Multinationals, Intangibles and the Wage Skill Premium*

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Abstract

This paper studies the impact of foreign ownership on the wage skill premium by endogenzing skill biased technological change with intangible skill complementarity in production. Increased intangible investment raises the relative demand for skilled labor, which in turn raises the wage skill premium. Foreign owned firms, who are more intangible intensive, amplify this effect. I provide supporting empirical evidence from Spain, documenting aggregate increases in intangible investment and skilled labor compensation. Foreign owned firms operate at a large scale and I show that a change to foreign ownership leads to a scaling up of production, as well as, higher relative employment of skilled workers. I develop a quantitative firm dynamics model with intangible skill complementarity in production and heterogeneity in ownership. Foreign multinationals endogenously enter through acquisition and their subsidiaries receive a technology transfer prompting them to invest at higher levels. An exogenous decline in intangible investment price triggers the mechanism and further increases foreign entry. Upon matching the decline to the data, the model accounts for nearly forty percent of the increase in the wage skill premium between 2002 and 2017 where about a quarter is attributed to foreign ownership. Through the lens of the model, intangible investment subsidies exclusively for foreign owned firms can increase aggregate output and total factor productivity, but also have welfare implications.

Keywords: Intangible Capital, MNE, Skill Premium, Technological Change

JEL Classification: E22, F23, J31, O33

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1 Introduction

Since the 1980s, countries worldwide have opened their economies to foreign ownership, leading to a rise in the presence of multinational corporations across the globe. The economic literature has emphasized the benefits of openness to foreign ownership. Macroeconomic studies have documented large gains, as it contributes to increased production and productivity, while the empirical literature has found that foreign-owned firms often have superior management practices, innovate more and generate positive spillover effects for domestic firms.[1] However, while openness to foreign ownership may bring various benefits, it may also contribute to the wage skill premium, or the wage differential between skilled and unskilled workers. Indeed, countries where foreign ownership make up a larger share of aggregate sales revenue tend to have a higher skill premium (Figure D.1). This paper addresses a gap in the literature by examining the impact of foreign ownership on the wage skill premium. The rise in the wage skill premium is typically attributed to skill-biased technological change (SBTC), where technological progress disproportionately benefits skilled workers, resulting in an increase in demand for their labor relative to the unskilled.[2] While there are many economic models that endogenize SBTC, this paper introduces a novel mechanism that can account for recent economy-wide changes: intangible-skill complementarity. Intangible capital, which encompasses non-physical assets such as intellectual property, software and organizational capital, has been growing in prominence across economies. When these assets complement skilled labor, increased intangible investment raises the demand for skilled workers, resulting in an increase in the wage skill premium. Foreign ownership plays an important role in all of this as foreign-owned firms tend to be more intangible-intensive. When these firms enter or expand within an economy, they can significantly impact labor markets. This paper ultimately studies how foreign ownership, acting through intangible-skill complementarity, affects the rise in the wage skill premium.

My country of analysis is Spain and I begin by establishing three stylized facts at both the aggregate and firm levels that offer support to intangible-skill complementarity and the role of foreign ownership in amplifying it. First, since the 2000s the aggregate intangible share of investment nearly doubled and labor compensation share paid to skilled (tertiary-educated) workers surpassed that of unskilled. The second stylized fact is that foreign ownership is greater in intangible-intensive sectors, where foreign ownership is defined as firms with majority ownership by a foreign entity. These firms are few in number as they comprise less than 1% of all firms, yet have a large presence in aggregate production, accounting for more than 25% of total revenue. The number of foreign-owned firms has increased over time, coinciding with the trends in the first stylized fact. This influx primarily occurred through acquisitions of already existing Spanish firms. In Spain, as in other advanced economies, multinational entry primarily takes the form of mergers and acquisitions (M&A) (Barba-Navaretti & Venables, 2004).[3] At the firm level,

[1] Macro literature: Burstein and Monge-Naranjo (2009); McGrattan and Prescott (2009, 2010a); Ramondo and Rodríguez-Clare (2013). Empirical literature: Bloom, Sadun, and Van Reenen (2012); Fons-Rosen, Kalemli-Ozcan, Sørensen, Villegas-Sanchez, and Volosovych (2017); Guadalupe, Kuzmina, and Thomas (2012)

[2] See Acemoglu and Autor (2011); Violante (2008) for surveys.

[3] Multinational entry is considered to be inward foreign direct investment (FDI) which takes two primary forms: greenfield or M&A. Greenfield investment involves a multinational parent company establishing an enterprise in

foreign-owned firms are large and more intangible-intensive which is partially attributed to foreign ownership. The third stylized fact is that at the firm level a change to foreign ownership is associated with scaling up production and a change in the skill composition toward more skilled labor, where the latter has been less studied due to data limitations. I use firm-level data of Spanish manufacturing firms from 1990 to 2017 and analyze the impact of foreign ownership on various outcomes following acquisitions by foreign multinationals. Acquired firms tend to be already highly productive prior to acquisition. To address potential selection bias of targets, I use propensity score matching (PSM) methods by matching acquired firms with similar non-acquired domestic firms and run reweighted propensity score linear regressions.[4] The results show that acquisition by a foreign multinational is positively associated with increased productivity, higher investment and a disproportionate rise in skilled labor employment. While the impact of foreign ownership on productivity and investment has been widely studied, my contribution lies in finding that the labor composition also changes in response to foreign acquisition, with demand for skilled labor increasing significantly more than for unskilled labor.

Building on the empirical facts, I develop a framework to quantify foreign ownership's contribution to the wage skill premium and study policy implications. I formulate a variant model of firm dynamics from Hopenhayn (1992) with endogenous entry and exit. Heterogeneous firms invest in intangible and tangible capital while hiring skilled and unskilled labor. Households differ by skill type and endogenously supply labor. I extend the standard model in two distinct dimensions. The first being that I introduce the concept of intangible-skill complementarity in production similar to that of Krusell, Ohanian, Ríos-Rull, and Violante (2000). Increased intangible investment drives up the relative demand for skilled labor and consequently, the wage skill premium. Second, I incorporate ongoing acquisition where domestic firms endogenously agree to transfer ownership rights to foreign multinational entrants. These extensions lead to two aggregate effects that influence both the firm distribution and the wage skill premium. The selection effect arises from the dynamics of entry and exit. The other is the foreign ownership effect. Prior to acquisition, this effect impacts domestic firms through anticipation as they elevate their investment levels when they expect to be acquired. As a result, this raises firm value and makes them more attractive acquisition targets. Post-acquisition, firms receive a technology transfer from their foreign parent which differentiates them from their domestic counterparts by increasing their productivity and leading to higher investment levels. Both the anticipation before the acquisition and the increased investment afterward work to amplify the impact of foreign ownership on the wage skill premium.

I analyze the model in general equilibrium and in a stationary environment without aggregate uncertainty. The model is calibrated to match sector and firm-level moments in Spanish manufacturing during the period 2002-2006, which is the first five years of the sampling period.

another country by building it from the ground up. On the other hand, M&A involves a multinational parent acquiring a controlling stake in an already existing firm in another country.

[4] This approach is widely favored in the empirical foreign acquisition literature. While foreign-owned firms generally outperform their domestic counterparts, their superior performance could stem from the selection of higher-performing domestic firms, as highlighted by Guadalupe et al. (2012). By employing PSM to control for selection bias, the empirical foreign acquisition literature often interprets its findings as causal. However, endogeneity may still be an issue, as foreign multinationals might be superior in identifying firms with higher growth potential, or domestic targets may anticipate acquisitions.

The calibration is specific to the manufacturing because the firm-level data used in the empirical analysis only covers this sector. The model's outcomes correspond with the empirical observations. Specifically, it generates positive selection in acquisitions where the largest and most productive firms are predominantly acquired. In addition, foreign-owned firms are few in number but account for a large share of output, in line with the second stylized fact. The model generates post-acquisition changes consistent with the third stylized fact, despite not being explicitly targeted. There are notably minor gains in TFP post-acquisition, alongside more substantial increases in investment and output. Anticipation of acquisition also plays a role by influencing investment and hiring decisions, particularly among the most productive firms, compared to a model without acquisitions.

I study how the model is affected by an intangible-investment-specific technological change. This change is modeled as an exogenous decline in the price of intangible investment relative to the final output good, which has been in decline over time across advanced economies.[5] Cheaper intangible investment raises its share of overall investment and increases the likelihood of acquisitions. In addition, due to intangible-skill complementarity, this technological change is skill-biased. I then analyze how foreign ownership acts through this skill-biased change to account the rise in the wage skill premium and affect other equilibrium outcomes. I evaluate the model's ability to account for empirical trends by comparing two steady states. One is the initial steady state calibrated to the start-of-sample years (2002-2006) and the other is the new steady state where the relative intangible investment price is set to that from the end-of-sample period (2013-2017), ie after the technological change has occurred. The model accounts for 39% of the observed increase in the wage skill premium and 12% of the acquisition rate.[6] Furthermore, it is also consistent with the changes in the investment and compensation shares as documented by the first stylized fact. The model explains 22% of the increase in the intangible share and predicts a change in the skill composition, accounting for a portion of the rise in the skilled labor share and a decline in the unskilled share. Along with the wage skill premium, aggregate output and TFP are higher in the new steady state. Through a decomposition, I show that approximately 24% of the increase in the wage skill premium can be attributed to foreign ownership, while it is behind about 37% of the increases in output and TFP. Despite being few in number, the substantial size foreign-owned firms means that they have an impact in the aggregate. Aggregate consumption also increases, but is uneven as about two-thirds of the increase comes from skilled households, driven by the higher skill premium. I quantify the overall welfare impact on skilled and unskilled households in the new steady state and find that skilled are better off while unskilled are worse off. This outcome is primarily due to the labor hours supplied by each household, which increase for both.

[5] The decline in the relative price of intangible investment can be interpreted as an improvement in the quality of intangible investment goods or a reduction in their cost. This price decline is one force (but not the only) that can lead to a change in the investment composition in equilibrium and therefore account for the rise of intangible investment. Some papers that have documented the decline are Zhang (2024) and Lashkari, Bauer, and Boussard (2024).

[6] Intangible-skill complementarity, coupled with the decline in the relative intangible investment price, is one mechanism among several that potentially contribute to the change in the wage skill premium over time. Furthermore, the model only accounts for how foreign ownership affects the wage skill premium through intangible-skill complementarity. The unexplained portion of the wage skill premium increase could contain other mechanisms that are strongly influenced by foreign ownership.

Although both groups experience welfare gains from increased consumption, the additional labor supplied by unskilled households offsets these gains, resulting in a net welfare loss.

The paper concludes by studying policy implications. Recently, the current government in Spain has used COVID-19 recovery funds to encourage foreign multinationals to increase intangible investment. Through the lens of the model, foreign ownership, acting through a mechanism of skill-biased technological change, contributes to increases in output and TFP but also widens the wage gap between skilled and unskilled households, thus influencing labor income inequality. Policies that seek to either subsidize or expand this small group of firms have non-trivial consequences for the aggregate economy and welfare. While such policies may increase long-run output and TFP, they also carry unintended consequences for income inequality which affect welfare. I analyze a policy which subsidizes intangible investment by foreign-owned firms. This policy not only raises intangible investment done by existing incumbents, but also increases acquisitions due to the higher expected returns. However, this policy is inherently skill-biased, disproportionately benefiting skilled workers and further widening the wage gap between skilled and unskilled labor. The challenge is to find an optimal subsidy rate that balances the benefits of higher output and TFP with the costs of increasing income inequality. The optimal subsidy rate that maximizes aggregate welfare is 7.7%, leading to an increases in the wage skill premium, output and TFP. While skill groups experience uneven welfare gains, they are positive for both.

Related Literature This paper contributes to the macroeconomic literature on growth and multinational production. Papers such as Burstein and Monge-Naranjo (2009) and McGrattan and Prescott (2009, 2010a) quantify gains from openness to multinational production. These papers utilize multi-country models that abstract from firm heterogeneity and do not distinguish between entry mode, with the only friction being a barrier to foreign entry. The mechanism in these models is that a multinational's technology is non-rival and shared across borders through its subsidiaries. Such technology can be managerial knowledge (Burstein & Monge-Naranjo, 2009) or a parent's accumulated know-how from investing in intangible capital (McGrattan & Prescott, 2009, 2010a). Takayama (2023) is recent work that incorporates heterogeneity and entry mode. Their model has heterogeneous multinationals who choose between mode of entry (greenfield or M&A). My paper is also connected to the macro-trade literature that has augmented models of trade to incorporate the establishment of subsidiaries abroad by multinational corporations, in addition to being able to export (Arkolakis, Ramondo, Rodríguez-Clare, & Yeaple, 2018; Ramondo & Rodríguez-Clare, 2013; Tintelnot, 2017). These papers emphasize that analyzing exporting and FDI in isolation may generate inaccurate estimates of the gains from openness. In contrast with all of these papers, I study the benefits and drawbacks from multinational production through a dynamic quantitative model with heterogeneity that incorporates endogenous multinational entry.

The heterogeneity of local firms in my quantitative framework links to the voluminous empirical literature that studies foreign ownership's association with productivity, investment and skill composition of acquired subsidiaries. The most extensively studied outcome is the effect on productivity, being either TFP and/or labor productivity.[7] In advanced economies this literature typically finds modest increases in TFP but larger increases in production and labor productivity. Some explanations for improvements following ownership transfer are better management (Bloom et al., 2012) or an international market demand shock (Guadalupe et al., 2012). A smaller group of empirical papers study foreign ownership's association with the skill composition of employment. Using firm-level data from three advanced and two developing countries, Hijzen, Martins, Schank, and Upward (2013) find that the average wage and employment increase following acquisition. They argue that the increase in wages probably comes from the creation of new skilled jobs. Koch and Smolka (2019) argue that foreign acquisition is skill-bias and find that acquired firms hire more recent university graduates.

Finally, I contribute to research on the increase of intangible investment and its implications for the aggregate economy (Corrado & Hulten, 2010; Koh, Santaeulàlia-Llopis, & Zheng, 2020; McGrattan & Prescott, 2010b), where I emphasize complementarity of skilled labor and intangible capital. The idea of skilled labor and capital being complements reaches back to Griliches (1969). Krusell et al. (2000) embed capital-skill complementarity in a nested production function and argue that, when accompanied by falling equipment investment prices, it can account for mostly all of the wage skill premium increase in the US between 1960-1990. Some papers have recently emphasized that advances in information and communication technologies (ie, computers and software) and its complementarity relationship with skilled labor as opposed to equipment (Eckert, Ganapati, & Walsh, 2022; Lashkari et al., 2024). Other papers exclusively focus on software (Aum, 2020; Aum & Shin, 2024).

Outline The paper is organized as follows. Section 2 documents the empirical evidence. Section 3 describes the model and defines the stationary recursive competitive equilibrium. Section 4 covers calibration and validation. Section 5 presents the main results of the paper. Section 6 discusses policy implications. Section 7 concludes.

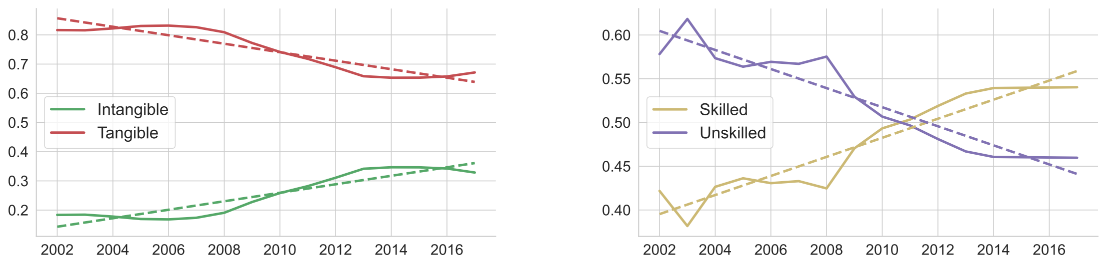
2 Empirical Evidence

This section documents stylized facts at the aggregate, sector and firm levels within Spain that that offer support to intangible-skill complementarity and the role of foreign ownership in amplifying it. Section 2.1 examines trends related to intangible investments and the labor skill composition. Section 2.2 looks at foreign ownership in the aggregate and across sectors. Section 2.3 analyzes foreign ownership at the firm level.

