Greenfield or Brownfield?
FDI Entry Mode and Intangible Capital

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Abstract

When a multinational firm invests abroad, it can either establish a new facility (greenfield investment, GF) or purchase a local firm (cross-border merger and acquisition, M&A). Using a novel US firm-level dataset, I provide the first evidence that multinationals with higher levels of intangible capital systematically invest through GF rather than through M&A. Motivated by this empirical result, I develop and quantify 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 from the host country's perspective. 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

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; Burnstein 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

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[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.

The model suggests that equilibrium FDI patterns can be suboptimal from the host country's perspective. Therefore, there could be room for the local government to improve local welfare using FDI policies that incentivize one entry type over the other. To examine this possibility, I quantitatively assess 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; Burnstein and Monge-Naranjo, 2009; McGrattan and Prescott, 2010; Bloom et al., 2012; Arkolakis et al., 2018; Bilir and Morales, 2020). In particular, Burnstein 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 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.

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[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.

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, 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

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[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.

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. The depreciation rates and the multiplier of SG&A spending are from Ewens, et al. (2020). I use a 33% depreciation rate for knowledge capital accumulation. I use 27% of SG&A spending and a 20% depreciation rate to accumulate organizational capital.[10] These depreciation rates of intangible capital are higher than the depreciation rate of physical capital. Intangible capital adjusts slowly compared with physical capital, which makes purchasing already-accumulated capital stock attractive.

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[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. In addition, 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% (instead of 27%) for the SG&A multiplier, 15% or 25% (instead of 20%) for the depreciation rate of organizational capital, and 20% or 40% (instead of 33%) for the depreciation rate of knowledge capital.

(iv) Host Country Characteristics: I also 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. Distances from the US to host countries come from the CEPII database.

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 2,667 Compustat firms in total. During the sample period (2003 - 2018), 695 firms made only GF investments, while 789 firms made only cross-border M&As. 1,183 firms made investments using both FDI modes. In SDC Platinum, I match around 92% of deals made by publicly-listed ultimate acquires with Compustat firms. Unfortunately, I cannot identify which firms are listed in the fDi Market database. According to the BEA data, there are around 4,500 US multinational parents in 2014.[11] Therefore, my dataset covers roughly 60% of US multinational parents.

2.3 Data for Regressions

After merging the datasets, I aggregate firms' investments by firm-industry-destination. For firms that made more than one investment in the same industry and destination country, I extract the first FDI from the merged data.[12] 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

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[11]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.

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

Table 1: Summary Statistics

| | My data | | | | Nocke & Yeaple | |
| | All industries | | Manufacturing only | | | |
Variable	mean	s.d.	mean	s.d.	mean	s.d.
M&A	0.417	0.493	0.415	0.493	0.435	0.496
Sales	21.809	2.287	22.037	2.227	15.37	1.61
SG&A/Sales	−2.964	0.858	−3.055	0.814	-	-
R&D/Sales	−3.100	1.407	−3.330	1.361	−0.389	1.32
Intangibles/Sales	−1.313	0.956	−1.255	0.858	-	-
GDPPC	10.048	0.841	10.011	0.853	9.81	0.723
Population	17.622	1.653	17.716	1.689	16.7	1.38
Openness	4.262	0.559	4.259	0.555	3.94	0.648
Distance	8.766	0.813	8.804	0.772	8.72	0.69
Number of obs	15,475		8,579		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 are in logs.

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

[d] The number of observations for R&D/sales are 10,375 in all industries, and 7,439 in manufacturing industries.

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).[13] 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 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) more GF investments

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[13]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.

Figure 1: Share of GF Investments and Intangible Capital

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

are made in less developed and distant countries.

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

Table 2: Logit Regressions of Firms' FDI Mode Choices

Dep var: $\mathbb{1}[MA_{i,h,j,t} = 1]$	(1) Intangible	(2) Knowledge	(3) Organizational	(4) Physical
Capital	$-$ 0.220***	-0.190***	-0.102*	-0.036
	(0.047)	(0.050)	(0.050)	(0.047)
Sales	0.108**	0.101*	0.004	-0.047
	(0.044)	(0.052)	(0.047)	(0.050)
Parent Industry FEs	Yes	Yes	Yes	Yes
Affiliates Industry FEs	Yes	Yes	Yes	Yes
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
N	14805	8783	14805	14529
$PseudoR^2$	0.291	0.288	0.289	0.287

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

[b] All explanatory variables are in logs.

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

$$\mathbb{1}[MA_{i,h,j,t} = 1] = \alpha \times intangibles_{i,t-1} + \beta \times sales_{i,t-1} + country_h + firm\text{-}industry_i$$
$$+ affiliate\text{-}industry_j + year_t + \epsilon_{i,h,j,t},$$

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 endogeneity issue between firm's investment decisions and its financial status in the same data period.[14] In addition, I control for firm size using $sales_{i,t-1}$ since I need to consider the importance of intangible assets in firms' business operations.[15] For example, Arrighetti et al. (2014) shows that larger firms have more intangible capital using the data on Italian manufacturing firms. Lastly, I also control for country, investing (or parent) firm industry, affiliate industry, and year using fixed effects.

Table 2 presents the results. In the first column, the coefficient on intangible capital is negative and statistically significant. This shows that probability of making a GF investment

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

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

Table 3: Logit Regressions of Firms' FDI Mode Choices with Country Variables

Dep var: $\mathbb{1}[MA_{i,h,j,t} = 1]$	(1) Intangibles	(2) Knowledge	(3) Organizational
Capital	−0.200***	−0.159***	−0.097*
	(0.045)	(0.048)	(0.049)
GDPPC	0.869***	0.964***	0.872***
	(0.027)	(0.044)	(0.027)
DIST	−0.510***	−0.664***	−0.510***
	(0.010)	(0.018)	(0.010)
POP	0.003	0.002	0.006
	(0.005)	(0.009)	(0.005)
OPEN	−0.688***	−0.708***	−0.687***
	(0.029)	(0.041)	(0.030)
N	15019	9039	15019
$PseudoR^2$	0.242	0.227	0.240

[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.

increases with the amount of intangible capital. These effects are driven both by the amount of knowledge capital and organizational capital (see the second and the third columns). The results mean that if firms have enough intangible capital, they invest via GF; otherwise they invest via M&A to benefit more from acquiring local intangibles. Interestingly, column 4 shows that the coefficient on physical capital is insignificant. This result supports my prediction that physical capital is not a significant determinant of an investment mode because firms establish their physical facilities abroad either through M&A or GF, and thus underlines the importance of intangible capital in FDI mode choice.

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.[16] My results show that there is an additional determinant of firms' FDI decisions, in addition to firm's sales.

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[16] Table A.2 shows that I obtain the same results in the regressions analogous to Nocke and Yeaple (2008), using my dataset in 2003-2018.

