# Greenfield or Brownfield?
# FDI Entry Mode and Intangible Capital

Haruka Takayama*

University at Albany, SUNY

October 8, 2022

Click here to view most recent version.

**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 because of search externalities. 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

*I am grateful to my advisors: Kerem Coşar, James Harrigan, John McLaren for their valuable advice and encouragements. I especially thank Toshihiko Mukoyama, Natalia Ramondo, and Yoichi Sugita for various discussions. I appreciate suggestions and comments from Zachary Bethune, Peter Debaere, Brett Fischer, Taiji Furusawa, Hiroaki Kaido, Hayato Kato, Stefania Garetto, Andrew Greenland, Ryan Kim, Sonal Pandya, John Pepper, Alan Spearot, Kensuke Teshima, and Eiichi Tomiura. I also thank Craig Epstein for his excellent research assistance. I gratefully acknowledge the financial support from the Dissertation Completion Fellowship, the Bankard Pre-doctoral Fellowship, the Quantitative Collaborative Bynum grant funding, and the Marshall Jevons research grant at the University of Virginia. This working paper won the Kanematsu Prize, Kobe University in 2021. All errors are mine.

# 1 Introduction

In 2016, 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, many 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, the number of greenfield investments (GF) has been approximately 2.5 times larger than the number of cross-border mergers and acquisitions (M&A), whereas the values of these transactions are almost the same (UNCTAD, 2019). Although both modes of investment are economically important, policymakers seem to prefer GF over M&A: Only one-half of governments' investment promotion agencies solicit M&As, while around 90% of them target GF investors (UNCTAD, 2001).[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 nonrivalness. 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, 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 intangible capital—will likely pursue GF investments (DePamphilis, 2019). Firms that do not have well-known

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

[2] An investment promotion agency is a government agency that aims to attract FDI to its country. Each agency can promote either or both FDI modes.

brands or reputations will seek instead to acquire local brands.

To test this hypothesis, I empirically analyze how the amount of intangible capital stock 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). Although my data focus only on publicly listed firms, this new dataset covers approximately 60% of US multinational firms. I measure the amount of firm's intangible capital following Peters and Taylor (2017) and Ewens et al. (2020). My regression analysis shows 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. I also find that firms are more likely to make GF investments instead of M&A if they invest in host countries with lower GDP per capita and longer distance from the US. This result reflects the fact that multinationals face difficulties in finding local firms to merge with if their host countries are less developed (because of fewer local target firms and institutional barriers to FDI) and distant (because of higher search costs and cultural differences).

Motivated by this empirical result, I develop a general equilibrium search model of firm FDI choice. Expanding on Nocke and Yeaple (2007, 2008), I incorporate search and matching frictions in the merger market. In this framework, 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 completely 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. To focus on the role of intangible capital, 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. Multinationals with higher levels of intangible capital invest through

GF, consistent with my empirical results.

I also investigate if the market equilibrium is efficient by considering the social optimal 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 social 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), who extend Helpman et al. (2004) by incorporating cross-border M&A. 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 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

[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.

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 explain the data in Section 2, report the empirical evidence in Section 3, and present the model in Section 4. I match the model to the data in Section 5, present the counterfactual analyses in Section 6, and 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 to construct my US firm-level dataset: cross-border M&A deals (SDC Platinum), GF projects (fDi Market), and US firms' financial information (Compustat). In addition, I employ data that describe host country characteristics such as GDP per capita and distance. In this section, I first introduce each data source. I then provide a brief explanation of how to merge these data sources and also how I organize the merged data for regression analysis. Appendix A provides the further details.

## 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 as 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. I extract only 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, and the classification is not about the investing firm's main business.[6] Therefore, 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,

[5] Unlike SDC Platinum below, I can sort only by headquarter location of parent firms (not the locations of investing firms) in the fDi Market database.

[6] For example, if a firm establishes its new research center to develop IT software, the industry sector of this project is classified to Software & IT Services, regardless what kind of primary business the firm operates.

produced by Thomson Reuters. This database covers both domestic and cross-border M&A deals globally. To match these M&A data to my greenfield investment database, I extract all cross-border projects involving US acquiring (parent) firms. I restrict my attention to deals involving acquisitions of more than 10% ownership.[7] The 10% cutoff is common in most of FDI studies to determine whether an acquiring firm has control over the target firm (Davies et al., 2018). 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. In addition, I delete deals involving investment funds such as hedge funds, sovereign wealth funds because these acquisitions are conducted based on speculative activities, not on seeking a new business in foreign markets.[8]

**(iii) US Firms' Financial Information**: I obtain financial information of publicly-listed US firms between 1980 and 2018 from Compustat. 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.[9] 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 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%.[10] These depreciation rates of intangible capital are higher

[7] I only delete about 3% of all deals in this step.

[8] I delete deals if the target or acquirer's primary NAICS code is 523 (Securities, Commodity Contracts, and Other Financial Investments and Related Activities) or 525 (Funds, Trusts, and Other Financial Vehicles). See Appendix A about SDC Plantinum's unique NAICS codes.

[9] There are two types of intangibles: one is internally generated intangible capital, and the other is intangibles purchased externally by acquiring another firm. The latter is the sum of goodwill and other intangible assets, and both are shown in firm's financial sheets. Goodwill is the excess purchase price of an acquired firm and is often confounded with over-payment or under-payment in deals. Additionally, the purchased intangible capital is amortized for approximately 5-10 years after its purchase and the amortization schedules vary depending on firms. Thus, I focus only on internally generated intangible capital in this study.

[10] My empirical results are robust to using alternative calculations of intangible capital with different depreciation rates and multiplier 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.

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

**(iv) Host Country Characteristics**: 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 has the common language with the US). I obtain the FDI Regulatory Restrictiveness Index (FDI index) from the OECD database.[11]

## 2.2 Merging the Firm Datasets

I merge both (i) cross-border M&A deals (SDC Platinum) and (ii) GF projects (fDi Market) 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.

After merging the datasets, I obtain a dataset with 2,650 Compustat firms in total. During the sample period (2003 - 2018), 698 firms made only GF investments, while 777 firms made only cross-border M&As. 1,175 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.[12] According to the BEA data, there are around 4,500 US multinational

[11]The FDI regulatory restrictiveness Index (FDI 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]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.

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 |
| 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 index | 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.

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

parents in 2014, and thus my dataset covers roughly 60% of US multinational parents.[13]

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.[14] 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.1 shows that 84% of firms which made a GF investment in their first entry in a particular industry and country, made also GF investments in their subsequent FDIs in the same industry and country.

In Table 1, I compare my data to the BEA data in Nocke and Yeaple (2008).[15] Unlike my data spanning 2003-2018, Nocke and Yeaple (2008) only use data from 1994-1998. My data is similar to Nocke and Yeaple's especially with the share of M&A investment and country

[13] 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.

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

[15] 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.

variables, but I have more observations. In addition, my data cover FDI activities in service industry, and interestingly share of M&A investment is similar both in manufacturing and service industry.

# 3 Empirical Evidence of FDI Entry Modes

Using my unique dataset, I find two main empirical facts: 1) firms with more intangible capital are more likely to make GF investments rather than M&A; and 2) 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).

## 3.1 Intangible Capital

One of my main research questions is how investing firms choose between GF and M&A investment. Firms will obtain physical capital either through GF or M&A investment, but they can acquire existing intangible capital only through M&A. Thus, I hypothesize that M&A is the preferred market entry option for firms that seek to obtain existing intangible capital.