[7] See Fons-Rosen, Kalemli-Ozcan, Sørensen, Villegas-Sanchez, and Volosovych (2021) for a survey concerning the effects on TFP and labor productivity. Estimates for TFP in advanced economies range from nil to 5% (much higher increases are typically found in developing countries), while increases in labor productivity tend to be between 9 % to 16%.

Figure 1: Aggregate Trends in Spain

(a) Share of Capital Investment (b) Share of Labor Compensation



Notes: The figure displays the series of aggregate investment and labor compensation shares in Spain between 2002 to 2017. Subfigure (a) shows the shows the share of aggregate investment by capital type. Intangible investment is expenditures of R&D, software, artistic originals, design, brand, organizational capital and training. Tangible investment is expenditures on traditional forms of physical capital: equipment, non-residential buildings and structures. Subfigure (b) depicts the share of labor compensation paid to skilled workers (tertiary degree or higher) and unskilled (no tertiary degree). Series for manufacturing and business services sectors can be found in Figures D.4-D.5 in Appendix D. Details regarding how the shares are calculated are in Appendix C.2.
Source: Author's calculations using EUKLEMS-INTANProd database.

2.1 Aggregate Trends in Spain

I use aggregate and sector level data from the EUKLEMS-INTANProd Database.[8] Documentation regarding data collection and construction is provided in Bontadini, Corrado, Haskel, Iommi, and Jona-Lasinio (2023). EUKLEMS-INTANProd, henceforth KLEMS, is a harmonized set of country and industry national accounts developed initially by a number of European Institutes led by GGDC and NIESR that have subsequently been extended and developed with further funding from the European Commission. The database includes measures of gross output, intermediate inputs, gross value added, employment and compensation (also by education group), as well as investment in both tangible and intangible assets for 28 European countries at the 2-digit industry level for the years 1995-2020. A novel feature of the data is that intangible expenditures such as R&D, software, artistic originals, design, brand, organizational capital and training are treated as investment.[9] In regard to the education level of labor, KLEMS provides data at the the 2-digit industry level on the share of hours worked and compensation which are broken down into three skill groups: low skill (lower secondary education or lower), medium skill (upper secondary education and post-secondary non-tertiary) and high skills (tertiary degree).[10] KLEMS does not provide the number of workers by skill type. I define skilled workers as those with tertiary education and combine the low and medium skill group to form unskilled workers. The sampling time period is from 2002 to 2017.[11]

Spain is transitioning towards a more intangible intensive and skill driven economy. Figure 1 displays the share of aggregate investment by capital type and the share of total labor compensation

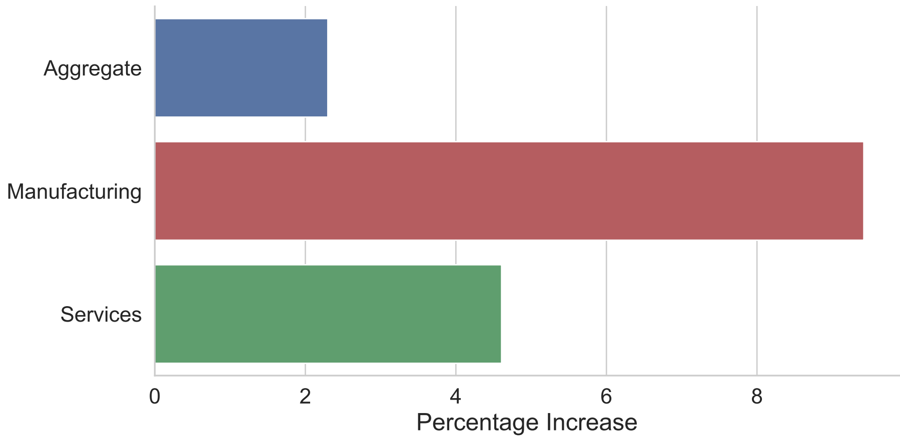
[8] 2023 release. Further information https://euklems-intanprod-llee.luiss.it/

[9] National accounts in the US and EU typically only treat expenditures in R&D, software and artistic originals as intangible investment.

[10] KLEMS aggregates education levels according to the International Standard Classification of Education (IECED). Low skill: IECED 0-2. Medium Skill IECED 3-4. High Skill IECED 5-8.

[11] I focus on this particular time period as 2002 is the earliest year that data on labor by education group is available and 2017 is the final year in the firm-level dataset.

Figure 2: Wage Skill Premium Percentage Point Change in Spain (2002-2017)



Notes: This figure depicts the percentage point change from its beginning of sample average (2002-2006) to the end of sample average (2013-2017). Appendix C.1 provides the wage skill premium calculation. Aggregate covers ISIC rev. 4 sector codes $A-R$, manufacturing is ISIC rev. 4 sector code C and business services are ISIC rev. 4 sector codes $G-N$. About one-third of the aggregate consists of sectors outside of manufacturing and business services such as agriculture, construction, public administration and more. Table E.3 in Appendix E contains the wage skill premium by sector.
Source: Author's calculations using EUKLEMS-INTANProd database.

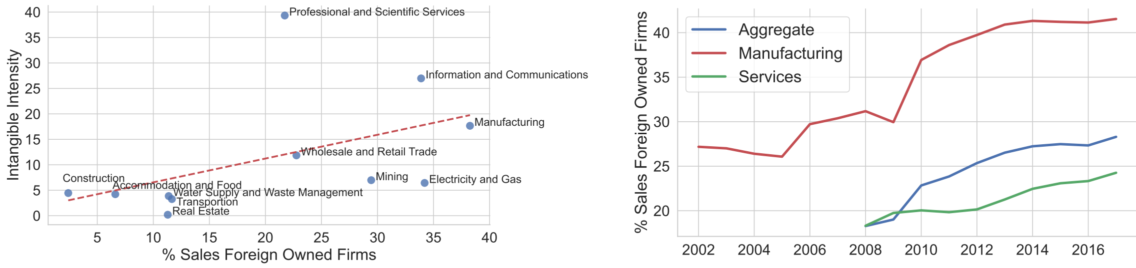
by skill type. The share of intangible investment rose from 0.2 in 2002 to 0.35 in 2017, marking an 75% increase. Tangible investment, which includes expenditures on equipment and non-residential buildings, declined from 0.8 in 2002 to 0.65 in 2017. While intangible investment in KLEMS embodies many different expenditures, its growth over this period was driven by expenditures in R&D and software (Figure D.6 in Appendix D). Figure 1b shows the composition of labor compensation, which also underwent significant changes over this period. Compensation for unskilled labor dropped from 0.58 in 2002 to 0.46 in 2017, a 21% decline, while the share of compensation for skilled labor increased and surpassed that of unskilled labor. Similar trends in investment and compensation are observed in both manufacturing and services, but they differ in magnitude (Figures D.4-D.5 in Appendix D). The services sector closely resembles the overall aggregate, while the manufacturing sector is significantly more intangible-intensive and experienced much stronger shifts in skill compensation.

The increase in the share of labor compensation going to skilled workers and the coinciding decline to unskilled can partly be attributed to the growing number of workers with tertiary education. However, this shift may also be driven by a widening wage differential between skill types. Figure 2 shows the percentage point change in the average wage skill premium between the first five years (2002-2006) and the last five years (2013-2017) of the sample period. At the aggregate level, the wage skill premium modestly increased by 2.3%. Prior studies have documented stagnation or even periods of decline in the wage premium from the late 1990s to 2008 (Felgueroso, Hidalgo-Pérez, & Jiménez-Martín, 2016; Pijoan-Mas & Sánchez-Marcos, 2010), which partially overlaps with the sample period I use. While the aggregate wage skill premium shows little change, there are differences across sectors: the manufacturing sector experienced a significant increase of 9.1%, while business services saw a smaller rise of 4.6%. The lower increase in the aggregate is driven by sharp declines in public service sectors such as public administration

Figure 3: Foreign Production in Spain

(a) % Foreign Sales and Intangibility

(b) % Foreign Sales Over Time



Notes: A firm is considered to be foreign owned if it is a subsidiary or at least 50% or more of its capital is owned by a foreign entity. The left subfigure has intangible intensity (intangible capital over total capital) and percentage of aggregate sales revenue done by foreign owned firms. The points are for one-digit sector averaged between the years 2008-2017. The right subfigure displays the percentage of aggregate sales revenue done by foreign owned firms over time. It depicts the time series at the aggregate, manufacturing (ISIC Rev. sector code C) and business services (ISIC Rev. 4 sector codes $G - N$) levels. Data collection for the aggregate and all sectors starts in 2008, except for manufacturing. Figure D.2 shows the percentage of foreign owned firms over time and . Figure D.7 shows how the number of both domestic and foreign firms changed over time.
Source: Author's calculations using EUKLEMS-INTANProd and OECD AMNE and SBDS database.

and education. Tables E.2-E.3 in Appendix E break down the wage skill premium by sector.

2.2 Foreign Ownership in the Aggregate

The Spanish economy is comprised of firms that are either domestically owned, headquartered within the country, or foreign owned, which are owned by multinational corporations based outside the country.[12] Foreign-owned firms can be further classified into affiliates and subsidiaries. Following the OECD's defintion, affiliates are those where less than 50% of its capital is owned by a foreign multinational, whereas subsidiaries have at least 50% ownership by the foreign parent company. For the purposes of this paper, I define foreign-owned firms specifically as subsidiaries and use the terms "foreign-owned firms" and "foreign subsidiaries" interchangeably throughout. I use aggregate and sector level data on foreign subsidiaries from the OECD's Analytical Multinational Enterprises (AMNE) and Structural and Demographic Business Statistics (SDBS) databases which is sourced by Spain's national statistics office (INE in Spanish).[13] The data coverage is somewhat limited, with information for aggregate and sector levels available from 2008, except for manufacturing, which extends further back.

Foreign ownership is greater in more intangible-intensive sectors. Figure 3a shows that in one-digit sectors where the percentage of sales revenue done by foreign-owned firms is higher, so is the share of intangible capital over total capital. Foreign-owned firms have made an increasingly significant contribution to overall production over time. Figure 3b shows that by 2017, these firms accounted for over 25% of aggregate sales revenue. Despite their sizable presence in aggregate production, the number of foreign-owned firms remains small. Although their numbers have

[12] In 2020, the top five countries of origin for multinationals operating in Spain were France, United States, Germany, United Kingdom, and Italy. Multinationals from these countries also accounted for the majority of multinational production in Spain (INE).

[13] AMNE: https://www.oecd.org/industry/ind/analytical-amne-database.htm
SDBS: https://www.oecd.org/sdd/business-stats/structuralanddemographicbusinessstatisticssdbsoecd.htm

grown, similar to that of trends in Figure 3b, they make up less than one percent of all firms in 2017 (see Figure D.2a in Appendix D). The increase in the revenue share and relative number can be attributed to the influx of new foreign firms, as opposed to the decline in the number of domestic ones. Figure D.7 in Appendix D shows the number of firms categorized by ownership status relative to their 2008 levels. By 2017, the relative number of foreign-owned firms in Spain increased by approximately 80%. On the other hand, domestic-owned firms experienced a decline before returning to its pre-crisis level by 2016.

2.3 Foreign Ownership at the Firm Level

This section goes to the firm level and examines the outcomes of Spanish firms after they are acquired by a foreign multinational.

2.3.1 Data

The firm-level data that I use is from the Survey on Business Strategies (ESEE in Spanish) which is an annual survey of the Spanish manufacturing sector carried out by the SEPI foundation and is sponsored by the Spanish Ministry of Industry.[14] The ESEE began in 1990 and covers roughly 1,900 Spanish manufacturing firms. It is a representative sample of manufacturing firms with between 10 and 200 employees and surveys the whole population of manufacturing firms with more than 200 employees.[15] The average response rate is greater than 90% and new firms are added over time to replace those that either exit or are unresponsive. Further details regarding ESEE are available in Appendix B.

The survey is unique in that it offers complete balance sheet and income statement information, the skill-level of its employees and whether a particular firm is foreign-owned or not. Given the panel structure this allows me to analyze the within-firm variation before and after a change in ownership. I define a firm as foreign-owned if at least 50% of its capital is owned by a foreign company. Among all firms in the data, 17.7% are foreign-owned when they first appear in the dataset and the remaining 83.3% first appear domestically owned.[16] To focus the analysis on potential acquisition targets, I narrow the sample to firms that enter the dataset as domestically owned. This leaves me with 5.9% of firms that transfer from domestic to foreign ownership at some point and the remaining 94.1% maintain domestic ownership throughout the entire sample period. I concentrate on how three outcomes are affected by foreign ownership: productivity, investment and the skill labor composition. The first two have been studied in many countries and are typically done so together. The third has barely been studied due to data limitations.

[14] https://www.fundacionsepi.es/investigacion/esee/en/spresentacion.asp

[15] The subset of firms with 200 or less but more than 10 employees are selected according to a stratified sampling scheme that guarantees that they can establish representativeness of the data for different industries and the manufacturing sector as a whole.

[16] I classify firms with minority foreign ownership, those whose percentage of capital owned by a foreign entity is greater than zero but less than 50 percent, as domestically owned. There are few firms with minority foreign ownership stake as 5.1% of all the firms first appear with it. Excluding these firms does not significantly change the empirical results. Almost all firms that report a change in ownership become subsidiaries, not affiliates. Only 35 firms (approximately 0.7% of the sample) report changes in the share of capital owned by a foreign company from zero to less than 50%. Excluding these firms does not affect the empirical results nor does including these firms in the group of foreign-acquired firms.

Table 1: ESEE Summary Statistics (1990-2017)

Avg. Variable (in logs)	Domestic Never Acquired	Foreign *Before*	Foreign *After*	Obs.
Sales	15.40	17.57	17.96	39,011 / 2,271 / 1,727
TFP	-0.051	0.027	0.039	32,791 / 1,853 / 1,640
Intangibility	-3.10	-2.64	-2.63	27,427 / 1,710 / 1,563
In-House R&D	11.99	13.02	13.15	9,241 / 1,198 / 970
Tangible Inv.	11.86	13.87	14.18	27,593 / 1,988 / 1,485
Skilled Emp.	1.44	2.54	3.00	12,580 / 681 / 504
Unskilled Emp.	3.71	5.30	5.51	12,580 / 681 / 504

Notes: Variables in constant 2015 prices. Intangibility is the share intangible fixed assets over total fixed assets (tangible and intangible). Extended Table E.1 in Appendix E contains additional variables.
Source: Author's calculations using ESEE.

To assess the impact of foreign ownership on productivity I look at its effect on real sales and TFP where the latter is estimated using the methodology established by Ackerberg, Caves, and Frazer (2015). Additionally, I analyze the impact on investment by examining research and development (R&D) and tangible investment in property, plant and equipment (PP&E). R&D is defined as a set of expenditures that are aimed at developing new products and services or improving existing ones. The ESEE contains both intramural R&D (in-house) and extramural R&D (payments to outside R&D laboratories and research centers). For the empirical analysis I use in-house R&D to confirm that it occurs on-site after acquisition. Finally, a unique feature of the data is that it asks firms on the education level of its personnel. The ESEE classifies three education types, workers with secondary education or below, with a specialized non-tertiary certificate and with a tertiary degree or higher. Upon collecting information on the total numbered employed the ESEE asks for the number of workers that fall into each of the three categories. The ESEE initially collected this variable every four years but it became an annually collected variable since 2015. As in the previous section, I classify skilled labor as those with a tertiary degree or higher and the rest as unskilled.

Summary Statistics Table 1 provides the summary statistics, pooling observations across all years and presenting the averages for domestically owned firms, domestically owned firms before acquisition, and foreign-owned firms. There are considerable differences across the three groups. On average, acquired firms operate at a much larger scale and are more intangible-intensive than their domestic peers prior to acquisition, and they tend to scale up further post-acquisition. In addition to differences in productivity, firms differ in levels of investment and skill-compositions. The number of firm-year observations are reported in the final column and differ for a number of reasons. Sales has no missing observations in the dataset. An observation for TFP is missing if any input used in the estimation procedure (capital, labor hours, intermediate expenses) is missing. Tangible investment is lumpy, resulting in fewer observations compared to sales and TFP, and even fewer for R&D, which is inherently subject to higher rates of inaction. Finally, the

Table 2: P.S. Reweighted Regressions of Productivity and Investment Outcomes

	Productivity		Investment	
	(1) Sales	(2) TFP	(3) In-House R&D	(4) Tangible
Lag Foreign	0.131***	0.039***	0.283***	0.248**
	(0.043)	(0.012)	(0.106)	(0.104)
Obs.	33249	32064	8895	24059
R-squared	.96	.659	.785	.738

Notes: * p<0.10; ** p<0.05; *** p<0.01. Standard errors clustered by firm in parentheses. All regressions include firm and industry-year effects. All dependent variables are in logs. Lag foreign is a dummy variable for foreign ownership in previous period (equal to one if at least 50% the firm's capital is foreign owned by and zero otherwise). The characteristics used to obtain the propensity score are log sales, log labor productivity (value added over employment), sales growth, labor productivity growth, log average wage, log total fixed assets (tangible plus intangible), R&D status, and a year trend. All the previously mentioned variables are lagged one period relative to acquisition. I allow for this relationship to vary across industries by estimating the propensity score separately for each industry. I ensured that only observations within the region of common support are included. I performed the standard tests to check that the balancing hypothesis holds within each industry and found that all covariates are balanced between treated and control observations for all blocks in all industries.

skilled employment levels are observed less frequently as data on the skill composition of the firm was only collected every four years starting in 1990 and began as an annual variable after 2015.