3.2 Country Characteristics

In addition to firm heterogeneity, variations in destination countries are also matters for firms' FDI decisions. Instead of country FEs, I include covariates describing the host country: GDP per capita (GDPPC), population (POP), openness to trade (OPEN), and distance (DIST). I refer to Nocke and Yeaple (2008) to select these country variables. Table 3 shows the regression results. For country variables, signs and significance, except DIST, in my regression are the same as those in Nocke and Yeaple (2008). The positive coefficients on GDPPC show that there are more M&A investments in developed countries. There are more firms with greater intangible capital in countries with higher GDPPC, thus acquiring existing assets is more attractive for firms that invest in these countries. In addition, the negative coefficients on distance show that investing firms are less likely to make M&A investments in distant countries. This could reflect the fact that there is a smaller matching probability between target and acquiring firms, as well as higher search costs, if the investing countries are more distant. Unlike Nocke and Yeaple (2008), who use US FDI data from 1994-1998, I obtain negative signs on DIST. The negative signs in my regressions correspond to the results in Davies et al. (2018), which uses more recent global transactions from 2003-2010. The authors conclude that there are fewer M&A investments as barriers between countries get larger because M&A relies on intra-firm integration.

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.[17] 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

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[17]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.

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 their M&A partners in h, while some of them conduct GF without searching. If multinationals search and 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.[18] 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. Consumer supply labor and consume final good.

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[18]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 a recent paper on the small open economy framework in the monopolistic competition setting.

4.1.1 Intermediate Good Firms

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

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

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

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

where θ is a shape parameter. For simplicity, assume that productivity for multinational firm i is constant at the value $\tilde{Z}$.[19]

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

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

where $\tilde{z}$ is productivity, κ is intangible capital, and ℓ_j is labor. The productivity of local firm j is constant at the value $\tilde{z}$ such that $\tilde{z} \leq \tilde{Z}$. A firm's level of intangible capital is homogeneous and it is given as κ.[20]

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:[21]

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

---

[19]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.

[20]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.

[21]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.

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:

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

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.

(i) Greenfield Firms: Multinational firm i which either did not search or failed to find a target conducts a greenfield investment (GF). This assumption is reasonable within this model, as we see below that the multinational firm can receive a positive net return from the GF investment. Unlike physical capital, both productivity, $\tilde{Z}$, and intangible capital, K_i, can easily 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.[22]

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, κ, in producing. This is in line with the fact

---

[22]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.

that M&As improve the acquirer's productivity (e.g., Schoar 2002; Li 2013; Dimopoulos and Sacchetto 2017). I assume that the merged firm inherits the acquirer's productivity $\tilde{Z}$. 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.[23] This imperfect "scalability" in M&A investments is represented by η. Note that the formulation here highlights the difference between technology and intangible capital: technology does not have an additive property (for example, a better management practice prevails within a firm) whereas intangible capital can accumulate within a firm (patents can have independent values; local network and brand name can have separate effects). Let the amount of intangible capital of the merged firm m be $k_m \equiv (\kappa + \eta K_i)$, and its productivity be $\tilde{Z}_m \equiv \tilde{Z}$.

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

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

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

4.1.4 Final Good Producer

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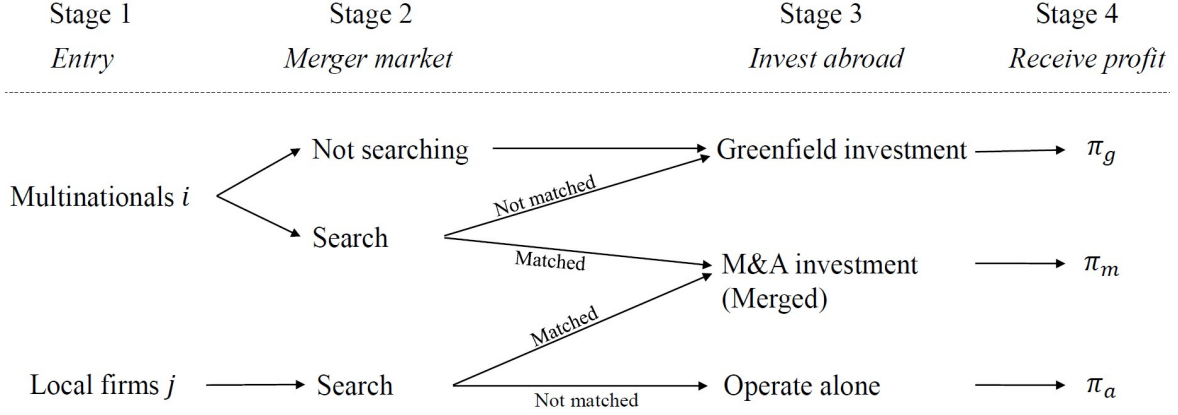
The final-good production function is:

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

---

[23]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.

Figure 2: Timing of the Model

where $\sigma > 1$ is the elasticity of substitution.[24]

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:

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.

---

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

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, Ξ. I use the final good as a numéraire, and normalize Ξ to one.[25] The inverse demand function for good ω is

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

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

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

w is the wage in the host country. I assume that $\alpha = \sigma/(\sigma - 1) - \beta$ (with $0 < \beta \le 1$). Note that the amount of intangibles, K, is determined exogenously. This assumption is without a loss of generality in the setting here, as one can always change the unit of measurement for K by a monotonic transformation, so that α satisfies this relationship.[26]

---

[25]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.

[26]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.

Solutions for the labor demand, ℓ_ω, are:

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

where $\tilde{\Theta}(w, Y) \equiv \left[\frac{Y^{1/\sigma}}{w}(1 - \frac{\sigma-1}{\sigma}\alpha) \right]^{\frac{\sigma}{\alpha(\sigma-1)}}$. 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:

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

Here, $\Theta(w, Y) \equiv w \left(\frac{\alpha(\sigma-1)}{\sigma - \alpha(\sigma-1)} \right) \tilde{\Theta}(w, Y)$. The expression of firms' profits is analogous to the ones in Nocke and Yeaple (2007, 2008): the profit depends on two types of production efficiency, productivity (Z and z) and intangible capital (K and κ), as well as the wage in the host country w.[27]

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 Θ in place of $\Theta(w, Y)$. The combined gain (surplus) from the merger (i.e., "synergy" from mergers), Σ, for multinationals which match with local firms is given by:

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

Multinationals consummate mergers so long as they have positive merger gain. The gains are the profit of the merged firm, π_m, less the profit that the multinational would have earned

---

[27]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).

through GF, π_g (the multinational's outside option), and the pre-merger profit of the local firm, π_a (the target's outside option).

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

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

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

Using equation (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

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

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:*

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

Proof. See Appendix C.1.

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^*.

One of the main objectives of this paper is to investigate how multinational firms choose their modes of FDI depending on their levels of intangible capital stock. 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.

