data come from the fDi Markets database published by the Financial Times Ltd. This database is considered to be one of the main data sources of global greenfield projects, and it is used in UNCTAD's World Investment Reports. The database provides information about all cross-border physical investments in new projects, expansion of existing projects, and joint ventures, since 2003. In this paper, I focus exclusively on new investment projects made by US parent companies (that is, companies with headquarters in the US).[5] The most useful feature of this dataset is that the industry classification represents the specific operations of the new establishment.[6] By merging with Compustat, which provides the parent firm's main industry classification, I can identify whether the firm made intra- or inter-industry FDI.

(ii) Cross-border M&A Deals: My cross-border M&A data come from SDC Platinum, produced by Thomson Reuters. This database covers both domestic and cross-border M&A deals globally. I extract all cross-border projects involving US acquiring (parent) firms. I restrict my attention to deals involving acquisitions of more than 10% ownership. The 10% cutoff is common in most FDI studies to determine whether an acquiring firm has control over its target firm.[7] In addition, I delete deals involving investment funds such as hedge funds and sovereign wealth funds because these acquisitions are conducted based on speculative activities, not on seeking a new business in foreign markets.

(iii) US Firms' Financial Information: I use the Compustat database to measure the intangible capital stocks, sales, value-added per worker, and other financial characteristics of publicly-listed US firms between 1980 and 2018. I measure US firms' intangible capital following the methodology of Peter and Taylor (2017) and Ewens et al. (2020) who also estimate the intangible capital stocks among firms in the Compustat database.[8] Intangible capital created by an investing firm is defined as the sum of its *knowledge capital* and its *organizational capital*. Knowledge capital is any capital stock pertaining to R&D, while organizational capital includes human capital, branding, customer relationships, and distribution

[5]Unlike the SDC Platinum (the database of cross-border M&As), I can sort only by headquarter location of parent firms (not the locations of investing firms) in the fDi Market database. I do not use the data for the expansion of existing projects and joint ventures. The expansion and joint ventures account for around 10% and less than 1% of the investment made by US firms, respectively.

[6]That means the classification in the fDi market database is not about the investing firm's primary business. For example, if a firm establishes its new research center in the IT software industry, the industry sector of this project is classified as Software & IT Services, regardless of what kind of primary business the firm operates.

[7]For example, the Bureau of Economic Analysis (BEA) defines foreign affiliates as overseas business entities that are established by US direct investment and in which US firms own or control 10% or more of the voting shares. Most acquirers obtain more than 10% ownership. Acquisitions with less than 10% ownership consist of only 3% of the total deals in my dataset.

[8]There are two types of intangible capital, internally generated intangible capital and externally generated intangible capital. Recall that internally generated intangible capital refers to assets that the firm creates itself through R&D and SG&A spending. Externally generated intangible capital refers to assets the firm acquires by purchasing another firm. The Compustat data records intangible assets, but these only include externally generated intangible capital (Corrado et al., 2022). In this paper, I focus on internally generated intangible capital, which reflects actual investment in intangible assets without the markups that accompany firm acquisitions (i.e., goodwill).

systems. I assume that a firm accumulates knowledge capital through R&D spending, and that organizational capital is accumulated through a part of selling, general, and administrative (SG&A) spending. Following Peter and Taylor (2017), I assume that organizational capital has a 20% depreciation rate. The multiplier of SG&A spending and the depreciation rate for R&D spending are from Ewens, et al. (2020), and both vary across industries. On average, 27% of SG&A spending is used to form organizational capital, and the knowledge capital depreciation rate is 33%.[9] These depreciation rates of intangible capital are higher than the depreciation rate of physical capital. Intangible capital adjusts slowly compared with physical capital, which makes purchasing already-accumulated capital stock attractive. In addition to intangible capital, I obtain sales and value-added per worker to consider a firm's size and productivity.[10]

(iv) Information of Host Countries: I include variables describing host country characteristics in my regression analyses. I measure the level of development using GDP per capita (GDPPC) and the market size using population. These two variables are from the Penn World Table. I also measure the level of openness to trade using the ratio of the sum of exports and imports to GDP. These data come from the World Bank Database. The CEPII database gives the following information: distances from the US to host countries and whether English is the official language in a host country (i.e., if a host country shares a common language with the US). I also obtain the FDI Regulatory Restrictiveness Index from the OECD database.[11]

I obtain the number of local firms and intangible capital stocks in host countries from the OECD database and the EUKLEMS & INTANProd database. These datasets are only available for a subset of countries and industries but are still useful for considering how the characteristics of local firms in host countries affect multinationals' FDI mode choices.[12]

[9] My empirical results are robust to using alternative calculations of intangible capital with different depreciation rates and multipliers for SG&A spending. Alternate parameters are 20% or 40% for the SG&A multiplier, 15% or 25% for the depreciation rate of organizational capital, and 20% or 40% for the depreciation rate of knowledge capital.

[10] I refer to İmrohoroğlu and Şelale (2014) to construct value-added per worker.

[11] The FDI regulatory restrictiveness index measures institutional restrictions on FDI. The OECD looks at the following restrictions to create the index: foreign equity limitations, discriminatory screening or approval mechanisms, restrictions on the employment of foreigners as key personnel, and other operational restrictions including land ownership. The index ranges from 0 (open) to 1 (closed).

[12] In the SDBS Structural Business Statistics database, the OECD reports the number of firms in 45 countries by ISIC Rev.4 industry classification. In the EUKLEMS & INTANProd database, I observe the total intangible capital stocks of 30 countries by NACE Rev.2 industry classification.

2.2 Merging the Firm Datasets

I merge both (i) greenfield investment projects (fDi Market) and (ii) cross-border M&A deals (SDC Platinum) with (iii) US-listed firms' financial information (Compustat). I implement the data merging process in two steps. First, I exploit CUSIP (Committee on Uniform Security Identification Procedures) codes, which SDC Platinum reports for publicly-listed firms. I match 60% of publicly-listed ultimate acquires with Compustat firms. Next, for the remaining 40% of the firms in SDC Platinum and all firms in fDi Market, I matched them with Compustat firms using company names and headquarters states. I also check firms that changed their names manually using the internet.

There are 2,645 Compustat firms in my final data. During the sample period (from 2003 to 2018), 693 firms made only GF investments, while 784 firms made only cross-border M&As. 1,168 firms made investments using both FDI modes. In SDC Platinum, I match around 92% of deals made by publicly-listed ultimate acquirers with Compustat firms.[13] According to the BEA data, there are around 4,500 US multinational parents in 2014, and thus my dataset covers roughly 60% of US multinational parents.[14]

I aggregate firms' investments by firm-industry-destination to run regressions. For firms that made more than one investment in the same industry and destination country, I extract the first FDI from the merged data.[15] I focus on a firm's first investment in a given industry-by-destination because my research question concerns market entry, not additional investments in existing subsidiaries. Additionally, a firm's first entry mode correlates strongly with its entry mode in any subsequent FDI deal. For example, Table A.2 shows that 84% of firms that made a GF investment in their first entry in a particular industry and country, also made GF investments in their subsequent FDIs in the same industry and country.

In Table 1, I compare my data to the BEA data (i.e., confidential data of all US multinationals) in Nocke and Yeaple (2008).[16] Unlike my data spanning 2003-2018, Nocke and Yeaple (2008) use data from 1994-1998. Notably, although my data contains only publicly listed firms, my data is similar to Nocke and Yeaple's, especially with the share of M&A investment and country variables, but I have more observations. In addition, my data cover

[13] I do not identify which firms are publicly-listed in the fDi Market database, and therefore I cannot measure the matching rate for GF investing firms.

[14] According to the BEA's benchmark survey of US direct investment abroad, there are 2,541 (in 2004), 2,340 (in 2009), and 4,541 (in 2014) multinationals.

[15] There is more than one investment in 27% of firm-industry-country cells.

[16] I aggregate the data in a slightly different way from Nocke and Yeaple (2008). For firms with more than one investment in a particular industry and country, Nocke and Yeaple (2008) consider firms that made M&As if and only if all investments made during the data period are through M&As.

Table 1: Summary Statistics

	My data				Nocke & Yeaple	
	All industries		Manufacturing only			
Variable	mean	s.d.	mean	s.d.	mean	s.d.
M&A	0.414	0.493	0.415	0.493	0.435	0.496
Intangibles	20.541	2.127	20.760	2.068	-	-
Sales	21.826	2.287	22.038	2.223	15.37	1.61
Value-added per worker	4.562	0.6981	4.572	0.605	4.45	0.523
Distance	8.769	0.814	8.809	0.776	8.72	0.69
Common language	0.377	0.485	0.344	0.475	-	-
GDPPC	10.053	0.838	10.018	0.849	9.81	0.723
Population	17.613	1.645	17.705	1.680	16.7	1.38
Openness	4.263	0.558	4.260	0.554	3.94	0.648
FDI restrictiveness	0.123	0.118	0.135	0.123	-	-
Number of obs	16,062		8,976		856	

[a] Nocke and Yeaple's data is from 1994 to 1998. I deflate the mean of sales in Nocke and Yeaple using the CPI for all urban consumers (FRED series CPIAUCSL).

[b] All continuous variables, except the FDI index, are in logs. The unit of distance is a kilometer, and other monetary values, such as intangible capital and sales, are in USD.

[c] M&A is equal to one if the firm made an M&A investment.

[d] The summary statistics for the number of local firms and local intangible capital stock is in Table A.1.

FDI activities in the service industry, and interestingly share of M&A investment is similar both in the manufacturing and service industries.

My final data show that 2,645 US-listed firms invested in 153 countries; the five major FDI destinations are the UK, Canada, China, Germany, and India (Table A.3). China and India attract more GF investments, while the other three destinations are major locations of cross-border M&A. US multinationals invest in multiple industrial sectors; the main investing industries are information and software, computer and electronic product, chemical products, professional and technical services, and machinery.[17] For around half of FDI, the main industry of a US multinational is different from the industry of its new foreign affiliate (i.e., inter-industry FDI).[18]

Moreover, I observe the costs associated with FDI (the amount of capital invested for GF

[17] The corresponding three-digit NAICS codes are 511, 334, 325, 541, 333.

[18] Inter-industry investment accounts for 56% of total FDI. This share is almost the same both in GF and M&A FDI, but relatively more M&A firms (63% of total M&A firms) invest in an industry other than their own industry compared to GF firms (51% of total GF firms).

firms and the acquisition prices for M&A firms) in my datasets.[19] The average GF investment is worth \$60 million, while that of M&A is \$252 million. The average M&A investment is actually worth more than the average GF investment, for any size of firm (Appendix A.7). This pattern reflects the fact that firms need to spend more to acquire existing firms than to establish their own firms via GF because the existing entities have intangible capital in addition to physical assets.

3 Empirical Evidence of FDI Entry Modes

My unique and extensive dataset reveals the three facts on firms' FDI mode choice. These three empirical findings guide the model to be introduced in the subsequent section.

3.1 Fact 1: FDI mode decisions are mainly driven by firm heterogeneity.

My data provide information on GF investments and cross-border M&A deals undertaken by US-listed firms, including descriptions of the industries and countries involved in the transactions. These unique data allow me to analyze the extent to which three different sources of variation—firm-level heterogeneity, cross-industry variation, and cross-country variation—drive GF and M&A investment decisions. I investigate which of these factors matters most when a firm decides which FDI mode it chooses.

Several studies conduct empirical analyses on firms' investment mode decisions and arrive at different conclusions about the relative importance of firm, industry, and country variation in driving decisions over FDI mode. For example, Nocke and Yeaple (2008) focus on firm efficiency and show that more efficient firms choose GF investments, while Davies et al. (2018) focus on the characteristics of host countries and conclude that firms are less likely to choose M&A investments when they invest in distant countries with larger cultural differences. Industry characteristics likely matter as well, and in fact, more M&A investment occurs in intangible-intensive industries such as beverages and medical devices (World Bank, 2018). All factors seem important, and we do not know so much about which factor plays the biggest role when firms decide which investment mode to pursue.

[19] Acquisition prices are available for 43% of M&A deals in my data. I observe the value of capital invested in almost all GF investments, however 84% of the GF capital investment data reflect estimates provided by the Financial Times. Even though the data are estimated, they still represent the most comprehensive and accurate data on GF investments.

Table 2: Sources of Variation in Firm FDI Mode Decisions

	Single fixed effects			Pairwise fixed effects		
	Firm$_i$	Country$_h$	Industry$_j$	Firm-country$_{ih}$	Firm-ind$_{ij}$	Country-ind$_{hj}$
Direct effect						
	0.273	0.210	0.144	0.357	0.467	0.327
Partial determination						
	0.212	0.135	0.147	0.359	0.417	0.270

The unit of observation is a firm-FDI deal. The first panel (direct effect) shows adjusted R^2 values from regressions of whether the deal involves M&A on the fixed effects given in each column. For example, I regress MA_{ihjt} on firm fixed effects, α_i and record the adjusted R_i^2 for the first column. The second panel (partial determination) shows the share of variation each of the fixed effects explains compared to the variation explained by the other fixed effects specification. For example, in the first column, I regress MA_{ihjt} on firm fixed effects, α_i, and country-industry fixed effects, α_{hj}, and keep the adjusted R^2, $R^2_{i,hj}$. I then regress MA_{ihjt} only using country-industry fixed effects, α_{hj}, and keep the adjusted R^2, R^2_{hj}. I then get the partial contribution of firm variation by calculating $(R^2_{i,hj} - R^2_{hj})/(1 - R^2_{hj})$.

To empirically investigate this question, I follow Coşar and Demir (2018) and run fixed effect regressions to analyze the source of variation in firm FDI mode choices. Let $MA_{i,h,j,t}$ be an indicator representing firm i's FDI mode choice. This variable equals one if firm i uses M&A for its first FDI in host country h and industry j in year t, and equals zero if firm i chooses GF investment. To gauge the relative importance of different sources of variation in FDI mode decisions, I regress $MA_{i,h,j,t}$ separately on firm, industry, and country fixed effects, and compare the resulting adjusted R-squared values.

In the first panel of Table 2, titled *direct effect*, I present adjusted R-squared values from my three fixed effects specifications.[20] Firm heterogeneity explains around 30% of the variation in FDI mode choices; the explanatory power of industry variation is noticeably lower, as is the explanatory power of country-level variation. This comparison suggests that firm-level heterogeneity matters most in FDI mode decisions.

To probe these results further, I consider interacted fixed effects models in which I consider the respective roles of firm-country, firm-industry, and country-by-industry variation. The results with pair fixed effects again show the firm-industry level factors matter the most. In particular, firm-industry fixed effects explain almost half (46.7%) of the total variation in FDI mode choices.

[20] I exclude year fixed effects because they explain very little variation. For example, the direct effect of year variation is 0.010.

In the second panel of Table 2, titled *partial determination*, I explore the robustness of the findings from the first panel. Specifically, I evaluate the relative explanatory power of the fixed effects involving firm-level variation to the best-performing specification that does *not* include firm-level effects—namely, the model with country-industry fixed effects. These "partial determination" results confirm my findings from the first panel.[21]

3.2 Fact 2: Firms with more intangible capital are more likely to make GF investments rather than M&A.

I showed that firm heterogeneity matters most in terms of multinationals' FDI mode decisions. I next analyze which firm-level variable affects the firms' FDI decisions. Firms will obtain physical capital either through GF or M&A investment, but they can acquire existing intangible capital only through M&A. Therefore, I hypothesize that M&A is the preferred market entry option for firms that seek to obtain existing intangible capital.

Giving a glimpse of the detailed empirical analysis to be presented below, Figure 1 plots the relationship between firm intangible capital intensity (intangible assets divided by sales) and the share of FDI investments done through GF. The positive and statistically significant correlation supports the hypothesis that firms with higher levels of intangible capital tend to pursue GF rather than M&A.