2.3.2 Controlling for Selection and Empirical Results

Table 1 shows that foreign-owned firms tend to operate at a much larger scale than their domestic peers, yet these domestic firms also did so prior to acquisition.[17] The superior performance of foreign-owned firms could stem from the selection of higher-performing domestic firms (Guadalupe et al., 2012). To mitigate selection bias I follow the literature by employing a propensity score reweighting estimator to assess the impact of foreign ownership on Spanish firms, where foreign ownership is considered to be the treatment variable. The propensity scores denote the likelihood of being acquired and are calculated by categorizing firms acquired in a given year as treated observations and those never acquired as control observations. The observations in each group are then aggregated across all years and the propensity scores are estimated by running industry-specific probit regressions of foreign ownership on a set of observable variables. These variables are log sales, log labor productivity (value added over employment), sales growth, labor productivity growth, log average wage, log total fixed assets (tangible plus intangible), R&D status, and a year trend. All the previously mentioned variables are lagged one period relative to acquisition. The estimated propensity scores p are subsequently used to reweigh treated firms by $1/p$ and control firms by $1/(1-p)$. I ensure that only observations within the region of common support are included. Finally, I verify that the balancing property is satisfied across all industries.

[17]Foreign multinationals often target subsidiaries that resemble them closely for several strategic considerations. Firstly, such acquisitions provide an immediate presence in target markets, expediting market penetration. Secondly, this approach is cost-effective, as acquiring sizable and productive subsidiaries allows foreign multinationals to leverage existing operational structures operating at scale. This facilitates smoother integration into the multinational's distribution network.

Table 3: P.S. Reweighted Regressions of Labor Skill Composition

	(1) Skill Emp. Ratio	(2) Skilled Employment	(3) Unskilled Employment
Lag Foreign	0.183***	0.247***	0.064
	(0.066)	(0.075)	(0.053)
Obs.	6473	6473	6473
R-squared	.272	.237	.151

Notes: * p<0.10; ** p<0.05; *** p<0.01. Standard errors clustered by firm in parentheses. The dependent variables are observed every 4 years between 1990-2014 and annually after. All regressions include firm and industry-year effects. All dependent variables are in logs. Lag foreign is a dummy variable for foreign ownership in previous period (equal to one if at least 50% the firm's capital is foreign owned by and zero otherwise). The characteristics used to obtain the propensity score are log sales, log labor productivity (value added over employment), sales growth, labor productivity growth, log average wage, log total fixed assets (tangible plus intangible), R&D status, and a year trend. All the previously mentioned variables are lagged one period relative to acquisition. I allow for this relationship to vary across industries by estimating the propensity score separately for each industry. I ensured that only observations within the region of common support are included. I performed the standard tests to check that the balancing hypothesis holds within each industry and found that all covariates are balanced between treated and control observations for all blocks in all industries.

Having developed a method to control for selection bias I turn to regressing a set of variables on a lagged dummy variable of foreign ownership. All regressions include firm and industry-year effects and standard errors are clustered at the firm-level. All dependent variables are in logs. The first two columns in Table 2 consider two different measures of firm productivity in sales and total factor productivity (TFP). I find that, on average, sales increase by 13.1% following an acquisition by a foreign multinational. Sales only partially measures productivity, as it does not consider the use of other inputs, such as capital and intermediate goods. In contrast, TFP is a more comprehensive measure of productivity that captures how effectively all inputs are used in generating output. Here, a change to foreign ownership modestly increases TFP by 3.9%, which is at the higher end of the 0 to 5% range commonly observed in the literature.[18] The third and fourth columns in Table 2 show how foreign ownership is associated with investment. Following acquisition, investment levels are higher as there is a large and significant increase of 28.3% for in-house R&D and an 24.8% increase in tangible investment.

The dependent variable in the first column of Table 3 is the ratio of skilled employees to unskilled within a given firm. The estimate indicates that after acquisition by a foreign multinational the ratio of skilled employment increases on average by 18.3%. This suggests that newly acquired foreign subsidiaries experience a change in the skill composition, favoring skilled workers. The second and third columns of Table 3 show the changes for employment level by skill. These two variables are the numerator and denominator of the skill ratio. Following an acquisition, the number of skilled employees within the firm on average undergoes a statistically significant increase of 24.7%. Conversely, there is a smaller yet statistically insignificant increase in unskilled employment. These results suggest a distinct bias toward skilled employment following a change to foreign ownership. Regressions for additional variables are in Table E.5 in Appendix E.

[18]Table E.6 in Appendix E provides regressions for different measures of TFP. The results are very similar.

2.3.3 Concern For Lingering Endogeneity

The empirical evidence broadly aligns with a common finding in the literature that, after controlling for selection bias, being acquired by a foreign multinational is positively associated with an increase in productivity and investment. My contribution is that in addition to this, I find that the labor composition changes in response to foreign acquisition as the demand for skilled labor increases significantly more than for unskilled. The question is whether to interpret these estimates as causal. The foreign acquisition literature that uses propensity score matching typically argues that controlling for selection gives way for causal interpretation. The argument and assumptions required are as follows. There are two effects of foreign ownership. The first is the selection in acquisition effect where foreign multinationals "cherry-pick" domestic firms who are already superior relative to their domestic competition. The second is the exogenous treatment effect. That is, changes that occur in the firm after being acquired are because of foreign ownership and would not have occurred had the firm remained domestically owned. In this sense, by controlling for the selection in acquisition effect, one is estimating the average treatment effect of foreign acquisition. The critical assumption in the estimation is that conditional on observable characteristics that affect selection, acquisition (ie the treatment) is random. Consequently, the outcomes of acquired firms are solely attributable to acquisition by foreign multinationals. Furthermore, the assumption implicitly relies on that by matching on observable firm characteristics, one also also matches the distribution of unobservable characteristics that affect selection in acquisition as well.

While such an assumption would alleviate any endogeneity concerns, there remains a lingering worry that endogeneity that may still yet bias the empirical results. Exogenous technological changes such as the rise of intangibles or specific policies targeting foreign multinationals, could still endogenously influence acquisitions by foreign firms. Matching on unobservables may also still be a problem. The assumption that matched firms share identical expectations regarding acquisition does not hold if they are a function of idiosyncratic unobservable characteristics. For instance, firms may differ in their preferences for being acquired. Some firms might actively seek acquisition, investing heavily to spur growth and attract potential buyers. In contrast, a manager of a similar firm might never be open to the idea of acquisition, perhaps to maintain family ownership. This emphasizes the need for a cautious interpretation of the empirical findings as endogeneity that may potentially persist.

3 Model

I construct a model of firm dynamics along the lines of Hopenhayn (1992) with endogenous entry and exit. I augment the model in two distinct dimensions. The first is the presence of intangible-skill complementarity in production. An increase in intangible investment pushes up the relative demand for skilled labor and, in turn, the wage skill premium. The second is ongoing acquisitions where domestic firms endogenously agree to sell their ownership rights to foreign multinationals. These augmentations result in two aggregate effects that impact both the distribution of firms and the wage skill premium. The first is the selection effect, which arises through entry and exit. The second is the foreign ownership effect which stems from ownership transfer. This impacts firms before and after acquisition. Domestic firms anticipate acquisitions ex-ante and increase their investment levels when they expect to be acquired. Post-acquisition, firms receive a technology transfer from their foreign parent which differentiates them from their domestic counterparts by increasing their productivity and investment levels.

3.1 Environment

Time is discrete and infinite. The economy is populated by a continuum of firms that compete in a perfectly competitive final good market. The final good serves as the numeraire in the economy. Firms face persistent idiosyncratic productivity shocks which together with endogenous entry and exit, generate heterogeneity in production. They invest in intangible k_I and tangible k_T capital and own the stocks, which depreciate at rates δ_I and δ_T. They employ both skilled l_s and unskilled l_u labor types. Firms are either domestic or foreign owned $o = \{d, f\}$ where foreign-owned firms operate as subsidiaries and send dividends abroad. The final good is sold to skilled and unskilled households with masses (N_s, N_u), who supply labor hours endogenously. I consider only the equilibrium of the domestic economy (one country model). I study a stationary general equilibrium without aggregate uncertainty.

Production Firms with TFP z combine both types of capital with skilled and unskilled labor to produce the final good. Similar in nature to Krusell et al. (2000), the production function is Cobb-Douglas over tangible capital and has a nested CES structure over the remaining inputs

$$\mathcal{F} = z k_T^{\alpha} \Big[(1-\varsigma)\, l_u^{\sigma} + \varsigma\, \left(\varrho l_s^{\rho} + (1-\varrho) k_I^{\rho}\right)^{\frac{\sigma}{\rho}} \Big]^{\frac{(1-\alpha)\nu}{\sigma}}. \tag{1}$$

The parameters $(\sigma, \rho) \in (-\infty, 1) \times (-\infty, 1)$ determine the elasticities of substitution. The elasticity of substitution between skilled (or intangible capital) and unskilled labor is $\frac{1}{1-\sigma}$ and the elasticity between skilled labor and the intangible capital is $\frac{1}{1-\rho}$. If $\sigma > \rho$ then the relative demand for skilled labor increases with intangible capital and there is intangible-skill complementarity in production. The share parameters are (ς, ϱ). The parameter $\nu \in (0, 1)$ is the span-of-control and generates decreasing returns; a necessary condition that ensures a well-defined firm distribution.

Idiosyncratic TFP A firm's underlying TFP a follows a AR(1) process in logs with persistence ρ_a and normally distributed i.i.d. innovations $\varepsilon \sim N(0, \sigma_a^2)$ with variance σ_a^2. The process is normalized to have mean one. TFP used in production z depends on ownership as described in equation (3). If a firm is domestically owned then z takes the same value as a. A foreign-owned firm's TFP is enhanced through technology provided by the foreign parent. The scaling parameter ϑ represents the enhancement that a foreign multinational brings independent of any particular subsidiary. The elasticity parameter is θ, and when $\theta < 1$, the marginal productivity difference relative to domestic firms is small for high values of a and large for low values. The opposite is true for $\theta > 1$. A special case arises when $\theta = 1$, where the marginal TFP difference is the same across all levels of a. When $\vartheta > 1$ and $\theta > \frac{\ln(a/\vartheta)}{\ln(a)}$, this enhancement makes all subsidiaries operate at a larger average firm size compared to their domestic peers. Productivity improvements from technology transfer can arise through various mechanisms. I abstract from a specific mechanism, however, existing literature suggests several contributors, which include latent intangible variables such as better management practices (Bloom et al., 2012), superior R&D know-how (McGrattan & Prescott, 2009, 2010a), or a permanent demand shock due to expanded access to international markets (Guadalupe et al., 2012).[19] The underlying TFP process is

$$\ln(a') = \rho_a \ln(a) + \varepsilon' \tag{2}$$

where TFP used in production differs by ownership

$$z = \begin{cases} a & \text{if } o = d \\ \vartheta a^{\theta} & \text{if } o = f \end{cases} \tag{3}$$

3.2 Incumbent Firms

An incumbent hires labor and invests in capital each period, making production decisions after acquisitions occur. Per-period profits are given by

$$\pi = \max_{l_s,\, l_u} \mathcal{F} - w_s l_s - w_u l_u - \kappa_{op}. \tag{4}$$

Wages (w_s, w_u) are paid to skilled and unskilled types. The parameter κ_{op} is a fixed operational cost that the firm must incur each period. Firm value depends on current period profits and its expected future value. The incumbent with ownership o solves the following recursive dynamic problem

$$V(a, k_I, k_T, o) = \max_{k_I', k_T'} \pi - p_I x_I - p_T x_T + \frac{1-\xi}{1+r} \max\left\{\mathbb{E}_a\left[\mathcal{V}(a', k_I', k_T', o')\right], 0\right\}. \tag{5}$$

subject to

$$x_I = k_I' - k_I(1-\delta_I) \qquad\qquad x_T = k_T' - k_T(1-\delta_T).$$

Investment in each capital type is subject to prices (p_I, p_T). The firm decides to exit when its continuation value is less than or equal to the value of exiting, which is normalized to zero. The exit decision is denoted by $\chi(a, k_I, k_T, o) = \{0, 1\}$. The expected continuation value $\mathcal{V}$ is conditional on the current productivity level a. Firms discount the future at $(1-\xi)/(1+r)$ where ξ is an exogenous exit shock and r is the interest rate. The continuation value of the domestic incumbent incorporates that it can either continue as domestically owned or that it is acquired and changes ownership in the next period. On the other hand, a foreign subsidiary's continuation

[19] Due to data limitations, I lack firm-level information on specific characteristics of foreign acquirers. I can only observe the amount of capital owned by a foreign entity. Therefore, I do not take a specific stance on the mechanism behind TFP enhancement from foreign ownership.

value does not consider the prospect of acquisition nor returning to domestic ownership.[20]

3.3 Entry

Domestic Entrant Each period there is an endogenous mass M of potential domestic entrant firms. A potential entrant pays a fixed cost of entry κ_e and enters the economy in the next period. Upon entry, firms receive their initial TFP level which is drawn from the the ergodic distribution of the log a process. If initial TFP is low enough such that the exit decision $\chi(\cdot)$ equals one then the entrant immediately exits. The present discounted value of the potential entrant is

$$V_e = \max_{k'_{I,e}, k'_{T,e}} -p_I k'_{I,e} - p_T k'_{T,e} + \frac{1-\xi}{1+r}\mathbb{E}\left[V(a', k'_{I,e}, k'_{T,e}, d)\right] - \kappa_e. \tag{6}$$

Firms continue to enter the economy as long as $V_e \geq 0$. In a stationary equilibrium free entry guarantees that $V_e = 0$.

Foreign Multinational There is an exogenous mass of identical foreign multinationals that have decided to enter the domestic economy. Due to data limitations I lack firm-level information on the characteristics of foreign acquirers. I therefore make as few assumptions as possible in regard to the multinational's entry decision and assume that the decision to enter is already sunk. A multinational enters the economy by acquiring an already existing domestic incumbent.[21] A foreign multinational is randomly matched with a domestic incumbent. To proceed with the acquisition, the foreign multinational must negotiate with the domestic incumbent, and both parties must agree on a sale price. If an agreement is reached then the domestic incumbent becomes a foreign subsidiary with value $V(a, k_I, k_T, f)$. In the event of no agreement, the foreign multinational does not enter the economy and the domestic incumbent continues under domestic ownership.

3.4 Acquisition Market

Domestic incumbents participate in a market of ownership transfer to foreign multinational entrants. In this market domestic firms face the same chance of being matched at the random rate $\mu \in [0, 1]$. Conditional on a formation of a match, the foreign multinational and domestic firm negotiate the acquisition terms following a Nash bargaining process with equal bargaining power. Only the foreign multinational can be the acquirer and I do not allow domestic incumbents to merge among themselves. The following equations are the solutions to the bargaining problem. The derivation of these results can be found in Appendix A.1.

The total surplus from acquisition in equation (7) is the value generated from a deal between a

[20]There a very few instances of subsidiaries that return to domestic ownership in the ESEE and I therefore abstract from this possibility.