4.2.4 Measures of Firms

Using the matching probability, $\hat{\mu}(K^*)$, I define the measures of the three types of firms which exist after multinationals invest. The measure of multinational firms which make M&As is:

$$E_m = \hat{\mu}(K^*)MG(K^*). \tag{13}$$

The measure of multinational firms which make GF investments is:

$$E_g = [1 - \hat{\mu}(K^*)]MG(K^*) + M(1 - G(K^*)), \tag{14}$$

22

where the first term represents the multinationals which failed to find an M&A partner, and the second term represents the multinationals which chose GF without searching.

If E_m multinationals conduct M&As, the same number of firms are acquired in country h. The remaining firms, the mass of $N - E_m$, continue to operate independently. The measure of these local firms is:

$$E_a = N - E_m = N - \hat{\mu}(K^*)MG(K^*).$$

From the viewpoint of a local firm, the probability of being acquired is:

$$\lambda(K^*) = \frac{E_m}{N} = \frac{\hat{\mu}(K^*)MG(K^*)}{N}. \tag{15}$$

4.3 Characterization of the Equilibrium

I consider the equilibrium in the host country in this section. I first show output and labor demand for each type of firm. I then state conditions satisfied in the equilibrium. The equilibrium is characterized by the wage level, w, and the cutoff in the level of multinational's intangibles, K^*.

4.3.1 Intermediate Good Firm Outcomes

In section 4.2.3, the cutoff level of intangible capital for M&A, K^*, is pinned down for a given (w, Y). To compute the aggregate output and the aggregate labor demand, I organize the output, y_ω, and labor demand, ℓ_ω, for each type of firm, $\{m, g, a\}$, using (K^*, w, Y) as below:

(i) For M&A firms which successfully match with local firms with probability, $\hat{\mu}(K^*)$
   $\rightarrow y_m(K_i; w, Y)$ and $\ell_m(K_i; w, Y)$ where $K_i \in [\underline{K}, K^*]$.

(ii) For GF firms which search and fail to match with local firms with probability, $1 - \hat{\mu}(K^*)$
   $\rightarrow y_g(K_i; w, Y)$ and $\ell_g(K_i; w, Y)$ where $K_i \in [\underline{K}, K^*]$.

(iii) For GF firms which decide to make GF investment without searching
   $\rightarrow y_g(K_i; w, Y)$ and $\ell_g(K_i; w, Y)$ where $K_i \in [K^*, \infty]$.

(iv) For local firms that operate alone with probability, $\lambda(K^*)$
   $\rightarrow y_a(w, Y)$ and $\ell_a(w, Y)$.

Using the above description, I now consider the intermediate goods market, the labor market clearing conditions.

4.3.2 Intermediate Goods Market

There are three unknowns in the equilibrium, (w, K^*, Y). First, using the production function (3), I show that Y can be represented as a function of (w, K^*). From equation (3),

$$
\begin{aligned}
Y &= \left[\int_\Omega y_\omega^{\frac{\sigma-1}{\sigma}} \, d\omega \right]^{\frac{\sigma}{\sigma-1}} \\
&= \left[\hat{\mu}(K^*)M \int_{\underline{K}}^{K^*} y_m(w, K, Y)^{\frac{\sigma-1}{\sigma}} dG(K) \right. \\
&\quad + (1 - \hat{\mu}(K^*))M \int_{\underline{K}}^{K^*} y_g(w, K, Y)^{\frac{\sigma-1}{\sigma}} dG(K) \\
&\quad + M \int_{K^*}^{\infty} y_g(w, K, Y)^{\frac{\sigma-1}{\sigma}} dG(K) \\
&\quad \left. + (1 - \lambda(K^*))N \, y_a(w)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}.
\end{aligned}
$$

The right-hand side is a function of (w, K^*, Y). Thus, one can solve this equation for Y and represent Y as a function of (w, K^*). The solution for Y is

$$
Y = \left[\frac{1}{w} \left(1 - \frac{\sigma-1}{\sigma} \alpha \right) \right]^{\frac{\beta}{1-\beta}} \left\{ \hat{\mu}(K^*)MZ \int_{\underline{K}}^{K^*} k_m \, dG(K) + (1 - \hat{\mu}(K^*))MZ \int_{\underline{K}}^{K^*} k_g \, dG(K) \right.
$$
$$
\left. + MZ \int_{K^*}^{\infty} k_g \, dG(K) + (1 - \lambda(K^*))Nzk_a \right\}^{\frac{\sigma\alpha}{\alpha(\sigma-1)-\beta}}.
$$

This shows that the aggregate output, Y, is a function of (w, K^*). Appendix C.2 provides the detailed derivation. For graphical analyses, now I characterize equilibrium conditions using two unknowns (w, K^*). Below, I use the notation $\tilde{\Theta}(w, K^*)$ and $\Theta(w, K^*)$ in place of $\tilde{\Theta}(w, Y)$ and $\Theta(w, Y)$.

4.3.3 Cutoff Condition

In sections 4.2.2 and 4.2.3, I showed that K^* can be solved for a given (w, Y). Restating the cutoff condition, equation (12), using the notation $\Theta(w, K^*)$ instead of Θ,

$$
(1 - \chi)\hat{\mu}(K^*)\Theta(w, K^*) \left[(Z - z)\kappa - Z(1 - \eta)K^* \right] = \psi. \tag{16}
$$

4.3.4 Labor Market

The labor market in the host country is cleared by equating the labor supply to the aggregate labor demand. I compute the aggregate labor demand using the cutoff level K^* shown in section 4.3.1, and equating it to the labor supply, L:

$$
L = \hat{\mu}(K^*)M \int_{\underline{K}}^{K^*} \ell_m(w, K)dG(K)
$$

$$
+ [1 - \hat{\mu}(K^*)]M \int_{\underline{K}}^{K^*} \ell_g(w, K)dG(K)
$$

$$
+ M \int_{K^*}^{\infty} \ell_g(w, K)dG(K)
$$

$$
+ [1 - \lambda(K^*)]N\ell_a(w, K^*).
$$

Inserting equation (1), (6) and (15) to the right-hand side of this equation, the expression for the aggregate labor demand below:

$$
L = \hat{\mu}(K^*)M\tilde{\Theta}(w, K^*)Z \left[\kappa(\underline{K}^{-\theta} - K^{*-\theta}) + \frac{\eta\theta}{\theta - 1}(\underline{K}^{1-\theta} - K^{*1-\theta}) \right] \tag{17}
$$

$$
+ [1 - \hat{\mu}(K^*)]M\tilde{\Theta}(w, K^*)Z\frac{\theta}{\theta - 1} \left[\underline{K}^{1-\theta} - K^{*1-\theta} \right]
$$

$$
+ M\tilde{\Theta}(w, K^*)Z\frac{\theta}{\theta - 1}K^{*1-\theta}
$$

$$
+ \tilde{\Theta}(w, K^*)z\kappa \left[N - \hat{\mu}(K^*)MG(K^*) \right].
$$

4.3.5 Equilibrium

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

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

(i) The labor market condition in equation (17).