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

$$\mathbb{1}[MA_{i,h,j,t} = 1] = \beta_1 \times \mathit{intangibles}_{i,t-1} + \beta_2 \times \mathit{sales}_{i,t-1} + \beta_3 \times \mathit{value\text{-}added\text{-}per\text{-}worker}_{i,t-1} + \alpha_{h,t} + \alpha_{i,j,t} + \epsilon_{i,h,j,t},$$

where $\mathbb{1}[MA_{i,h,j,t} = 1]$ is an indicator for whether firm $i$ uses M&A for its first FDI in market $h$ and industry $j$ in year $t$. 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.[16] In addition, I control for firm size and productivity using $\mathit{sales}_{i,t-1}$ and $\mathit{value\text{-}added\text{-}per\text{-}worker}_{i,t-1}$.[17] I also add country-year fixed effects, $\alpha_{h,t}$, and industry-pair-year fixed effects, $\alpha_{i,j,t}$. 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),

[16] I refer to Spearot (2012) who studies firms' investment decisions between new (or greenfield) investment and M&A in the US, using the Compustat database.

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

Table 2: Firms' FDI Decisions and Intangibles

| | Dependent variable: $\mathbb{1}[MA_{i,h,j,t} = 1]$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Intangible capital | $-0.036^{***}$ | $-0.019^{***}$ | $-0.033^{***}$ | $-0.052^{***}$ |
| | (0.004) | (0.003) | (0.009) | (0.010) |
| Sales | | | 0.006 | $0.024^{**}$ |
| | | | (0.009) | (0.010) |
| Value-added per worker | | | 0.013 | 0.012 |
| | | | (0.011) | (0.012) |
| Parent Industry × Year FE | Yes | Yes | Yes | |
| Country × Year FE | | Yes | Yes | Yes |
| Industry Pair × Year FE | | | | Yes |
| Observations | 15,906 | 15,524 | 14,725 | 12,258 |
| Adjusted $R^2$ | 0.104 | 0.278 | 0.289 | 0.385 |

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

and the latter controls 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, $i$ and $j$).

Table 2 presents the results. In the first and second specifications, I estimate the correlation between a firm's intangible capital and the probability of making GF investment without controlling for sales and value-added per worker. I include only parent-industry-year fixed effects in the first column and add country-year fixed effects in the second column. The coefficient on intangible capital is negative and statistically significant in the first two specifications, and it stays the same when I control for sales and value-added per worker. This shows that the probability of making a GF investment increases with the amount of intangible capital that a parent firm holds. While parent-industry-year fixed effects cannot control for heterogeneity across affiliate industries, using industry-pair-year fixed effects will drop many observations that are unique parent industry-affiliate industry-year triplets. In order to consider a wider range of observations, I use parent-industry-year fixed effects in the first three columns. Still, the specification in the fourth column includes these industry-pair-year fixed effects that absorb the average probability that a firm chooses M&A investment in each industry pair and year. The sign and statistical significance of the coefficient on intangible

Table 3: Firms' FDI Decisions and Other Types of Capital

| | Dependent variable: $\mathbb{1}[MA_{i,h,j,t} = 1]$ | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| | Intangible | | Non-intangible |
| | Knowledge | Organizational | Physical |
| Capital | $-0.034^{***}$ | $-0.037^{***}$ | $-0.010$ |
| | (0.010) | (0.010) | (0.010) |
| Sales | 0.010 | 0.009 | $-0.014$ |
| | (0.011) | (0.010) | (0.011) |
| Value-added per worker | 0.017 | 0.009 | 0.011 |
| | (0.015) | (0.012) | (0.013) |
| Country × Year FE | Yes | Yes | Yes |
| Industry Pair × Year FE | Yes | Yes | Yes |
| Observations | 7,560 | 12,258 | 12,076 |
| Adjusted $R^2$ | 0.374 | 0.383 | 0.382 |

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

capital remain the same.

Overall, the results in Table 2 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 decision. For example, Nocke and Yeaple (2008) shows that more productive firms (i.e., firms with greater sales) are more likely to choose GF investment rather than M&A.[18] My results show that there is an additional determinant of firms' FDI decisions, in addition to firm's sales.

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 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 3. Both types of intangible capital yield qualitatively similar results (negative and

[18] 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.

statistically significant coefficients) as the total intangible capital (i.e., the result in column 4 of Table 2). 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 4 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. These results underline the importance of intangible capital in FDI mode choice.

## 3.2 Country Characteristics

In addition to firm heterogeneity, the characteristics of destination countries are also important for firms' FDI decisions. Instead of country-year fixed effects, I include the following covariates describing the host country in the regressions: log of distance (DIST), common language (LANG), log of GDP per capita (GDPPC), log of population (POP), log of openness to trade (OPEN), and FDI index.[19] The results are in Table 4. In the first two specifications, I control for firm heterogeneity using fixed effects instead of using firms' financial information such as intangibles, sales, and value-added per worker. In the second specification, I use firm-year fixed effects that restrict observations only to firms that made multiple FDI investments in a particular year. The third column shows the results with the main specification, including country characteristics instead of country-year fixed effects.

The signs and statistical significance of the coefficients are similar across three 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 the effect of institutional restrictions on firms' FDI mode choices using the FDI

[19] 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 index additionally.

Table 4: Firms' FDI Decisions and Country Characteristics

| | Dependent variable: $\mathbb{1}[MA_{i,h,j,t} = 1]$ | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| DIST | $-0.071^{***}$ | $-0.022^{**}$ | $-0.053^{***}$ |
| | (0.017) | (0.009) | (0.011) |
| LANG | $0.065^{**}$ | $0.079^{***}$ | $0.111^{***}$ |
| | (0.026) | (0.017) | (0.027) |
| GDPPC | $0.111^{***}$ | $0.096^{***}$ | $0.148^{***}$ |
| | (0.019) | (0.015) | (0.018) |
| POP | $-0.003$ | 0.012 | 0.014 |
| | (0.009) | (0.008) | (0.013) |
| OPEN | $-0.098^{***}$ | $-0.012$ | $-0.028$ |
| | (0.022) | (0.020) | (0.037) |
| FDI index | | $-0.307^{***}$ | $-0.325^{**}$ |
| | | (0.086) | (0.129) |
| Intangibles | | | $-0.049^{***}$ |
| | | | (0.012) |
| Firm FE | Yes | | |
| Firm × Year FE | | Yes | |
| Industry Pair × Year FE | Yes | Yes | Yes |
| Observations | 11,891 | 6,349 | 10,471 |
| Adjusted $R^2$ | 0.470 | 0.468 | 0.349 |

[a] Standard errors are clustered by firm and country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

[b] All continuous variables, except the FDI index, are in logs. I control for firm size and efficiency using sales and value-added per worker for column (3).

regulatory restrictiveness index (FDI index). The statistically significant and negative coefficients on the FDI index show that tighter restrictions in a destination country deter firms from making M&A investments.[20]

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 reflect the fact that there is a smaller matching probability between target and acquiring

[20] 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 (FDI index), the FDI index captures most of the variation that explains institutional barriers, and the coefficients on openness (OPEN) become insignificant.

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 affects a firm's FDI mode choice. My model is static and builds upon Nocke and Yeaple (2007, 2008), in which firm's production efficiency consists of two exogenous parameters.[21] In my paper, two exogenous parameters are productivity and intangible capital. Along the lines of Nocke and Yeaple's study, firms can trade one of the parameters—intangible capital in my paper—in the merger market, which incentivizes firms to conduct M&As rather than greenfield (GF) investments.

To characterize the international merger market, I follow David (forthcoming), who analyzes domestic M&A activity. In my model, a firm's outside option of conducting M&A is making a greenfield investment, and the merger gain and acquisition price are endogenously determined depending on the stock of intangible capital a firm holds.