I test the hypothesis in a more rigorous way by estimating the following linear probability model:

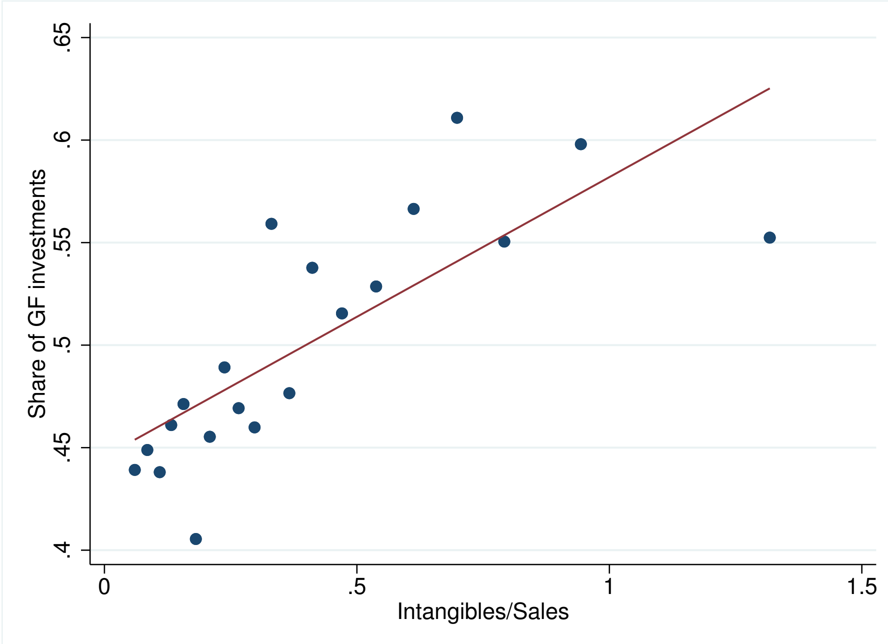
$$\begin{aligned} MA_{i,h,j,t} = \beta_1 \times \mathit{intangibles}_{i,t-1} + \beta_2 \times \mathit{sales}_{i,t-1} + \beta_3 \times \mathit{value\text{-}added\text{-}per\text{-}worker}_{i,t-1} \\ + \alpha_{h,t} + \alpha_{j_p,j} + \epsilon_{i,h,j,t}, \end{aligned} \tag{1}$$

where $MA_{i,h,j,t}$ is an indicator for whether US parent firm i uses M&A for its first FDI in market h and industry j in year t. There are two types of industry: parent industry, j_p, and foreign affiliate industry, j. All explanatory variables in regressions are in logs. Firm i's intangible capital in year $t-1$ is denoted by $Intangibles_{i,t-1}$. Using lagged explanatory variables prevents a potential simultaneity issue between firm's investment decisions and its financial status in the same data period.[22] In addition, I control for firm size and productivity

[21] I obtain coefficients of partial determination using the same logic as Coşar and Demir (2018). For firm i, I first regress $MA_{i,h,j,t}$ on firm fixed effects and country-industry pair fixed effects (i.e., individual fixed effects and pair fixed effects of the remaining factors) and obtain the adjusted $R^2_{i,hj}$. I next regress $MA_{i,h,j,t}$ only on country-industry pair fixed effects (without firm fixed effects) and keep the adjusted R^2_{hj}. I then obtain the share of variation that firm fixed effects can explain by computing $(R^2_{i,hj} - R^2_{hj})/(1 - R^2_{hj})$.

[22] I refer to Spearot (2012) who studies firms' investment decisions between new (or greenfield) investment

Figure 1: Share of GF Investments and Intangible Capital



[a] The vertical axis shows the share of GF investment that each firm made (i.e., how many GF investments are made as a share of the total number of investments), and the horizontal axis shows the ratio of intangible capital to sales.
[b] This figure is a binned scatter plot. The data space is partitioned into rectangular bins and compute the mean of the variables in the horizontal and vertical axes within each bin. I then create a scatter plot of these data points.
[c] I delete outliers (observations below the 5th percentile and ones above the 95th percentile).

using $sales_{i,t-1}$ and $value\text{-}added\text{-}per\text{-}worker_{i,t-1}$.[23] I also add country-year fixed effects, $\alpha_{h,t}$, and industry-pair fixed effects, $\alpha_{j_p,j}$. The former controls for any shocks affecting a firm's entry decision in country h and year t (such as a policy change regarding M&A), and the latter controls for industry characteristics between an investing firm and an affiliate firm.

Table 3 presents the results. In the first specification, I estimate the correlation between a firm's intangible capital and the probability of making cross-border M&A without controlling for sales and value-added per worker. The coefficient on intangible capital is negative and statistically significant in the first specification, and it stays the same when I control for sales and value-added per worker (in column 2). This result shows that the probability of making a GF investment increases with the amount of intangible capital that a parent firm holds. In the third specification, I use industry-pair-year fixed effects instead of industry-pair fixed

and M&A in the US, using the Compustat database.

[23] I include intangibles and sales separately, instead of using the ratio of intangible capital to sales, $(intangibles/sales)_{i,t-1}$. Using the ratio imposes an unnecessary restriction that the coefficients on *intangibles* and *sales* must be the same values.

Table 3: Firms' FDI Decisions and Intangibles

	Dependent variable: $MA_{i,h,j,t}$		
	(1)	(2)	(3)
Intangible capital	-0.020^{***}	-0.043^{***}	-0.052^{***}
	(0.003)	(0.008)	(0.010)
Sales		0.014	0.024^{**}
		(0.009)	(0.010)
Value-added per worker		0.014	0.012
		(0.011)	(0.012)
Country × Year FE	Yes	Yes	Yes
Industry Pair FE	Yes	Yes	
Industry Pair × Year FE			Yes
Observations	15,161	14,373	12,258
Adjusted R^2	0.393	0.402	0.385

Standard errors are clustered by parent firm. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All explanatory variables are in logs.

effects to control for any shocks specific to an industry pair between an investing firm and an affiliate firm in year t (such as demand or supply shocks affecting an industry pair, j_p and j). Using industry-pair-year fixed effects will drop many observations that are unique parent industry-affiliate industry-year triplets. The sign and statistical significance of the coefficient on intangible capital remain the same.

Overall, the results in Table 3 show that firms with more intangible capital are likely to choose GF investment rather than M&A. This suggests that if firms have enough intangible capital, they invest via GF; otherwise, they invest via M&A to benefit more from acquiring local intangibles. Note that these results provide a new perspective on the literature studying the determinant of firms' FDI decisions. For example, Nocke and Yeaple (2008) show that more productive firms (i.e., firms with greater sales and value-added per worker) are more likely to choose GF investment rather than M&A.[24] My results show that there is an additional determinant of firms' FDI decisions—the amount of intangible capital.

I also run linear probability regressions disaggregating intangible capital into its components, to see whether a specific type of intangible capital matters more for a firm's choices of

[24]Table B.1 shows that I obtain the same results in the logit regressions analogous to Nocke and Yeaple (2008), using my dataset in 2003-2018.

Table 4: Firms' FDI Decisions and Other Types of Capital

	Dependent variable: $MA_{i,h,j,t}$		
	(1)	(2)	(3)
	Intangible		Non-intangible
	Knowledge	Organizational	Physical
Capital	-0.023^{***}	-0.031^{***}	-0.009
	(0.009)	(0.009)	(0.009)
Sales	0.003	0.003	-0.016^{*}
	(0.010)	(0.009)	(0.010)
Value-added per worker	0.020	0.013	0.013
	(0.013)	(0.011)	(0.011)
Country × Year FE	Yes	Yes	Yes
Industry Pair FE	Yes	Yes	Yes
Observations	8,620	14,373	14,171
Adjusted R^2	0.384	0.400	0.398

Standard errors are clustered by parent firm. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
All explanatory variables are in logs.

FDI mode. A firm's intangible capital is the sum of its knowledge capital and organizational capital. Instead of using the total amount of intangible capital as the explanatory variable, I include knowledge capital and organizational capital separately in columns 1 and 2 of Table 4.[25] Both types of intangible capital yield qualitatively similar results (negative and statistically significant coefficients) as the total intangible capital (i.e., the result in column 2 of Table 3). This means that the effects of total intangible capital are driven both by the amount of knowledge capital and organizational capital. Finally, I include physical capital as an explanatory variable. As expected, column 3 shows that the coefficient on physical capital is insignificant. This result supports my prediction that only intangible capital, not physical capital, is a significant determinant of an investment mode because firms establish their physical facilities abroad either through M&A or GF. This finding underlines the importance of intangible capital in FDI mode choice.

[25]Note that R&D spending (the variable with which I measure knowledge capital) is missing for some Compustat firms.

3.3 Fact 3: Frictions to search for local partners affect a firm's FDI mode choice.

Unlike GF investment, a multinational needs to search and finds a local partner in its host country to conduct M&A. Existing studies highlight the importance of the friction between an acquirer and a target firm. For example, Head and Ries (2008) show that geographical and cultural frictions hinder cross-border M&A as investing firms have imperfect information on foreign firms. Given this background, I consider how geographical and cultural frictions affect firms' FDI mode choices.

Instead of country-year fixed effects, I include the following covariates describing the host country in equation (1): distance (DIST), common language (LANG), GDP per capita (GDPPC), population (POP), openness to trade (OPEN), and FDI regulatory restrictiveness index.[26] I take logs for all continuous variables. DIST and LANG are variables that relate to frictions for multinationals to conduct M&A.

The results are in the first and second columns of Table 5. In the first specification, I control for firm heterogeneity using fixed effects instead of using firms' financial information, such as intangibles, sales, and value-added per worker. The second and third column shows the results with the main specification, including country characteristics instead of country-year fixed effects. In the fourth specification, I use industry-pair-year fixed effects that absorb the average probability that a firm chooses M&A investment in each industry pair and year. I include the FDI regulatory restrictiveness index only in the third and fourth specifications because the OECD reports the FDI regulatory restrictiveness index only for 66 countries.

The signs and statistical significance of the coefficients are similar across four specifications. The coefficients on DIST and LANG are both statistically significant, and the signs of the coefficients on DIST are negative, while those on LANG are positive. These estimates indicate that American investing firms are less likely to make M&A investments in countries far from the US and in counties where English is not the most common language. This result corresponds to Davies et al. (2018), which analyzes a firm's investment mode choice using global transaction data from 2003-2010. They conclude that there are fewer M&A investments as barriers between countries get larger because M&A relies on intra-firm integration. The positive coefficients on GDPPC show that there are more M&A investments in developed countries. Firms in countries with high GDPPC likely have more intangible capital on average, and thus investing firms can easily find target firms in these countries. I also study

[26]Nocke and Yeaple (2008) use the four country variables in their regressions: GDP per capita, population, openness to trade, and distance. I use language and the FDI regulatory restrictiveness index additionally.

Table 5: Firms' FDI Decisions and Country Characteristics

	Dependent variable: $MA_{i,h,j,t}$			
	(1)	(2)	(3)	(4)
DIST	-0.071^{***}	-0.072^{***}	-0.045^{***}	-0.053^{***}
	(0.017)	(0.022)	(0.010)	(0.011)
LANG	0.065^{**}	0.078^{***}	0.112^{***}	0.111^{***}
	(0.026)	(0.030)	(0.025)	(0.027)
GDPPC	0.111^{***}	0.128^{***}	0.150^{***}	0.148^{***}
	(0.019)	(0.022)	(0.019)	(0.018)
POP	-0.003	-0.006	0.006	0.014
	(0.009)	(0.010)	(0.011)	(0.013)
OPEN	-0.098^{***}	-0.120^{***}	-0.056^{*}	-0.028
	(0.022)	(0.029)	(0.032)	(0.037)
FDI restrictiveness			-0.032^{**}	-0.325^{**}
			(0.013)	(0.129)
Intangibles		-0.040^{***}	-0.043^{***}	-0.049^{***}
		(0.009)	(0.010)	(0.012)
Firm FE	Yes			
Industry Pair FE	Yes	Yes	Yes	
Year FE	Yes	Yes	Yes	
Industry Pair × Year FE				Yes
Observations	11,891	14,027	12,410	10,471
Adjusted R^2	0.470	0.363	0.367	0.349

Standard errors are clustered by firm and country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All continuous variables are in logs. I control for firm size and efficiency using sales and value-added per worker.

the effect of institutional restrictions on firms' FDI mode choices using the FDI regulatory restrictiveness index. The statistically significant and negative coefficients on the regulatory index show that tighter restrictions in a destination country deter firms from making M&A investments.[27]

Overall, this analysis suggests that geographic, linguistic, and institutional barriers matter for multinationals in their search for partners with whom to conduct M&A. This could

[27] Trade restrictions affect a country's openness to trade, and both trade and FDI restrictions are closely related (i.e., countries with fewer trade restrictions have fewer FDI restrictions). Once I control for FDI restrictiveness, the FDI regulatory restrictiveness index captures most of the variation that explains institutional barriers, and the coefficients on openness (OPEN) become insignificant.

reflect the fact that there is a smaller matching probability between target and acquiring firms, as well as higher search costs, if the barriers between the US and a destination country get larger.

4 A Model of FDI Entry Mode by Multinational Firms

I develop a model to further investigate how intangible capital stock—the main source of firm heterogeneity—affects a firm's FDI mode choice. My static model builds upon Nocke and Yeaple (2007, 2008), who model a firm's production efficiency as a function of two exogenous parameters.[28] I adapt this framework to consider the effects of firm productivity and intangible capital.[29] Along the lines of Nocke and Yeaple's study, firms can trade one of the parameters—intangible capital—in the merger market, which incentivizes firms to conduct M&A rather than greenfield (GF).

A multinational's search decision is characterized based on the Diamond-Mortensen-Pissarides (DMP) model (Diamond, 1993; Mortensen and Pissarides, 1994). I follow Rhodes-Kropf and Robinson (2008) and David (2021), who analyze domestic M&A activity, to incorporate search frictions into my model of the international merger market. A multinational and its local partner bargain over their surplus from merging. A firm's outside option of conducting M&A is making a greenfield investment, and the merger gains and acquisition price are endogenously determined depending on the stock of total intangible capital that the acquiring and target firms hold.

One of this paper's main goals is to study how foreign investment affects welfare in an investment-receiving country. I construct a model of domestic general equilibrium in the host country to study these effects. The model endogenously determines wage, and the volumes of M&A and GF investment that occur in the host country. I also analyze the social efficiency of the market equilibrium.

4.1 Basic Setup

Consider two types of firms in two countries: multinational firms (indexed by i) in source country s and local firms (indexed by j) in host country h. Both multinational and local

[28] In Nocke and Yeaple (2007), two types of production efficiencies are *mobile capability*, such as technology, and *non-mobile capability*, such as marketing ability. In Nocke and Yeaple (2008), production efficiencies are characterized by an *entrepreneurial ability*, such as productivity, and *production division*, such as market size. The first paper focuses on industry heterogeneity, and the latter focuses on firm heterogeneity.

[29] I omit physical capital in my model because it does not affect firms' FDI mode decisions (see Section 3.2).

firms produce intermediate goods, y. A final good is produced by combining the intermediate goods.

The mass of multinational firms is M in country s, and the mass of local firms is N in country h. All multinational firms in country s make foreign direct investment (FDI) in country h either through M&A or GF. Some of the multinationals search for their M&A partners, while some of them conduct GF without searching. If multinationals search and find their partners, they can merge with local firms. Multinationals that do not search and also those which fail to search make GF investment and establish their own affiliates to produce.[30]

I assume host country h is a small open economy, and labor is not mobile across countries.[31] Here, the final good, Y, is traded between s and h, but each intermediate good, y, is not traded. Part of the final good, Y, becomes the firm's wage bill and profit. Multinational firms are owned by foreign entities, and the profits are shipped out to source country s, whereas local firms are owned by local entities. Households supply labor and consume the final good.

4.1.1 Intermediate Good Firms

A multinational firm i in s produces a differentiated variety of good, y_i, using a Cobb-Douglas production technology:

$$y_i = \tilde{Z} K_i^{\alpha} \ell_i^{\beta},$$

where $\tilde{Z}$ is productivity, K_i is intangible capital, and ℓ_i is labor. Each multinational draws its intangible capital when it enters. I assume that the distribution of intangibles across multinationals follows a Pareto distribution. The cumulative distribution function is:

$$G(K) = 1 - K^{-\theta} \quad \text{with support} \quad [\underline{K}, \infty) \quad \text{for} \quad \underline{K} = 1 \quad \text{and} \quad \theta > 1, \tag{2}$$

[30] There is anecdotal evidence that M&A firms consider the costs to invest via GF as outside options to make M&A in the due diligence phase.