(ii) The cutoff condition in equation (16).

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

Figure 3: Equilibrium Conditions
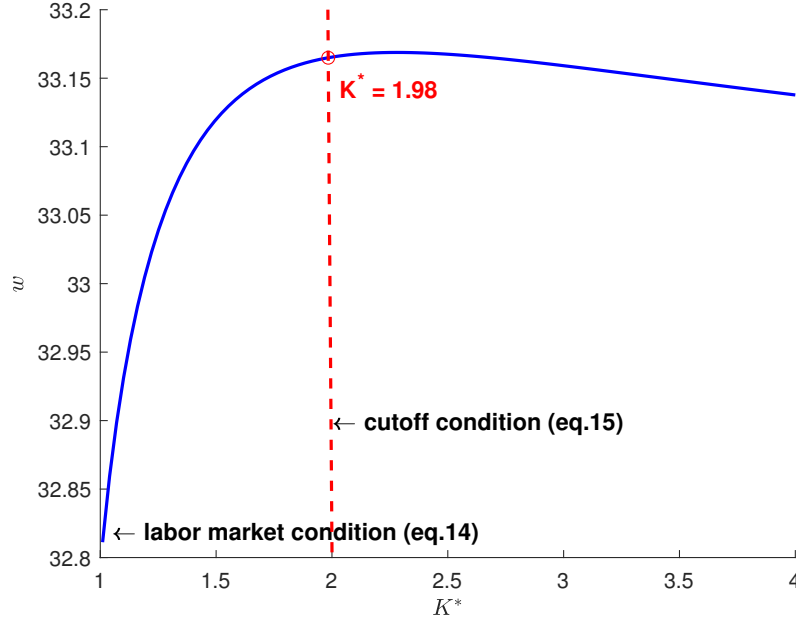
equation (5), and the labor market clears when equation (17) is satisfied. From Walras' Law, the final-good market automatically clears.[28]

The system of two equations—the labor market condition (equation 17), and the cutoff condition (equation 16)—has a unique solution. In Figure 3, I plot the equilibrium wage level, w, and the threshold level of intangible capital, K^*, which satisfy each of the conditions. The cutoff condition is strictly decreasing, while the labor market condition is a concave function.
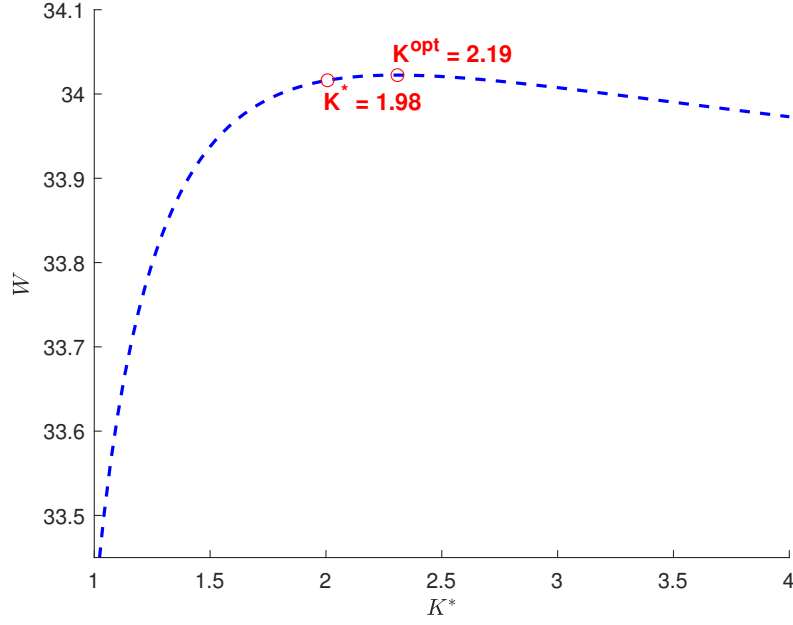
4.3.6 Welfare

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:

$$W(w, K^*) = wL + (1 - \lambda(K^*))N\pi_a(w, K^*) + \hat{\mu}(K^*)M \int_{\underline{K}}^{K^*} P(w, K)dG(K) \qquad (18)$$

---

[28]Final-market clearing condition is in Appendix C.3.

Figure 4: Socially Optimal K^*

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 socially optimal threshold level of intangibles maximizes welfare in the host country subject to the labor market clearing condition. The following problem gives the socially optimal K^{opt}:

$$\max_{w, K^*} W \quad \text{subject to the labor market condition (equation 17).}$$

Figure 4 shows that there is a cutoff level of multinationals' intangibles, K^{opt}, which maximizes welfare, W. Interestingly, the equilibrium threshold level of intangible, K^*, can be different from the optimal level, K^{opt}. Externalities are generated during search and matching. Multinational and local firms bargain over a merger gain, after a match is made. Firms are not likely to take the search cost of those still unmatched into consideration. In

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my model, the threshold level of intangible capital determines the types of investment that the host country receives. The equilibrium FDI patterns can be suboptimal from the host country's perspective, meaning that there is a certain level of greenfield or M&A investment that maximizes local welfare. If policymakers seek to maximize welfare, W, they would like to pursue a policy that leads to the optimal threshold level, K^{opt}. For example, suppose there is a country for which $K^* > K^{opt}$. In this case, policymakers restrict M&As to lower the value of K^*. This model prediction motivates me to conduct experiments regarding FDI policies by 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.

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.[29] 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 5).[30]

I estimate the value of the shape parameter, θ, following Axtell (2001) and Helpman et al. (2004). First, I rank firms in descending order, according to their amount of intangible capital (i.e., the firm with the largest intangible capital is ranked first). I then plot the logarithms of the ranking and the firm's intangible capital. Following the existing literature, I focus on the upper tail of the distribution when estimating the shape parameter. I consider firms within the top 1 percentile of intangibles.[31] This log-log plot (Figure 6) is known as

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[29]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.

[30]Figure A.1 in Appendix C.4 shows the quantile plots of intangible capital and sales. The figures shows that the shapes of both distribution are the same.