One of this paper's main goals is to analyze how foreign investment policies affect multinationals' FDI decisions and welfare in investment-receiving countries. To analyze these effects, I construct a model of domestic general equilibrium in the host country. The model endogenously determines wage, and the volumes of M&A and GF investment that occur in the host country.

## 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 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

[21] 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 a manufacturing plant. The first paper focuses on industry heterogeneity, and the latter focuses on firm heterogeneity.

find their partners, they can merge with local firms. Multinationals which do not search and also those which fail to search make GF investment and establish their own affiliates to produce.

I assume host country $h$ is a small open economy, and labor is not mobile across countries.[22] 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 $\ell_i$ 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:

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

where $\theta$ is a shape parameter. For simplicity, assume that productivity for multinational firm $i$ is constant at the value $\tilde{Z}$.[23]

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, $\kappa$ is intangible capital, and $\ell_j$ 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

[22] 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.

[23] 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.

homogeneous and it is given as $\kappa$.[24]

### 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:[25]

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

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:

$$\begin{aligned}\mu(n) &= \frac{v(N,n)}{n} \\ &= \left(\frac{1}{1+(n/N)^\rho}\right)^{\frac{1}{\rho}}.\end{aligned} \tag{2}$$

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 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

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

[25] 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.

GF investment. Unlike physical capital, both productivity, $\tilde{Z}$, and intangible capital, $K_i$, can easily replicated and be 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, $h$.[26]

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 $i$ is merged with a local firm, it can take advantage of the acquired firm's intangibles, $\kappa$, in producing. This 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 2017).[27] I assume that the merged firm inherits the acquirer's productivity $\tilde{Z}$ and both the target's and acquirer's intangible capital, $\kappa$ and $K_i$. The production function for merged firm $m$ is

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

where $\eta \in (0, 1)$. In post-merger integration process, a multinational will not be able to transfer all of its intangible to the new foreign affiliate. Some of the business segment is duplicated with its target firm, and a multinational uses some part of target firm's intangible (instead of its intangible capital) to benefit it in the local market.[28] This imperfect "scalability" in M&A investments is represented by $\eta$. 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

[26] 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.

[27] Guadalupe et al. (2012) emphasis on two sources of complimentary (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 ($\varphi$ in their model) and the post-merger innovation. Although this paper is not looking at the post-merger innovation, my production function works similar to their variable profit function if I set $A$ as $Z$ (inherit by multinational) and $\varphi$ as $\kappa$ (inherit by local). Building on Guadalupe et al. (2012), I have an additional source of profitability ($\eta K_i$) transferred through multinational.

[28] 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.

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 $\omega$. Each firm, $\omega$, is assigned to one of the firm types: M&A firm, $m$, GF firm, $g$, and local firm, $a$. $\Omega$ is the set of all of the firms, $\omega \in \Omega$.

The final-good production function is:

$$Y = \left[\int_{\Omega} y_{\omega}^{\frac{\sigma-1}{\sigma}} d\omega\right]^{\frac{\sigma}{\sigma-1}}, \tag{3}$$

where $\sigma > 1$ is the elasticity of substitution.[29]

### 4.1.5 Households

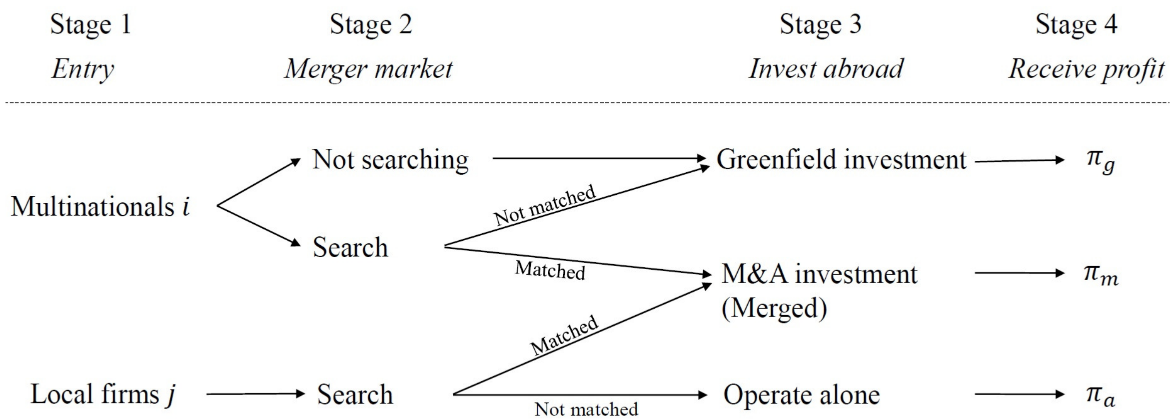
There is a measure of representative households, $L$, in host country $h$ and they maximize utility by consuming final good, $C$. The households supply labor, $L$, at wage, $w$. The households earn income, $I$, from the wage payment, $wL$, profits of local firms, and acquisition transfer, $P$. Both households'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

### 4.1.6 Timing

I summarize the timing of the model over the following 4 stages:

[29] We can consider that each firm, $\omega$, produces its differentiated variety, $y_\omega$ 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 1: Timing of 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 which do not search make GF investments in $h$. If multinationals search for their partners and find them, they will make M&As 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 backwards 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 good 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:

$$\min_{y_\omega} \int_\Omega p_\omega y_\omega d\omega \qquad \text{subject to equation (3).} \tag{4}$$

The unit price of the final output us $\Xi = [\int_\Omega p_\omega^{1-\sigma} d\omega]^{1/(1-\sigma)}$. The final good market is perfectly competitive, and a final good producer can sell any amount of good, $Y$, at the market price, $\Xi$. I use the final good as a numéraire, and normalize $\Xi$ to one.[30] The inverse demand function for good $\omega$ is

$$p_\omega = \left(\frac{Y}{y_\omega}\right)^{1/\sigma}. \tag{5}$$

Given the CES demand function, firm $\omega$ solves the maximization problem for its profit:

$$\max_{\ell_\omega, p_\omega, y_\omega} p_\omega y_\omega - w\ell_\omega \qquad \text{subject to equations (3) and (5).}$$

$w$ 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 $\alpha$ satisfies this relationship.[31]

Solutions for the labor demand, $\ell_\omega$, are:

$$\begin{cases} \ell_m(K_i; w, Y) = \tilde{\Theta}(w,Y)Z(\kappa + \eta K_i) & \text{for merged multinationals,} \\ \ell_g(K_i; w, Y) \ = \tilde{\Theta}(w,Y)ZK_i & \text{for GF multinationals, and} \\ \ell_a(w, Y) \ = \tilde{\Theta}(w,Y)z\kappa & \text{for non-merged local firms.} \end{cases} \tag{6}$$

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 entities are:

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

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'

[30]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 the intermediate goods are non-tradables and the final good is used for the international transactions.