[31] I study the effects of unilateral investment policies made by the host country and analyze how these policies affect the multinationals' FDI entry mode as well as labor market outcomes in the host country. The small open economy setting is reasonable in this study because my focus is not on the economic outcomes of source country policies but rather on host country outcomes. See Demidova and Rodríguez-Clare (2013) and Haaland and Venables (2016) for recent papers on the small open economy framework in the monopolistic competition setting.

where θ is a shape parameter. For simplicity, assume that productivity for multinational firm i is constant at the value $\tilde{Z}$.[32]

A local firm j in h produces a differentiated variety of good y_j with a Cobb-Douglas production technology:

$$y_j = \tilde{z}\kappa^{\alpha}\ell_j^{\beta},$$

where $\tilde{z}$ is productivity, κ is intangible capital, and ℓ_j is labor. The productivity of local firm j is constant at the value $\tilde{z}$ such that $\tilde{z} \leq \tilde{Z}$. A firm's level of intangible capital is homogeneous and it is given as κ.[33]

4.1.2 Merger Market

The rate at which an searching firm matches with its target is determined by a matching technology. Let the number of matches that is created be $v(N, n)$, where n is the measure of searching multinational firms. I assume the matching function:[34]

$$v(N, n) = \frac{Nn}{(N^{\rho} + n^{\rho})^{1/\rho}},$$

where $\rho > 0$. The probability that a multinational finds an M&A partner in host country h is denoted as $\mu(n) \in (0, 1)$. When n multinational firms search, $\mu(n)n$ multinationals find their targets, and therefore $\mu(n)n$ local firms are acquired. Assume that the number of local firm, N is sufficiently large so that $N > \mu(n)n$. With the above functional form, the matching probability $\mu(n)$ is:

$$\begin{aligned}\mu(n) &= \frac{v(N, n)}{n} \\ &= \left(\frac{1}{1 + (n/N)^{\rho}}\right)^{\frac{1}{\rho}}.\end{aligned} \tag{3}$$

Because $\mu'(n) < 0$, when more multinationals search, the matching probability falls (i.e., there is congestion in search). I assume that when a multinational firm searches, it incurs a

[32]This setting is analogous to the probability distribution in Eaton et al. (2011) who consider that the measure of multinationals with productivity at least z is $\mu^z(z) = Tz^{-\theta}$, where T is an exogenous technology parameter.

[33]I choose this assumption because I don't observe the local firm's intangible capital in the data. Potential extensions are (i) making local-firm intangible capital to be heterogeneous capital and (ii) making the local capital investment to be endogenous.

[34]This functional form follows Den Haan et al. (2000) and is also used in Coşar et al. (2016). The benefit of this functional form, compared to Cobb-Douglas matching technology, is that this form guarantees matching probabilities are between 0 and 1.

search cost $\psi > 0$. After searching and matching with a local firm, if a multinational decides to make an M&A investment, it needs to pay the price of acquisition, P.

4.1.3 Foreign Direct Investment (FDI)

After multinationals make FDI, the following three types of firms exist in the host country, h.

(i) Greenfield Firms: Multinational firm i which either did not search or failed to find a target conducts a greenfield investment (GF). This assumption is reasonable within this model, as we see below that the multinational firm can receive a positive net return from the GF investment. Unlike physical capital, both productivity, $\tilde{Z}$, and intangible capital, K_i, can easily be replicated and transferred into the new market. Thus, a GF multinational can operate with the same level of production technology as it had before FDI in a host country, h.[35]

The production function for GF firm g is

$$y_g = \tilde{Z} K_i^{\alpha} \ell_g^{\beta}.$$

Let the amount of intangibles of the GF firm g be $k_g \equiv K_i$, and its productivity be $\tilde{Z}_g \equiv \tilde{Z}$.

(ii) Merged Firms: When multinational firm i merges with a local firm, it can take advantage of the acquired firm's intangibles, κ, in production. This assumption is in line with the fact that M&As improve the acquirer's productivity (e.g., Schoar 2002; Li 2013; Dimopoulos and Sacchetto 2017), and the performance of merged firms depends on productivities both of target and acquired firms (Guadalupe et al. 2012; David 2021).[36] I assume that a merged firm inherits its acquirer's productivity, $\tilde{Z}$, and both the target's and acquirer's intangible capital, κ and K_i. The production function for merged firm m is

$$y_m = \tilde{Z}(\kappa + \eta K_i)^{\alpha} \ell_m^{\beta},$$

[35] This setting is the same as Nocke and Yeaple (2008) and McGrattan and Prescott (2010). They assume that a subsidiary of a multinational operates with the same productivity as the parent firm.

[36] Guadalupe et al. (2012) emphasize two sources of complimentarity (i) between the market size of an acquiring multinational (A in their model) and post-merger innovation, and (ii) between productivity of a target firm (φ in their model) and post-merger innovation. Although this paper is not looking at post-merger innovation, my production function is similar to their variable profit function if I set A as Z (a multinational's TFP) and φ as κ (a local firm's intangibles). Building on Guadalupe et al. (2012), I have an additional source of profitability (ηK_i) transferred from an acquiring multinational to a local target.

where $\eta \in (0,1)$. In the post-merger integration process, a multinational will not be able to transfer all of its intangible capital to the new foreign affiliate. For example, some business segments are duplicated between acquiring and target firms, and a multinational uses some part of target firm's intangibles (instead of its intangible capital) in the local market.[37] This imperfect "scalability" in M&A investments is represented by η. Note that the formulation here highlights the difference between technology and intangible capital: technology does not have an additive property (for example, a better management practice prevails within a firm) whereas intangible capital can accumulate within a firm (patents can have independent values; local network and brand name can have separate effects). Let the amount of intangible capital of the merged firm m be $k_m \equiv (\kappa + \eta K_i)$, and its productivity be $\tilde{Z}_m \equiv \tilde{Z}$.

(iii) Local Firms: If local firm j does not merge with multinational i, it operates alone. The production function for a local producer a is

$$y_a = \tilde{z}\kappa^{\alpha}\ell_a^{\beta}.$$

Let the amount of intangible capital of the local firm a be $k_a \equiv \kappa$, and its productivity be $\tilde{Z}_a \equiv \tilde{z}$.

4.1.4 Final Good Producer

I assume there is a final good producer that aggregates three types of outputs: y_m, y_g, and y_a. I index firms in the host country after investment by ω. Each firm, ω, is assigned to one of the firm types: M&A firm, m, GF firm, g, and local firm, a. Ω is the set of all of the firms, $\omega \in \Omega$.

The final-good production function is:

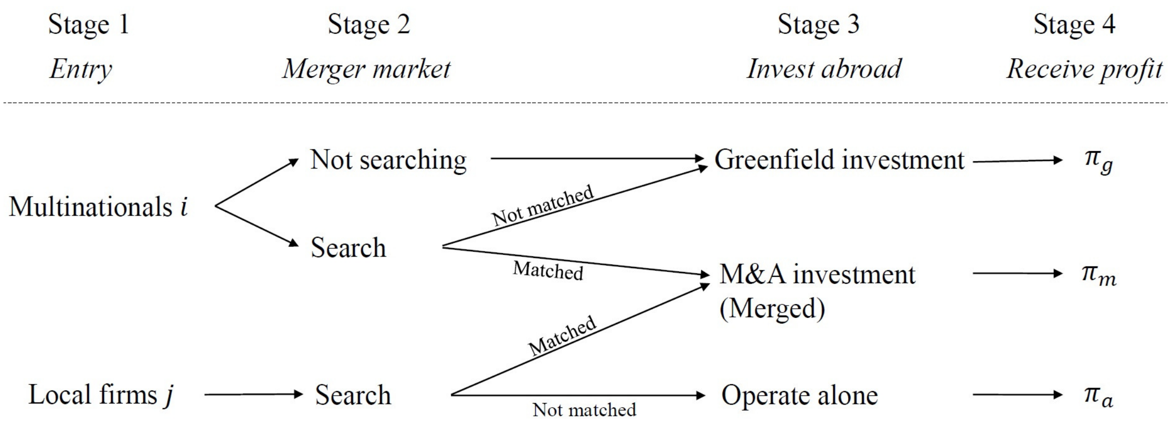
$$Y = \left[\int_{\Omega} y_{\omega}^{\frac{\sigma-1}{\sigma}} d\omega\right]^{\frac{\sigma}{\sigma-1}}, \tag{4}$$

where $\sigma > 1$ is the elasticity of substitution.[38]

[37] For example, when Walmart acquired a Japanese supermarket, Seiyu sold Walmart's products under Seiyu's name. This is one example of how merged multinationals gave up some part of their own intangibles.

[38] We can consider that each firm, ω, produces its differentiated variety, y_ω given the other firms' production, Y. We can call Y "the other firms' production" because one firm is negligible with a continuum of firms.

Figure 2: Timing of the Model



4.1.5 Households

There is a measure of representative households, L, in host country h. They maximize utility by consuming the final good, C, and supply labor, L, at wage, w. The households earn income, I, from the wage payment, wL, profits of local firms, and acquisition transfer, P.

I assume local firms are owned by local consumers, whereas M&A and GF firms are foreign-owned. All firms earn profits and pay wage bills. When multinationals search, they incur search costs, and if they acquire local firms, they make acquisition payments. All payments are made in terms of the final good, Y. The representative household's consumption is also denominated in terms of Y.

4.1.6 Timing

There are four stages in the model:

Stage 1: Multinationals in s and local firms in h enter.

Stage 2: Multinationals decide if they search for their M&A partners in the merger market, or make GF investment without searching.

Stage 3: Multinationals that do not search make GF investments in h. If multinationals search for their partners and find them, they will make M&A deals in h. Otherwise, they will make GF investments.

Stage 4: Firms hire workers, produce, and receive profits. Households consume.

4.2 Model Solution

I solve the model backward according to the timing given in Section 4.1.6.

4.2.1 Profit Maximization (Stage 4)

After multinationals invest in Stage 3, three types of intermediate goods firms exist in country h: merged multinationals, m, greenfield multinationals, g, and local firms which operates alone, a. In Stage 4, a final good is produced and each intermediate good firm maximizes its profit given the three types of production function, defined in Section 4.1.3.

First, the final-good producer minimizes its expenditure:

$$\min_{y_\omega} \int_\Omega p_\omega y_\omega d\omega \qquad \text{subject to equation (4).} \tag{5}$$

The unit price of the final output is $\Xi = [\int_\Omega p_\omega^{1-\sigma} d\omega]^{1/(1-\sigma)}$. The final good market is perfectly competitive, and a final good producer can sell any amount of good Y at the market price, Ξ. I use the final good as a numéraire, and normalize Ξ to one.[39] The inverse demand function for good ω is

$$p_\omega = \left(\frac{Y}{y_\omega}\right)^{1/\sigma}. \tag{6}$$

Given the CES demand function, firm ω solves the maximization problem for its profit:

$$\max_{\ell_\omega, p_\omega, y_\omega} p_\omega y_\omega - w\ell_\omega \qquad \text{subject to equations (4) and (6).}$$

w is the wage in the host country. I assume that $\alpha = \sigma/(\sigma-1) - \beta$ (with $0 < \beta \leq 1$). Note that the amount of intangibles, K, is determined exogenously. This assumption is without a loss of generality in the setting here, as one can always change the unit of measurement for K by a monotonic transformation, so that α satisfies this relationship.[40]

[39] The optimization in the final good sector yields the Constant Elasticity of Substitution (CES) demand function. One can, instead, directly assume that the consumers have CES preferences. Here, the representative consumers receive local firms' profits and merger payments which are endogenously determined in the model. The advantage of the current formulation (setting the price index equal to one and also using the final good sector) is that profit transfer and merger payments can be made internationally in the final good unit, so that the final good can serve as "dollars". Also, it is easier to clarify what is traded and what is not traded—I am explicit that intermediate goods are non-tradables and the final good is used for international transactions.

[40] Note that the distribution $G(K)$ is for the post-transformed value of K. This assumption would not be without loss of generality if multinational firm i chooses K_i by investment, for example, as the unit of measurement also affects the form of the investment cost function.

Solutions for the labor demand, ℓ_ω, are:

$$\begin{cases} \ell_m(K_i; w, Y) = \tilde{\Theta}(w, Y)Z(\kappa + \eta K_i) & \text{for merged multinationals,} \\ \ell_g(K_i; w, Y) \ = \tilde{\Theta}(w, Y)ZK_i & \text{for GF multinationals, and} \\ \ell_a(w, Y) \ = \tilde{\Theta}(w, Y)z\kappa & \text{for non-merged local firms.} \end{cases} \tag{7}$$

where $\tilde{\Theta}(w, Y) \equiv \left[\frac{Y^{1/\sigma}}{w}(\beta(\sigma-1)/\sigma)\right]^{\frac{\sigma}{(1-\beta)\sigma+\beta}}$. For notational simplicity, let $Z \equiv \tilde{Z}^{1/\alpha}$ and $z \equiv \tilde{z}^{1/\alpha}$.

The profits of each type of entity are:

$$\begin{cases} \pi_m(K_i; w, Y) = \Theta(w, Y)Z(\kappa + \eta K_i) & \text{for merged multinationals,} \\ \pi_g(K_i; w, Y) \ = \Theta(w, Y)ZK_i & \text{for GF multinationals, and} \\ \pi_a(w, Y) \ = \Theta(w, Y)z\kappa & \text{for non-merged local firms,} \end{cases} \tag{8}$$

where $\Theta(w, Y) \equiv \frac{\sigma-(\sigma-1)\beta}{\sigma} Y^{\frac{1}{\sigma}} \tilde{\Theta}(w, Y)^{\frac{\sigma-1}{\sigma}\beta}$. Here, $\tilde{\Theta}(w, Y)$ and $\Theta(w, Y)$ are decreasing in w and increasing in Y, and so do the labor demand and the profits. The expression of firms' profits is analogous to the ones in Nocke and Yeaple (2007, 2008): the profit depends on two types of production efficiency, productivity (Z and z) and intangible capital (K and κ), as well as the wage in the host country w.[41]

4.2.2 Gain from Mergers (Stage 3)

In Stage 3, a multinational firm decides whether to pursue M&A or GF investment after it matches with its target. All analyses in Stage 3 and Stage 2 are for a given (w, Y). In these two stages, I omit the dependence on (w, Y) to simplify the notation. For example, I use Θ in place of $\Theta(w, Y)$. The combined gain (surplus) from the merger (i.e., "synergy" from mergers), Σ, for multinationals that match with local firms is given by:

$$\begin{aligned} \Sigma(K_i) &= \pi_m(K_i) - \pi_g(K_i) - \pi_a \\ &= \Theta Z(\kappa + \eta K_i) - \Theta Z K_i - \Theta z\kappa \\ &= \Theta\left[(Z - z)\kappa - Z(1-\eta)K_i\right]. \end{aligned} \tag{9}$$

[41] Although I set the levels of productivity, Z and z, are constant in this study, if I make the productivity heterogeneous across firms, I can also state that the profit functions show the complementary between two production technologies (i.e., $\frac{\partial^2 \pi}{\partial Z \partial K} > 0$), similarly to Nocke and Yeaple (2008).

Multinationals consummate mergers so long as they have positive merger gains. The gains are the profit of the merged firm, π_m, less the profit that the multinational would have earned through GF, π_g (the multinational's outside option), and the pre-merger profit of the local firm, π_a (the target's outside option).

Note that multinationals face a tradeoff between conducting M&A and GF investments: M&A firms can leverage the difference in productivity between multinational and local firms, $(Z-z)$, and upgrade local firms' intangibles, κ; but they would lose some part of their intangibles, K_i, at rate $Z(1-\eta)$. The gains from merging are decreasing in a multinational's intangible capital, K_i, because $\eta \in (0,1)$. This tradeoff implies that multinationals with smaller intangible capital stock observe larger marginal benefits from obtaining additional intangibles through M&As, and have a greater incentive to merge. One can also see that the gains from merging are higher if the multinational firm can transfer a larger fraction of its intangible capital (i.e., if η is higher).

If a multinational consummates a merger (i.e., gain from merging $\Sigma > 0$), it pays a price of acquisition. The purchase price, $P(K_i)$, is determined through Nash bargaining between the multinational and the local firm. I set the local firm's bargaining power as $\chi \in (0,1)$, and the multinational's bargaining power as $1-\chi$. The acquisition price (i.e., the merger gains of local firms) is the sum of the profit of the local firm, π_a, and the target's share of the combined gain, $\chi\Sigma$:

$$P(K_i) = \pi_a + \chi\Sigma(K_i).$$

Using equation (9) and (8),

$$P(K_i) = \Theta z\kappa + \chi\Theta\left[(Z-z)\kappa - Z(1-\eta)K_i\right]. \tag{10}$$

4.2.3 Search Decision (Stage 2)

In Stage 2, a multinational firm decides whether it will (i) try to find a target firm by undertaking a search effort or (ii) not undertake a search effort. Multinational i participates in the merger market if it satisfies the following condition,

$$\mu(n)\left[\pi_m(K_i) - P(K_i)\right] + (1-\mu(n))\pi_g(K_i) - \psi \geq \pi_g(K_i), \tag{11}$$

that is, its expected (net) profit from searching (left-hand side) must be higher than its profit from making a GF investment, the outside option from searching (right-hand side).[42]

[42]For simplicity, there are no fixed costs to make GF. Costs of doing M&A are higher than the costs of doing GF in any firm size (Figure A.1). Multinationals incur more costs to obtain additional intangible

Using (10) and (8), inequality (11) becomes to

$$\mu(n)(1-\chi)\Theta\left[(Z-z)\kappa - Z(1-\eta)K_i\right] - \psi \geq 0. \tag{12}$$

The left-hand side equation is a multinational's expected gain from searching. A multinational searches for a local partner as far as its expected gain from searching is positive and that gain is decreasing in K_i. This means that a multinational firm with a lower level of intangible capital K_i is more likely to search for an M&A partner.