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

Figure 5: Distribution of Firms' Intangible Capital
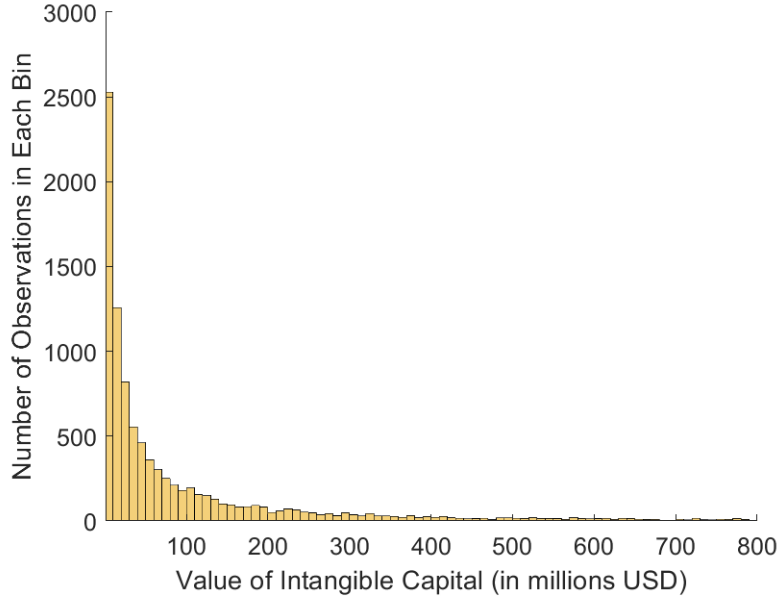
Table 4: Estimated Shape Parameter in $G(K)$

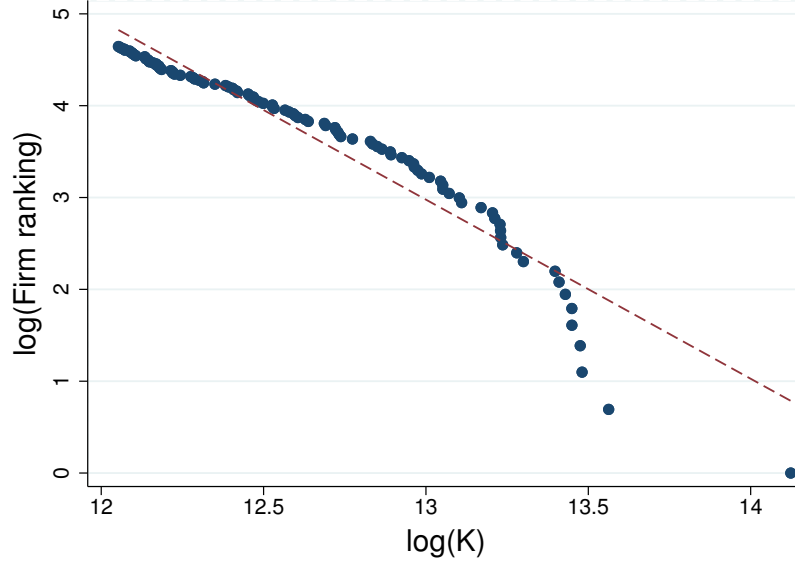| Estimated θ	Adjusted R^2
1.951 (0.055)	0.924

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, θ. I normalize the data by setting the lowest value of intangibles equal to one since I set the scale parameter $\underline{K} = 1$. I set $\theta = 1.95$ from the regression result (Table 4).[32]

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.

[32]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.

Figure 6: Zipf Plot: Firm's Intangible Capital

5.2 Baseline Parameters

I set the cutoff level of intangible capital, K^*, and the matching function parameter, ρ, using moments obtained from my data. The values from both the data and also the calibrated model are shown in Table 5. In this subsection, I do not distinguish the US investing firms by destination countries and instead use the whole sample. I call these parameters the baseline parameters. These numbers are reported in Table 6.

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. In order to pin down K^*, I first calculate the mean of M&A firms' intangibles, and divide the value by the overall mean of intangibles. This moment describes how much the mean of intangibles among M&A firms deviates from that of all firms. As the moment gets larger, firms with larger intangible capital make more M&A investments. The moment is represented in the model as:

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

where $\overline{K}_{MA}$ is the mean of M&A firms' intangibles, and $\overline{K}$ is the mean of all firms' intangi-

Table 5: 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.

bles. I then match this moment with the one in the data. The value in the data is 0.65, so I set $K^* = 1.98$.[33]

Matching probability: Using equation (13) and (14), the share of multinational firms which make M&A investments is:

$$\frac{E_m}{E_m + E_g} = \hat{\mu}(K^*)G(K^*). \tag{19}$$

The number is 0.42 in the dataset (Table 1). Since $G(K^*)$ is 0.74, I find $\hat{\mu}(K^*) = 0.57$. Using the matching function (equation 2), I set the elasticity parameter, ρ, to 0.55. In order to pin down ρ, I need to choose the number of multinationals, M, and the number of local firms, N. In my dataset, the average number of FDI projects across destination country is 630. For the number of local firms, I predict the numbers of firms in destination countries, using their GDPs and the number of US firms. I weight by total number of investments and compute the weighted average across destination country. I set $M = 630$ and $N = 3430$.[34]

Firm's technology: I set the exogenous technology parameter Z and z using productivity per hour worked.[35] In the data, the labor productivity in US (61.056) is double the average

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[33]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 targets, it makes 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 result of matching 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 $K_i \leq K^*$.

[34]The number of total firms are not available in each destination, 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 GDPs (correlation is 0.97), I project the number of local firms in each destination country. I use the number of US firms with more than 250 employees (the number is 26,225 and comes from the Census data). Around 90% of US multinationals in my dataset have more than 250 employees. Since acquirers usually buy targets with similar size, I focus on firms with more than 250 employees.

[35]The data come from Our World in Data, a project by the University of Oxford. The data are

Table 6: Baseline Parameters

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

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

of the values 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. Additionally, I use the fact that the average profitability of US acquirers is 7.5 times larger than that of US target firms (David, forthcoming). In my model, the relationship is $\frac{\pi_m(\overline{K}_{MA})}{\pi_a} = \frac{Z\overline{K}_{MA}}{z\kappa} = 7.5$. I set the level of local firm's intangibles κ to 1.09. While this fact is observed in the US domestic M&A market, existing studies also report the fact that foreign acquirers are more productive than domestic target firms (e.g., Guadalupe et al., 2012).

I take the remaining parameters from existing literature and other data sources. I take elasticity of substitution, σ, from Broda and Weinstein (2006), and the bargaining power of target firms from David (forthcoming): $\sigma = 6$ and $\chi = 0.5$. I also set the labor share in the Cobb-Douglas production function, β, to 0.7. I normalize the number of labor force to one. As I showed in section 4.3.5, the equilibrium can be characterized by two parameters, w and K^*. I pin down the wage level, w, using the labor market clearing condition (equation 17), and obtain $w = 33.17$.