[21]Another form of entry is greenfield investment where a foreign multinational builds a subsidiary. I abstract from greenfield and restrict the only mode of entry to acquisition which is the most common form of inward FDI in Spain.

domestic firm and the foreign multinational entrant

$$S(a, k_I, k_T) = V(a, k_I, k_T, f) - V(a, k_I, k_T, d) - \kappa_{ts}. \tag{7}$$

Acquisitions occur if $S > 0$ for price $p_d(a, k_I, k_T)$. Agreed acquisitions are subject to a one-off integration cost κ_{ts}. This cost is incurred by the foreign multinational.[22] The acquisition price that is paid for a domestic incumbent with states (a, k_I, k_T) is the current value of the domestic firm plus half of the value generated from the acquisition

$$p_d(a, k_I, k_T) = V(a, k_I, k_T, d) + \frac{S(a, k_I, k_T)}{2}. \tag{8}$$

If $S < 0$ then the acquisition price would be less than the value of the domestic incumbent and hence it would not transfer ownership. If $S = 0$, it would be indifferent.

Positive value generated from an acquisition comes from the value of the new foreign subsidiary. The new TFP level from equation (3) and its expected future values are ultimately the source behind the value of the acquired firm under the control of the foreign multinational. Outcomes of acquisitions are heterogeneous and uncertain. Being foreign-owned enhances productivity which gives the foreign subsidiary a competitive edge over its domestic rivals, but it does not insulate it as a series of negative shocks could lead to potential exit.[23]

Potential Acquisition and the Continuation Value The continuation value in equations (10)-(11) differs depending on ownership type o. Equation (11) is the continuation value for a firm already under foreign ownership and does not consider any potential future changes in ownership. On the other hand, the continuation value of the domestic incumbent incorporates that in the next period it either remains domestically owned or that meets a foreign multinational and is acquired. Let φ denote the product of an indicator function, which equals one when the total acquisition surplus is positive, and the probability μ of meeting a foreign multinational

$$\varphi = \mu \cdot \mathbb{1}\left\{\mathbb{E}_a\left[S(a', k'_I, k'_T)\right] > 0\right\}. \tag{9}$$

The first term in equation (10) is the expected firm value remaining under domestic ownership in the next period. The second term p_d is the expected acquisition price if it meets a foreign multinational and agrees to transfer ownership

$$\text{Domestic Owned:}\quad \mathbb{E}_a\left[\mathcal{V}(a', k'_I, k'_T, d')\right] = \mathbb{E}_a\left[(1-\varphi)V(a', k'_I, k'_T, d') + \varphi p_d(a', k'_I, k'_T)\right] \tag{10}$$

$$\text{Foreign Owned:}\quad \mathbb{E}_a\left[\mathcal{V}(a', k'_I, k'_T, f')\right] = \mathbb{E}_a\left[V(a', k'_I, k'_T, f')\right]. \tag{11}$$

[22] Such a cost could be the search cost. It also can be the transfer cost which can include integrating IT systems, business processes, organizational structures, legal fees and external financing costs.

[23] Allowing for idiosyncratic outcomes following acquisitions could reflect a foreign multinational that thought the acquired firm had more growth potential than it actually did or could also be poor management on the foreign multinational's part.

The acquisition price is strictly positive under any agreement and is increasing the arguments (a', k'_I, k'_T). Its inclusion increases the continuation value and incentivizes the firm to invest more in both types of capital. Anticipation is driven by the domestic firm's perception of the possibility of an acquisition. On one hand, future productivity a' is exogenous, yet if a firm expects a high TFP level in the future then it expects a higher sale price. On the other hand, the firm can endogenously affect the increase price by choosing a higher capital stocks (k'_I, k'_T).

3.5 Households

There is a mass of households which differ by skill type $i \in \{s, u\}$ and are fully insured against income risk. They get utility U from consumption and disutility from work. The number of type i workers in the labor force is mass N_i; the total household mass is $N = N_s + N_u$. I assume that N_i is exogenous. Thus, I abstract from the extensive margin where an unskilled household chooses to become skilled and vice versa. All individual households are endowed with one unit of time per period and endogenously supply labor $h_i \in (0, 1)$ on the intensive margin. Time not spent working is leisure. Since investment decisions are made by firms, there are no dynamic linkages in the household's choices; therefore, an individual type i household maximizes the following static problem

$$U(c_i, h_i) = \max_{c_i, h_i} \ln(c_i) - \psi_i \frac{h_i^{1+\frac{1}{\chi}}}{1 + \frac{1}{\chi}} \tag{12}$$

subject to

$$c_i = w_i h_i + \frac{\Pi_d + P_d}{N}. \tag{13}$$

The household gets log utility from consumption. The parameters that govern disutility of work are the frisch elasticity χ and labor disutility scalar ψ_i. The household consumes all of its labor and business income. The latter is evenly split across all households and includes dividends $\Pi_d = \Pi - \Pi_f$ paid by the domestic firms that the households own, as well as the per-period sale price P_d of domestic firms sold to foreign multinationals. The transfer of ownership impacts household consumption. The sale of domestic firms yields a one-time financial gain, yet it entails forfeiting the rights to any future dividends as they are redirected to the parent company of the foreign multinational situated outside the domestic economy. Because they are identical, all households within each type i choose the same hours to supply and have the same consumption level. However, it is important to note that consumption and hours worked differ between skilled and unskilled household types. Aggregate labor supplied by skill type i is $L_i = N_i h_i$, and total consumption is $C_i = N_i c_i$.

3.6 Stationary Equilibrium

The state space for an incumbent firms is $(\mathcal{A} \times \mathcal{K_I} \times \mathcal{K_T} \times \mathcal{O})$ where $(a, k_I, k_T, o) \in S$. To simplify the equilibrium exposition denote the states as $s = (a, k_I, k_T, o)$, where the state vectors for domestic and foreign ownership are $s_d = (a, k_I, k_T, d)$ and $s_f = (a, k_I, k_T, f)$. Let λ be the invariant measure of incumbent firms where P_M is the measure of domestically owned firms matched with a foreign entrant, P_U is the measure of unmatched domestically owned firms and

P_F is the measure of foreign-owned firms. Denote M as the mass of potential domestic entrants who draw their initial TFP level from $G(a)$. A more formal definition is in Appendix A.2.

SRCE Definition A stationary recursive competitive equilibrium (SRCE) consists of prices (w_s, w_u), an invariant measure of firms λ, a constant mass of entrants M, a value function for incumbent firm $V(s)$, a value function for the entrant firm V_e, policy functions for the incumbent firm $l_s(s)$, $l_u(s)$, $k'_I(s)$, $k'_T(s)$, $\chi(s)$, and for the entrant firm $k'_{I,e}$, $k'_{T,e}$ such that

1. Given prices, the policy functions $l_s(s)$, $l_u(s)$, $k'_I(s)$, $k'_T(s)$, $\chi(s)$ solve the incumbent firm's problem in equation (5) with the associated value function $V(s)$. The policy functions $k'_{I,e}$ and $k'_{T,e}$ solve the entrant firm's problem with the associated function V^e in equation (6).
2. Given prices, households of type $i \in \{s, u\}$ with mass N_i maximize utility in equation (12) subject to the budget constraint in equation (13). Aggregate labor supplied is $L_i = N_i h_i$.
3. Matched domestic firms transfer ownership only if the total acquisition surplus in equation (7) is strictly positive. The aggregate sale price is $P_d = \mu \int \mathbb{1}_{\{S(s_d)>0\}} p(s_d) d\lambda(s_d)$.
4. Markets clear
   (a) Skilled labor: $L_s = \int_{\mathbf{S}} l_s(s) d\lambda(s)$
   (b) Unskilled labor: $L_u = \int_{\mathbf{S}} l_u(s) d\lambda(s)$
   (c) Goods:[24] $C + X_I + X_T + \kappa_e M = \int_{\mathbf{S}} (\mathcal{F}(z, k_I, k_T, l_s(s), l_u(s)) - \kappa_{op}) d\lambda(s) + P_d - \Pi_f$
5. The invariant measure of firms λ satisfies

$$\lambda(\mathcal{A} \times \mathcal{K_I} \times \mathcal{K_T} \times \mathcal{O}) = [P_M(s_d) + P_U(s_d) + P_F(s_f)] + M \int_{a' \in \mathcal{A}} dG(a'). \tag{14}$$

6. The free entry condition is satisfied: $V_e = 0$.

3.7 Timing

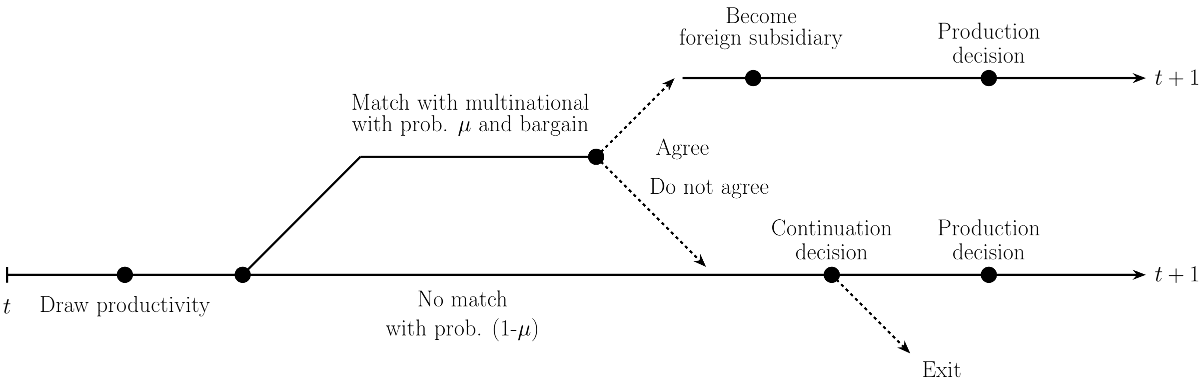
The timing of events, summarized in Figure 4, is as follows: incumbent firms observe the realization of their idiosyncratic TFP level a. Domestic incumbents meet a foreign multinational with probability μ and begin to bargain over an acquisition price. If an agreement is reached, the domestic incumbent transfers ownership and becomes a foreign subsidiary, otherwise it continues under domestic ownership. After the bargaining stage all incumbents choose to continue or exit the economy. Newly acquired subsidiaries never immediately exit. Finally, incumbents then hire labor and make their investment decisions. In the meantime there is a mass of domestic entrants

[24] where

i. Aggregate profits by ownership type $o \in \{d, f\}$ are $\Pi_o = \int_{\mathbf{S}} \pi_o(s) d\lambda(s)$ and foreign dividends Π_f flow out the economy.

ii. Investment for capital type $j \in \{I, T\}$ is $X_j = p_j \int_{\mathbf{S}} (k'_j(s) - (1 - \delta_j) k_j) d\lambda(s)$.

Figure 4: Domestic Incumbent Timeline



that enter the economy having paid a fixed entry cost in the previous period. Entrant firms do not participate in the merger market prior to entering.

4 Calibration

The model is calibrated to the Spanish manufacturing sector during the period 2002-2006, using several data sources. Firm-level data is taken from the ESEE, while sector-level data is obtained from KLEMS, INE, and the OECD's AMNE and SBDS databases for foreign ownership. The skill composition of the labor force in manufacturing and hours supplied by education type is sourced from the Survey of Household Finances (EFF in Spanish), administered by the Bank of Spain.[25] The period 2002-2006 is specifically chosen because 2002 is the earliest year for which KLEMS provides labor data by skill type for Spain, and it is also the earliest available year for the EFF. Section 4.1 provides a detailed quantification of the model parameters. This begins with the description of externally calibrated parameters, followed by the internal calibration of remaining parameters using the Simulated Method of Moments (SMM). Section 4.2 discusses non-targeted moments and cross-sectional implications of the calibrated model.

4.1 Parameterization

Table 4 displays the externally and internally calibrated parameters in the model.

4.1.1 Externally Calibrated Parameters

I externally calibrate eleven parameters. I set the interest rate $r = 0.04$. The depreciation rates for tangible and intangible capital in the Spanish manufacturing sector are taken from KLEMS. The returns-to-scale parameter is set to $\nu = 0.85$. Two parameters govern the idiosyncratic TFP process. Estimates of the persistence parameter fall in the range 0.5 to 0.9. I opt for an intermediate value of $\rho_a = 0.7$. For the standard deviation of innovations influencing the productivity process, the literature reports a smaller range of 0.15 to 0.28. I set the standard deviation of innovations $\sigma_a = 0.2$, which is in the lower middle part of the estimated range.[26]

[25] https://app.bde.es/efs_www/home?lang=EN
[26] See Clementi and Palazzo (2015) for an in-depth review.

Table 4: Parameter Values

Calibrated Parameter	Value	Description
External		
r	0.040	Annual interest rate
δ_T	0.140	Tangible depreciation rate
δ_I	0.200	Intangible depreciation rate
ν	0.850	Returns to scale
ρ_a	0.700	Persistence of AR(1) process a
σ_a	0.200	Std. dev. of AR(1) process a
$\mathfrak{s}$	0.292	Skill ratio of labor force
M	0.007	Mass of potential entrants
σ	0.579	Substitution param. skilled and unskilled labor
ρ	-0.322	Substitution param. skilled labor and intangibles
χ	0.500	Frisch elasticity
Internal		
ϑ	1.120	TFP enhancement scalar
θ	0.886	TFP enhancement elasticity
μ	0.214	Match probability
α	0.298	Tangible capital output elasticity
ς	0.634	Production function: skill and unskill share
ϱ	0.435	Production function: skilled labor and intang. share
κ_{ts}	6.234	Acquisition fixed cost
κ_{op}	0.311	Operation fixed cost
κ_e	0.796	Entry cost
ξ	0.026	Exogenous Prob. Exit
ψ_s	14.398	Skilled labor disutility
ψ_u	9.218	Unskilled labor disutility

I normalize both investment prices to one. KLEMS nor does INE publicly provide the data on the skill composition of the labor force by sector. I construct the skill composition for the manufacturing sector using the EFF. I define the manufacturing labor force as those employed and unemployed (previously employed) in the manufacturing sector. The skill ratio of the labor force is $\mathfrak{s} = \frac{N_s}{N_u} = 0.292$. In the model, I normalize the size of the unskilled labor force N_u to one, resulting in $N_s = \mathfrak{s}$. The measure of potential entrants M scales the distribution of entrants (see equation (A.5)) and is set such that the aggregate demand for unskilled labor equals $L_u = N_u h_u = 1$, which effectively clears that market. Note that h_u is a choice variable of the household.

I externally calibrate the parameters (σ, ρ) in the production function, which determine the elasticities of substitution, and internally calibrate the remaining three parameters $(\alpha, \varsigma, \varrho)$. The parameters (σ, ρ) cannot be credibly identified using firm-level data from the ESEE due to a lack of information on wages paid by skill type. The common assumption in firm dynamics models is that the parameters governing the firm-level production function are the same as those for the aggregate function. Leveraging this assumption of parameter invariance to aggregation, I estimate the substitution parameters (σ, ρ) at the sector level using the manufacturing data series

Table 5: Moments Fit

Target Moment	Data	Model
Foreign Ownership		
Acq. rate (in pp)	0.351	0.351
Foreign output share	0.273	0.258
Acquisition distribution: Middle 30%	0.292	0.307
Acquisition distribution: Top 20%	0.591	0.631
Production		
Wage skill premium	1.426	1.426
Intangible share	0.177	0.177
Tangible share	0.271	0.271
Skilled hours supplied	0.356	0.356
Unskilled hours supplied	0.344	0.344
Selection		
Average firm size	6.374	6.369
Exit rate	0.079	0.081
Exit rate firms with emp. ≥ 20	0.026	0.026

from KLEMS. This approach allows for separate identification and estimation through the nested CES structure.[27] The estimate for the substitution parameter across skilled and unskilled labor hours turns out to be $\sigma = 0.579$, implying an elasticity of substitution equal to $1/(1-\sigma) = 2.375$. In the U.S., the range for this parameter varies widely, ranging from as low as 1.4 to as high as 4 (Acemoglu & Autor, 2011). Despite being an imperfect comparison, my estimate is somewhere in the middle of this range. The estimate for the substitution parameter between intangible capital and skilled labor is $\rho = -0.322$, implying an elasticity of substitution of $1/(1-\rho) = 0.756$.