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

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 $\kappa$), as well as the wage in the host country $w$.[32]

### 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 $(w, Y)$. Thus in these two stages, I omit the dependence on $(w, Y)$ to simplify the notation. For example, I use $\Theta$ in place of $\Theta(w, Y)$. The combined gain (surplus) from the merger (i.e., "synergy" from mergers), $\Sigma$, for multinationals which match with local firms is given by:

$$\begin{aligned}\Sigma(K_i) &= \pi_m(K_i) - \pi_g(K_i) - \pi_a \\ &= \Theta Z(\kappa + \eta K_i) - \Theta Z K_i - \Theta z \kappa \\ &= \Theta \left[(Z - z)\kappa - Z(1 - \eta)K_i\right]. \end{aligned} \tag{8}$$

Multinationals consummate mergers so long as they have positive merger gain. The gains are the profit of the merged firm, $\pi_m$, less the profit that the multinational would have earned through GF, $\pi_g$ (the multinational's outside option), and the pre-merger profit of the local firm, $\pi_a$ (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, $\kappa$; 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 $\eta$ 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

[32] 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).

gains of local firms) is sum of the profit of the local firm, $\pi_a$, and the target's share of the combined gain, $\chi\Sigma$:

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

Using equation (8) and (7),

$$P(K_i) = \Theta z\kappa + \chi\Theta\left[(Z-z)\kappa - Z(1-\eta)K_i\right]. \tag{9}$$

### 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,

$$\mu(n)\left[\pi_m(K_i) - P(K_i)\right] + (1-\mu(n))\pi_g(K_i) - \psi \geq \pi_g(K_i), \tag{10}$$

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

Using (9) and (7), inequality (10) can be rewritten as

$$(1-\chi)\mu(n)\underbrace{\Theta\left[(Z-z)\kappa - Z(1-\eta)K_i\right]}_{\text{gain from mergers, }\Sigma} \geq \psi. \tag{11}$$

There are two findings of note. First, the left-hand side of the above inequality 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. Second, if the above inequality holds, a searching multinational will always obtain positive gains from merging, which means $\Sigma \geq 0$. Thus, if a multinational firm searches and finds a target firm, it always conducts M&A. These two 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, and one with $K_i \geq K^*$ make a GF investment. The threshold level of intangible capital $K^*$ satisfies the following equation:*

$$(1-\chi)\hat{\mu}(K^*)\Theta\left[(Z-z)\kappa - Z(1-\eta)K^*\right] = \psi. \tag{12}$$

*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. 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 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

Using the threshold level of intangible capital, $K^*$, I define the four types of firms which exist after multinationals invest.

(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 and operate independently. The measure of such firms is $N - \hat{\mu}(K^*)MG(K^*)$. I can set the probability that local firms operate alone to $1 - (\hat{\mu}(K^*)MG(K^*)/N)$.

### 4.3 Characterization of the Equilibrium

I consider the equilibrium in the host country 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 (3), 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 6), one can solve for $Y$:

$$Y = \left( \frac{1}{w} \frac{\beta(\sigma - 1)}{\sigma} \right)^{\frac{\beta}{1-\beta}} \hat{Y}(K^*)^{\frac{\alpha}{1-\beta}}, \tag{13}$$

where

$$\hat{Y}(K^*) = Nz\kappa + MZ \int_{\underline{K}=1}^{\infty} K \, dG(K) + \hat{\mu}(K^*) M \int_{\underline{K}=1}^{K^*} [(Z - z)\kappa - Z(1 - \eta) K dG(K)].$$

Appendix C.2 provides the detailed derivation.

Equation (13) 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 initial value of the productivity in the local economy (i.e., the productivity of all local firms plus that of all multinationals when $K^* \to 1$). The last term is the total productivity gains from merging which represents the measure of multinationals that conduct M&A, $\hat{\mu}(K^*) M G(K^*)$, times the average productivity gains from merging, $\int_{\underline{K}=1}^{K^*} [(Z - z)\kappa - Z(1 - \eta) K] dG(K)/G(K^*)$. When multinationals merge with local firms, multinationals upgrade the locals' intangibles, $\kappa$, by exploiting the gap in productivities between multinationals and locals, $(Z - z)$. However, M&A multinationals cannot transfer all intangibles to their merged entities, and this decreases the productivity of acquiring multinationals by $Z(1 - \eta)K$. This negative effect will dominate the positive effect as more multinationals choose M&A (i.e., as $K^*$ gets larger). This trade off on the merger gain 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 output such that $\hat{K}^* = \arg\max_{K^*} \hat{Y}(K^*)^{\frac{\alpha}{1-\beta}}$.*

*Proof.* See Appendix C.3.

### 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 I show that $Y$ is a function of $w$ and $K^*$ in the previous section 4.3.1, I restate the cutoff condition (equation 12) with the notation $\Theta(w, K^*)$ instead of $\Theta(w, Y)$.

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

### 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 firms (equation 6),

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

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

Inserting $\hat{Y}(K^*)$ to equation (13), the total output, $Y$, can be defined as a function of $w$:

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

Note that the function above holds only under the labor market condition. Now, the labor market condition is

$$L = \tilde{\Theta}(w)\hat{Y}(K^*), \tag{15}$$

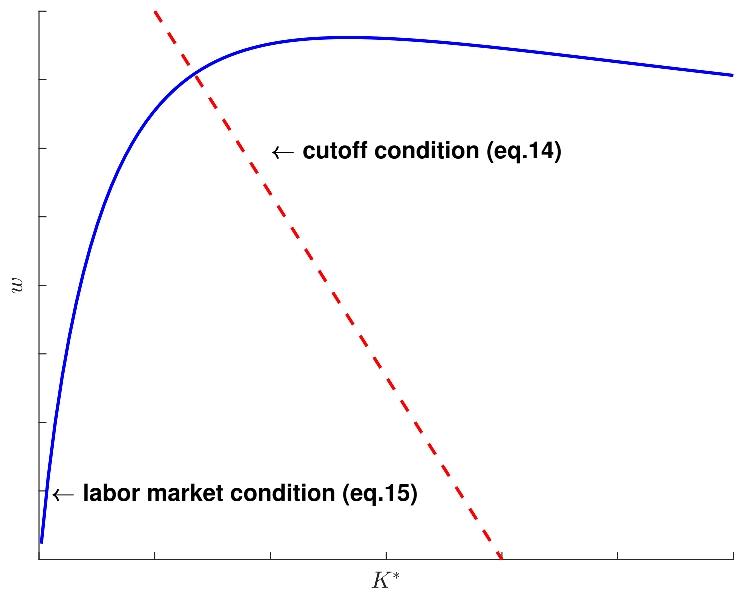
where I use $\tilde{\Theta}(w)$ in place of $\tilde{\Theta}(w, Y)$.[33]

### 4.3.4 Equilibrium

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

[33]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 2: Cutoff and Labor Market Clearing Conditions




**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 (14).*

*(ii) The labor market condition in equation (15).*

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 $p_\omega$ and $y_\omega$ satisfy the firm's profit maximization problem and the intermediate good demand curve in equation (5). The labor market clears when equation (15) is satisfied. From Walras' Law, the final-good market automatically clears.[34]

**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 15) and the labor market condition (equation 14), 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

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

intangible capital, $K^*$, on the x-axis, then the cutoff condition is strictly decreasing and the labor market condition is concave (see Figure 2).

## 4.4 Efficiency

In this section, I focus on the level of intangible capital in the local economy, $K^*$, that defines the amount of M&A and GF investments that the local economy receives. The question to investigate is whether the value of $K^*$ in the market equilibrium is socially optimal, and if not, what kinds of inefficiencies exist in the economy. I show the equation that characterizes the value of $K^*$ in the market equilibrium in Section 4.4.1 and then the one that defines the threshold value of intangibles in the social planner's problem, $K^s$ in Section 4.4.2. In Section 4.4.3, I analyze the inefficiency, the difference between the market equilibrium and the social planner's solution. The detailed derivation is in Appendix C.6.

### 4.4.1 Condition in the Market Equilibrium

I state the equation that characterizes the equilibrium value of $K^*$. Using the cutoff condition (equation 14) and the labor market condition (equation 15), $K^*$ satisfies the following equation in equilibrium:

$$\frac{\sigma-(\sigma-1)\beta}{\sigma}\ \hat{Y}(K^*)^{\frac{1}{\sigma-1}-\beta}L^{\beta}\hat{\mu}(K^*)(1-\chi)[(Z-z)\kappa-Z(1-\eta)K^*]=\psi. \tag{16}$$

Using equations (6) and (15), the labor demand is $\ell_\omega=\frac{LZ_\omega K_\omega}{\hat{Y}(K^*)}$ in equilibrium.