Lastly, I pin down M&A friction parameter, η, using the average merger premium. The

Table 7: Profits with the Baseline Parameters

Level of K	Profit	Definition (all values are in average)	Value
	$\pi_m(\overline{K}_{MA})$	M&A profits (in gross)	0.0157
$\overline{K}_{MA}$	$P(\overline{K}_{MA})$	Acquisition price	0.0050
	$\pi_g(\overline{K}_{MA})$	GF profits (firms which have searched)	0.0098
$\overline{K}_{GF}$	$\pi_g(\overline{K}_{GF})$	GF profits (firms which have not search)	0.0298
κ	π_a	Local firm's Profits	0.0040

[a] Numbers are replicated with the parameters shown in Table 6. $\overline{K}_{MA}$ is the mean of
M&A firms' intangibles, $\overline{K}_{GF}$ is the mean of GF firms' intangibles, and κ is local firms'
intangibles (this value is constant). $\overline{K}_{MA} = 1.33$, $\overline{K}_{GF} = 4.07$, and $\kappa = 1.09$.

calibrated model replicates the profits of each type of firm and the acquisition price. Table
7 shows the average of each type of profits. Using these numbers, I define the average
merger premium as $\frac{P(\overline{K}_{MA}) - \pi_a}{\pi_a}$, where $P(\overline{K}_{MA})$ is the acquisition price with the mean of
M&A firms' intangibles, and π_a is profits of a local firm. According to a report by Thomson
Reuters (2018), the average world M&A premium ranges between 20% and 26%. I set the
M&A friction parameter, η, so that the average merger premium replicated using parameters
equals to 25%. I set $\eta = 0.80$. Using the cutoff condition (equation 12), I pin down the search
cost, $\psi = 0.00030$.

Figure 3 shows the labor market condition and cutoff condition with two endogenous
variables, w and K^*. In addition, as Table 5 shows, the calibrated model produce moments
similar to the data.

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

Table 8: Parameters (by Destination)

| Parameter	Definition	Value North	South
ρ	Elasticity of the matching function	0.71	0.35
M	Number of multinationals (FDI projects)	1023	576
N	Number of local firms	3081	5303
Z	Technology level in the US	1	1
z	Technology level in host countries	0.72	0.24
κ	Intangible capital of local firms	1.11	1.08
η	M&A friction	0.92	0.68
ψ	Search cost	0.00016	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.

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 8. M&A firms investing in the North have a higher level of $\frac{\overline{K_{MA}}}{\overline{K}}$ than those investing in the South (Table 5). Reflecting this difference, I find that firms investing in the North face a higher level of cutoff K^*. I set $K^* = 3.73$ for firms investing in the North, and $K^* = 1.33$ for firms investing in the South. Firms with intangibles larger than the cutoff will invest via GF without searching for their M&A partners. The cutoff in the North is 2.5 times larger than that in the South. Therefore, firms making GF in the North have a larger amount of intangible capital than those in the South.

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

Figure 7: K^* and K^w ([top] the North, [bottom] the South)
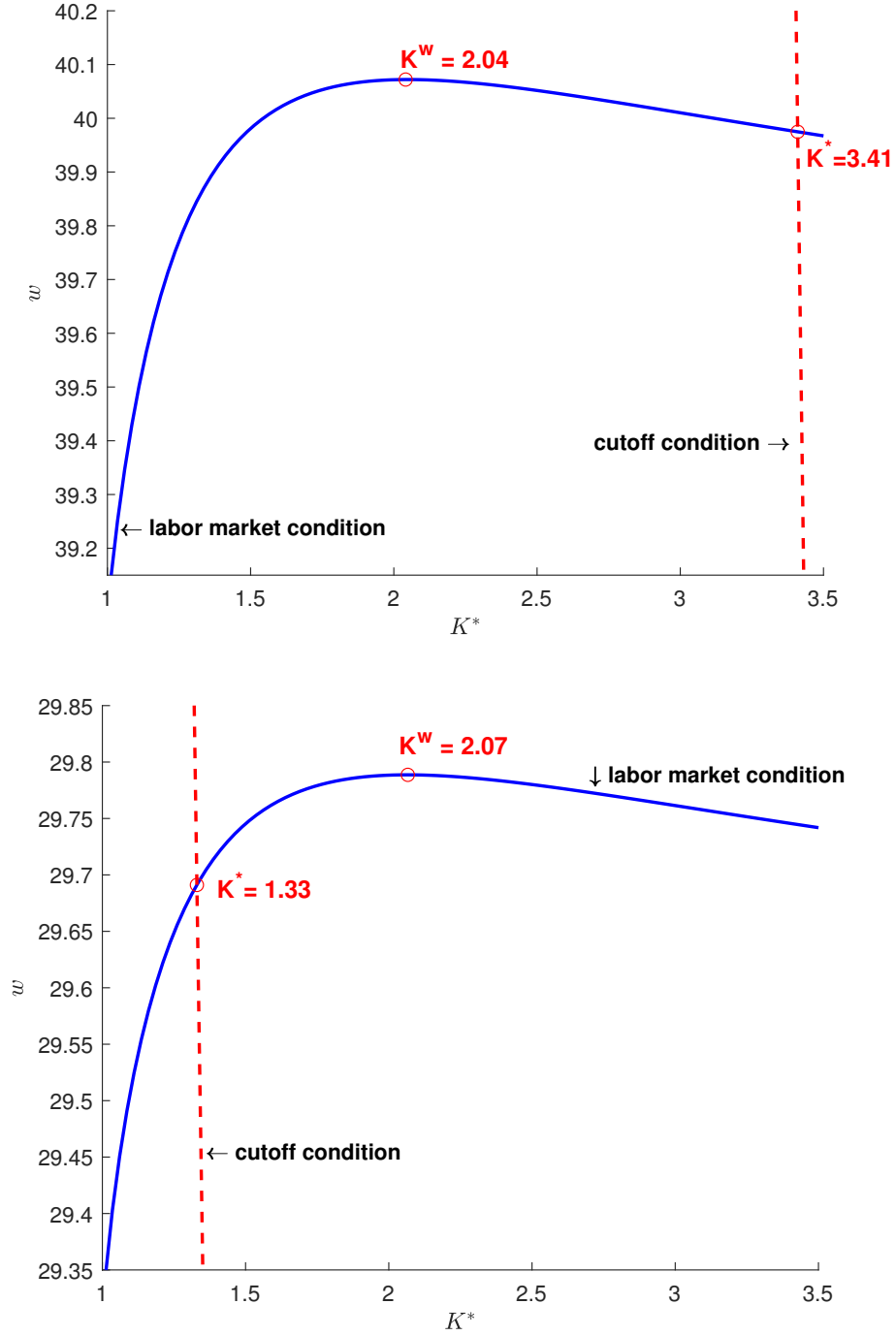
from mergers and the lower probability of matching create a much higher search cost, and discourage firms from searching for M&A partners in the South. To set the M&A friction parameters, η, I consider the fact that cultural barriers and communication costs affect the quality of post-acquisition integration. Thus, I assume the distance between host countries and the US governs the M&A friction parameter, and use the number of investments to compute a weighted average of the distance. The ratio of the average distance in the South to that of the North is 1.35.[36] 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 17), I obtain the equilibrium wage, w^*, in the North is 39.97 and 29.68 in the South. Interestingly, the cutoff level of intangibles achieving the highest wage, K^w, is smaller than the current cutoff, K^*, in the North, while it is larger in the South (Figure 7). 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 show in the previous section, the optimal policy response differs in the North and the South. In the North, if policymakers 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   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 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:

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

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

Table 9: 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.

where $\tau > 0$. The cutoff condition (equation 16) becomes

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

Figure 8 shows that if there is a tax on GF profits, the cutoff condition shifts to the right. The equilibrium level of intangible capital, K^{**}, is larger than the previous cutoff level, K^*. 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.