4.1.2 Internally Calibrated Parameters

The remaining twelve parameters are internally calibrated using Simulated Method of Methods (SMM). The parameter vector is

$$\Theta = \{\vartheta, \theta, \mu, \alpha, \varsigma, \varrho, \kappa_{ts}, \kappa_{op}, \kappa_e, \xi, \psi_s, \psi_u\}. \tag{15}$$

Specifically, I search over this parameter vector to find the combination that minimizes the distance between a set of empirical moments and their equilibrium analogues. The parameter vector $\widehat{\Theta}$ minimizes the criterion function

$$L(\Theta) = \min_{\Theta} \; [\Psi_{\text{data}} - \Psi_{\text{model}}(\Theta)]' \; \mathbf{W} \; [\Psi_{\text{data}} - \Psi_{\text{model}}(\Theta)]\,. \tag{16}$$

Each moment has equal weighting and the criterion function is the sum of squared percent deviations. Here, the diagonal weighting matrix is $\mathbf{W} = \text{diag}(1/\Psi^2_{\text{data}})$ and vectors Ψ_{data} and

[27] Refer to the Appendix C.3 for more details.

Ψ_{model} contain the empirical and model moments. The model is just-identified.

Every targeted moment is determined simultaneously by all parameters, yet for intuitive purposes, I discuss each parameter and its relation to its moment that most directly identifies it. All empirical moments are from the ESEE, KLEMS, INE, EFF and the OECD's AMNE and SBDS databases. Table 5 lists the parameters, their targeted empirical moments, and the moments generated by the model. The first set of parameters $(\mu, \theta, \kappa_{ts}, \vartheta)$ concern acquisition activity and foreign production. The parameter μ is the rate at which domestic incumbents and foreign multinational entrants are matched and it is therefore important in determining the acquisition rate. I calculate the annual acquisition rate as the the percentage of firms that report being foreign owned and were domestically owned in the previous year. The average acquisition rate in the ESEE during the time period is 0.351%. The parameter θ affects the marginal productivity gain from acquisition in equation (3) and the parameter κ_{ts} is a fixed cost that influences the total surplus of acquisitions (equation (7)). I use these parameters to target the upper half of the marginal distribution of acquired domestic firms, where most acquisitions are concentrated. As θ increases, it raises the value created by high TFP domestic firms and lowers it for low TFP firms, making high TFP domestic firms more likely to be acquired in equilibrium. A high fixed acquisition cost lowers the total surplus and, as a result, acquisition of low TFP domestic firms. I construct the empirical distribution from ESEE by calculating the firm size distribution across all firms in each industry and year and counting the proportion of acquired firms that fall into each decile. I specifically target the top 20% of the marginal distribution (9th and 10 deciles) and middle 30% (6th, 7th and 8th declines). The marginal distribution below the median is untargeted. Most acquired firms are in the upper end of the firm size distribution, with 59.1% in the top 20% of firms at the time of acquisition, and 29.2% in the middle 30%.[28] The scalar parameter ϑ from equation (3) is an important component that the scale at which foreign subsidiaries operate. Higher values of ϑ raise the TFP level of subsidiaries relative to domestic incumbents and therefore their scale of production. I use this parameter to target the share of total output by foreign-owned firms which is calculated from the OECD's AMNE and SBDS databases.

For the production function I use the the output elasticity of tangible capital α to target the tangible capital share, defined as tangible investment over gross value added. I calibrate the share parameters of the production function (ς, ϱ) to match the wage skill premium and intangible share, defined as intangible investment over gross value added. Higher values of the parameter ς increase the skilled labor demanded by the firm. This has considerable influence on the labor compensation ratio $\frac{w_s L_s}{w_u L_u}$. As the labor demands are equated with supply in equilibrium, I target the manufacturing wage skill premium $\omega \equiv \frac{w_s}{w_u}$ which I take from KLEMS. The parameter ϱ is the share parameter for skilled labor and intangible capital and I use it to target the intangible share.

Th parameters $(\kappa_{op}, \kappa_e, \xi)$ influence the entry/exit dynamics. I use the operational and entry fixed costs to target the exit rate and the average incumbent size by employment. The fixed

[28] The empirical and model distributions appear in Figure D.8 in Appendix D

Table 6: Non-Targated Moments

Moment	Data	Model
Skilled Labor Share	0.181	0.166
Unskilled Labor Share	0.371	0.386
Pct. of Foreign Owned Firms	0.736%	0.787%
Average Entrant Size	2.938	3.373

operation cost κ_{op} has significant influence over the former, while the latter impacts the free entry condition and, consequently, the type of domestic firms entering the economy. The ESEE provides a representative sample of the Spanish manufacturing sector, although it does not aim to be representative of entry/exit flows. To calculate these moments I use data for the manufacturing sector from the Public Registry of Firms (DIRCE in Spanish), which is published by INE. The average exit rate during the time period is 0.079 and the average number of employed at a firm is 6.374. The fixed cost of operation has a strong influence over endogenous entry and exit and primarily affects the smallest (least productive) firms. In contrast, the exogenous exit shock ξ is size-independent, allowing me to target exit events among larger firms. Using DIRCE I calculate the exit rate of firms with 20 or more employees and find it to be 0.026.[29] The final set of parameters (ψ_s, ψ_u) are the disutility of labor supplied by the household for each skill type. I target the average share of hours worked per week which is collected by EFF. I calculate them and find them to be 0.356 for skilled workers and 0.344 for unskilled. I set ψ_s and ψ_u such that the household endogenously chooses (h_s, h_u) to equal these hour shares.

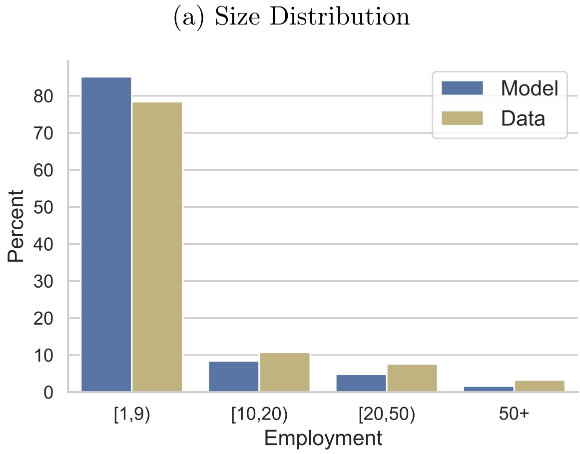
The final two columns in Table 5 show the targeted moments from the data and the model. The fit of the model is quite accurate with respect to the majority of moments. However, it generates a lower production share by foreign firms (0.256) compared to the data (0.273). The model also struggles to match the decile bins in the marginal acquisition distribution. The top 20% of the acquisition distribution consists of the largest domestic firms in terms of employment, with a share of 0.591 of acquired firms coming from this group. The model overpredicts this moment with a share of 0.631. Additionally, the model slightly overestimates the share of acquired firms from the middle 30% of the marginal acquisition distribution, where the share is 0.292 in the data and 0.307 in the model. Consequently, the marginal acquisition distribution in the model is slightly more skewed towards the largest firms than in the data.

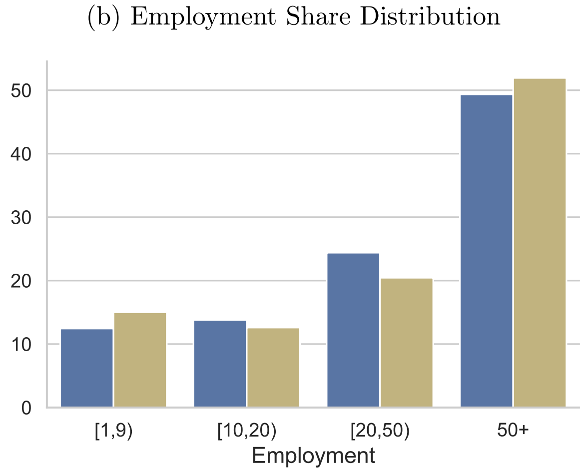
4.2 Cross-Sectional Outcomes

This section provides validation of the the calibrated model. Section 4.2.1 presents moments and distributions which are not explicitly targeted. Section 4.2.2 examines the cross-sectional implications of foreign acquisitions and compares it to the empirical evidence.

[29] 20 employees is the highest employee stratum that DIRCE publicly provides.

Figure 5: Firm Distributions: Model Versus Data





Notes: The figures show the firm size distributions by employment which are not targeted in the calibration. The blue bars depict the distributions from model and the yellow depict those from the data. The right figure displays the share of firms for different employment stratum. The right figure contains the employment share for different employment stratum. The empirical distributions for the Spanish manufacturing sector are from the OECD SDBS database.

4.2.1 Non-Targeted Moments

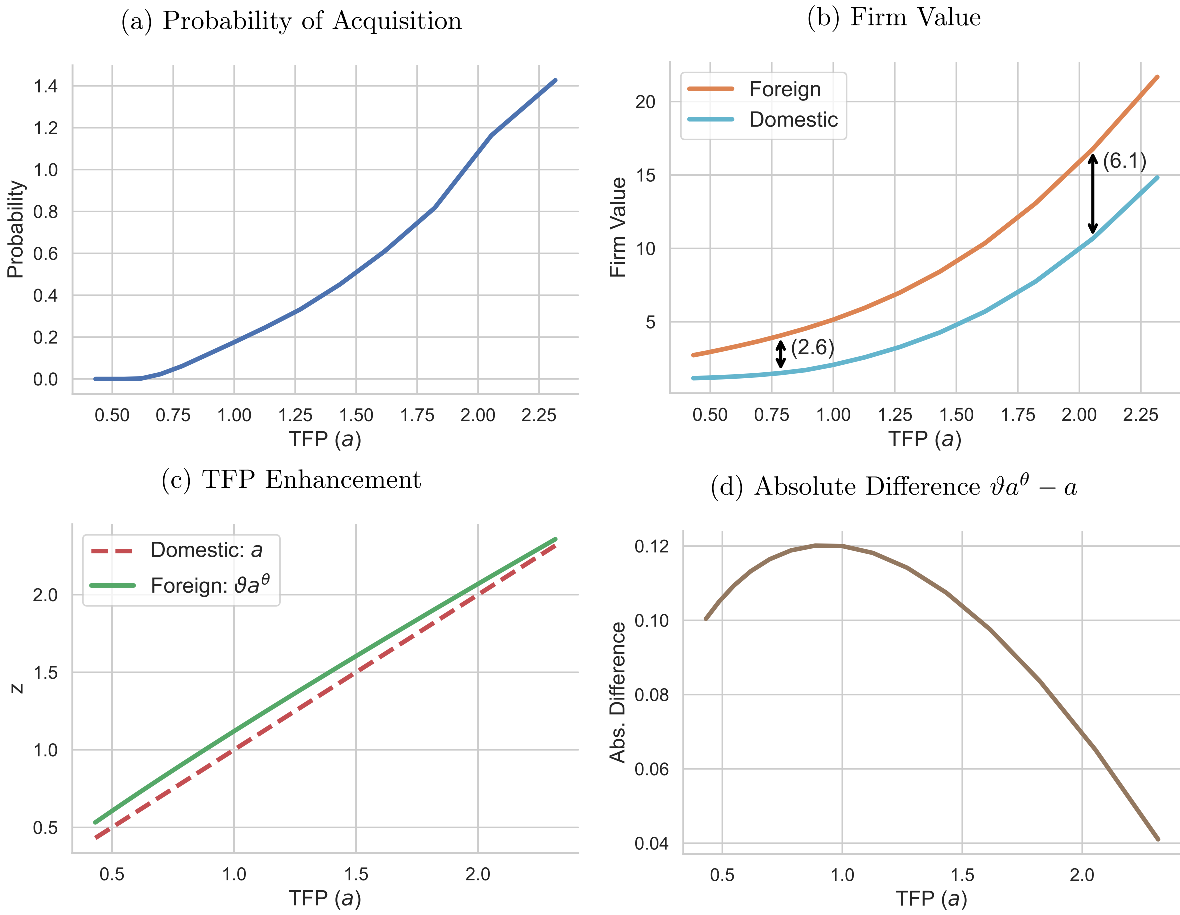
Table 6 presents a comparison between the non-targeted moments predicted by the model and their empirical counterparts. The model performs well in reproducing the non-targeted moments. The first two moments are the share of labor compensation by skill type over gross value added. The skilled labor share in the model is 0.166, which is close to the empirical value of 0.181. Similarly, the unskilled labor share is slightly higher at 0.386 compared to 0.371 in the data. The percentage of foreign-owned firms is very low in the economy, yet these firms operate on a large scale. The empirical percentage of foreign-owned firms at the beginning of the sample is 0.736%. The model predicts a similar value of 0.787%. Finally, while the average incumbent size is a targeted moment, the average entrant size is not. The model predicts a higher average entrant size, with 3.373 compared to the empirical 2.938.

Figure 5 compares the firm size distribution generated by the model to the empirical distribution averaged over the start-of-sample years 2002-2006. Figure 5a is the firm size distribution by employment stratum and Figure 5b is the share of employment. The model correctly predicts that the majority of the firms in the economy are small, while a small hand full of large firms account for the majority of employment. However, the model generates too few large firms. This is evident in the firm size distribution, where the tail of the size distribution is not as thick as in the data. This is also reflected in the employment share, where the proportion of employment for firms with 50 or more employees is lower than in the data.

4.2.2 Acquisitions

There is positive selection in acquisition and most firms that are acquired are in the upper tail of the firm distribution (Figure D.8). The most productive (largest) firms in the economy create the

Figure 6: Acquisition in Equilibrium and Foreign Technology Transfer



Notes: Subfigure (a) displays a domestic incumbent's probability of being acquired as a function of TFP. Subfigure (b) shows firm value as a function of TFP, with both intangible and tangible capital at their marginal distributional median values: $V(a, med(k_I), med(k_T), o)$. Domestic firms are represented by the teal line, foreign firms by the orange, with the black arrows indicating the value difference. Figure D.9 in Appendix D shows a the same pattern at different capital distributional percentiles. Subfigure (c) is the TFP enhancement (green line) from equation (3) with the calibrated parameters $\vartheta = 1.120$ and $\theta = 0.887$. The dashed red line is domestic TFP. Subfigure (d) is the absolute difference between foreign and domestic TFP.

most value from being acquired. Figure 6a displays the probability that a firm is acquired as a function of TFP. The total acquisition surplus, or the value created from acquisitions, is highest for domestic firms with an initially high level of TFP. As a result, the acquisition probability increases with TFP. This occurs because firm value is convex in TFP, a common characteristic in firm dynamics models. Consequently, even a slight increase in TFP for domestically owned firms with initially high TFP results in more value created through acquisition compared to domestic firms with initially low TFP. This is illustrated in Figure 6b, where the absolute difference in value (indicated by the black arrows) widens.

Figure 6c displays the TFP enhancement function from equation (3) under the calibrated parameters and Figure 6d plots the absolute difference. The technology of the foreign multinational raises the TFP of its acquired subsidiary but is diminishing in TFP as the curvature parameter $\theta = 0.887$. Table 7 compares the simulated performance of firms before and after foreign acquisition. It shows the (untargeted) percentage increases under foreign ownership relative to

Table 7: Model Simulation – Avg. Increase After Acquisition (in pp.)

Output	TFP	Intangible Inv.	Tangible Inv.	Skill Comp.
25.7	4.6	43.6	38.9	13.7

their average levels as domestic firms. The results align with the empirical evidence. There is a modest gain in TFP and a larger increase in output. Investment patterns are similar, with intangible investment increasing more than tangible investment, though both exceed the increases observed in the data. Additionally, while the skill composition shifts toward more skilled labor, the change is slightly smaller than the observed increase. As a final exercise, I examine the role of anticipation in increasing investment by domestic incumbents. Figure D.10 in Appendix D shows the intangible and tangible investment policy functions. The gray line represents the intangible investment level for domestic firms in the model without acquisitions, and thus, without foreign ownership. Investment is slightly lower in this case due to the absence of a potential sale price in the continuation value from equation (10), which reduces the expected marginal benefit of investment. While anticipation plays a role in the model, it has modest effects and only slightly increases investment primarily because the probability of acquisition is small.

5 Quantitative Analysis

This section provides the main results of the paper. Section 5.1 conducts a steady state comparison through a (skill-biased) intangible-investment-specific technological change. It first quantifies the model's ability to account for observed changes in the data and then decomposes aggregate variables to assess how much of the changes can be attributed to foreign ownership. Section 5.2 examines the welfare impact on household types.

5.1 Steady State Comparison

The previous section demonstrated that the calibrated model is consistent with the observed cross-sectional empirical patterns. This section examines how the model is affected by an intangible-investment-specific technological change and quantifies its ability to account for the observed empirical trends by comparing two steady states. This technological change is modeled as an exogenous decline in the relative intangible investment price.[30] The cheapening of investment results in greater usage of intangibles in production and increases the likelihood of acquisitions. Furthermore, due to intangible-skill complementarity, this technological change is skill-biased.