### 4.4.2 Social Planner's Constrained Problem

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 (3).

The solution is

$$\frac{\sigma-(\sigma-1)\beta}{\sigma-1}\hat{Y}(K^*)^{\frac{1}{\sigma-1}-\beta}L^{\beta}\hat{\mu}(K^s)$$
$$\times\left((1-\xi(K^s))[(Z-z)\kappa-Z(1-\eta)K^s]-\frac{\xi(K^s)}{G(K^s)}\int_{\underline{K}}^{K^s}[Z(1-\eta)(K^s-K)]dG(K)\right)=\psi, \tag{17}$$

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

Four types of externalities can be defined by comparing the equations that characterize the amount of GF (or M&A) investment in the market equilibrium ($K^*$ in equation 16) and the social equilibrium ($K^s$ in equation 17).

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. This occurs because multinationals decide to search for local firms by looking only at the probability of matching, $\hat{\mu}(K^*)$ in equation (16), while the social planner cares about the marginal change in the probability of matching, $\hat{\mu}(K^s)(1-\xi(K^s))$ in equation (17). If $\xi(K^s)$ 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 in equation 16) 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 third externality comes from the difference between the objective functions of multinationals and the social planner. In the market equilibrium, multinationals bargain over the surplus from the merger, $\Theta(w,Y)[(Z-z)\kappa-Z(1-\eta)K^*]$, and decide whether to search based on their expected gains. The first term of equation (16), $\frac{\sigma-(\sigma-1)\beta}{\sigma}$, is from $\Theta(w,Y)$. The multinational only considers its private benefit of merging (i.e., additional profits that it gains through mergers), whereas the social planner maximizes social welfare and considers the marginal output, Y, made by the additional searching firm. The first term of equation (17), $\frac{\sigma-(\sigma-1)\beta}{\sigma-1}$, is from the derivative of total output, $Y$, with respect to $K^s$. Since multinationals consider only the surplus from the merger, not the total output of the local economy, this difference makes multinationals underestimate the benefit of searching and leads to fewer searching multinationals in the market equilibrium compared to the socially optimal situation (i.e., $K^* < K^s$).[35]

The fourth externality is the additional congestion externality and corresponds to the last term in parentheses in equation (17).[36] This term exists because searching multinationals are heterogeneous, and therefore the congestion externality is heterogeneous as well. In particular, a firm with small $K$ realizes a large 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., $K^* > K^s$).

Given the above conflicting effects, in equilibrium, the rate at which multinationals search for firms to acquire may be too high or too low, relative to the social optimum. I also show that 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? The threshold level of intangible capital determines the types of investment that the host country receives. If there are more searching multinationals 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.

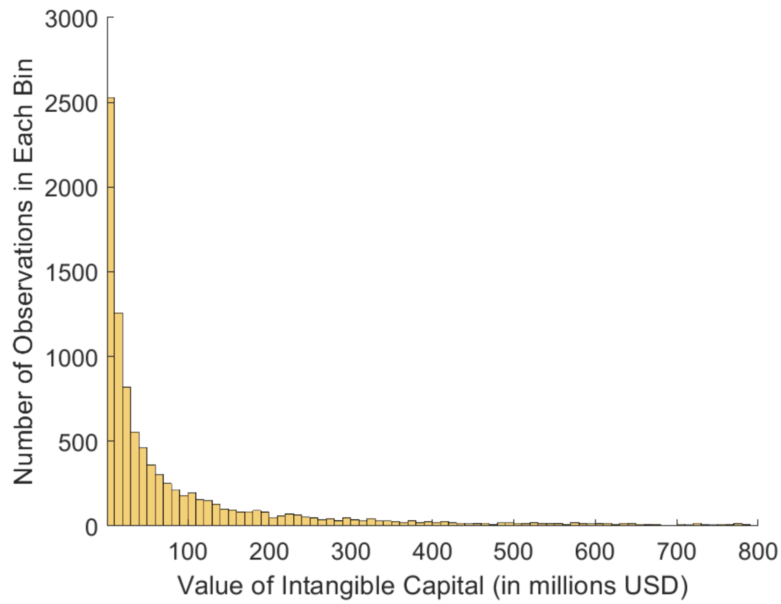
# 5 Quantitative Analyses

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.

[35] This externality does not exist in the Diamond-Mortensen-Pissarides (DMP) model because the multinationals and the local firms share the gain from merging (i.e., extra profit) and ignore the benefit for workers (i.e., wage payment here). In the DMP model, all parties (firms and workers) participate in the Nash bargaining.

[36] This additional externality does not show up in the standard DMP model since the firms and workers are homogeneous in the model.

Figure 3: 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.

## 5.1 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 it's cumulative distribution function is $G(K)$ as defined in equation (1). A large number of studies suggest that distribution of firm sizes, measured by sales and the number of employees, can be characterized by a Pareto distribution.[37] Arrighetti et al. (2014) uses the data on Italian manufacturing firms and shows 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 3).[38]

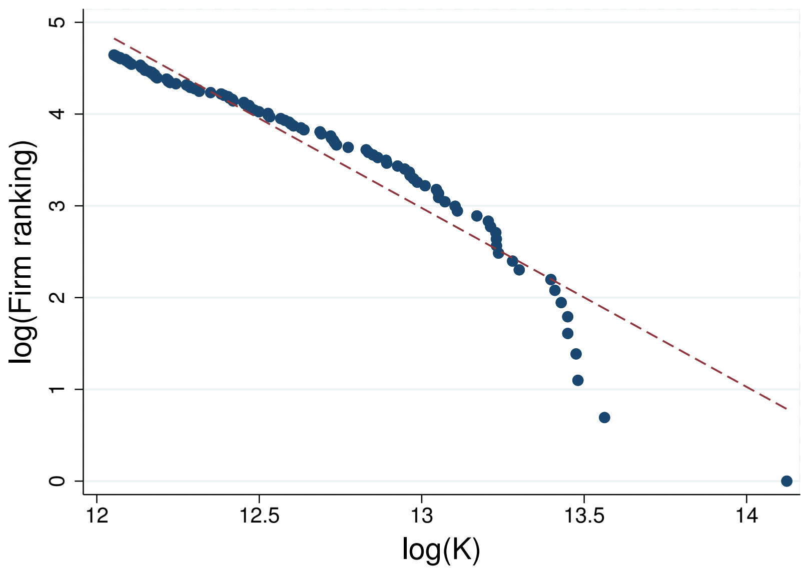
I estimate the value of the shape parameter, $\theta$, following Axtell (2001) and Helpman et al. (2004). First, I rank firms in descending order, according to their amount of intangible capital (i.e., the firm with the largest intangible capital is ranked first). I then plot the logarithms of the ranking 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.[39] This log-log plot (Figure 4) is known as

[37]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.

[38]Figure C.1 in Appendix C.7 shows the quantile plots of intangible capital and sales. The figures shows that the shapes of both distribution are the same.

[39]For example, Eaton et al. (2011) consider the top 1% of firms in their dataset. By the assumption of the

Figure 4: Zipf Plot: Firm's Intangible Capital




[a] 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 5.

Table 5: Estimated Shape Parameter in $G(K)$

| Estimated $\theta$ | Adjusted $R^2$ |
|---|---|
| 1.951 (0.055) | 0.924 |

[a] Standard error of the estimated parameter is shown in the parenthesis.

a Zipf plot. We expect to observe a negative linear relationship in the Zipt 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, $\theta$. 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 5).[40]

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 footnote 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.