The local welfare consists of four parts: wage payment, local profits, acquisition transfer, and tax transfer. Table 9 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.

6.2 Subsidy on GF investments in the North

I next consider the effects of state subsidies on GF multinationals in the North. Figure 8 shows that if governments subsidize GF profits (i.e., $\tau < 0$ in equation 20), the cutoff

Table 10: 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.

condition shifts to the left. The equilibrium level of intangible capital, K^{**}, is smaller than the previous cutoff level, K^*. Higher expected profits from making GF investments discourage multinationals from searching for their M&A partners, and thus fewer M&As occur.

Table 10 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

In this paper, I investigate 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

Figure 8: [top] Subsidy on GF Profits in the North, [bottom] Tax on GF Profits in the South
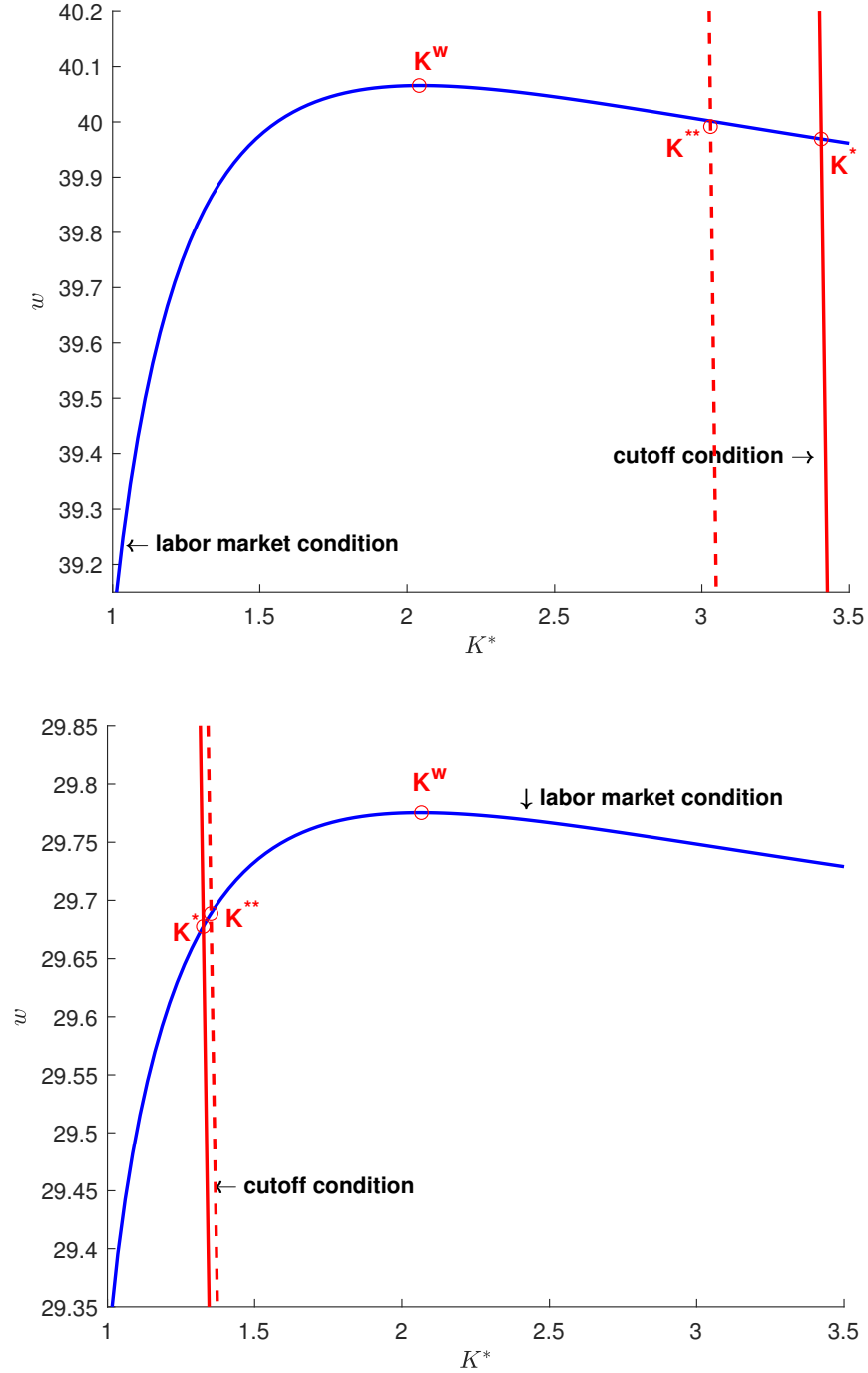
^a The lines in this figure show the K^* and w which satisfy the labor market condition (equation 17 is shown as the blue curved line) and the cutoff condition (equation 16 is shown as the a red straight line). I use the parameters in Table 8.

^b [top] The dashed line is the cutoff condition when there is a 1% subsidy on profits of GF multinationals.

^b [bottom] The dashed lines are the conditions when there is a 1% tax on profits of GF multinationals.

show that firms with lower intangible capital tend to choose GF, which is consistent with my empirical results. Moreover, I show that equilibrium FDI patterns can be suboptimal from the host country's perspective, which implies that there is a certain level of GF investment that maximizes local welfare. This allows me to assess the welfare effects of various policies in investment-receiving countries through changes in FDI. In particular, I find that the effects of FDI policies differ between a developed economy (i.e., the North) and a developing economy (i.e., the South). In the South, policies that restrict GF investments raise total welfare. By contrast, in the North, I find that policies that promote GF decrease total welfare.

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

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Appendix A   Data Appendix

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. Most of the firms choose the same entry mode in the subsequent FDIs.

Table A.1: Entry Modes in Additional Investments

First FDI	Subsequent FDIs			
	GF	M&A	Both	Total
GF	**1923**	189	166	2278
M&A	225	**814**	99	1138

[a] There are 9,163 first GF deals, and 6,595 first M&A deals in firm-affiliate industry-country.

Appendix B   Additional Empirical Results

This table 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 A.2: Logit Regressions Analogous to Nocke and Yeaple (2008)

Dep var: MA= 1 vs GF = 0	(1) SALE	(2) VADDPW	(3) SALE	(4) 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.

Appendix C   Detailed Calculations and Parameters

C.1   Proof for Equation (12)

Let H is the left-hand side of equation (12).