Further, inequality (13) can be written as

$$\mu(n)\underbrace{(1-\chi)\Theta\left[(Z-z)\kappa - Z(1-\eta)K_i\right]}_{\text{a multinational's gain from merging, } (1-\chi)\Sigma} \geq \psi. \tag{13}$$

If the above inequality holds, a searching multinational will always obtain a positive gain from merging, which means $(1-\chi)\Sigma \geq 0$ because $\psi > 0$ and $\mu(n) > 0$. Thus, if a multinational firm searches for and finds a target firm, it always conducts M&A.

These findings lead the following proposition:

Proposition 1 *Given (w, Y), there exists a threshold, K^*, such that a multinational firm with $K_i < K^*$ will search and pursue M&A if it matches with a local target firm, and one with $K_i \geq K^*$ make a GF investment. The threshold level of intangible capital K^* satisfies the following equation:*

$$\hat{\mu}(K^*)(1-\chi)\Theta\left[(Z-z)\kappa - Z(1-\eta)K^*\right] = \psi. \tag{14}$$

This condition gives the upper bound of K^* such that $\bar{K}^* = \frac{(Z-z)\kappa}{Z(1-\eta)}$ because $\psi > 0$.

Proof. See Appendix C.1.

The model shows that, under reasonable assumptions, firms with less intangible capital are more likely to choose M&A investments. This prediction is consistent with the empirical results shown in Section 3.2. Recall that the multinational's intangible capital is distributed across firms with a cumulative distribution function $G(K)$. In equilibrium, the fraction $G(K^*)$ of the mass of multinationals will search and conduct M&As, and the fraction $1 - G(K^*)$ of multinationals will make GF investments without searching in the merger market. I

capital from acquired firms if their intangible capital is lower and observe higher expected gains from making M&A.

denote the matching probability $\mu(n)$ as $\hat{\mu}(K^*)$ because the mass of searching multinationals is now $n = MG(K^*)$. The matching probability, $\hat{\mu}(K^*)$, is a decreasing function of K^*.

4.2.4 Measures of Firms

I summarize four types of firms that exist after multinationals invest using the threshold level of intangible capital, K^*:

(i) Multinationals with $K_i \in [\underline{K}, K^*]$ search for local target firms and successfully merge with probability, $\hat{\mu}(K^*)$. The measure of such M&A firms is $\hat{\mu}(K^*)MG(K^*)$.

(ii) Multinationals with $K_i \in [\underline{K}, K^*]$ search for local target firms but fail to merge with probability, $1 - \hat{\mu}(K^*)$. The measure of such GF firms is $[1 - \hat{\mu}(K^*)]MG(K^*)$.

(iii) Multinationals with $K_i \in [K^*, \infty]$ make GF investment without searching. The measure of such GF firms is $M(1 - G(K^*))$.

(iv) Local firms that have not merged with multinationals operate independently. The measure of such firms is $N - \hat{\mu}(K^*)MG(K^*)$. The probability that local firms operate alone is $1 - (\hat{\mu}(K^*)MG(K^*)/N)$.

Using these measures of firms, the share of M&A and GF that a host country receives can be represented as

$$\begin{cases} \text{Share of M\&A} & = \hat{\mu}(K^*)G(K^*) \\ \text{Share of GF} & = 1 - \hat{\mu}(K^*)G(K^*). \end{cases}$$

4.2.5 Representative Household's Income

I defined the representative household's income, I, in Section 4.1.5. Here, I state the equation for the income, I, with the threshold level of intangible capital, K^*:

$$I(w, K^*) = wL + (N - \hat{\mu}(K^*)MG(K^*))\Theta(w)z\kappa + \hat{\mu}(K^*)M \int_{\underline{K}=1}^{K^*} P(w, K)dG(K), \quad (15)$$

where the income, I, is the sum of wage payments, profits of local firms, and acquisition transfers.

4.3 Characterization of the Equilibrium

I consider the domestic equilibrium in the host country—a country that receives FDI—in this section. I first show that the total output, Y, is a function of the wage level, w, and the threshold level of multinational's intangibles, K^*. I then state two conditions, the cutoff condition and the labor market clearing condition, that are satisfied in equilibrium. These two equilibrium conditions uniquely determine w and K^*.

4.3.1 Total Output in the Host Country

Both multinationals and local firms produce in the host country after multinationals invest. From the production function (4), the total output is defined as

$$Y = \Bigg\{ \hat{\mu}(K^*) M \int_{\underline{K}=1}^{K^*} [Z^\alpha (\kappa + \eta K)^\alpha \ell_m^\beta]^{\frac{\sigma-1}{\sigma}} dG(K) + (1-\hat{\mu}(K^*)) M \int_{\underline{K}=1}^{K^*} [Z^\alpha K^\alpha \ell_g^\beta]^{\frac{\sigma-1}{\sigma}} dG(K)$$
$$+ M \int_{K^*}^{\infty} [Z^\alpha K^\alpha \ell_g^\beta]^{\frac{\sigma-1}{\sigma}} dG(K) + (N - \hat{\mu}(K^*) M G(K^*)) [z^\alpha \kappa^\alpha \ell_a^\beta]^{\frac{\sigma-1}{\sigma}} \Bigg\}^{\frac{\sigma}{\sigma-1}} .$$

Each term on the left-hand side corresponds to the output produced by each type of firm, as defined in Section 4.2.4. Using the labor demand (equation 7), one can solve for Y:

$$Y = \left(\frac{1}{w} \frac{\beta(\sigma-1)}{\sigma} \right)^{\frac{\beta}{1-\beta}} \hat{Y}(K^*)^{\frac{\alpha}{1-\beta}}, \tag{16}$$

where

$$\hat{Y}(K^*) = \underbrace{Nz\kappa + MZ \int_{\underline{K}=1}^{\infty} K \; dG(K)}_{\text{Baseline productivity}} + \underbrace{\hat{\mu}(K^*) M \int_{\underline{K}=1}^{K^*} [(Z-z)\kappa - Z(1-\eta)] \, K dG(K)}_{\text{Productivity trade-off through M\&A}} .$$

Appendix C.2 provides the detailed derivation.

Equation (16) shows that the aggregate output, Y, is decreasing in the local wage, w, and increasing in the total productivity of the local economy, $\hat{Y}(K^*)$. The total productivity consists of two parts. The first two terms of $\hat{Y}(K^*)$ show the baseline level of the productivity in the local economy (i.e., the initial productivity of all local firms plus that of all multinationals). If there is no M&A (when $K^* \to 1$), all local firms operate alone and all multinationals invest via GF.

The last term of $\hat{Y}(K^*)$ is the aggregate productivity trade-off through M&A that represent the measure of M&A multinationals, $\hat{\mu}(K^*) M G(K^*)$, times the average change in productivity through M&A, $\int_{\underline{K}=1}^{K^*}[(Z-z)\kappa - Z(1-\eta)K]dG(K)/G(K^*)$. When multinationals conduct M&A, they upgrade locals' intangibles, κ, by exploiting the gap in productivities between multinationals and locals, $(Z-z)$. However, M&A multinationals cannot transfer all of their intangibles to their merged entities, which decreases the productivity of acquiring multinationals by $Z(1-\eta)K$.

This productivity trade-off can be positive or negative. When few multinationals conduct M&A (i.e., if K^* is small and the share of GF is large), the positive effect dominates the negative effect, and M&A multinationals continue to upgrade the productivity of the host country until some level of M&A investment the host country receives. However, as more multinationals choose M&A (i.e., if K^* is large and the share of GF is small), the negative effect starts dominating the positive effect, and the total productivity becomes lower than the maximum. This trade-off in the aggregate merger gains provides intuition for the following proposition:

Proposition 2 *The function of the aggregate productivity in the local economy, $\hat{Y}(K^*)$, is concave, and there exists K^* that maximizes the total productivity of the local economy such that $\hat{K}^* = \arg\max_{K^*} \hat{Y}(K^*)^{\frac{\alpha}{1-\beta}}$.*

Proof. See Appendix C.3.

When the local economy receives too many M&A (if $\hat{K}^* < K^*$) or too small M&A (if $\hat{K}^* > K^*$), the aggregate productivity is smaller than the maximum level. There exists a certain level of M&A investment that maximizes the total productivity of the host country.

4.3.2 Cutoff Condition

In Section 4.2.3, I showed that there exists a threshold level of intangible capital, K^*, below which a multinational searches for a local target and above which it invests via GF. Because Y is a function of w and K^* (shown in the previous Section 4.3.1), I restate the equation that determines the cutoff level of intangibles (equation 14) with the notation $\Theta(w, K^*)$ instead of $\Theta(w, Y)$.

$$\hat{\mu}(K^*)(1-\chi)\Theta(w, K^*)\left[(Z-z)\kappa - Z(1-\eta)K^*\right] = \psi. \tag{17}$$

I call this condition the cutoff condition.

4.3.3 Labor Market Clearing

The labor market in the host country is cleared by equating the labor supply (L on the left-hand side) to the aggregate labor demand (shown on the right-hand side). Using the labor demand by each type of firm (equation 7),

$$L = \hat{\mu}(K^*)M \int_{\underline{K}=1}^{K^*} \tilde{\Theta}(w,Y)Z(\kappa + \eta K)dG(K) + [1 - \hat{\mu}(K^*)]M \int_{\underline{K}=1}^{K^*} \tilde{\Theta}(w,Y)ZKdG(K)$$
$$+ M \int_{K^*}^{\infty} \tilde{\Theta}(w,Y)ZKdG(K) + (N - \hat{\mu}(K^*)MG(K^*))\tilde{\Theta}(w,Y)z\kappa.$$

The expression for the aggregate labor demand can be defined as $L = \tilde{\Theta}(w,Y)\hat{Y}(K^*)$.

Using this expression, the total output Y (equation 16) can be represented as:

$$Y = w\frac{\sigma}{\beta(\sigma - 1)}L.$$

The function above shows that the total output, Y, is a function of w. I use $\tilde{\Theta}(w)$ in place of $\tilde{\Theta}(w,Y)$ and rewrite the labor market clearing condition as:[43]

$$L = \tilde{\Theta}(w)\hat{Y}(K^*). \tag{18}$$

4.3.4 Equilibrium

Now I am ready to state the domestic equilibrium in the host country h.

Definition 1 *Given parameters* $\{Z,\ z,\ \kappa,\ \underline{K},\ \theta,\ \chi,\ \eta,\ \sigma,\ \beta,\ N,\ M,\ L,\ \psi,\ \rho\}$, *the domestic equilibrium is characterized by the equilibrium wage,* w*, and the cutoff in the level of intangibles,* K^**, satisfying*

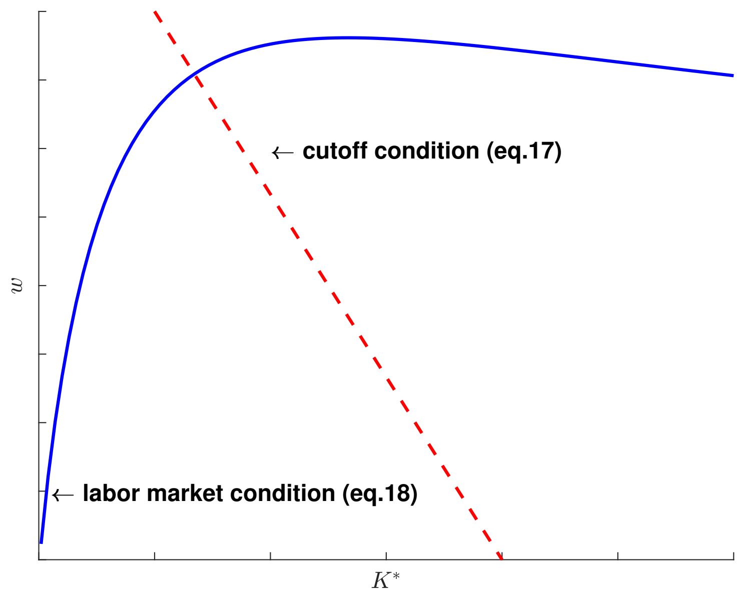
(i) The cutoff condition in equation (17).

(ii) The labor market clearing condition in equation (18).

There are three markets in host country h: the final-good market, the intermediate-goods market, and the labor market. The intermediate good market clears such that p_ω and y_ω satisfy the firm's profit maximization problem and the intermediate good demand curve in

[43] Under the labor market condition, I can use the notation $\tilde{\Theta}(w)$ and $\Theta(w)$ in place of $\tilde{\Theta}(w,Y)$ and $\Theta(w,Y)$. Both terms are decreasing in w. The calculation is in Appendix C.4.

Figure 3: Cutoff and Labor Market Clearing Conditions



equation (6). The labor market clears when equation (18) is satisfied. From Walras' Law, the final-good market automatically clears.[44]

Proposition 3 *There exists a unique equilibrium combination of* (w, K^*).

Proof. See Appendix C.4.

Proposition 3 states that the system of two equations, the cutoff condition (equation 18) and the labor market condition (equation 17), has a unique solution. If I plot the two conditions by setting the equilibrium wage level, w, on the y-axis and the threshold level of intangible capital, K^*, on the x-axis, then the cutoff condition is strictly decreasing and the labor market condition is concave (see Figure 3).

4.4 Efficiency

I stated that wage and the patterns of FDI (i.e., the threshold level of multinationals' intangibles, K^*) are uniquely determined in equilibrium. A multinational is willing to invest via M&A when its expected gain from searching is positive. However, there is friction in searching for a local partner, and a multinational needs to bargain over the merger gains with a local partner after matching. In this section, I study if the equilibrium solution is

[44]The final-good market clearing condition is in Appendix C.5.

socially efficient and how the searching externalities affect the efficiency of equilibrium. The detailed derivation is in Appendix C.6.

4.4.1 Market Equilibrium Condition

I first state the equation that characterizes the value of K^* in the market equilibrium. The two equilibrium conditions, the cutoff condition (equation 17) and the labor market condition (equation 18), lead the following equation in equilibrium:

$$\frac{\sigma - (\sigma - 1)\beta}{\sigma} \hat{Y}(K^*)^{\frac{1}{\sigma-1}-\beta} L^\beta \hat{\mu}(K^*)(1-\chi)[(Z-z)\kappa - Z(1-\eta)K^*] = \psi. \tag{19}$$

The threshold level of intangibles, K^*, satisfies the equation above in the equilibrium.

4.4.2 Socially Optimal Condition

I now consider the social planner's constrained problem. The social planner decides how many multinationals search for their target firms in the local economy and the allocation of workers to three types of firms (M&A multinationals, GF multinationals, and local firms) to maximize social welfare. The social planner makes these decisions given the labor endowment and the search-matching friction.

The social planner's problem is

$$\max_{K^s, \ell_\omega} Y - MG(K^s)\psi,$$

subject to the resource constraint, $L = \int \ell_\omega d\omega$. K^s is the threshold value of intangibles in the social planner's constrained problem, and the total output Y is defined in equation (4).

The optimal solution is

$$\begin{aligned} &\frac{\sigma - (\sigma - 1)\beta}{\sigma - 1} \hat{Y}(K^*)^{\frac{1}{\sigma-1}-\beta} L^\beta \hat{\mu}(K^s) \\ &\times \left((1-\xi(K^s))[(Z-z)\kappa - Z(1-\eta)K^s] - \frac{\xi(K^s)}{G(K^s)} \int_{\underline{K}}^{K^s} [Z(1-\eta)(K^s - K)]dG(K) \right) = \psi, \end{aligned} \tag{20}$$

where $\xi(K^s)$ is the elasticity of the matching function:

$$\xi(K^s) = -\frac{\mu'(MG(K^s))MG(K^s)}{\mu(MG(K^s))}.$$

4.4.3 Externalities

I compare two equations that characterize the volumes of M&A and GF investment in the market equilibrium (K^* in equation 19) and the social optimum (K^s in equation 20). The differences between the two equations indicate the four types of externalities.

The first two externalities are the ones defined under the efficiency condition studied by Hosios (1990). The first externality is known as the *congestion externality*. Multinationals decide to search for local firms by looking only at the probability of matching, $\hat{\mu}(K^*)$ in equation (19), while the social planner cares about the marginal change in the probability of matching, $\hat{\mu}(K^s)(1 - \xi(K^s))$ in equation (20). If the elasticity of the matching function, $\xi(K^s)$, is high, marginal searching multinationals cause more congestion for other searching firms. This congestion externality makes more multinationals search in the market equilibrium than in the socially optimal situation (i.e., $K^* > K^s$).

The second externality is called the *appropriability problem*. This externality occurs as multinationals consider only the fraction $1 - \chi$ (the bargaining power of multinationals) of the value of mergers, whereas the social planner evaluates the whole social welfare. This externality leads to fewer searching multinationals (i.e., $K^* < K^s$).