The initial steady state is the benchmark model, calibrated to the start-of-sample years (2002-2006). The new steady state is calibrated to the end-of-sample period (2013-2017) after the technological change has occurred. There are two exogenous changes in the new steady state. The first is an 8.5% decline in the relative price of intangible investment. Due to intangible-skill complementarity,

[30]The decline is prevalent across many advanced economies. Recent papers document the decline in the U.S. (Zhang, 2024) and France (Lashkari et al., 2024). The decline in the relative price of intangible investment can be interpreted as an improvement in the quality of intangible investment goods or a reduction in their cost. The cheapening of investment is one force (but not the only) that can lead to an increase in intangible investment.

Table 8: Steady State Comparison – Data versus Model

	Initial S.S.		New S.S.		**Change (in pp.)**	
	Data	Model	Data	Model	**Data**	**Model**
Targeted Moments						
Wage Skill Premium	1.426	1.426	1.560	1.479	**+9.4**	**+3.7**
Acquisition Rate (in pp.)	0.351	0.351	0.589	0.378	**+67.8**	**+7.8**
Foreign Output Share	0.273	0.252	0.412	0.277	**+50.9**	**+10.0**
Intangible Share	0.177	0.177	0.242	0.191	**+36.7**	**+8.2**
Tangible Share	0.271	0.271	0.265	0.266	**-2.2**	**-2.0**
Non-Targeted Moments						
Pct. of Foreign Owned Firms	0.736	0.787	1.166	1.072	**+58.4**	**+36.2**
Skilled Labor Share	0.181	0.166	0.232	0.170	**+28.2**	**+2.1**
Unskilled Labor Share	0.371	0.386	0.262	0.373	**-29.4**	**-3.3**

Notes: Initial steady state: 2002-2006 average. New steady state: 2013-2017 average.

this applies upward pressure on the wage skill premium. The second exogenous change is the skill composition within the manufacturing labor force. During this period the number of skilled workers grew, leading to a 7.9% increase in the skilled-to-unskilled worker ratio. Such a change exerts downward pressure on the wage skill premium. The new steady state is after the changes in both the investment price p_I and the skill ratio of the labor force $\mathfrak{s}$ have occurred, with their values set to the average levels observed during the end-of-sample period (2013-2017). Aside from these two changes, all other parameters in the new steady state are the same as in the initial.

Table 8 presents the steady state comparison of the wage skill premium, foreign ownership and the income shares. The second and third columns display the data values and their corresponding model analogues for the initial steady state, representing averages from the beginning of the sample period, 2002-2006. The fourth and fifth columns show the values for the new steady state. The wage skill premium in manufacturing increased from 1.426 at the start of the sample to 1.560 by the end. Taking into account the increased skill ratio of the labor force, the model accounts for 39% of the rise in the wage skill premium. Additionally, increased investment raises the firm value of domestic incumbents and the total acquisition surplus (see equation (7)) leading to a higher number of acquisition deals. The acquisition rate saw an increase of 67.8% over the sample period and the model accounts for approximately 12% of its rise. The share of production by foreign-owned firms increases as well.

The next four moments in Table 8 present changes in the income shares of investment by capital type and the labor compensation by skill. The intangible share, defined as intangible investment over gross value added in manufacturing, increased by 36.7% by the end of the sample period. The model aligns with the observed trend of intangible deepening, accounting for approximately 22% of the increase. The model also captures the decline in the tangible share. The model

Table 9: Steady State Comparison – Changes in Aggregate Variables (in pp.)

	Aggregate		Domestic		Foreign
Wage Skill Premium $\frac{w_s}{w_u}$	+3.7		+2.8		+0.9
Output Y	+3.3		+2.1		+1.2
TFP Z	+0.8		+0.5		+0.3

	Aggregate		Labor Income		Business Income
Consumption C	+2.3		+2.8		-0.5
		Skilled HH	+2.0	Domestic Dividends	-3.3
		Unskilled HH	+0.8	Acquisition Sale Price	+2.8

	Aggregate		Skilled HH		Unskilled HH
Labor Supply Nh	+4.1		+1.8		+2.3
Avg. Hours h	–		+0.3		+2.9

Notes: Details regarding how aggregate variables are decomposed by ownership are in Appendix A.3. Labor income is defined as the product of the wage and hours worked $w_i h_i$ where business income is the sum of dividends paid by domestic-owned firms and the total sale price of all firms sold in a given period: $\Pi_d + P_d$. Aggregate labor supply takes into account not only hours worked, but also the number of workers in the labor force which is higher in the steady state. Average hours worked is hours supplied by skill type i and all households of each type supply the same amount.

predicts a change in the composition of labor compensation, defined as labor compensation over gross value added in manufacturing. These shares are not targeted in the initial steady state. By the end of the sample period, the composition of labor compensation changes in favor of skilled labor, reducing the share for unskilled labor. This change can be attributed to both the increased relative demand for skilled labor and the growth in its relative supply within the labor force. The model accounts for 7% of the increase in the skilled labor share and 11% of the decline in the unskilled labor share. The final untargeted moment in the table is the percentage of foreign owned firms and the model accounts for more than half of the increase observed in the data.

The model is able to quantitatively account for a portion of the observed increases in the wage skill premium, foreign owernship and changes in investment and labor shares. In the new steady state, aggregate variables such as output, TFP and consumption are also higher. However, it raises the question of how much of the increase in the wage skill premium and other aggregate variables is attributable to foreign ownership, especially given the relatively small number of foreign-owned firms. Does their presence have a significant impact on these changes? Table 9 summarizes the aggregate changes along with a decomposition by ownership. The second row shows the wage skill premium where foreign ownership accounts for approximately 24% (0.9/3.7) of its increase.[31] Domestic ownership contributes more to the change in the wage skill premium because its overall distributional mass is larger relative to foreign ownership. However, foreign ownership's impact on wages is particularly remarkable, despite the small number of foreign-owned firms. This is due to their significant scale, which magnifies their influence in the aggregate.

The third and forth rows display the changes in steady state output and TFP, which experience increases by 3.3 and 0.8 percentage points. The aggregate increases stem from a combination of

[31] It is important to note that this is how foreign ownership affects the wage skill premium through intangible-skill complementarity. The unexplained portion of the wage skill premium increase could contain other mechanisms through which foreign ownership might have an important influence.

the selection and foreign ownership effects within the model. Holding equilibrium prices fixed, the decline of the relative investment price makes intangible investment less costly, leading to an increase in the present discounted value of entry ($V_e > 0$). In equilibrium, wages endogenously adjust upward until the free entry condition is satisfied ($V_e = 0$), which raises the entry/exit threshold for both domestic entrants and operating incumbents.[32] The increased presence of foreign owned firms plays an important role. These firms operate at a larger scale and have higher TFP levels on average compared to their domestic counterparts. Their larger operational scale requires more resources, which puts additional upward pressure on equilibrium prices and the entry/exit threshold. The decomposition shows that foreign-owned firms contribute to approximately 38% of the increases in both output and TFP.

In addition to increases in the wage skill premium, output, and TFP, aggregate consumption rises by 2.3%. This change can be attributed to two main components: total business income and total labor income. Total business income, which includes domestic dividends and the proceeds from selling firms to foreign multinationals, is distributed uniformly across all households since each household owns one share. The increase in foreign-owned firms leads to a 3.3% decrease in domestic dividends. The increased frequency of acquisitions raises the revenue from ownership transfers by 2.8%, however it does not fully offset the decline in dividends, resulting in an overall decrease in business income. The other component, total labor income, increases by 2.8%. This increase in labor income outweighs the decline in business income, making it the primary driver of the rise in aggregate consumption. Total labor income's increase is mainly attributed to skilled households, whose income rises by 2.0%, compared to a 0.8% increase for unskilled households. This disparity is driven by the increased wage skill premium. Finally, aggregate labor supplied increases by 4.1% where unskilled contributed more. At the individual household level, skilled hours supplied increases by 0.3% while unskilled increases by 2.9%.[33] While aggregate consumption is higher, the disparity in labor income growth and hours worked suggests that skilled and unskilled households may experience different levels of welfare gains due to different hours worked. This begs the question: Are both household types better off in the new steady state, or do these disparities result in unequal welfare outcomes?

5.2 Welfare

To evaluate whether different household types are better off in the new steady state, I quantify the overall welfare impact using consumption equivalent variation. Given the form of the utility function, the welfare consequences for type i household of moving from the initial steady state

[32] Consequently, the number of domestic incumbents and entrants decreases. The domestic entry/exit rate decreases by 24.6% and the mass of domestic entrants attempting to enter the economy shrinks by 13.6%.

[33] It is important to note that aggregate labor supplied by skilled households reflects additional hours supplied on the margin and the increase in the number of skilled workers. Almost all of the 1.9% increase in the aggregate supply of skilled labor is due to the increase in the number of skilled workers.

Table 10: Welfare Change Between Steady States (in pp.)

	Aggregate	Skilled	Unskilled
Total Welfare Change CEV	+1.6	+7.0	-0.5
Welfare Change from Consumption CEV_c	+2.8	+7.2	+0.6
Welfare Change from Hours Supplied CEV_h	-1.2	-0.2	-1.1

Notes: Aggregate welfare is $N_{s,\text{new}}CEV_s + N_{u,\text{new}}CEV_u$.

with consumption-labor allocation $(c_{i,\text{initial}}, h_{i,\text{initial}})$ to $(c_{i,\text{new}}, h_{i,\text{new}})$ is

$$CEV_i = \frac{c_{i,\text{new}}}{c_{i,\text{initial}}} \exp\left(\frac{\psi_i\left(h_{i,\text{initial}}^{1+\frac{1}{\chi}} - h_{i,\text{new}}^{1+\frac{1}{\chi}}\right)}{1+\frac{1}{\chi}}\right) - 1. \tag{17}$$

This measures the percentage change in consumption required to maintain the same utility level between the initial and new steady states for each household type. I further decompose CEV_i into components that stem from changes in consumption $CEV_{i,c}$ and labor hours supplied $CEV_{i,h}$.[34]

Table 10 presents the welfare results. The aggregate welfare change (CEV) shows an increase of 1.6%, indicating an overall positive welfare gain in the new steady state. However, this aggregate improvement masks the welfare differences across skill types. Skilled households see a welfare increase of 7.0%, where welfare from increased consumption is 7.2% and an increase in labor hours results in a welfare loss of -0.2%. This indicates that skilled households are better off in the new steady state as higher consumption levels more than offset the additional work hours. In contrast, unskilled households experience a welfare decline of 0.5%. While there is a positive increase in consumption (0.5%), it is overshadowed by the negative impact of longer working hours (-1.1%). The increased labor supplied by unskilled households offsets the gains from higher consumption, resulting in a net welfare loss. Despite an overall increase in welfare, the results show that there is an asymmetric impact on different skill types. Skilled households are better off in the new steady state, however, unskilled households are not as their limited welfare gains in consumption are offset by having to work more.

[34]The consumption equivalent variation is formally is defined as

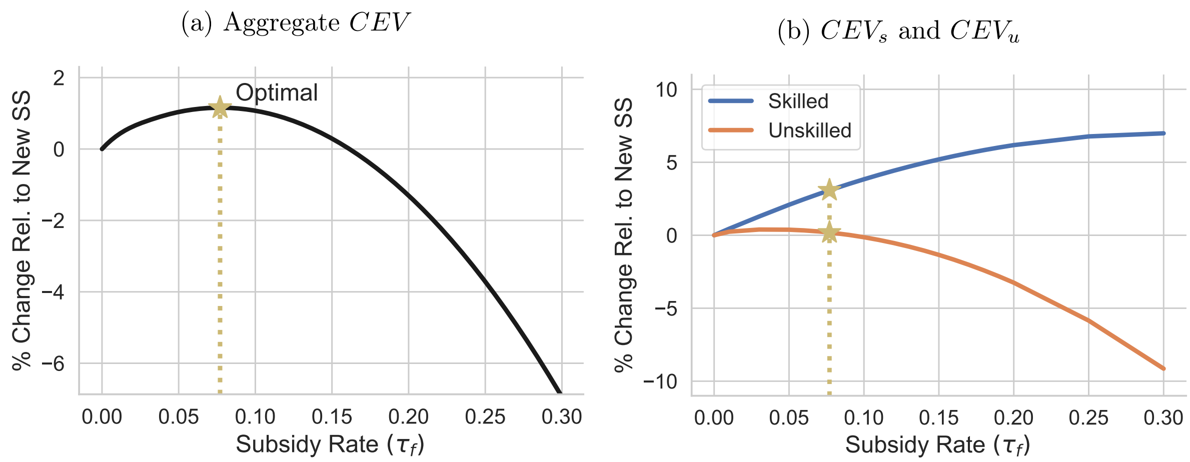
$$U((1+CEV_i)c_{i,\text{initial}}, h_{i,\text{initial}}) = U(c_{i,\text{new}}, h_{i,\text{new}})$$

Welfare can be decomposed by changes from consumption and hours supplied (Conesa, Kitao, & Krueger, 2009). The components $CEV_{i,c}$ and $CEV_{i,h}$ are defined as

$$U((1+CEV_{i,c})c_{i,initial}, h_{i,\text{initial}}) = U(c_{i,new}, h_{i,\text{initial}})$$
$$U((1+CEV_{i,h})c_{i,new}, h_{i,\text{initial}}) = U(c_{i,new}, h_{i,\text{new}}).$$

It follows that $1+CEV_i = (1+CEV_{i,c})(1+CEV_{i,h})$, or approximately $CEV_i \approx CEV_{i,c} + CEV_{i,h}$.

Figure 7: Welfare and Foreign Intangible Investment Subsidy



Notes: The figure displays welfare, measured in consumption equivalent variation, as a function of the foreign intangible investment subsidy τ_f. Percentage changes are relative to the new steady state. Subfigure (a) is aggregate welfare $CEV = N_sCEV_s + N_uCEV_u$. Subfigure (b) shows welfare by skill type. Additional figures shows the changes in the wage skill premium, output, TFP and the acquisition rate are in Figure D.11 in Appendix D. The gold stars are the values at the optimal policy rate.

6 Policy Implications

Foreign ownership has a significant impact on the aggregate and policies that incentivize foreign-owned firms to either expand or enter the market have non-trivial consequences for both the overall economy and welfare. This section examines the consequences of investment subsidies. In the context of Spain, policymakers from both major political parties have long prioritized attracting investment from foreign multinationals. Following the COVID-19 pandemic, Spanish policymakers are seeking to encourage foreign multinationals to invest more in intangibles such as R&D and software.[35] The rationale is that such investments can improve competition and potentially create positive spillovers. An additional benefit is the creation of employment and is a key aspect that policymakers emphasize when promoting such policies to Spanish voters. Indeed, these policies are not misguided, as foreign ownership is beneficial for output and TFP, as both this paper and the literature argue. However, they carry unintended consequences by amplifying skill-biased technological change.

I consider a policy that subsidizes intangible investments exclusively by foreign-owned firms and find the optimal rate that a Ramsey planner would choose. This policy not only encourages increased investment by existing foreign incumbents but also indirectly stimulates market entry through acquisitions. Due to intangible-skill complementarity, such a policy is inherently skill-biased, as it widens the wage skill premium and creates uneven welfare outcomes for households. The challenge for the Ramsey planner is to find a subsidy that balances the benefits of higher output and TFP with the cost of growing inequality. In the model, the addition of the

[35]The Coinvestment Fund (FOCO in Spanish) was established using relief from the NextGen Recovery Fund. This fund provides investment subsidies exclusively to foreign investors for intangible and green investments in Spain. Additionally, private agreements have been directly made with major multinationals, such as Volkswagen to expand R&D production and Cisco to establish a major subsidiary.

Table 11: Changes (in pp.) Under Optimal Intangible Investment Policy $\tau_f^\star$

Wage Skill Premium	Acquisition Rate	Output	TFP
+3.04	+15.31	+2.79	+0.69

	Aggregate	Skilled HH	Unskilled HH
Total Welfare CEV	+1.16	+3.08	+0.19
Consumption CEV_c	+1.35	+3.11	+0.37
Hours CEV_h	-0.19	-0.03	-0.18

Notes: All values are percentage changes under the optimal foreign intangible investment subsidy $\tau_f^\star$ relative to the new steady state from the previous section. The second row are percentage changes in aggregate variables and rates. The final three rows display welfare measured in consumption equivalent variation, where the final two decompose the welfare change resulting from changes in consumption and hours supplied. Aggregate welfare is $CEV = N_s CEV_s + N_u CEV_u$.

subsidy τ_f modifies two equations and introduces an additional policy constraint.