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

Since $\frac{\partial \hat{\mu}(K^*)}{\partial K^*} < 0$, the left-hand side of equation (12) is decreasing in K^* (i.e., $\frac{\partial H}{\partial K^*} < 0$). The right-hand side of equation (12) is constant as ψ, therefore there is one unique solution of K^*.

If multinational's intangible capital, K_i, is larger than the cutoff, K^*, search condition, equation (11), holds. Also, such multinational obtains the positive merger gain. Thus, a multinational firm with $K_i < K^*$ will search and consummate the M&A.

C.2   Solution for Y

From equation (3): $Y = \left[\int_\Omega y_\omega^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}}$,

$$
\begin{aligned}
Y^{\frac{\sigma-1}{\sigma}} &= \int_\Omega y_\omega^{\frac{\sigma-1}{\sigma}} d\omega \\
&= \hat{\mu}(K^*)M \int_{\underline{K}}^{K^*} y_m(w,K,Y)^{\frac{\sigma-1}{\sigma}} dG(K) \\
&\quad + (1-\hat{\mu}(K^*))M \int_{\underline{K}}^{K^*} y_g(w,K,Y)^{\frac{\sigma-1}{\sigma}} dG(K) \\
&\quad + M \int_{K^*}^{\infty} y_g(w,K,Y)^{\frac{\sigma-1}{\sigma}} dG(K) \\
&\quad + (1-\lambda(K^*))N \ y_a(w,Y)^{\frac{\sigma-1}{\sigma}} \\
&= \hat{\mu}(K^*)MZ \left[\frac{1}{w}\left(1-\frac{\sigma-1}{\sigma}\alpha\right) \right]^{\beta/\alpha} Y^{\beta/\sigma\alpha} \int_{\underline{K}}^{K^*} k_m \ dG(K) \\
&\quad + (1-\hat{\mu}(K^*))MZ \left[\frac{1}{w}\left(1-\frac{\sigma-1}{\sigma}\alpha\right) \right]^{\beta/\alpha} Y^{\beta/\sigma\alpha} \int_{\underline{K}}^{K^*} k_g \ dG(K) \\
&\quad + MZ \left[\frac{1}{w}\left(1-\frac{\sigma-1}{\sigma}\alpha\right) \right]^{\beta/\alpha} Y^{\beta/\sigma\alpha} \int_{K^*}^{\infty} k_g \ dG(K) \\
&\quad + (1-\lambda(K^*))NZ \left[\frac{1}{w}\left(1-\frac{\sigma-1}{\sigma}\alpha\right) \right]^{\beta/\alpha} Y^{\beta/\sigma\alpha} \ k_a.
\end{aligned}
$$

This becomes

$$Y^{\frac{\sigma-1}{\sigma}-\frac{\beta}{\sigma\alpha}} = \left[\frac{1}{w}\left(1-\frac{\sigma-1}{\sigma}\alpha\right)\right]^{\beta/\alpha} \left\{\hat{\mu}(K^*)MZ\int_{\underline{K}}^{K^*} k_m\ dG(K) + (1-\hat{\mu}(K^*))MZ\int_{\underline{K}}^{K^*} k_g\ dG(K)\right.$$

$$\left.+MZ\int_{K^*}^{\infty} k_g\ dG(K) + (1-\lambda(K^*))NZk_a\right\}.$$

Thus,

$$Y = \left[\frac{1}{w}\left(1-\frac{\sigma-1}{\sigma}\alpha\right)\right]^{\frac{\beta}{1-\beta}} \left\{\hat{\mu}(K^*)MZ\int_{\underline{K}}^{K^*} k_m\ dG(K) + (1-\hat{\mu}(K^*))MZ\int_{\underline{K}}^{K^*} k_g\ dG(K)\right.$$

$$\left.+MZ\int_{K^*}^{\infty} k_g\ dG(K) + (1-\lambda(K^*))Nzk_a\right\}^{\frac{\sigma\alpha}{\alpha(\sigma-1)-\beta}}.$$

This shows that the aggregate output, Y, is a function of w and K^*.

C.3 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:

$$I(w, K^*) = wL + (1-\lambda(K^*))N\pi_a(w, K^*) + \hat{\mu}(K^*)M\int_{\underline{K}}^{K^*} P(w, K^*, K)dG(K) \qquad \text{(A.1)}$$

The final good market clears such that:

$$Y(w, K^*) = I(w, K^*) + \mu(K^*)M\int_{\underline{K}}^{K^*} \pi_m(w, K^*, K)dG(K) \qquad \text{(A.2)}$$

$$+ [1-\mu(K^*)]M\int_{\underline{K}}^{K^*} \pi_g(w, K^*, K)dG(K)$$

$$+ M\int_{K^*}^{\infty} \pi_g(w, K^*, K)dG(K)$$

$$+ MG(K^*)\psi,$$

where $I(w, K^*)$ is defined in equation (A.1). 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.[37]

C.4 Additional Figures in Section 5

This figure 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 A.1: Quantile Plots: Intangible Capital (left) and Sales (right)

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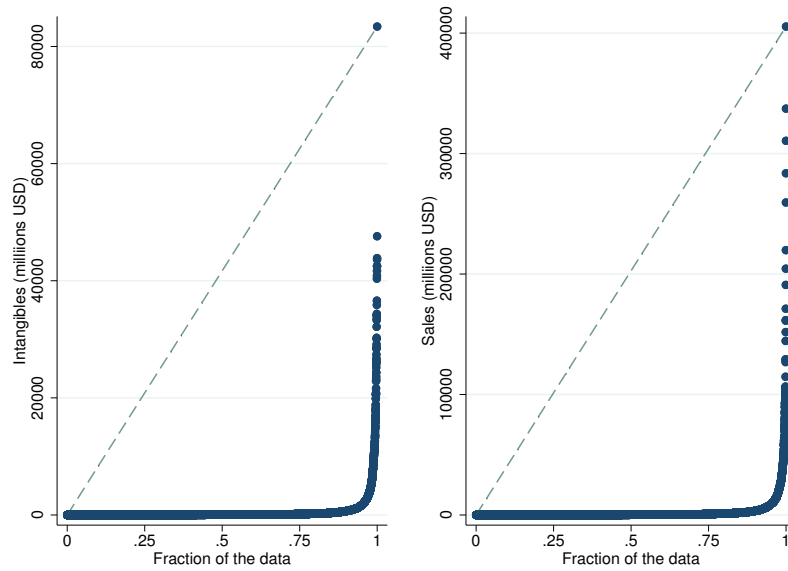
[a] Both intangible capital and sales are yearly average over the sample period in 2003-2018, and based on the Compustat database.
[b] In quantile plot, each value is plotted according to the fraction of the data. Both distributions are right skewed since all points are below the reference line.

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[37]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 using 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.