The other two externalities do not exist in the standard DMP model. The third externality is the additional congestion externality and corresponds to the last term in parentheses in equation (20), $-\frac{\xi(K^s)}{G(K^s)} \int_{\underline{K}}^{K^s} [Z(1-\eta)(K^s - K)] dG(K)$. This term exists because searching multinationals are heterogeneous, and therefore the congestion externality is heterogeneous as well. In particular, a firm with smaller intangible capital K realizes a larger gain from merging, $Z(1-\eta)(K^s - K)$, and thus suffers from extra losses due to congestion. Multinationals overestimate the benefit of searching compared to the social benefit because of this negative congestion externality, and there will be too many searching multinationals in the market equilibrium (i.e., $K^* > K^s$).

The fourth externality comes from the difference between the objective functions of firms and the social planner. In the market equilibrium, each firm maximizes its profit under monopolistic competition, whereas the social planner decides which multinational makes GF or M&A and allocates workers to multinationals and local firms to maximize social welfare. The social planner's allocation decisions are not subject to competition. Specifically, the market equilibrium solution is discounted by $(\sigma - 1)/\sigma$ than the socially optimal solution.[45]

[45] The first term of the socially optimal solution (equation 20), $\frac{\sigma-(\sigma-1)\beta}{\sigma-1}$, is from the derivative of total output, Y, with respect to K^s. On the other hand, the first term of the market equilibrium condition, $\frac{\sigma-(\sigma-1)\beta}{\sigma}$, comes from $\Theta(w, Y)$, the part of the profit function.

Given the above conflicting effects, in equilibrium, the volumes of M&A and GF investment a host country receives may be too high or too low, relative to the social optimum. Additionally, the Hosios condition, $\xi(K^s) = \chi$, does not guarantee the efficiency of the market equilibrium because additional externalities exist in my model. How do these externalities affect the optimal FDI policy of a local economy? If a host country receives more M&A than the optimal level ($K^* > K^s$), policymakers should restrict M&As to lower the value of K^*. This model prediction motivates me to conduct experiments regarding FDI policies in an investment-receiving country.

5 Testing Model Implications

My stylized general equilibrium model for a host country has two features: first, there exists the threshold value of multinational's intangibles K^* that determines whether a multinational searches for its M&A partner, and second, the market equilibrium K^* differs from the socially optimal level. This threshold level of intangibles, K^*, depends on exogenous parameters that relate to host country characteristics. In this section, I analyze how host country characteristics determine K^* (i.e., the probability that multinationals choose M&A or GF) using my data of US multinationals' FDI. Understanding the determinants of K^* is critical for evaluating the welfare implications of different FDI investment modes.

5.1 Testable Implications

Equation (12) shows that a multinational searches for its partner if its expected gain from searching is positive; otherwise, it conducts GF investment without searching. The threshold level of intangibles, K^*, is uniquely identified when the multinational's expected gain from searching is zero. Although some searching multinationals that do not match with local firms make GF investment instead of M&A, the decision to search is positively correlated with the probability that multinationals choose M&A.

I rewrite the multinational's expected gain from searching (equation 12), including the exogenous parameters and the multinational's intangible capital, K_i.[46] For multinational firm i, host country h, and affiliate industry j, the multinational's expected gain from searching

[46] In this equation, unlike in equation (12), I omit the number of multinationals, M_{hj}, because the number of multinationals, together with the endogenous K^*, affects the expected gain from searching by driving the measure of searching multinationals, $M_{hj}G(K^*)$.

is

$$\tilde{\Sigma}_{ihj} = \mu(N_{hj})(1-\chi)\Theta\left[(Z^{US} - z_h)\kappa_{hj} - Z^{US}(1-\eta)K_i\right] - \psi_h.$$

If multinationals observe that their expected gain from searching, $\tilde{\Sigma}$, is positive, they search for local partners; otherwise, they invest via GF without searching. The parameters that vary across country and industry are the number of local firms, N_{hj}, and the average level of local firm intangibles, κ_{hj}. I still assume that the level of productivity (or TFP) of US and local firms, Z^{US} and z_h, and search costs, ψ_h, vary only across countries, not within industries.

5.2 Specifications and Results

I run linear probability regressions to test the relationship between host-country and affiliate-industry variables, N_{hj} and κ_{hj}, and the probability that a US multinational with intangibles K_i chooses M&A. Specifically, I include the host-country and affiliate-industry variables in equation (1) from Section 3.2. Multinationals with higher intangibles observe lower expected gain from searching, and they are likely to make GF without searching. The sign on the coefficient of multinationals' intangibles, K_i, should be negative, same as the empirical fact in Section 3.2.

I expect the signs of the coefficients both on the number of local firms, N_{hj}, and the level of a local firm's intangibles, κ_{hj}, to be positive. If there are more local firms in a host country, that increases a matching probability, and thus multinationals observe higher expected gains from mergers. Similarly, a higher average level of intangible capital among local firms, κ_{hj}, increases the expected merger gains, making more multinationals search for a local partner.

As expected, I observe a negative coefficient on multinationals' intangibles, K_i, and positive coefficients on the number of local firms, N_{hj}, and average local firm intangibles, κ_{hj} (columns 1 and 2 of Table 6). All coefficients are significant at least at the 5% level. Moreover, when I instead consider the effect of a host country's total intangible capital stock ($N_{hj} \times \kappa_{hj}$), I again find a positive and significant coefficient.[47]

Additionally, I consider the search costs, ψ_h, that multinationals face when trying to find a local partner with which to pursue an M&A deal. The model implies that expected gain from searching decreases in search costs. However, I cannot observe search costs directly.

[47] Recall that I only observe the number of local firms and the total amount of intangible stock for a subset of industries and countries. Therefore, the number of observations is significantly smaller than that in the analyses in Section 3. I obtain the number of local firms for 45 OECD countries and the total amount of intangible stock for 23 countries (the UK, Japan, and EU countries). The summary statistics of three industry-country variables are in Appendix A.1.

Table 6: Testing Model Implications: Multinationals' Searching Decisions

Dependent variable: $MA_{i,h,j,t}$	Country-industry variation			Country variation		
	(1)	(2)	(3)	(4)	(5)	(6)
Number of local firms (N_{hj})	0.047^{***}			0.069^{***}		
	(0.016)			(0.013)		
Average local intangibles (κ_{hj})		0.017^{**}			0.041^{**}	
		(0.007)			(0.017)	
Local intangible stock ($N_{hj}\kappa_{hj}$)			0.028^{**}			0.066^{**}
			(0.006)			(0.015)
Distance (ψ_h)				-0.143^{**}	-0.538^{**}	-0.478^{***}
				(0.063)	(0.227)	(0.062)
Intangible capital (K_i)	-0.033^{**}	-0.028^{***}	-0.044^{***}	-0.033^{**}	-0.028^{*}	-0.044^{***}
	(0.013)	(0.011)	(0.013)	(0.014)	(0.016)	(0.014)
Country $\times$ Year FE	Yes	Yes	Yes			
Industry Pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE				Yes	Yes	Yes
Observations	5,911	3,642	4,878	5,653	3,457	4,676
Adjusted R^2	0.287	0.254	0.267	0.245	0.226	0.243

I control for firm size and efficiency using sales and value-added per worker in all specifications. Other country variables, such as the FDI regulatory restrictiveness index, population, and openness, are included in columns 4-6. I do not include common language (because the UK is only the English-speaking country in my data sample) and GDP per capita (because it is highly correlated with the total intangible stocks). Standard errors are clustered by country and firm. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All explanatory variables are in logs.

Rather, I use the distance between the US and each host country as a proxy for search costs, similar to my analysis in Section 3.3.[48] Columns 4-6 of Table 6 show that all of the signs on distance are negative and significant, which suggests that, as expected, higher search costs reduce the rate at which multinational firms choose M&A.

Overall, the data support the predictions from my model—namely, (1) multinationals with more intangibles assets are more likely to choose GF; (2) countries with more local firms and higher intangible capital stock are more likely to attract M&A; and (3) higher search costs (i.e., more distant host countries) decrease the rate of M&A investment.[49]

[48] I do not use common language as the indicator of search costs because the UK is only the English-speaking country in the data sample.

[49] I aggregate the data to the country and affiliate-industry level and conduct a similar analysis using the share of M&A. The data also support the model predictions. The results are in Appendix D.

6 Quantitative Analyses

I match the model to the data in order to quantitatively assess how a multinational firm's intangible capital relates to their FDI decisions and to the welfare in the local country. I also analyze how these relationships differ between developed and developing countries. I then use the resulting parameters for policy experiments in Section 6.4.

6.1 Distribution of Intangible Capital

First, I analyze the distribution of intangible capital among US investing firms. The firm's intangible capital is assumed to have a Pareto distribution, and its cumulative distribution function is $G(K)$ as defined in equation (2). A large number of studies suggest that the distribution of firm sizes, measured by sales and the number of employees, can be characterized by a Pareto distribution.[50] Arrighetti et al. (2014) use the data on Italian manufacturing firms and show that the probability of investing in intangibles depends on a firm's size. In my US firm-level data, the distribution of firms' intangibles is also skewed right (Figure 4).[51]

I estimate the value of the shape parameter, θ, following Axtell (2001) and Helpman et al. (2004). First, I rank firms in descending order, according to their amount of intangible capital (i.e., the firm with the largest intangible capital is ranked first). I then plot the logarithms of the ranking and the firm's intangible capital. Following the existing literature, I focus on the upper tail of the distribution when estimating the shape parameter. I consider firms within the top 1 percentile of intangibles.[52] This log-log plot (Figure 5) is known as a Zipf plot. We expect to observe a negative linear relationship in the Zipf plot if the data follow a Pareto distribution. Finally, I estimate the slope of the line using OLS. Consider the survival function, $\bar{G}(K) = K^{-\theta}$. If I take logs on both sides, I obtain $\ln(\bar{G}(K)) = -\theta \ln(K)$. The slope of the log-log plot corresponds to $-\theta$. Thus, the absolute value of the coefficient is equivalent to the shape parameter, θ. I normalize the data by setting the lowest value of intangibles equal to one since I set the scale parameter $\underline{K} = 1$. I set $\theta = 1.95$ from the regression result (Table 7).[53]

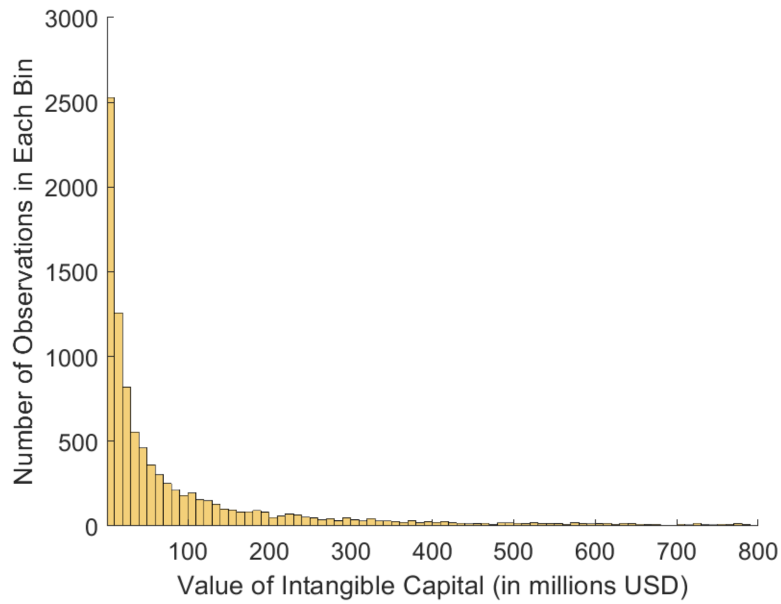
[50] See Simon and Bonini (1958) and Axtell (2001) as examples of studies that introduce the fact that a firm's size distribution follows a Pareto distribution.

[51] Figure E.1 shows the quantile plots of intangible capital and sales. The shapes of both distributions are the same.

[52] For example, Eaton et al. (2011) consider the top 1% of firms in their dataset. By the assumption of the Pareto distribution, the shape parameter does not depend on the level of the cutoff (further references can be found in footnote 26 in Helpman et al. (2004) and footnotes 7 and 8 in Eaton et al. (2011)). In my data, I obtain a similar coefficient ($\theta \approx 2$) using the other cutoffs at around the 99th percentile of the data.

[53] The Pareto distribution has an infinite variance if $\theta \leq 2$. This means that the moment will not converge

Figure 4: Distribution of Firms' Intangible Capital



[a] This figure shows the histogram of US firm's intangible capital. Each bin has a width of 10 million dollars. The vertical axis shows the number of observations that fall in each bin.

Table 7: Estimated Shape Parameter in $G(K)$

Estimated θ	Adjusted R^2
1.951 (0.055)	0.924

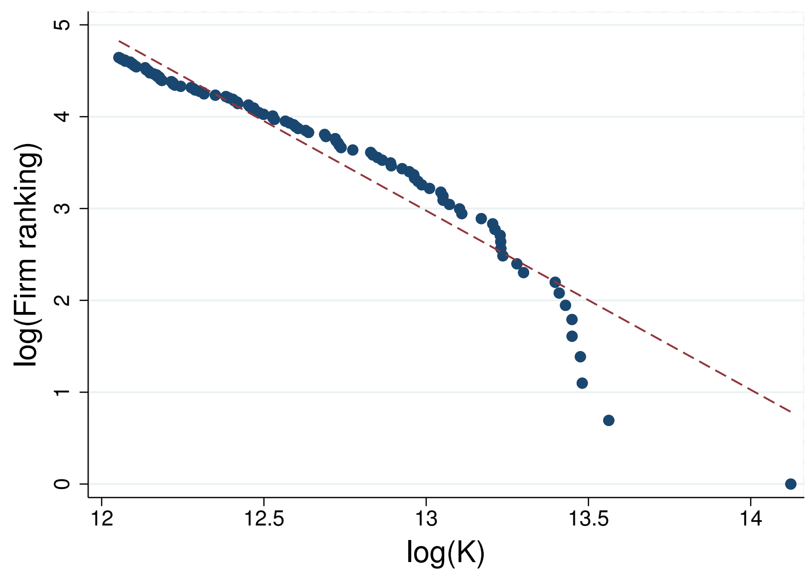
The standard error of the estimated parameter is shown in the parenthesis.

6.2 Baseline Parameters

I set parameters using moments that are obtained from my data. The cutoff condition (equation 14) and the labor market clearing condition (equation 18) are functions of the cutoff level of intangible capital $K^*(w, \theta, \rho, \kappa, \eta, \psi; X)$ and the real wage in the host country $w(K^*, \theta, \rho, \kappa, \eta, \psi; X)$. The shape parameter of the Pareto distribution, θ, is estimated in the previous subsection 6.1. ρ is the elasticity of the matching function, κ is the intangible capital of local firms, η is the friction parameter (i.e., the degree of incomplete transfer of intangibles), and ψ is the search cost. X indicates other parameters that are exogenously determined. The details of these parameters are shown in Table 9. In this subsection, I

as the sample size goes to infinity. This is not a problem in this paper since the variance exists in a finite sample.

Figure 5: Zipf Plot: Firm's Intangible Capital



The horizontal axis is the amount of intangible capital, and the vertical axis is the ranking of the firms. Both values are in logs. I normalize the value of intangibles by setting the lowest value of intangibles to one. The dotted line is the fitted OLS line. Regression results are shown in Table 7.

include all FDI deals in my sample, regardless of their destination country.

I pin down four parameters, ρ, κ, η, and ψ, using the following four moments in addition to the two equilibrium conditions for $K^*(w, \theta, \rho, \kappa, \eta, \psi; X)$ and $w(K^*, \theta, \rho, \kappa, \eta, \psi; X)$: (i) the share of multinational firms that make M&A investments, (ii) the productivity difference between acquiring and target firms, (iii) the average merger premium, and (iv) the threshold level of intangible capital.