[40]The Pareto distribution has an infinite variance if $\theta \leq 2$. This means that the moment will not converge as the sample size goes to infinity. This is not a problem in this paper since the variance exists in a finite sample.

## 5.2 Baseline Parameters

I set parameters using moments that are obtained from my data. The cutoff condition (equation 12) and the labor market clearing condition (equation 15) 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, $\theta$, is estimated in the previous subsection 5.1. $\rho$ is the elasticity of the matching function, $\kappa$ is the intangible capital of local firms, $\eta$ is the friction parameter (i.e., the degree of incomplete transfer of intangibles), and $\psi$ is the search cost. $X$ indicates other parameters that are exogenously determined. The details of these parameters are shown in Table 6. In this subsection, I include all FDI deals in my sample, regardless of their destination country.

I pin down four parameters, $\rho$, $\kappa$, $\eta$, and $\psi$, 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) The share of M&A multinationals**

Using the measure of firms defined in section 4.2.4, the share of multinational firms that make M&A investments is:

$$\frac{E_m}{E_m + E_g} = \hat{\mu}(K^*)G(K^*). \tag{18}$$

The value is 0.42 in the data (Table 1). The matching function $\hat{\mu}$ (equation 2) is a function of $K^*$ and other parameters: the elasticity of the matching function $\rho$, the number of multinationals $M$, the number of local firms $N$, and the shape parameter, $\theta$. I fix $M$ and $N$ so that $\rho$ 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—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 weight by the total number of investments and compute the weighted average across destination countries. I calculate that $M = 630$ and $N = 3430$.[41]

[41] 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.

**(ii) The 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, $\kappa$, 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.[42] 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) The average merger premium**

The average merger premium gives the relationship between the M&A friction parameter, $\eta$, the cutoff level of intangible capital, $K^*$, and the real wage in the host country, $w$. According 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 $\pi_a$ is the profit of the local firm. The average merger premium is a function of ($\eta$, $K^*$, $w$, $Z$, $z$, $\beta$, $\sigma$, $\chi$). In addition to $Z$ and $z$, I take the last three parameters, $\beta$, $\sigma$, and $\chi$, from the existing literature and other data sources, and therefore $\eta$ can be represented a function of two unknowns, $K^*$ and $w$. I take the elasticity of substitution, $\sigma$, 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, $\beta$, to 0.7.

[42]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 6: Baseline Parameters

| Parameters | Definition | Value |
|---|---|---|
| *estimated/ calibrated* | | |
| $\theta$ | Shape parameter of $G(K)$ | 1.95 |
| $\rho$ | Elasticity of the matching function | 0.55 |
| $\kappa$ | Intangible capital of local firms | 1.09 |
| $\eta$ | M&A friction | 0.80 |
| $\psi$ | 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 |
| $\sigma$ | Elasticity of substitution | 6 |
| $\beta$ | Labor share of the production function | 0.7 |
| $\chi$ | Bargaining power of local firms | 0.5 |
| $L$ | Labor force size | 1 |

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

**(iv) The 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 by the overall mean of intangibles. In my model, the relationship is

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

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.[43] As the moment gets larger, firms with larger intangible capital make more M&A investments.

[43] 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 $K_i \leq K^*$.

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, $\rho$, $\kappa$, and $\eta$, and the two endogeneous variables, $K^*$ and $w$. The last moment, (iv), the threshold level of intangible capital, determines the search cost, $\psi$ through the cutoff condition (equation 12). 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 15). Table C.3 shows that the calibrated model produces moments similar to the data.[44]

## 5.3 Different Types of Host Countries (FDIs in the North or the South)

In this subsection, I split the FDI projects by destination. As I discuss in Section 3.2, 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 developing countries. Analyzing the difference between developed and developing countries could provide the insight regarding 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 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 7. M&A firms investing in the North have a higher level of intangibles than those investing in the South (see $\frac{\overline{K}_{MA}}{\overline{K}}$ in Table C.3). 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,

[44]The calibrated model replicates the profit of each type of firm and the acquisition price.

Table 7: Parameters (by Destination)

| Parameter | Definition | Value | |
|---|---|---|---|
| | | North | South |
| $\rho$ | 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 |
| $\kappa$ | Intangible capital of local firms | 1.11 | 1.08 |
| $\eta$ | M&A friction | 0.92 | 0.68 |
| $\psi$ | Search cost | 0.00016 | 0.0018 |

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

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, $\rho$, 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, $\rho$, 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 discourage firms from searching for M&A partners in the South. To set the M&A friction parameters, $\eta$, 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.[45] 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 15), I obtain the equilibrium wage, $w^*$, in the North is 39.97

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

and 29.68 in the South.

The cutoff level of intangibles, $K^*$, in the North is much larger than that in the South, and therefore we expect that the amount of M&A can be too many in the North (i.e., $K^* > K^s$) and too little in the South (i.e., $K^* < K^s$). 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 the next section.

# 6 Counterfactual Experiments

In this section, I evaluate the impact of FDI policies on welfare in host countries. As I discuss in the previous section, the optimal policy response can differ in the North and the South. For example, if policymakers in the North would like to increase real wages, they should promote GF investments. Conversely, if policymakers in the South would like to increase real wages, they should restrict GF investments.

## 6.1 Welfare

In this section, I study the change in welfare of the local economy by policy instrument such as a tax and a subsidy. Here, I define the welfare of the local economy. The representative household's income, $I$, is equal to its consumption of final good, $C$, which is defined as an index of welfare. The welfare of the representative household is the sum of wage payments, profits of local firms, and acquisition transfers:

$$W(w, K^*) = wL + (N - \hat{\mu}(K^*)MG(K^*))\Theta(w)z\kappa + \hat{\mu}(K^*)M \int_{\underline{K}=1}^{K^*} P(w, K)dG(K) \tag{19}$$

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 $Y$.

## 6.2 Tax on GF investments in the South

First, I consider the effects of a tax on the profits of GF multinationals in the North. A change in firms' profits affects the cutoff condition which determines the minimum level of

Table 8: Welfare Change: 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 |

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

intangible capital whether a multinational firm needs to make an M&A search worthwhile. Consider a $\tau$% tax on GF profits. the profits of a GF multinational with intangible capital $K_i$ are given by:

$$(1-\tau)\pi_g(w, Y, K_i) \ = (1-\tau)\Theta(w, Y) Z K_i, \tag{20}$$

where $\tau > 0$. The cutoff condition (equation 14) becomes

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

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%.

The local welfare consists of four parts: wage payment, local profits, acquisition transfer, and tax transfer. Table 8 shows that, if the government taxes GF multinationals, wages and acquisition transfers both 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 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.

Table 9: Welfare Change: 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 |

[a] This table shows how welfare changes when a government subisidies on GF multinationals in the North.

### 6.3 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 20). 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 9 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 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 $\kappa$ heterogeneous and consider sorting between multinationals and locals (i.e., a high-$K$ multinational may look for a high-$\kappa$ local firm). Another possible extension is to endogenize multinational firms' intangibles $K$ and local firms' intangibles $\kappa$. 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.

# References


[1] Arkolakis, Costas, Natalia Ramondo, Andrés Rodríguez-Clare, and Stephen Yeaple. "Innovation and production in the global economy." *American Economic Review* 108, no. 8 (2018): 2128-73.

[2] Arrighetti, Alessandro, Fabio Landini, and Andrea Lasagni. "Intangible assets and firm heterogeneity: Evidence from Italy." *Research Policy* 43, no. 1 (2014): 202-213.

[3] Ashraf, Ayesha, Dierk Herzer, and Peter Nunnenkamp. "The effects of Greenfield FDI and cross-border M&As on total factor productivity." *The world economy* 39, no. 11 (2016): 1728-1755.