Firm Maximization Problem with τ_f

$$V(a, k_I, k_T, o) = \max_{x'_I, x'_T} \pi - p_I x_I (1 - \tau_f \cdot \mathbb{1}_{o=f}) - p_T x_T + \frac{1-\xi}{1+r} \max \left\{ \mathbb{E}_a \left[\mathcal{V}(a', k'_I, k'_T, o') \right], 0 \right\} \tag{18}$$

Household Budget Constraint of Skill Type i

$$c_i = w_i h_i + \frac{\Pi_d + P_d - T}{N} \tag{19}$$

Policy Budget Balance

$$\tau_f p_I \int x_I(a, k_I, k_T, f) d\lambda(a, k_I, k_T, f) + NT = 0. \tag{20}$$

Equation (18) modifies the incumbent firm's Bellman equation from equation (5) by including the foreign-specific subsidy for intangible investment. Since the investment is subsidized, this increases the expected value of foreign-owned firms, leading to more acquisitions. Households finance the subsidy through an equally distributed lump-sum tax T as shown in equation (19). Equation (20) imposes that the subsidy for foreign intangible investment and the lump-sum tax are budget-neutral, meaning that all subsidized investment is fully paid for by households.

I examine the effects of the policy in the new steady state, where the relative price of intangible investment and labor force skill ratio are set to their average values during 2013-2017. The optimal subsidy rate is the one that maximizes aggregate welfare, which, as shown in Figure 7, displays an inverted U-shape in its relationship with τ_f. As the subsidy rate τ_f increases, skilled workers experience a rise in welfare. In contrast, the welfare of unskilled workers initially shows a slight increase before eventually declining. This decline becomes large enough to offset the welfare gains made by the skilled, thus reducing aggregate welfare at higher subsidy levels. I find that aggregate welfare peaks at an optimal subsidy rate $\tau_f^\star = 0.077$.

Table 11 shows the percentage changes relative to the new steady state under the optimal subsidy rate. The wage skill premium and aggregate output both increase by approximately 3%, while TFP is 0.69% higher. The subsidy also increases the acquisition rate, which rises from 0.378% in the new steady state to 0.436% (an increase of 15.31%). Aggregate welfare improves by 1.16%, indicating that households are overall better off under the optimal subsidy. Similar to the previous section, breaking down welfare by skill type shows that skilled households benefit more, with an increase of 3.08%. However, unlike the previous section, unskilled households also experience a positive welfare gain. Although both skilled and unskilled households work more hours, the resulting increase in consumption for both groups is sufficient to generate a net positive welfare outcome.

7 Conclusion

This paper has studied how foreign ownership affects the wage skill premium through intangible-skill complementarity in production. The results show that foreign ownership contributes to a portion of the increase in the wage skill premium, despite being few in number. While foreign ownership contributes to increased aggregate output and TFP as well, it also has implications for labor inequality and welfare. A possible extension of the model could incorporate investment or hiring frictions, which would further enrich the quantitative results. Another avenue is to explore mechanisms that prompt acquired firms to scale up. In the current quantitative model, a multinational enhances its subsidiary's TFP, leading to a higher average optimal firm size for foreign-owned firms, which implies higher investment and employment levels. A possible extension could involve a multinational parent's ability to enhance its subsidiary's productivity in the production of intangibles. Finally, incorporating a dataset that contains characteristics of foreign acquirers would further strengthen the empirical analysis and enhance the bargaining process in the model. All of the mentioned extensions and additions are currently being pursued.

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Appendix A Model Details

A.1 The Bargaining Problem

Let the foreign multinational f be the bidder and the domestic incumbent d the target. To simplify notation I write the value of the foreign subsidiary as $V_f \equiv V(a, k_I, k_T, f)$ and of the domestic target $V_d \equiv V(a, k_I, k_T, d)$. Let $S(a, k_I, k_T) \geq 0$ and p_d be the total surplus of acquisition and price at which the target is sold.

The bidder's surplus is

$$\Sigma_f(p_d) = V_f - \kappa_{ts} - p_d - \overbrace{V_f^x}^{=0}$$

The value of the target under foreign ownership is V_f. The foreign multinational's outside option V_f^x is no entry into the economy and is normalized to zero.

The target's surplus is

$$\Sigma_d(p_d) = p_d - V_d$$

where V_d is the value of the domestic target.

The total surplus of the acquisition is

$$\begin{aligned} S &= \Sigma_f(p_d) + \Sigma_d(p_d) \\ S &= V_f - V_d - \kappa_{ts} \end{aligned}$$

By assumption the two firms have equal bargaining power and the price, p_d^*, solves the Nash bargaining problem.

$$p_d^* = \arg\max_{p_d \geq 0} \frac{1}{2} \ln\left(\Sigma_f(p_d)\right) + \frac{1}{2} \ln\left(\Sigma_d(p_d)\right)$$

subject to

$$\Sigma_f(p_d) \geq 0 \qquad \text{and} \qquad \Sigma_d(p_d) \geq 0$$

Note that if the price causes either of the surpluses to be negative then the objective function is undefined. Due to the strict concavity of the objective function there exists a unique interior solution p_d^* for a given negotiating pair. Taking the first order condition $\frac{d}{dp_d} = 0$:

$$\begin{aligned} -\frac{1}{2\Sigma_f(p_d)} + \frac{1}{2\Sigma_d(p_d)} &= 0 \\ \Sigma_f(p_d) &= \Sigma_d(p_d) \\ V_f - \kappa_{ts} - p_d &= p_d - V_d \\ V_f - \kappa_{ts} + V_d &= 2p_d \\ V_f - \kappa_{ts} + V_d - V_d &= 2p_d - V_d \\ \underbrace{V_f - V_d - \kappa_{ts}}_{=S} + 2V_d &= 2p_d \end{aligned}$$

The optimal acquisition price is

$$p_d^* = V_d + \frac{S}{2}$$

It follows then

$$\Sigma_f(p_d^*) = \Sigma_d(p_d^*) = \frac{S}{2} > 0$$

A.2 Stationary Equilibrium Formally Defined

To simplify the equilibrium exposition denote the states as $s = (a, k_I, k_T, o)$. Define the compact sets $a \in \mathbf{A} = [\underline{a}, \overline{a}]$, $k_I \in \mathbf{K_I} = [\underline{k}_I, \overline{k}_I]$, $k_T \in \mathbf{K_T} = [\underline{k}_T, \overline{k}_T]$ and the countable set $o \in \mathbf{O} = \{d, f\}$ as all possible values of TFP, intangible capital, tangible capital and ownership type. The state space $\mathbf{S}$ is the Cartesian product $\mathbf{A} \times \mathbf{K_I} \times \mathbf{K_T} \times \mathbf{O}$ and the σ-algebra $\Sigma_\mathbf{S}$ is defined as $\mathbf{B}(\mathbf{A}) \times \mathbf{B}(\mathbf{K_I}) \times \mathbf{B}(\mathbf{K_T}) \times \mathbf{P}(\mathbf{O})$ where $\mathbf{B}(\mathbf{Z})$, $\mathbf{B}(\mathbf{K_I})$ and $\mathbf{B}(\mathbf{K_T})$ are the Borel σ-algebras on $\mathbf{A}$, $\mathbf{K_I}$ and $\mathbf{K_T}$ and $\mathbf{P}(\mathbf{O})$ is the power set of $\mathbf{O}$. The space $(\mathbf{S}, \Sigma_\mathbf{S})$ is a measurable space. Let $\mathcal{S} = (\mathcal{A} \times \mathcal{K_I} \times \mathcal{K_T} \times \mathcal{O})$ be a typical subset of $\Sigma_\mathbf{S}$. For any element of the σ-algebra $\mathcal{S} \in \Sigma_\mathbf{S}$, $\lambda(\mathcal{S})$ is an invariant probability measure of firms in set $\mathcal{S}$.

Law of Motion Firms transit across states over time through a transition function; Q : $\mathbf{S} \times \Sigma_\mathbf{S} \longrightarrow [0, 1]$ and

$$Q(s, \mathcal{S}) = (1 - \xi)\,[1 - \chi(s)] \int_{a' \in \mathcal{A}} \mathbb{1}_{k_I'(s) \in \mathcal{K_I}} \mathbb{1}_{k_T'(s) \in \mathcal{K_T}} \, d\Gamma(a'|a). \tag{A.1}$$

where $\mathbb{1}_{\{.\}}$ is an indicator function and $k_I'(s)$ and $k_T'(s)$ are the policy functions for intangible and tangible capital levels in the next period. As previously defined, ξ is an exogenous exit shock and $\chi(s)$ is the exit policy function. The conditional distribution a is $\Gamma(a'|a)$.

To distinguish between ownership states o I denote the state vectors for domestic and foreign ownership as $s_d = (a, k_I, k_T, d)$ and $s_f = (a, k_I, k_T, f)$. Abusing notation I denote the measures conditional on ownership as $\lambda(s_d) = \lambda(a, k_I, k_T \mid o = d)$ and $\lambda(s_f) = \lambda(a, k_I, k_T \mid o = d)$. Each period there are domestic firms that change ownership states (ie leaving $\lambda(s_d)$ and joining $\lambda(s_f)$). The measure of firms λ consists of three components which are defined as follows

Matched Domestic Owned Firms

$$P_M(s_d) \equiv \mu \int_\mathbf{S} \left[\mathbb{1}_{\{S(s_d)>0\}} + (1 - \mathbb{1}_{\{S(s_d)>0\}})\right] Q(s_d, \mathcal{S}) d\lambda(s_d) \tag{A.2}$$

Unmatched Domestic Owned Firms

$$P_U(s_d) \equiv (1 - \mu) \int_\mathbf{S} Q(s_d, \mathcal{S}) d\lambda(s_d) \tag{A.3}$$

Foreign Owned Firms

$$P_F(s_f) \equiv \int_\mathbf{S} Q(s_f, \mathcal{S}) d\lambda(s_f). \tag{A.4}$$

Matched domestic owned firms in equation (A.2) is the measure of domestic firms that meet a foreign multinational entrant with probability μ. The first term are firms that get acquired and transit to the $\lambda(s_f)$ in the same period. The second term are matched firms that do not reach an agreement and remain in the measure $\lambda(s_d)$. Unmatched domestic firms in equation (A.3) do not meet a foreign multinational entrant and remain under domestic ownership. Finally, the measure of foreign owned firms in equation (A.4) consists of firms that were acquired in the past and have not exited.

For all $(\mathcal{A} \times \mathcal{K}_{\mathcal{I}} \times \mathcal{K}_{\mathcal{T}} \times \mathcal{O}) \in \Sigma_{\mathbf{S}}$ the invariant measure of firms λ satisfies the law of motion

$$\lambda(\mathcal{A} \times \mathcal{K}_{\mathcal{I}} \times \mathcal{K}_{\mathcal{T}} \times \mathcal{O}) = [P_M(s_d) + P_U(s_d) + P_F(s_f)] + M \int_{a' \in \mathcal{A}} dG(a'). \tag{A.5}$$

The firm term in brackets accounts for transiting incumbent firms that choose to continue operating. These incumbents may exit or operate at different states in the following period. The second term is the mass of entrants that enter in the next period and draw their initial TFP level from CDF $G(a')$, which is the stationary distribution of a.

SRCE Definition A stationary recursive competitive equilibrium (SRCE) consists of prices (w_s, w_u), an invariant measure of firms λ, a constant mass of potential entrants M, a value function for incumbent firm $V(s)$, a value function for the entrant firm V_e, policy functions for the incumbent firm $l_s(s)$, $l_u(s)$, $k'_I(s)$, $k'_T(s)$, $\chi(s)$, and for the entrant firm $k'_{I,e}$, $k'_{T,e}$ such that

1. Given prices, the policy functions $l_s(s)$, $l_u(s)$, $k'_I(s)$, $k'_T(s)$, $\chi(s)$ solve the incumbent firm's problem in equation (5) with the associated value function $V(s)$. The policy functions $k'_{I,e}$ and $k'_{T,e}$ solve the entrant firm's problem with the associated function V^e in equation (6).
2. Given prices, households of type $i \in \{s, u\}$ with mass N_i maximize utility in equation (12) subject to the budget constraint in equation (13). Aggregate labor supplied is $L_i = N_i h_i$.
3. Matched domestic firms transfer ownership only if the total acquisition surplus in equation (7) is strictly positive. The aggregate sale price is $P_d = \mu \int \mathbb{1}_{\{S(s_d)>0\}} p(s_d) d\lambda(s_d)$.
4. Markets clear
   (a) Skilled labor: $L_s = \int_{\mathbf{S}} l_s(s) d\lambda(s)$
   (b) Unskilled labor: $L_u = \int_{\mathbf{S}} l_u(s) d\lambda(s)$
   (c) Goods:[36] $C + X_I + X_T + \kappa_e M = \int_{\mathbf{S}} (\mathcal{F}(z, k_I, k_T, l_s(s), l_u(s)) - \kappa_{op}) d\lambda(s) + P_d - \Pi_f$
5. The invariant measure of firms λ satisfies equation (A.5).
6. The free entry condition is satisfied: $V_e = 0$.

[36] where
i. Aggregate profits by ownership type $o \in \{d, f\}$ are $\Pi_o = \int_{\mathbf{S}} \pi_o(s) d\lambda(s)$ and foreign dividends Π_f flow out the economy.
ii. Investment for capital type $j \in \{I, T\}$ is $X_j = p_j \int_{\mathbf{S}} (k'_j(s) - (1 - \delta_j) k_j) d\lambda(s)$.

A.3 Decomposition of Steady State Changes

This subsection explains how output Y, TFP Z and the wage skill premium are decomposed by ownership type. Starting with the decomposition of output, let aggregate output be $Y = Y_d + Y_f$ where the subscript denotes ownership type. The change between steady states is

$$g_y = \frac{Y_{\text{new}} - Y_{\text{initial}}}{Y_{\text{initial}}} \qquad g_{y,d} = \frac{Y_{d,\text{new}} - Y_{d,\text{initial}}}{Y_{\text{initial}}} \qquad g_{y,f} = \frac{Y_{f,\text{new}} - Y_{f\text{initial}}}{Y_{\text{initial}}} \tag{A.6}$$

where g_y is the aggregate change, while $g_{y,d}$ and $g_{y,f}$ are changes in output by domestic and foreign firms. Note that the denominator Y_{initial} is the same for all. It follows that $g_y = g_{y,d} + g_{y,f}$. Aggregate TFP Z is decomposed the same way.

Wage Skill Premium The decomposition of the wage skill premium is a bit more involved given that all firms pay the same each to each skill type i. I approximate the contribution by ownership to the change in the wage skill premium by log-linearizing the ratio of marginal products of labor. As firms are perfectly competitive, the wage skill premium is equal to the ratio of the marginal products of labor by skill type. The skill premium is as follows where aggregate variables can be separated by ownership type

$$\begin{aligned}
\omega &= \frac{MPL_s}{MPL_u} \\
\omega &= \frac{\varsigma\varrho}{(1-\varsigma)} \left[(1-\varrho)\left(\frac{K_I}{L_s}\right)^{\rho} + \varrho\right]^{\frac{\sigma-\rho}{\rho}} \left(\frac{L_u}{L_s}\right)^{1-\sigma} \\
\omega &= \frac{\varsigma\varrho}{(1-\varsigma)} \left[(1-\varrho)\left(\frac{\sum_{o\in\{d,f\}} K_{I,o}}{\sum_{o\in\{d,f\}} L_{s,o}}\right)^{\rho} + \varrho\right]^{\frac{\sigma-\rho}{\rho}} \left(\frac{\sum_{o\in\{d,f\}} L_{u,o}}{\sum_{o\in\{d,f\}} L_{s,o}}\right)^{1-\sigma}.
\end{aligned} \tag{A.7}$$

Log-linearizing this expression around the initial steady state approximates the between steady state change in wage skill premium

$$g_\omega \approx \underbrace{(\sigma-\rho) \sum_{o\in\{d,f\}} \Xi_o \left(g_{K_{I,o}} - g_{L_{s,o}}\right)}_{\text{Intangible-Skill Complementarity Effect}} + \underbrace{(1-\sigma) \sum_{o\in\{d,f\}} \left(g_{L_{u,o}} - g_{L_{s,o}}\right)}_{\text{Relative Quantity Effect}} \tag{A.8}$$

where

$$\Xi = \frac{(1-\varrho)\left(\frac{K_{I,o,\text{initial}}}{L_{s,o,\text{initial}}}\right)^{\rho}}{(1-\varrho)\left(\frac{K_{I,o,\text{initial}}}{L_{s,o,\text{initial}}}\right)^{\rho} + \varrho}.$$

Equation (A.8) consists of two additive terms that affect g_ω differently. The first term is the intangible-skill complementarity effect which is present when $\sigma - \rho > 0$. A larger increase in the aggregate intangible stock relative to skilled labor ($g_{K_I} > g_{L_s}$) increases the wage skill premium. The second component, the relative quantity effect, shows that relatively faster growth in skilled labor supply ($g_{L_u} < g_{L_s}$) reduces the skill premium.