(i) Share of M&A multinationals

I define the share of multinational firms that make M&A investments is $\hat{\mu}(K^*)G(K^*)$, in Section 4.2.4. The value is 0.414 in the data. The matching function $\hat{\mu}$ (equation 3) is a function of K^* and other parameters: the elasticity of the matching function ρ, the number of multinationals M, the number of local firms N, and the shape parameter, θ. I fix M and N so that ρ has only one unknown, K^*. In my data, the average number of FDI projects across destination countries is 630. As a measure of local firms, N—which is unobservable for the whole country—I use the US as a baseline. I assume that N is equal to the number of US local firms times the ratio of local GDP to US GDP. I use the total number of investments as weight and compute the weighted average across destination countries. I set $M = 630$

Table 8: Details of the Moments

Moment	All FDI	FDI to the North	FDIs to the South
$\hat{\mu}(K^*)G(K^*)$	0.414	0.556	0.205
$\frac{\overline{K}_{MA}}{\overline{K}}$	0.649	0.773	0.570

$\hat{\mu}(K^*)G(K^*)$ is the first moment: (i) the share of M&A investment out of total investment (both M&A and GF). $\frac{\overline{K}_{MA}}{\overline{K}}$ is the fourth moment: (iv) the ratio of the average intangibles of M&A firms to that of all firms.

and $N = 3430$.[54]

(ii) Productivity difference between acquiring and target firms

I use the fact that the average profitability of US acquirers is 7.5 times that of US target firms (David, 2021). I assume this same ratio applies to international acquisitions as well. This assumption is consistent with research showing that foreign acquirers are more productive than their domestic targets (Guadalupe et al., 2012). This moment is represented in the model as:

$$\frac{\pi_m(\overline{K}_{MA})}{\pi_a} = \frac{Z\overline{K}_{MA}}{z\kappa} = \frac{Z(1 - K^{*1-\theta})}{z\kappa} = 7.5.$$

In the above equation, κ, the intangible capital of local firms, is a function of K^* and the two technology parameters—the technology level in the US, Z, and the technology in host countries, z. The two technology parameters are exogenously determined using productivity per hour worked.[55] In the data, the labor productivity in the US (61.056) is double the average across destination countries (30.174). I normalize the technology level of US firms, Z, to one, and set the level of the target firms, z, to 0.5.

(iii) Average merger premium

The average merger premium gives the relationship between the M&A friction parameter, η, the cutoff level of intangible capital, K^*, and the real wage in the host country, w. According

[54] The total number of firms is not available in each destination country, but I can see the number of listed firms in the World Bank data. Since there is a strong relationship between the number of listed firms and GDP (correlation is 0.97), I project the number of local firms in each destination country using GDP. I use the number of US firms with more than 250 employees (of which there are 26,225, according to the Census). Around 90% of US multinationals in my dataset have more than 250 employees. Since acquirers usually buy targets of a similar size, I focus on target firms with more than 250 employees.

[55] The data come from Our World in Data, a project by Oxford University. The data are based on Feenstra et al. (2015) and the Penn World Table. I take the average values during my data period (https://ourworldindata.org/grapher/labor-productivity-per-hour-pennworldtable, last accessed on Sep 17, 2020).

Table 9: Baseline Parameters

Parameters	Definition	Value
estimated/ calibrated		
θ	Shape parameter of $G(K)$	1.95
ρ	Elasticity of the matching function	0.55
κ	Intangible capital of local firms	1.09
η	M&A friction	0.80
ψ	Search cost	0.00030
exogeneously determined		
Z	Technology level in the US	1
z	Technology level in host countries	0.5
M	Number of multinationals (FDI projects)	630
N	Number of local firms	3430
σ	Elasticity of substitution	6
β	Labor share of the production function	0.7
χ	Bargaining power of local firms	0.5
L	Labor force size	1

This table shows the parameters I set for the analysis when I use all US investing firms.

to a report by Thomson Reuters (2018), the average world M&A premium ranges from 20% to 26%. I define the average merger premium as

$$\frac{P(\overline{K}_{MA}) - \pi_a}{\pi_a} = 0.25,$$

where $P(\overline{K}_{MA})$ is the acquisition price of a firm with the mean level of intangibles among M&A firms, and π_a is the profit of the local firm. The average merger premium is a function of (η, K^*, w, Z, z, β, σ, χ). In addition to Z and z, I take the last three parameters, β, σ, and χ, from the existing literature and other data sources, and therefore η can be represented as a function of two unknowns, K^* and w. I take the elasticity of substitution, σ, from Broda and Weinstein (2006), and the bargaining power of target firms from David (2021): $\sigma = 6$ and $\chi = 0.5$. I also set the labor share in the Cobb-Douglas production function, β, to 0.7.

(iv) Threshold level of intangible capital

An investing firm with intangible capital lower than the cutoff ($K_i \leq K^*$) chooses M&A investment rather than GF. I calculate the mean of M&A firms' intangibles, and divide it by the overall mean of intangibles. In my model, the relationship is

$$\frac{\overline{K}_{MA}}{\overline{K}} = \frac{[\int_{\underline{K}}^{K^*} KdG(K)]/G(K^*)}{\int_{\underline{K}}^{\infty} KdG(K)} = \frac{1 - K^{*1-\theta}}{1 - K^{*-\theta}},$$

where $\overline{K}_{MA}$ is the mean of M&A firms' intangibles, and $\overline{K}$ is the mean of all firms' intangibles. The value in the data is 0.65. This moment describes how much the mean of intangibles among M&A firms deviates from that of all firms.[56] As the moment gets larger, firms with larger intangible capital make more M&A investments.

As I showed in Section 4.3.4, the equilibrium can be characterized by two endogenous variables, K^* and w. The first three moments, (i) the share of multinational firms that make M&A investments, (ii) the productivity difference between acquiring and target firms, and (iii) the average merger premium, provide the relationships between parameters, ρ, κ, and η, and the two endogenous variables, K^* and w. The last moment, (iv), the threshold level of intangible capital, determines the search cost, ψ through the cutoff condition (equation 14). I set $\rho = 0.55$, $\kappa = 1.09$, $\eta = 0.80$, and $\psi = 0.00030$. I pin down the threshold level of intangible capital, $K^* = 1.98$, and the wage level, $w = 33.17$. I normalize the labor force size to one to apply the labor market clearing condition (equation 18).

6.3 Different Types of Host Countries (FDIs to the North or the South)

I split the FDI projects by destination in this subsection. As I discuss in Section 3.3, developed countries have received more M&A investments than developing countries. Therefore, the relationship between the cutoff level of intangibles and wages would differ across these two types of destinations. Moreover, recent global policies are polarized in the preference of receiving M&As. There are more restrictions on M&A in developed countries than in developing countries. Analyzing the difference between developed and developing countries could provide insight into the recent trend in M&A policies. To investigate the difference in FDI across different host countries, I repeat the analysis under two different parameter values. I use country classifications released by the IMF to categorize host countries. They

[56] I use the mean of M&A firms' intangibles rather than that of GF firms. In the model, if a searching firm i with $K_i \leq K^*$ fails to find a target, it chooses GF. Thus, the moments relating to GF firms represent not only the firms with $K_i > K^*$, but also firms with $K_i \leq K^*$. The matching outcome does not depend on the level of intangible capital that firms exogenously received before investing (i.e., random search). Therefore, the moments relating to M&A firms can be used to analyze the firms only with $K_i \leq K^*$.

Table 10: Parameters (by Destination)

Parameter	Definition	Value	
		North	South
ρ	Elasticity of the matching function	0.71	0.35
M	Number of multinationals (FDI projects)	1023	576
N	Number of local firms	3081	5303
Z	Technology level in the US	1	1
z	Technology level in host countries	0.72	0.24
κ	Intangible capital of local firms	1.11	1.08
η	M&A friction	0.92	0.68
ψ	Search cost	0.0007	0.017

This table shows the parameters I set when I analyze US investments by destination countries. Only the parameters that differ from the baseline model are presented here.

divide the economy into two groups: "advanced economies", and "emerging and developing economies." I call the former the North, and the latter the South. Below, I look at how the firm's FDI decisions differ if it invests in the North or in the South.

I set parameters using the same procedures as used for the baseline case. The resulting parameters are reported in Table 10. M&A firms investing in the North have a higher level of intangibles than those investing in the South (see Table 8). Reflecting this difference, I find that firms investing in the North face a higher level of cutoff K^*. I set $K^* = 3.73$ for firms investing in the North, and $K^* = 1.33$ for firms investing in the South. Firms with intangibles larger than the cutoff will invest via GF without searching for their M&A partners. The cutoff in the North is 2.5 times larger than that in the South. Therefore, firms making GF in the North have a larger amount of intangible capital than those in the South.

I pin down the matching function parameter, ρ, which is 0.71 in the North and 0.35 in the South. More occurrence of M&As means higher matching probability in the M&A market in the North. Thus, the matching function parameter, ρ, is higher for those firms. The average labor productivity in the North is 43.92, while that in the South is 14.93. Compared to the labor productivity in the US, which is 61.06, I set the exogenous technology parameter of local firms, z, to 0.72 for firms investing in the North, and 0.24 for firms investing in the South (again, $Z = 1$ for US firms). US acquirers have more opportunity to leverage the difference in productivity between acquirers and targets when they are making M&As in the South (i.e., $Z - z = 0.28$ in the North, while $Z - z = 0.76$ in the South). The larger gain from mergers and the lower probability of matching create a much higher search cost, and

Table 11: Socially Optimal K^s and Market Equilibrium K^*

	South		North	
	K^s	K^*	K^s	K^*
Threshold level of intangibles	1.370	1.326	3.624	3.730

This table shows the threshold level of intangible capital in market equilibrium, K^*, and that in social optimum, K^s. I compute the values using calibrated parameters and equations 19 and 20.

discourage firms from searching for M&A partners in the South. To set the M&A friction parameters, η, I consider the fact that cultural barriers and communication costs affect the quality of post-acquisition integration. Thus, I assume the distance between host countries and the US governs the M&A friction parameter, and use the number of investments to compute a weighted average of the distance. The ratio of the average distance in the South to that of the North is 1.35.[57] Considering the baseline value $\eta = 0.80$, I set the M&A friction parameter to 0.92 in the North and 0.68 in the South. Using the labor market clearing condition (equation 18), I obtain the equilibrium wage, w^*, in the North is 39.97 and 29.68 in the South.

6.4 Counterfactual Experiments

I showed that the market equilibrium can be socially inefficient, which means that the threshold level of intangibles in market equilibrium, K^*, is different from that in social optimum, K^s. Given that the equilibrium pattern of FDI is different between the South and the North, I first compute the two different threshold levels of intangibles, K^* and K^s, using the calibrated parameters. Table 11 shows the results. In the South, the socially optimal cutoff, K^s, is higher than the market equilibrium cutoff, K^* (i.e., $K^s > K^*$), while the former, K^s, is lower than the latter, K^* in the North (i.e., $K^s < K^*$). Therefore, we expect that the amount of M&A can be too many in the North and too little in the South. This difference suggests that policymakers in the South and the North would take opposite actions toward M&A restrictions. I discuss this policy implication in this section.

[57]The weighted average distances are 6962 km in the North and 9405 km in the South.

Table 12: Change in Local Welfare: Tax on Profits of GF Multinationals in the South

Welfare	baseline	0.5% tax		1%tax	
	value	value	change (%)	value	change (%)
Wage payment	29.678	29.683	0.019	29.689	0.037
Profits of local firms	26.368	26.335	−0.062	26.210	−0.123
Acquisition transfer	1.102	1.120	1.716	1.139	3.436
Tax transfer	0	0.100	–	0.964	–
Total	57.148	57.256	0.189	57.363	0.377

This table shows how welfare changes when there is a 1% and 5% tax on the profits of GF multinationals in the South.

6.4.1 Tax on GF investments in the South

First, I consider the effects of a tax on the profits of GF multinationals in the South. Policymakers in the South would restrict GF investment because the host country receives more GF than the socially optimal level. A change in firms' profits affects the cutoff condition which determines the minimum level of intangible capital whether a multinational firm needs to make an M&A search worthwhile. Consider a τ% tax on GF profits. The profits of a GF multinational with intangible capital K_i are given by:

$$(1-\tau)\pi_g(w, Y, K_i) \;= (1-\tau)\Theta(w)ZK_i, \tag{21}$$

where $\tau > 0$. The cutoff condition (equation 17) becomes

$$\hat{\mu}(K^*)(1-\chi)\Theta(w, K^*)\left[(Z-z)\kappa - Z((1-\tau)-\eta)K^*\right] = \psi.$$

When multinationals decide whether to search for an M&A target, they compare their expected profits from M&A and GF investments. Lower expected profits from choosing GF investments encourage multinationals to instead try to find an M&A partner, resulting in more M&A deals and fewer GF investments. In the experiment, I find that if there is a tax on GF profits, the threshold value of intangibles, K^*, increases and the amount of M&A investment that a local country receives increases by 3.8%.

I compute the change in local welfare using equation (15). Table 12 shows that, if the government taxes GF multinationals, both wages and acquisition transfers increase (by 0.037% and 3.44%, respectively, for a 1% tax). By contrast, local firms' profits decline (by 0.12%). Thus, the net welfare effect of the tax is positive: the increases in wages and

Table 13: Change in Local Welfare: Subsidy to Profits of GF Multinationals, in the North

Welfare	baseline	0.5% subsidy		1% subsidy	
	value	value	change (%)	value	change (%)
Wage payment	39.969	39.986	0.043	40.002	0.081
Profits of local firms	29.106	29.149	0.148	29.197	0.313
Acquisition transfer	7.305	7.247	−0.794	7.185	−1.643
Tax Payment	0	−0.087	–	−0.177	–
Total	76.380	76.382	0.003	76.383	0.004

This table shows how welfare changes when government subsidies on GF multinationals in the North.

acquisition transfers more than offset the decrease in local profits. Since more local firms will be acquired, households will receive lower profit dividends from local firms. However, the increase in wages and the additional acquisition transfers more than offset this loss, and thus the net effect on welfare will be positive. The government transfers all tax revenue to households.

6.4.2 Subsidy on GF investments in the North

I next consider the effects of state subsidies on GF multinationals in the North (i.e., $\tau < 0$ in equation 21). Higher expected profits from making GF investments discourage multinationals from searching for their M&A partners, and thus fewer M&As occur. The simulation shows that a tax on GF profits decreases the threshold value of intangibles, K^*, and the amount of GF investment that a local country receives increases by 0.7%.

Table 13 shows how welfare in the host country changes when it increases subsidies by 0.5% and 1%. When the host country receives more GF investments, both wage payments and the total profits of local firms increase. Although the representative consumer receives lower total acquisition receipts and needs to pay taxes to cover the subsidies, there is a positive net effect on welfare. There are two key findings to note. First, FDI policies that subsidize GF investments increase total welfare, but the net effect is small. Second, my counterfactual analysis shows that if policymakers would like to increase wage payments, they can restrict M&As even though total welfare does not increase by much. An increase in foreign M&A activity can bring objections from the public in the North because it endangers local jobs (Katitas, 2020). My model suggests that those concerns on the part of workers might be well-founded.

7 Conclusion

This paper investigates the determinants of firm FDI entry mode choice and how that choice affects welfare in investment-receiving countries. To do so, I first construct a novel dataset and empirically show that a firm with less intangible capital is more likely to make M&A investments, whereas one with more intangible capital is more likely to choose GF. This result allows me to develop a model of firm FDI choice. In the model, firms' intangible capital levels determine which mode of FDI they pursue. Under a reasonable set of assumptions, I show that firms with lower intangible capital tend to choose M&A, which is consistent with my empirical results.

Moreover, I show that equilibrium FDI patterns can be suboptimal because of search externalities. This allows me to assess the welfare effects of various policies in investment-receiving countries through changes in FDI. In particular, I find that the effects of FDI policies differ between a developed economy (i.e., the North) and a developing economy (i.e., the South). In the South, policies that restrict GF investments raise total welfare. By contrast, in the North, I find that policies that promote GF decrease total welfare.

The local firm's intangible capital is constant in my model because of data limitations. However, the recent M&A literature considers heterogeneous targets and assortative matching. A possible extension of my model is to make the local firm's intangibles κ heterogeneous and consider sorting between multinationals and locals (i.e., a high-K multinational may look for a high-κ local firm). Another possible extension is to endogenize multinational firms' intangibles K and local firms' intangibles κ. This extension would reveal potential sources of additional inefficiencies (e.g., over/under-investment) and further room for policy intervention. Lastly, my model can help in analyzing other policy interventions. For example, future work could investigate the possibility of a government's levying taxes on the costs of M&A (i.e., acquisition transfer or search costs) and distributing the tax revenue to GF multinationals as an investment incentive.

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Appendix A Data Appendix

I provide a detailed explanation of how to treat the three main datasets that I described in Section 2.1.

A.1 Greenfield Projects (fDi Market)

- The database provides source and destination locations at the city level. If a company made more than one investment in several cities (in the same country) on the same project date, these investments are recorded as different investments in the fDi Market database. I aggregated these investments.

- I assign a unique NAICS 2007 code to each sub-sector by referring to the cross-work the vendor, the Financial Times, provided.

A.2 Cross-border M&A Deals (SDC Platinum)

- There are mainly two dates concerning completed M&A deals: one is "date announced" and the other is "date effective" (i.e., completion date). fDi Market provides "project date" which indicates the month when the GF project started and does not provide information about when the GF project has been completed. In line with the fDi Market database, I use "date announced" in SDC Platinum as the date when the M&A project was started.

- If a firm acquired a particular target multiple times, I gathered these deals and aggregated these ownership shares. I keep the year when the firm made the first acquisition for this particular target.