[4] Atalay, Enghin, Ali Hortaçsu, and Chad Syverson. " Vertical integration and input flows." *American Economic Review* 104, no. 4 (2014): 1120-48.

[5] Bertrand, Olivier, Katariina Nilsson Hakkala, Pehr-Johan Norbäck, and Lars Persson. "Should countries block foreign takeovers of R&D champions and promote greenfield entry?" *Canadian Journal of Economics* 45, no. 3 (2012): 1083-1124.

[6] Bilir, L. Kamran, and Eduardo Morales. "Innovation in the global firm." *Journal of Political Economy* 128, no. 4 (2020): 1566-1625.

[7] Bloom, Nicholas, Raffaella Sadun, and John Van Reenen. "Americans do IT better: US multinationals and the productivity miracle." *American Economic Review* 102, no. 1 (2012): 167-201.

[8] Broda, Christian, and David E. Weinstein. "Globalization and the Gains from Variety." *The Quarterly journal of economics* 121, no. 2 (2006): 541-585.

[9] Burstein, Ariel T., and Alexander Monge-Naranjo. "Foreign know-how, firm control, and the income of developing countries." *The Quarterly Journal of Economics* 124, no. 1 (2009): 149-195.

[10] Chan, Jackie M.L., and Huanhuan Zheng. "FDI on the Move: Cross-border M&A and Migrant Networks. ScholarBank@NUS Repository (2019).

[11] Corrado, Carol A., and Charles R. Hulten. "How do you measure a "technological revolution"?" *American Economic Review* 100, no. 2 (2010): 99-104.

[12] Coşar, A. Kerem, Nezih Guner, and James Tybout. "Firm dynamics, job turnover, and wage distributions in an open economy." *American Economic Review* 106, no. 3 (2016): 625-63.

[13] David, Joel M. "The Aggregate Implications of Mergers and Acquisitions" *Review of Economic Studies* 88, no. 4 (2021): 1796-1830.

[14] Davies, Ronald B., Rodolphe Desbordes, and Anna Ray. "Greenfield versus merger and acquisition FDI: Same wine, different bottles?" *Canadian Journal of Economics* 51, no. 4 (2018): 1151-1190.

[15] Den Haan, Wouter J., Garey Ramey, and Joel Watson. "Job destruction and propagation of shocks." *American economic review* 90, no. 3 (2000): 482-498.

[16] Demidova, Svetlana, and Andres Rodríguez-Clare. "The simple analytics of the Melitz model in a small economy." *Journal of International Economics* 90, no. 2 (2013): 266-272.

[17] DePamphilis, Donald. "Mergers, acquisitions, and other restructuring activities: An integrated approach to process, tools, cases, and solutions." Academic Press, 2019.

[18] Díez, Federico J., and Alan C. Spearot. "Core competencies, matching and the structure of foreign direct investment." *Canadian Journal of Economics/Revue canadienne d'économique* 47, no. 3 (2014): 813-855.

[19] Dimopoulos, Theodosios, and Stefano Sacchetto. "Merger activity in industry equilibrium." *Journal of Financial Economics* 126, no. 1 (2017): 200-226.

[20] Dunning, John H. *International production and the multinational Enterprise (RLE international business).* Routledge, 1981.

[21] Ewens, Michael and Peters, Ryan H and Wang, Sean. "Acquisition Prices and the Measurement of Intangible Capital." *NEBR working paper* 25960 (2019).

[22] Feenstra, Robert C., Robert Inklaar, and Marcel P. Timmer. "The next generation of the Penn World Table." *American economic review* 105, no. 10 (2015): 3150-82.

[23] Guadalupe, Maria, Olga Kuzmina, and Catherine Thomas. "Innovation and foreign ownership." *American Economic Review* 102, no. 7 (2012): 3594-3627.

[24] Haaland, Jan I., and Anthony J. Venables. "Optimal trade policy with monopolistic competition and heterogeneous firms." *Journal of International Economics* 102 (2016): 85-95.

[25] Helpman, Elhanan, Marc J. Melitz, and Stephen R. Yeaple. "Export versus FDI with heterogeneous firms." *American economic review* 94, no. 1 (2004): 300-316.

[26] Hosios, Arthur J. "On the efficiency of matching and related models of search and unemployment." *The Review of Economic Studies* 57, no. 2 (1990): 279-298.

[27] İmrohoroğlu, Ayşe, and Şelale Tüzel. "Firm-level productivity, risk, and return." Management Science 60, no. 8 (2014): 2073-2090.

[28] Katitas, Ayan. "Foreign Direct Investment Neutralizes Perceived Economic Threat: Evidence From Chinese Investment in the U.S." Working paper (2020).

[29] Kim, Young-Han. "Cross-border M&A vs. greenfield FDI: Economic integration and its welfare impact." *Journal of Policy Modeling* 31, no. 1 (2009): 87-101.

[30] Li, Xiaoyang. "Productivity, restructuring, and the gains from takeovers." *Journal of Financial Economics* 109, no. 1 (2013): 250-271.

[31] Markusen, James R. "The boundaries of multinational enterprises and the theory of international trade." *Journal of Economic perspectives* 9, no. 2 (1995): 169-189.

[32] McGrattan, Ellen R., and Edward C. Prescott. "Technology capital and the US current account." *American Economic Review* 100, no. 4 (2010): 1493-1522.

[33] Melitz, Marc J. "The impact of trade on intra-industry reallocations and aggregate industry productivity." *Econometrica* 71, no. 6 (2003): 1695-1725.

[34] Nocke, Volker, and Stephen Yeaple. "Cross-border mergers and acquisitions vs. greenfield foreign direct investment: The role of firm heterogeneity." *Journal of International Economics* 72, no. 2 (2007): 336-365.

[35] Nocke, Volker, and Stephen Yeaple. "An assignment theory of foreign direct investment." *The Review of Economic Studies* 75, no. 2 (2008): 529-557.

[36] Norbäck, Pehr-Johan, and Lars Persson. "Investment liberalization—why a restrictive cross-border merger policy can be counterproductive." *Journal of International Economics* 72, no. 2 (2007): 366-380.

[37] Peters, Ryan H., and Lucian A. Taylor. "Intangible capital and the investment-q relation." *Journal of Financial Economics* 123, no. 2 (2017): 251-272.

[38] Raff, Horst, Michael Ryan, and Frank Stähler. "Firm productivity and the foreign-market entry decision." *Journal of Economics & Management Strategy* 21, no. 3 (2012): 849-871.

[39] Ramondo, Natalia. "FDI Entry Mode and the Activity of Affiliates of Multinational Firms." Working paper, Asian Development Bank. (2016).

[40] Ramondo, Natalia, and Andrés Rodríguez-Clare. "Trade, multinational production, and the gains from openness." *Journal of Political Economy* 121, no. 2 (2013): 273-322.

[41] Ramondo, Natalia, Veronica Rappoport, and Kim J. Ruhl. "Intrafirm trade and vertical fragmentation in US multinational corporations." *Journal of International Economics* 98 (2016): 51-59.

[42] Schoar, Antoinette. "Effects of corporate diversification on productivity." *The Journal of Finance* 57, no. 6 (2002): 2379-2403.

[43] Spearot, Alan C. "Firm heterogeneity, new investment and acquisitions." *The Journal of Industrial Economics* 60, no. 1 (2012): 1-45.

[44] Thomson Reuters. "Mergers & Acquisitions Review" (2018).

[45] Teece, David J. " Technology transfer by multinational firms: The resource cost of transferring technological know-how." *The economic journal* 87, no. 346 (1977): 242-261.