- The information of the share on acquisition is missing in 11.6% of the total deals. For these deals, I check if an acquirer owned the majority of its target's shares using the information of "form of transactions" (code in SDC: FORM). If the deals are with the following codes, I keep the transactions:

  - MERGER: A combination of businesses takes place, or 100% of the stock of a public or private company is acquired.
  - ACQUISITION: A deal in which 100% of a company is spun off or split off is classified as an acquisition by shareholders.

- ACQ OF MAJORITY INTEREST: An acquirer must have held less than 50% and be seeking to acquire 50% or more but less than 100% of the target company's stock.
- ACQ OF REMAINING INTEREST:A deal in which the acquirer holds over 50% and is seeking to acquire 100% of the target company's stock.

- I delete the deals with targets or acquirers in the following three-digit SDC Platinum NAICS codes (i.e., deals that involve investing funds and also government related agencies):
  - 523: Securities, Commodity Contracts, and Other Financial Investments and Related Activities
  - 525: Funds, Trusts, and Other Financial Vehicles
  - BCC: Blank Check Company, Sovereign Wealth Fund, Infrastructure Fund, Hedge Fund, and Financial Sponsor.
  - AAA: EU organizations and Bodies, Public Enterprise and Authority, Non-government Agency, City Agency, City Government, Regional/State Agency, Regional/State Government, National Government Agency, and National Government
  - 999: Non-government Agencies, City Agency, City Government, Regional Agency, Regional Government, National Government Agency, and National Government
- There are special NAICS codes in SDC Platinum data. I replace the following codes in accordance with 2007 NAICS to merge the SDC data with Compustat:
  - BBBBBA: Internet Service Providers (such as Comcast Corporation) → NAICS code: 517911
  - BBBBBB: Web Search Portals (such as Alphabet Inc.) → NAICS code: 518210

A.3 US firms' Financial Data (Compustat)

- I downloaded firms' financial data from Compustat North America—Annual Updates. The data period is from 1980 to 2018 in the firms' fiscal year. I use "data date" if the fiscal year is missing.
- I restricted firms only in the US by deleting 1) firms that report their financial statements in Canadian dollars, and 2) firms that have their headquarters outside the US.

- Following Peter and Taylor (2017), I deleted firms with negative sales.
- In order to accumulate intangible capital using sufficient financial information, I deleted firms with the information in less than a six-year period.
- Since the industry classification both in SDC Platinum and fDi Market databases are NAICS 2007, I changed NAICS codes in Compustat from 2017 NAICS to 2007 NAICS using historical NAICS codes (Compustat item *naicsh*). If the historical codes are missing, I checked their NAICS 2007 codes manually.
- Compustat assigns industry code 9999 (unclassified establishment) to some firms, and the code 9999 does not exist in the NAICS classification. In my dataset, there are around 20 firms with NAICS 9999. I assigned new industry codes to these firms using acquirers' NAICS codes in SDC Platinum if the firms made M&A investments. If those firms did not make M&As, I referred to the NAICS codes in their SEC filing.

A.4 Summary Statistics of Host Country Variables

Table A.1 shows the summary statistics of variables in host countries. The mean of average local intangible capital stock is smaller than multinationals' intangible capital stock (shown in Table 1). Local intangible capital stock includes non-multinational firms (small and medium-sized firms).

Table A.1: Summary Statistics (Local Firms' Variables)

Variable	mean	s.d.	min	max	Number of observations
Number of local firms	10.451	2.081	2.079	14.824	6,581
Average local intangibles	11.817	1.588	6.053	19.043	4,127
Local intangible stock	22.500	1.649	14.164	25.168	5,440

The number of local firms is from the SDBS Structural Business Statistics, and the total intangible stock is from the EUKLEMS & INTANProd database. Both variables are at the host country-affiliate industry level. The unit of intangible stock is a million USD. All variables are in logs.

A.5 Subsequent Investments

Table A.2 shows the relationship between the entry mode in the first FDI and that in the subsequent FDIs made in the same country and industry. There are 9,163 first GF deals, and 6,595 first M&A deals in firm-affiliate industry-country. 96% of GF investments were never followed up by M&A, and 95% of M&A investments were never followed up by GF.

Table A.2: Entry Modes in Additional Investments

	Subsequent FDIs				
First FDI	GF	M&A	Both	None	Total
GF	**1,923**	189	166	6,885	9,163
M&A	225	**814**	99	5,457	6,595

A.6 FDI destinations of US multinationals

This table shows the five major FDI destinations in terms of the number of FDI investments they received between 2003 and 2018. China and India attract more GF investments, while the UK, Canada, and Germany attract cross-border M&A.

Table A.3: Top Five FDI destinations

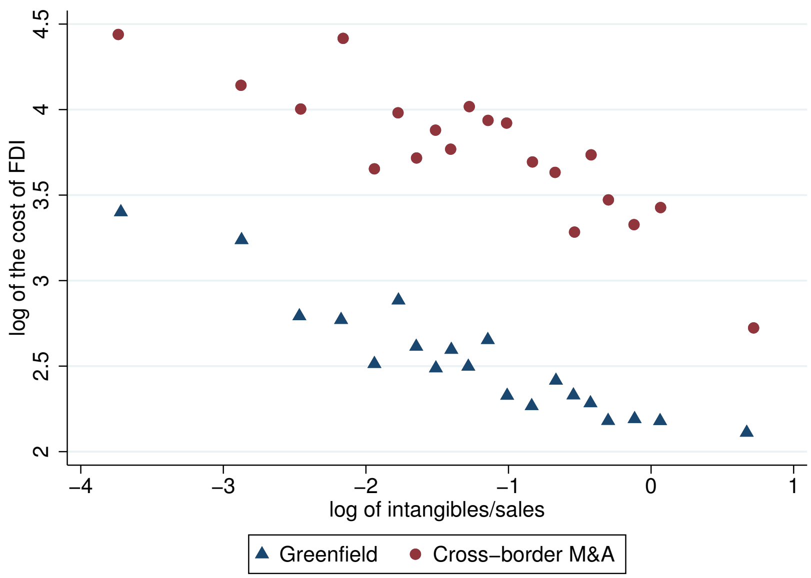
	All		GF		M&A	
Rank	Country	Share (%)	Country	Share (%)	Country	Share (%)
1	UK	10.2	China	9.0	UK	16.7
2	Canada	7.8	India	6.6	Canada	14.3
3	China	6.3	UK	5.6	Germany	8.0
4	Germany	5.5	Germany	3.8	Australia	4.6
5	India	4.9	Singapore	3.7	France	4.4

This table shows the five most common FDI destinations of US multinational firms. I rank the countries in terms of the number of FDI investments they received between 2003 and 2018. The first two columns show the names of host countries and the share of all FDI investments by US-listed firms that went to that location. The following columns show the same information by spiting FDI into GF investment and cross-border M&A.

A.7 Costs for GF and M&A

Figure A.1 is the bin-scatter plot on the log of the cost of FDI (in the y-axis) and the log of intangible capital intensity (the ratio of intangible capital to sales in the x-axis). I observe that M&A firms spend more than GF firms for any size of intangible intensity.

Figure A.1: Costs for FDI and Intangible Capital Intensity



The vertical axis shows the costs of investment, and the horizontal axis shows the ratio of intangible capital to sales. The cost of GF is the amount of capital investment (that comes from the fDi market database), and the cost for M&A is the acquisition price (that comes from the SDC Platinum database). This figure is a binned scatter plot. The data space is partitioned into rectangular bins and compute the mean of the variables in the horizontal and vertical axes within each bin. I then create a scatter plot of these data points.

Appendix B Additional Empirical Results

Table B.1 shows the results of the logit regressions analogous to Nocke and Yeaple (2008). Same as Nocke and Yeaple (2008), I find negative coefficients both on sales (SALE) and value-added per worker (VADDPW).

Table B.1: Logit Regressions Analogous to Nocke and Yeaple (2008)

Dep var:	(1)	(2)	(3)	(4)
MA= 1 vs GF = 0	SALE	VADDPW	SALE	VADDPW
efficiency	-0.083^{***}	-0.212^{***}	-0.104^{***}	-0.195^{***}
	(0.020)	(0.077)	(0.020)	(0.040)
emp		-0.079***		-0.103^{***}
		(0.024)		(0.023)
gdppc			0.877^{***}	0.890^{***}
			(0.164)	(0.165)
pop			0.009	0.011
			(0.069)	(0.071)
open			-0.685^{***}	-0.684^{***}
			(0.173)	(0.174)
dist			-0.509^{***}	-0.507^{***}
			(0.100)	(0.100)
Parent Ind FE	Yes	Yes	Yes	Yes
Affiliate Ind FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	No	No
N	14,805	14,479	15,019	14,690

Standard errors are clustered by firm (same as in Nocke and Yeaple, 2008). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All explanatory variables are in logs.

Appendix C Detailed Calculations and Parameters

C.1 Proof for Equation (14)

The derivative of the left-hand side of equation (14) with respect to K^* is:

$$(1-\chi)\Theta\frac{\partial\hat{\mu}(K^*)}{\partial K^*}\left[(Z-z)\kappa - Z(1-\eta)K^*\right] - (1-\chi)\Theta\hat{\mu}(K^*)\left[Z(1-\eta)\right].$$

Because $\frac{\partial\hat{\mu}(K^*)}{\partial K^*} < 0$ and the second term is negative, the left-hand side of equation (14) is decreasing in K^*. The right-hand side of equation (14) is constant as $\psi > 0$, and therefore there exists the threshold level of intangible capital, K^*. If multinational's intangible capital, K_i, is lower than the cutoff, K^*, the search condition, equation (13), holds. Such multinational obtains the positive merger gain. Thus, a multinational firm with $K_i < K^*$ will search and consummate the M&A.

Since $\psi > 0$, the right-hand side of equation (14) should be positive. This provides an upper bound of K^* such that $\bar{K}^* = \frac{(Z-z)\kappa}{Z(1-\eta)}$.

C.2 Solution for Y

From equation (4): $Y = \left[\int_\Omega y_\omega^{\frac{\sigma-1}{\sigma}} d\omega\right]^{\frac{\sigma}{\sigma-1}}$,

$$\begin{aligned}
Y^{\frac{\sigma-1}{\sigma}} &= \int_\Omega y_\omega^{\frac{\sigma-1}{\sigma}} d\omega \\
&= \hat{\mu}(K^*)M\int_{\underline{K}=1}^{K^*}\left[Z^\alpha(\kappa+\eta K)^\alpha \ell_m^\beta\right]^{\frac{\sigma-1}{\sigma}} dG(K) + (1-\hat{\mu}(K^*))M\int_{\underline{K}=1}^{K^*}\left[Z^\alpha K^\alpha \ell_g^\beta\right]^{\frac{\sigma-1}{\sigma}} dG(K) \\
&\quad + M\int_{K^*}^{\infty}\left[Z^\alpha K^\alpha \ell_g^\beta\right]^{\frac{\sigma-1}{\sigma}} dG(K) + (N-\hat{\mu}(K^*)MG(K^*))\left[z^\alpha\kappa^\alpha\ell_a^\beta\right]^{\frac{\sigma-1}{\sigma}}. \\
&= \left(\frac{1}{w}\frac{\beta(\sigma-1)}{\sigma}\right)^{\beta/\alpha} Y^{\beta/\sigma\alpha}\left\{\hat{\mu}(K^*)MZ\int_{\underline{K}=1}^{K^*}(\kappa+\eta K)\; dG(K) + (1-\hat{\mu}(K^*))MZ\int_{\underline{K}=1}^{K^*} K\; dG(K)\right. \\
&\quad \left. + MZ\int_{K^*}^{\infty} K\; dG(K) + (N-\hat{\mu}(K^*)MG(K^*))z\kappa\right\},
\end{aligned}$$

where I use the labor demand (equation 7) in the third equality. This becomes

$$Y^{\frac{\sigma-1}{\sigma}-\frac{\beta}{\sigma\alpha}} = \left(\frac{1}{w}\frac{\beta(\sigma-1)}{\sigma}\right)^{\beta/\alpha}\hat{Y}(K^*),$$

where

$$
\begin{aligned}
\hat{Y}(K^*) &= \hat{\mu}(K^*)MZ\int_{\underline{K}=1}^{K^*}(\kappa+\eta K)\ dG(K) + (1-\hat{\mu}(K^*))MZ\int_{\underline{K}=1}^{K^*}K\ dG(K) \\
&\quad + MZ\int_{K^*}^{\infty}K\ dG(K) + (N-\hat{\mu}(K^*)MG(K^*))z\kappa \\
&= Nz\kappa + MZ\int_{\underline{K}=1}^{\infty}k\ dG(K) + \hat{\mu}(K^*)MG(K^*)\left[(Z-z)\kappa - Z(1-\eta)\int_{\underline{K}=1}^{K^*}K\ \frac{1}{G(K^*)}\ dG(K)\right].
\end{aligned}
$$

Thus, $Y = \left(\frac{1}{w}\frac{\beta(\sigma-1)}{\sigma}\right)^{\frac{\beta}{1-\beta}}\hat{Y}(K^*)^{\frac{\alpha}{1-\beta}}$. This shows that the aggregate output, Y, is a function of w and K^*.

C.3 Proof for Proposition 2

$$
\begin{aligned}
\frac{\partial\hat{Y}(K^*)}{\partial K^*} &= \frac{\partial\hat{\mu}(K^*)}{\partial K^*}MG(K^*)\left[(Z-z)\kappa - Z(1-\eta)\int_{\underline{K}=1}^{K^*}K\ \frac{1}{G(K^*)}\ dG(K)\right] \\
&\quad + \hat{\mu}(K^*)Mg(K^*)[(Z-z)\kappa - Z(1-\eta)K^*]. \\
&= \hat{\mu}(K^*)Mg(K^*)\left\{-\frac{(MG(K^*)/N)^\rho}{1+(MG(K^*)/N)^\rho}\left[(Z-z)\kappa - Z(1-\eta)\int_{\underline{K}=1}^{K^*}K\ \frac{1}{G(K^*)}\ dG(K)\right]\right. \\
&\quad \left. +[(Z-z)\kappa - Z(1-\eta)K^*]\right\}.
\end{aligned}
$$

$\frac{(MG(K^*)/N)^\rho}{1+(MG(K^*)/N)^\rho} \in (0,1)$ and $K^* > E[K^*] = \int_{\underline{K}=1}^{K^*}K\ \frac{1}{G(K^*)}\ dG(K)$. This gives $\frac{\partial\hat{Y}(K^*)}{\partial K^*} > 0$ if $K^* \to 1$, and $\frac{\partial\hat{Y}(K^*)}{\partial K^*} < 0$ if $K^* \to \bar{K}^* = \frac{(Z-z)\kappa}{Z(1-\eta)}$. Thus, $\hat{Y}(K^*)$ is a concave function. Since $\hat{Y}(K^*)$ is continuous, there exists $\hat{K}^*$ that maximizes $\hat{Y}(K^*)$ and also the aggregate output Y.

C.4 Proof for Proposition 3

Before showing the existence and uniqueness, I show $\tilde{\Theta}(w)$ and $\Theta(w)$ are decreasing in w. In section 4.3.3, I show that under the labor market condition, the total output, Y, is a function only of w. Inserting $Y = w\frac{\sigma}{\beta(\sigma-1)}L$ into $\tilde{\Theta}(w,Y) \equiv \left[\frac{Y^{1/\sigma}}{w}(\beta(\sigma-1)/\sigma)\right]^{\frac{\sigma}{(1-\beta)\sigma+\beta}}$ (from equation 7) and $\Theta(w,Y) \equiv \left(w\frac{(1-\beta)\sigma+\beta}{\beta(\sigma-1)}\right)\tilde{\Theta}(w,Y)$ (from equation 8) gives $\tilde{\Theta}(w) = \Phi w^{-u}$ and $\Theta(w) = \frac{\Phi}{\beta u}w^{1-u}$ where $u = \frac{\sigma-1}{(1-\beta)\sigma+\beta}$ and $\Phi = L^{\frac{u}{\sigma-1}}(\beta(\sigma-1)/\sigma)^u$. Since $\Phi > 0$ and $u > 0$, $\tilde{\Theta}(w)$ is decreasing in w. $\Theta(w)$ is decreasing in w if $u > 1 \leftrightarrow \sigma > (1+\beta)/\beta$. I assume $u > 1$ in the following proof.

Existence: I restate the cutoff condition (equation 17) using $\Theta(w) = \frac{\Phi}{\beta u} w^{1-u}$

$$w^{u-1} = \frac{(1-\chi)\Phi\hat{\mu}(K^*)\left[(Z-z)\kappa - Z(1-\eta)K^*\right]}{\psi\beta u}. \tag{C.1}$$

$\hat{\mu}(K^*)$ has a property that it is decreasing in K^*, and it takes $\hat{\mu}(K^*) = 1$ when $K^* = \underline{K} = 1$ and $\lim_{K^*\to\infty} = \underline{\mu}$ where μ is the minimum value of $\underline{\mu}$. Thus, the right-hand side of equation C.1 is decreasing in K^*, and there exists $\bar{w} > 0$ and $\bar{K}^* > 0$ such that $w = \bar{w}$ when $K^* = \underline{K}$ and $w = 0$ when $K^* = \bar{K}^*$.

Using $\tilde{\Theta}(w) = w^{-u}\Phi$, the labor market condition (equation 18) is

$$w^u = \frac{\Phi}{L}\hat{Y}(K^*), \tag{C.2}$$

where $\hat{Y}(K^*)$ is defined by equation (16). $\hat{Y}(K^*)$ is a concave function (as I showed in proposition 2) and finite for any $K^* \geq 1$, and thus there exists $w > 0$ that solves this equation. To show the existence, it is sufficient to show that the solution to this equation when $K^* = \underline{K}$ is lower than $\bar{w}$. Whether this is the case depends on parameter values. In particular, it is straightforward to see that it is the case when ψ is sufficiently small (i.e., when $\bar{w}$ is large) or L is sufficiently large (i.e., the solution to this equation when $K^* = \underline{K}$ is small).

Uniqueness: To show the uniqueness, it is sufficient to show that the slope of the cutoff condition (equation C.1) is smaller (more negative) than the slope of the labor market condition (equation C.2) at the point where these two equations cross. The slope of equation C.1, $\frac{\partial w}{\partial K^*}$, is

$$\begin{aligned}\frac{1}{u-1}\Bigg\{&\left(\frac{(1-\chi)\hat{\mu}(K^*)[(Z-z)\kappa - Z(1-\eta)K^*]}{\psi}\right)^{\frac{1}{u-1}-1}\left(\frac{(1-\chi)\hat{\mu}'(K^*)[(Z-z)\kappa - Z(1-\eta)K^*]}{\psi}\right)\\ &-\left(\frac{(1-\chi)\hat{\mu}(K^*)[(Z-z)\kappa - Z(1-\eta)K^*]}{\psi}\right)^{\frac{1}{u-1}-1}\left(\frac{(1-\chi)\hat{\mu}(K^*)Z(1-\eta)}{\psi}\right)\Bigg\}.\end{aligned}$$

The second term is negative, so it is sufficient to show that the first term is sufficiently small. Using equation C.1, the first term can be written as

$$\frac{w}{u-1}\frac{\hat{\mu}'(K^*)}{\hat{\mu}(K^*)}.$$

Next, the slope of equation C.2 is

$$\frac{w}{u}\frac{\hat{\mu}'(K^*)MG(K^*)[(Z-z)\kappa - Z(1-\eta)\int_{\underline{K}=1}^{K^*} K\ \frac{1}{G(K^*)}\ dG(K)] + \hat{\mu}(K^*)Mg(K^*)[(Z-z)\kappa - Z(1-\eta)K^*]}{Nz\kappa + MZ\int_{\underline{K}=1}^{\infty} k\ dG(K) + \hat{\mu}(K^*)MG(K^*)\left[(Z-z)\kappa - Z(1-\eta)\int_{\underline{K}=1}^{K^*} K\ \frac{1}{G(K^*)}\ dG(K)\right]}$$

Since the second term of the numerator is positive, it is sufficient to show that the above value is sufficiently large even without it. Now our task is to show that

$$\frac{w}{u}\frac{\hat{\mu}'(K^*)MG(K^*)[(Z-z)\kappa - Z(1-\eta)\int_{\underline{K}=1}^{K^*} K\ \frac{1}{G(K^*)}\ dG(K)]}{Nz\kappa + MZ\int_{\underline{K}=1}^{\infty} k\ dG(K) + \hat{\mu}(K^*)MG(K^*)\left[(Z-z)\kappa - Z(1-\eta)\int_{\underline{K}=1}^{K^*} K\ \frac{1}{G(K^*)}\ dG(K)\right]}$$

is larger than

$$\frac{w}{u-1}\frac{\hat{\mu}'(K^*)}{\hat{\mu}(K^*)}.$$

We can rewrite the former equation as

$$\frac{w}{u}\frac{\hat{\mu}'(K^*)}{\hat{\mu}(K^*)}\frac{Q}{Q+S},$$

where Q is the numerator value and $S = Nz\kappa + MZ\int_{\underline{K}=1}^{\infty} k\ dG(K)$. Because $Q > 0$ and $S > 0$, $\frac{Q}{Q+S} \in (0,1)$. Thus,

$$\frac{w}{u}\frac{\hat{\mu}'(K^*)}{\hat{\mu}(K^*)}\frac{Q}{Q+S} > \frac{w}{u-1}\frac{\hat{\mu}'(K^*)}{\hat{\mu}(K^*)}.$$

Note that both sides in the inequality are negative since $\hat{\mu}'(K^*) < 0$.

C.5 Total Expenditure

I assume local firms are owned by local consumers, whereas M&A and GF firms are foreign-owned. All firms earn profits and pay wage bills. When multinationals search, they incur search costs, and if they acquire local firms, they make acquisition payments. All payments are made in terms of the final good, Y. The representative household's consumption is also denominated in terms of Y.

The income of the representative household, $I(w, K^*)$, is the sum of wage payments, profits of local firms, and acquisition transfers:

$$I(w, K^*) = wL + [N - \hat{\mu}(K^*)MG(K^*)]\Theta(w)z\kappa + \hat{\mu}(K^*)M\int_{\underline{K}=1}^{K^*} P(w, K)dG(K)$$

The final good market clears such that:

$$Y(w,K^*) = I(w,K^*) + \hat{\mu}(K^*)M\int_{\underline{K}}^{K^*}\Theta(w)Z(\kappa+\eta K)dG(K)$$
$$+[1-\hat{\mu}(K^*)]M\int_{\underline{K}}^{K^*}\Theta(w)ZKdG(K) + M\int_{K^*}^{\infty}\Theta(w)ZKdG(K) + MG(K^*)\psi.$$

where $I(w,K^*)$ is defined above. The second, third, and fourth terms represent the profits of M&A and GF firms, and they are repatriated to source country s. The last term is search costs.[58]

C.6 Efficiency

C.6.1 Market Equilibrium K^*

The cutoff condition (equation 17) is

$$\hat{\mu}(K^*)(1-\chi)\Theta(w,Y)\left[(Z-z)\kappa - Z(1-\eta)K^*\right] = \psi,$$

where $\Theta(w,Y) = \frac{\sigma-(\sigma-1)\beta}{\sigma}Y^{\frac{1}{\sigma}}\tilde{\Theta}(w,Y)^{\frac{\sigma-1}{\sigma}\beta}$. Using $\tilde{\Theta}(w,Y) = \left[\frac{Y^{1/\sigma}}{w}(\beta(\sigma-1)/\sigma)\right]^{\frac{\sigma}{(1-\beta)\sigma+\beta}}$ and $Y = \left(\frac{1}{w}\frac{\beta(\sigma-1)}{\sigma}\right)^{\frac{\beta}{1-\beta}}\hat{Y}(K^*)^{\frac{\alpha}{1-\beta}}$ (equation 16), $Y^{1/\sigma} = \tilde{\Theta}^{\beta/\sigma}\hat{Y}(K^*)^{\frac{1}{\sigma-1}}$. With this function of $Y^{1/\sigma}$ and $L = \tilde{\Theta}(w)\hat{Y}(K^*)$ (the labor market clearing condition, equation 18), I can set the following equation that K^* satisfies in equilibrium:

$$\frac{\sigma-(\sigma-1)\beta}{\sigma}\,\hat{Y}(K^*)^{\frac{1}{\sigma-1}-\beta}L^{\beta}\hat{\mu}(K^*)(1-\chi)[(Z-z)\kappa - Z(1-\eta)K^*] = \psi.$$

Using equations (7) and (18), the labor demand for each type of firms can be represented as $\ell_\omega = \frac{LZ_\omega K_\omega}{\hat{Y}(K^*)}$ in equilibrium.

C.6.2 Social Planner's Problem

I solve the social planner's problem:

$$\max_{K^s,\ell_\omega}\; Y - MG(K^s)\psi,$$

[58] I assume for simplicity that host country h only exports the final good Y to sources country s, and does not import anything s in return. Searching multinationals' finance acquisition prices and search costs are paid by an IOU. Because there are no imports, there are no gains in h from diversifying product varieties. The host country's gains from openness mainly come from technology transfer through FDIs. In this static model, host country h runs a trade surplus.

subject to the resource constraint, $L = \int \ell_\omega d\omega$. The problem can be divided into two steps: (i) the search decision and (ii) the allocation of workers given the search outcome. I solve the question backwards.

First, from equation (4), the labor decision problem is

$$\max_{\ell_\omega} \; Y = \left[\int_\Omega (Z_\omega^\alpha K_\omega^\alpha \ell_\omega^\beta)^{\frac{\sigma-1}{\sigma}} d\omega\right]^{\frac{\sigma}{\sigma-1}},$$

subject to the resource constraint, $L = \int \ell_\omega d\omega$.

Let λ be the Lagrange multiplier of the constraint. Then,

$$L = \left[\int_\Omega (Z_\omega^\alpha K_\omega^\alpha \ell_\omega^\beta)^{\frac{\sigma-1}{\sigma}} d\omega\right]^{\frac{\sigma}{\sigma-1}} + \lambda(L - \int \ell_\omega d\omega).$$

The first-order condition on ℓ_ω is

$$\begin{aligned} Y^{\frac{1}{\sigma}} (Z_\omega K_\omega)^{\left(1-\frac{\sigma-1}{\sigma}\beta\right)} \ell_\omega^{\left(\frac{\sigma-1}{\sigma}\beta-1\right)} \beta &= \lambda \\ \leftrightarrow \ell_\omega &= \left(\frac{Y^{1/\sigma}\beta}{\lambda}\right)^{\frac{\sigma}{\sigma-(\sigma-1)\beta}} Z_\omega K_\omega \end{aligned}$$

Using the resource constraint,

$$\begin{aligned} \int_\Omega \ell_\omega d\omega &= \left(\frac{Y^{1/\sigma}\beta}{\lambda}\right)^{\frac{\sigma}{\sigma-(\sigma-1)\beta}} \int_\Omega Z_\omega K_\omega d\omega \\ \leftrightarrow \left(\frac{Y^{1/\sigma}\beta}{\lambda}\right)^{\frac{\sigma}{\sigma-(\sigma-1)\beta}} &= \frac{L}{\int_\Omega Z_\omega K_\omega d\omega} \end{aligned}$$

because $L = \int_\Omega \ell_\omega d\omega$. Therefore, the solution is

$$\ell_\omega = \frac{L Z_\omega K_\omega}{\int_\Omega Z_\omega K_\omega d\omega}.$$

Since we can consider $\int_\Omega Z_\omega K_\omega d\omega = \hat{Y}(K^s)$, the labor allocation is identical to the market equilibrium if K^s is equal to K^*. If this is the case, the amount of M&A and GF investments that the local economy receives is the same as the one in the market equilibrium.

Second, the social planner solves the search decision problem:

$$\max_{K^s} \; Y - MG(K^s)\psi = \left[\int_\Omega (Z_\omega K_\omega)^{\frac{\sigma-1}{\sigma}} d\omega\right]^{\frac{\sigma}{\sigma-1}-\beta} L^\beta - MG(K^s)\psi$$

The first-order condition is

$$\frac{\sigma-(\sigma-1)\beta}{\sigma-1}\,\hat{Y}(K^*)^{\frac{1}{\sigma-1}-\beta}L^\beta\mu(MG(K^s))$$
$$\times\left([(Z-z)\kappa-Z(1-\eta)K^s]-\frac{\mu'(MG(K^s))MG(K^s)}{\mu(MG(K^s))}\int_{\underline{K}}^{K^s}[Z(1-\eta)(K^s-K)]dG(K)\right)=\psi,$$

where I use $\hat{\mu}(K^s)=\mu(MG(K^s))$.

The solution is

$$\frac{\sigma-(\sigma-1)\beta}{\sigma-1}\,\hat{Y}(K^*)^{\frac{1}{\sigma-1}-\beta}L^\beta\hat{\mu}(K^s)$$
$$\times\left((1-\xi(K^s))[(Z-z)\kappa-Z(1-\eta)K^s]-\frac{\xi(K^s)}{G(K^s)}\int_{\underline{K}}^{K^s}[Z(1-\eta)(K^s-K)]dG(K)\right)=\psi,$$

where $\xi(K^s)$ is the elasticity of the matching function:

$$\xi(K^s)=-\frac{\mu'(MG(K^s))MG(K^s)}{\mu(MG(K^s))}.$$

Appendix D Testing Model Implications: Share of M&A

I test model implications using the share of M&A. The share of M&A can be represented using the measure of firms defined in Section 4.2.4:

$$MA\text{-}share = \hat{\mu}(K^*)G(K^*),$$

where K^* is the threshold level of multinationals' intangibles. Here, I aggregate the data to the host-country-affiliate-industry level. The exogenous parameters that I considered in Section 5, $\{N_{hj},\ \kappa_{hj},\ \psi_h\}$, affect the share of M&A investment, $MA\text{-}share_{hj}$, through K^*. Taking derivatives of $MA\text{-}share_{hj}$ with respect the exogenous parameters, I expect signs on each coefficient: $\frac{\partial MA\text{-}share_{hj}}{\partial N_{hj}} > 0$, $\frac{\partial MA\text{-}share_{hj}}{\partial \kappa_{hj}} > 0$, $\frac{\partial MA\text{-}share_{hj}}{\partial N_{hj}\kappa_{hj}} > 0$, and $\frac{\partial MA\text{-}share_{hj}}{\partial \phi_h} < 0$.

Table D.1: Testing Model Implications: Share of M&A

Dependent variable: $MA\text{-}share_{hj}$	Country-industry variation			Country variation		
	(1)	(2)	(3)	(4)	(5)	(6)
Number of local firms (N_{hj})	0.028**			0.048***		
	(0.014)			(0.015)		
Average local intangibles (κ_{hj})		0.017***			0.089***	
		(0.007)			(0.023)	
Local intangible stock ($N_{hj}\kappa_{hj}$)			0.045**			0.122***
			(0.011)			(0.020)
Distance (ψ_h)				−0.118**	−0.611**	−0.570***
				(0.059)	(0.244)	(0.102)
Country FE	Yes	Yes	Yes			
Affiliate-industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	789	378	436	750	352	408
Adjusted R^2	0.498	0.542	0.508	0.360	0.469	0.457

Other country variables, such as the FDI regulatory restrictiveness index, population, and openness, are included in columns 4-6. I do not include common language (because the UK is only the English-speaking country in my data sample) and GDP per capita (because it is highly correlated with the total intangible stocks). Standard errors are clustered by country and affiliate-industry. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All explanatory variables are in logs.

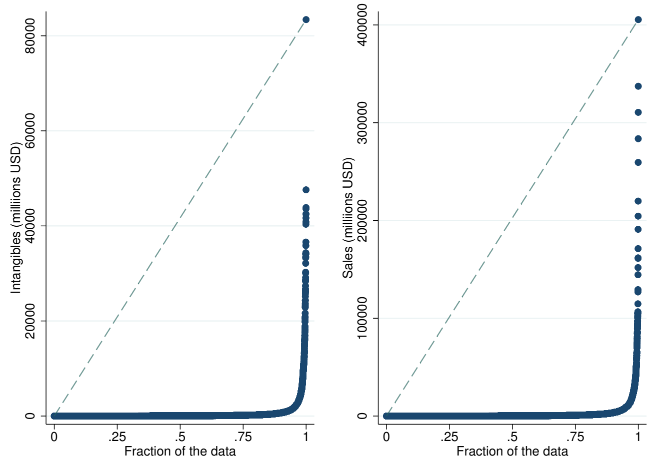
I regress the share of M&A, $MA\text{-}share_{hj}$, on each of the exogenous parameters, N_{hj}, κ_{hj} and $N_{hj}\kappa_{hj}$, together with country and affiliate industry fixed effects. Columns 1-3 of Table D.1 show that each of the coefficients has the same sign indicated by the partial derivative.

I include distance and other country variables instead of using country fixed effects in the specifications of columns 4-6. I observe the negative signs on distance, which corresponds to the sign of the partial derivative.

Appendix E Additional Figure and Table in Section 6

Figure E.1 shows the quantile plot of intangible capital and sales of Compustat firms. The distribution of intangible capital is skewed to the right same as the distribution of sales.

Figure E.1: Quantile Plots: Intangible Capital (left) and Sales (right)



[a] Both intangible capital and sales are yearly average over the sample period in 2003-2018, and based on the Compustat database.
[b] In quantile plot, each value is plotted according to the fraction of the data. Both distributions are right skewed since all points are below the reference line.