[46] Tintelnot, Felix. "Global production with export platforms." *The Quarterly Journal of Economics* 132, no. 1 (2017): 157-209.

[47] UNCTAD. "The world of investment promotion at a glance: a survey of investment promotion practices." UNCTAD/ITE/IPC3, ASIT advisory studies No.17 (2001).

[48] UNCTAD. *World investment report 2019.* (2019).

# Appendix A Data Appendix

## A.1 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 has started, and does not provide information 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 has been started.

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

- The information of the share of 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 business takes place or 100% of the stock of a public or private company is acquired.
  - ACQUISITION: deal in which 100% of a company is spun off or split off is classified as an acquisition by shareholders.
  - ACQ OF MAJORITY INTEREST: the 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: deals in which the acquirer holds over 50% and is seeking to acquire 100% of the target company's stock.

- 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.2 Greenfield Projects (fDi Market)

- The database provides source and destination locations at the city level. If a company made more than one investments 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 by country-date.

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

## 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 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 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 codes 9999 (unclassified establishment) to some firms and the code 9999 does not exist in 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 Subsequent Investments

This table 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 never followed up by M&A, and 95% of M&A investments never followed up by GF.

Table A.1: 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 |

# Appendix B Additional Empirical Results

Table B.1 shows the results of regressions analogues 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) |
| FE: Parent Ind | Yes | Yes | Yes | Yes |
| FE: Affiliate Ind | Yes | Yes | Yes | Yes |
| FE: Year | Yes | Yes | Yes | Yes |
| FE: Country | Yes | Yes | No | No |
| *N* | 14805 | 14479 | 15019 | 14690 |

[a] 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.

Table B.2 shows the results of regressions including the FDI index. The positive coefficients on the FDI index reflect the fact that multinationals are difficult to conduct M&A investment if a destination country has sever FDI restrictions such as a regulation on foreign ownership. Once I control for the FDI restriction, coefficients on population become significant.

Table B.2: Logit Regressions of Firms' FDI Mode Choices with Country Variables

| Dep var: | (1) | (2) | (3) |
|---|---|---|---|
| $\mathbb{1}[MA_{i,h,j,t}=1]$ | Intangibles | Knowledge | Organizational |
| Capital | $-0.200^{***}$ | $-0.162^{***}$ | $-0.095^{*}$ |
| | (0.046) | (0.049) | (0.052) |
| GDPPC | $0.907^{***}$ | $1.021^{***}$ | $0.910^{***}$ |
| | (0.051) | (0.067) | (0.051) |
| DIST | $-0.294^{***}$ | $-0.400^{***}$ | $-0.294^{***}$ |
| | (0.030) | (0.040) | (0.030) |
| POP | $0.090^{***}$ | $0.106^{***}$ | $0.093^{***}$ |
| | (0.025) | (0.032) | (0.025) |
| OPEN | $-0.225^{***}$ | $-0.147^{*}$ | $-0.226^{***}$ |
| | (0.061) | (0.077) | (0.061) |
| LANG | $0.614^{***}$ | $0.633^{***}$ | $0.617^{***}$ |
| | (0.050) | (0.063) | (0.050) |
| FDI_index | $-1.905^{***}$ | $-2.010^{***}$ | $-1.902^{***}$ |
| | (0.265) | (0.347) | (0.264) |
| $N$ | 13260 | 7996 | 13260 |
| $Pseudo R^2$ | 0.2467 | 0.2333 | 0.2447 |

[a] Standard errors are clustered by firm and country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

[b] All explanatory variables are in logs. I control for firm size using sales in addition to industry and year FEs.

# Appendix C Detailed Calculations and Parameters

## C.1 Proof for Equation (12)

The derivative of the left-hand side of equation (12) 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 (12) is decreasing in $K^*$. The right-hand side of equation (12) 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 (11), 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 (12) 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 (3): $Y = \left[\int_\Omega y_\omega^{\frac{\sigma-1}{\sigma}} d\omega\right]^{\frac{\sigma}{\sigma-1}}$,

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

where I use the labor demand (equation 6) 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 6) and $\Theta(w,Y) \equiv \left(w\frac{(1-\beta)\sigma+\beta}{\beta(\sigma-1)}\right)\tilde{\Theta}(w,Y)$ (from equation 7) 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 14) 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 $\mu$ 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 15) is

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

where $\hat{Y}(K^*)$ is defined by equation (13). $\hat{Y}(K^*)$ 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 $\psi$ 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

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

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.[46]

## C.6 Inefficiency

### C.6.1 Market Equilibrium $K^*$

The cutoff condition, equation (14), is

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

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 $Y = \left(\frac{1}{w}\frac{\beta(\sigma-1)}{\sigma}\right)^{\frac{\beta}{1-\beta}}\hat{Y}(K^*)^{\frac{\alpha}{1-\beta}}$ defined in equation (13), $Y^{1/\sigma} = \tilde{\Theta}^{\beta/\sigma}\hat{Y}(K^*)^{\frac{1}{\sigma-1}}$. With the function of $Y^{1/\sigma}$ and $L = \tilde{\Theta}(w)\hat{Y}(K^*)$ (the labor market condition defined in equation 15), I can set

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

### C.6.2 Social Planner's Problem

I solve the social planner's problem:

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

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

[46] 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.

the question backwards.

First, from equation (3), 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 $\lambda$ 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 $\ell_\omega$ is

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

Using the resource constraint,

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

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

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

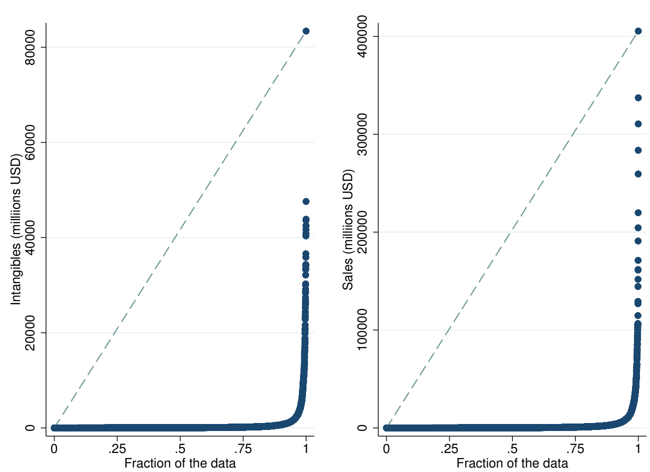
where $\xi(K^s)$ is the elasticity of the matching function:

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

## C.7 Additional Figure and Table in Section 5

Figure C.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 C.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.

Table C.3 shows the two types of moments that I use to calibrate parameters. One is the ratio of the average intangibles of M&A firms to that of all firms, $\frac{\overline{K}_{MA}}{\overline{K}}$, and the other is the share of M&A investments out of total investments (both M&A and GF), $\frac{E_m}{E_m+E_g}$.

Table C.3: Moments

| Moment | All FDIs (baseline) | | FDIs to the North | | FDIs to the South | |
|---|---|---|---|---|---|---|
| | Data | Model | Data | Model | Data | Model |
| $\frac{\overline{K}_{MA}}{\overline{K}}$ | 0.6490 | 0.6490 | 0.7730 | 0.7732 | 0.5700 | 0.5701 |
| $\frac{E_m}{E_m+E_g}$ | 0.4170 | 0.4168 | 0.5560 | 0.5561 | 0.2050 | 0.2053 |

[a] $\frac{\overline{K}_{MA}}{\overline{K}}$ is the ratio of the average intangibles of M&A firms to that of all firms. $\frac{E_m}{E_m+E_g}$ is the share of M&A investments out of total investments (both M&A and GF). I show the numbers from both the data and the calibrated model.