Table A.1 displays the approximate wage skill premium change between the initial and new steady states broken down by ownership and the two effects. The second row shows the change in the wage skill premium. The approximate change is 3.7%, which coincides with the percentage point increase of the wage skill premium in Table 8. The final two columns decompose growth by ownership with foreign ownership accounting for approximately 24% (0.9/3.7). Domestic ownership contributes more to the change in the wage skill premium because its overall distributional mass is larger relative to foreign ownership. However, foreign ownership's impact on wages is particularly remarkable, despite the small number of foreign-owned firms. This is due to their significant scale, which magnifies their influence in the aggregate.

Table A.1: Decomposition of Wage Skill Premium Change (in pp.)

	Total g_ω	Domestic $g_{\omega,d}$	Foreign $g_{\omega,f}$
Wage Skill Premium Change	+3.7	+2.8	+0.9
Intangible-Skill Complementarity Effect	+4.5	+3.1	+1.4
Relative Quantity Effect	-0.8	-0.3	-0.5

Notes: The table displays the decomposition of the approximated wage skill premium change between the initial (2002-2006) and new (2013-2017) steady states. The second column is the approximated total change. The third and fourth columns are growth by ownership type and when added together equal the total change. The final two rows displays the two additive terms in equation A.8.

The final two rows present the two effects. The intangible-skill complementarity effect is larger for domestic firms. This is because its increase in skilled labor $g_{L_{s,d}}$ is relatively lower than that from foreign $g_{L_{s,f}}$. While the supply of skilled labor increased, both in terms of hours and overall number of workers, it is higher for foreign-owned firms as more labor (of both types) is reallocated to them due to increased acquisitions ($g_{L_{s,d}} < g_{L_{s,f}}$). Consequently, this weighs down the intangible-skill complementarity effect for foreign-owned firms. The relative quantity effect embodies the change on the extensive margin of skill (more skilled workers relative to unskilled) and the intensive margin of hours supplied. This effect is ultimately weaker than the intangible-skill effect. In terms of ownership, the effect experiences a smaller decrease of 0.3 for domestic firms while the decrease is greater for foreign ones at 0.5. The difference is again due to the larger amount of skilled workers reallocated to foreign firms ($g_{L_{s,d}} < g_{L_{s,f}}$).

Appendix B Firm-Level Data

The firm-level data used in the paper is from the Survey on Business Strategies (ESEE in Spanish). It is a representative survey of Spanish manufacturing firms with 10 or more employees. Section 2.3 provides a description of the survey. Section B.1 contains variable definitions and Section B.2 explains how firm-level TFP is estimated. Summary statistics are in Table E.1.

B.1 ESEE Variable Definitions

This subsection describes the variables from the ESEE used in the paper. Unless stated otherwise, all variables are deflated by the manufacturing sector gross output price index with base year 2015 provided by INE.

- **Sales**. The sales of goods, the sales of transformed products (finished and half-finished), the provision of services and other sales (packages, packaging, byproducts and waste).
- **Value Added**. The sum of sales, the variation in stocks and other management income, minus intermediates.
- **Employment**. Number of personnel.
- **Wage Bill**. All gross salaries and wages, compensations, social security contributions paid by the company, the contributions made to supplementary pension systems and other social expenses.
- **Skilled and Unskilled Employment**. Skilled employment is the number of personnel with a tertiary education or higher. Unskilled employment is personal without a tertiary education.
- **Labor Hours**. Total effective hours worked. Determined by multiplying number of personal by effective hours worked per employee. Hours effectively worked during the year per worker is equal to the sum of the normal work time and overtime minus the non-worked hours.
- **Intermediate Expenditures**. The sum of purchases of intermediate goods (raw materials, components, energy) and external services, minus the variation in the stock of purchases.
- **Tangible Fixed Assets**. The gross value of property, plant and equipment (PP&E). This includes, land, buildings, technical facilities, machinery, tools, other facilities, furniture, information processing equipment and rolling stock. This variable is deflated by the manufacturing capital goods price index with base year 2015 provided by INE.
- **Intangible Fixed Assets**. The gross value of identifiable non-monetary asset without physical substance. According to the International Financial Reporting Standards Foundation (whose standards Spain follows), such an asset is identifiable when it is separable, or when it arises from contractual or other legal rights. Separable assets can be sold, transferred, licensed, etc. Examples of intangible assets include computer software, licenses, trademarks, patents, films, copyrights and import quotas. Goodwill acquired in a business combination is also accounted. Development expenditure that meets specified criteria is recognized as the cost of an intangible asset. This variable is deflated by the manufacturing capital goods price index with base year 2015 provided by INE.
- **Total R&D**. Total research and development expenditures that include the cost of intramural R&D activities that occurs on site (in-house R&D) and extramural activities, ie payments to outside R&D laboratories and research centers.

- **Tangible Investment**. The net difference between the purchase and sale of tangible fixed assets or property, plant and equipment (PP&E). These assets are defined as acquisitions of lands and natural goods, buildings, equipment for information processing, technical facilities, machinery and tools, rolling stock and furniture, office equipment. This variable is deflated by the manufacturing capital goods price index with base year 2015 provided by INE.

- **Patent Stock**. The ESEE records registered patents registered annually. In cases of foreign ownership the patent is registered with the foreign subsidiary. A patent can either be registered internationally (EU or US) and those registered with the national Spanish patent office. Most patents are registered with the former. I construct a patent stock by calculating the cumulative sum of all registered patents through time for each firm.

- **Exports**. Value in euros.

B.2 Firm-Level TFP Estimation

This appendix section describes how TFP reported in the empirical Section 2 is estimated. Let f denote a firm and t denote time. I follow the foreign ownership literature and assume that that the production function is Cobb-Douglas. Assuming a translog production function generates similar results. To estimate firm-level production functions, one needs to control for the simultaneity and selection bias, which is inherently present. I follow the procedure developed by Ackerberg et al. (2015) who rely on an observable proxy variable being a function of the unobserved productivity level (aka control function approach) paired with a law of motion for productivity. This method builds on standard control function methods by taking into account the fact that the variable factor of production adjusts in response to a productivity shock, whereas the fixed factor does not react to contemporaneous shocks to productivity, but it is correlated with the persistent productivity term. The observable proxy variable that I use expenditures on materials. The production function in logs is

$$y_{it} = \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \epsilon_{it}$$

where y_{it} is real value added, l_{it} is labor hours, k_{it} is the book value of tangible fixed assets and TFP is ω_{it}. The term ϵ_{it} is the measurement error an i.i.d. unanticipated shock to production. Firms do not observe ϵ_{it} when making optimal input decisions. Value added is deflated by an industry-specific price index. I estimate productivity over time using a rolling window of 10 years. Production functions are estimated by sector and year and the TFP distribution is winsorized at the 1st and 99th percentiles. As an extension I estimate TFP where the labor input l_{it} is the wage bill and also where value added is deflated by a firm-specific price index.[37] The results can

[37] Firms are asked to report average transaction price changes introduced from the previous to the reporting year in percentage points in up to five markets in which the firm operates. Most firms report 2-3 markets. The ESEE computes a global percentage change of prices of firm f across markets for each year using a Paasche type formula (current quantities, changing prices)

$$\%\text{price variation}_{ft} = \left(\frac{1}{\sum_k \frac{WEIGHT_{ftm}}{100+\%\text{ price variation }_{ftm}}} - 1 \right) \times 100$$

be found in Table E.6 are very similar. The two-step estimation is as follows

Stage One

- Get expected output

$$y_{it} = \phi_t(l_{it}, k_{it}, m_{it}) + \epsilon_{it}$$
$$y_{it} = \underbrace{\beta_l l_{it} + \beta_k k_{it} + h_{it}(m_{it}, k_{it}, l_{it})}_{=\phi_t} + \epsilon_{it}$$

- Run OLS y_{it} on a higher-order polynomial in (l_{it}, k_{it}, m_{it}) to obtain $\widehat{\phi}(l_{it}, k_{it}, m_{it})$.
- We now have expected output $\widehat{\phi}_{it}$ where ϵ_{it} is netted out.

Stage Two

- Estimate the coefficients β_l and β_k using a standard GMM techniques. Use block bootstrapping to get the standard errors.
- Guess the coefficients β_l and β_k. Get productivity:

$$\omega_{it}(\beta_k, \beta_l) = \widehat{\phi}_{it} - \beta_k k_{it} - \beta_l l_{it}$$

- Non-parametrically regress and take the innovations $\xi_{it}(\beta_k, \beta_l)$

$$\omega_{it}(\beta_k, \beta_l) = \overbrace{\omega_{it-1}(\beta_k, \beta_l) + \omega_{it-1}^2(\beta_k, \beta_l) + \omega_{it-1}^3(\beta_k, \beta_l)}^{\mathbb{E}(\omega_{it}(\beta_k,\beta_l)|\omega_{it-1}(\beta_k,\beta_l))} + \xi_{it}(\beta_k, \beta_l)$$

- There are two parameters and two moment conditions. Check if conditions are satisfied.

$$\mathbb{E}\left(\xi_{it}(\beta_k, \beta_l)\begin{pmatrix} l_{it-1} \\ k_{it} \end{pmatrix}\right) = 0$$
$$T^{-1}N^{-1}\sum_t \sum_i \left(\xi_{it}(\beta_k, \beta_l)\begin{pmatrix} l_{it-1} \\ k_{it} \end{pmatrix}\right) = 0$$

where m is the market and $WEIGHT_{ftm}$ is the share of sales of market m in total sales of firm f at time t. More precisely the variable $WEIGHT_{ftm}$ is the percentage which sales in market m represent on sales of all the markets identified and covered by the company. I compute recursively a price index for each firm f using $\%price\ variation_{ft}$:

$$p_{ft} = p_{ft-1}\left(1 + \frac{\%price\ variation_{ft}}{100}\right).$$

When t is the first year that firm f is observed I set p_{ft} equal to industry-specific price index of that year. Alternatively, if period t is the first time a firm is observed I could set p_{ft} equal to 1, calculate the price index over time and then normalize p_{ft} by the average value for each firm. Both methods produce similar indices.

Appendix C Data Series From EUKLEMS-INTANProd

This section describes how both the wage skill premium (Section C.1) and the income shares are calculated (Section C.2). Furthermore, it explains how the elasticities of the production functions from the model are estimated at the sector level (Section C.3). All three sections use data for Spain from EUKLEMS-INTANProd Database.[38]

C.1 Wage Skill Premium

To calculate the wage skill premium I use data from the labor accounts of EUKLEMS-INTANProd which provide the share of hours worked and share of labor compensation by three skill groups at the the 2-digit sector level. The skill groups are low skill (lower secondary education or lower), medium skill (upper secondary education and post-secondary non-tertiary) and high skill (tertiary degree).[39] I define skilled workers (denoted with subscript s) as those with tertiary education and I combine the low and medium skill groups to form unskilled workers which I denote with subscript u.

Denoting that share of labor compensation that goes to skilled workers as $\mathfrak{W}_t$ and share of hours worked by skilled workers as $\mathfrak{L}_t$, labor compensation and hours worked by skill type is

$$\text{Skilled Compensation} = \mathfrak{W}_t w_t L_t = w_{s,t} L_{s,t} \qquad \text{Skilled Hours} = \mathfrak{L}_t L_t = L_{s,t} \tag{C.1}$$

$$\text{Unskilled Compensation} = (1-\mathfrak{W}_t) w_t L_t = w_{u,t} L_{u,t} \quad \text{Unskilled Hours} = (1-\mathfrak{L}_t) L_t = L_{u,t} \tag{C.2}$$

The skill premium is then calculated by dividing the ratios of labor compensation to hours worked for skilled and unskilled workers

$$\text{Wage Skill Premium} = \frac{\text{skilled workers' wage}}{\text{unskilled workers' wage}} = \frac{\frac{w_{s,t}L_{s,t}}{L_{s,t}}}{\frac{w_{u,t}L_{u,t}}{L_{u,t}}} = \frac{w_{s,t}}{w_{u,t}} = \omega_t. \tag{C.3}$$

C.2 Income Shares

This section describes how the labor income share by skill type and the capital income share by capital type are calculated. The income share is the proportion of gross value added Y_t, which is the sum of labor and capital income.

C.2.1 Labor Share

I define the labor income share in year t as labor compensation $w_t L_t$ divided by gross value added Y_t

$$\text{Labor Share} = \frac{w_t L_t}{Y_t}. \tag{C.4}$$

[38] 2023 release. See description in 2.1. Further information https://euklems-intanprod-llee.luiss.it/

[39] KLEMS aggregates education levels according to the International Standard Classification of Education (IECED). Low skill: IECED 0-2. Medium Skill IECED 3-4. High Skill IECED 5-8.

As defined in the previous subsection, $\mathfrak{W}_t$ is the share of labor compensation that goes to skilled types. The labor share by skill type is

$$\text{Skilled Labor Share} = \frac{\mathfrak{W}_t w_t L_t}{Y_t} = \frac{w_{s,t} L_{s,t}}{Y_t} \tag{C.5}$$

$$\text{Unskilled Labor Share} = \frac{(1 - \mathfrak{W}_t) w_t L_t}{Y_t} = \frac{w_{u,t} L_{u,t}}{Y_t} \tag{C.6}$$

and $w_t L_t = w_{s,t} L_{s,t} + w_{u,t} L_{u,t}$.

C.2.2 Capital Share

The capital income share is the ratio of tangible and intangible investment to gross value added

$$\frac{R_{T,t} X_{T,t} + R_{I,t} X_{I,t}}{Y} = 1 - \frac{w_t L_t}{Y_t}. \tag{C.7}$$

As is commonly assumed in national accounting, all rents generated by intangibles goes to capital income. Investment of each capital type is gross fixed capital formation (GFCF) and is defined as resident producers' expenditures on new or acquisitions of existing fixed assets minus disposals. Tangible investment $X_{T,t}$ includes equipment, buildings and structures. It does not include land. Intangible investment $X_{I,t}$ includes R&D, software, artistic originals, design, brand, organizational capital and training.

To determine capital income, it is necessary to estimate the gross rate of return for each type of capital. I assume that the gross return R_j for capital type $j = \{T, I\}$ satisfies the no-arbitrage condition

$$R_{j,t} = (1 + r_t) p_{j,t-1} + (1 - \delta_{j,t}) p_{j,t} \tag{C.8}$$

where r_t is the net rate of return, $p_{j,t}$ is the price of capital j relative to final goods, and $\delta_{t,j}$ is the depreciation rate for capital type j. I calculate $p_{j,t}$ using the capital type j price index relative the price index for final output goods. I compute the depreciation rate using the net capital stock and investment

$$\delta_{j,t} = \frac{K_{j,t-1}\left(\frac{p_{j,t}}{p_{j,t-1}}\right) - K_{j,t} + X_{j,t}}{K_{j,t-1}\left(\frac{p_{j,t}}{p_{j,t-1}}\right)} \tag{C.9}$$

where $K_{j,t}$ is the nominal net capital stock for type j and is constructed by EUKLEMS-INTANProd.

The only unknown in equation (C.8) is the net return r_t where all other series $w_t L_t$, Y_t, $X_{j,t}$, $K_{j,t}$, $\delta_{j,t}$ and $p_{j,t}$ are taken from the data. Once r_t is found, so is $R_{j,t}$. I back out r_t from the rearranged equation (C.7)

$$\frac{w_t L_t}{Y_t} = 1 - \frac{R_{T,t}(p_{T,t}, \delta_{T,t}, r_t) X_{T,t} + R_{I,t}(p_{I,t}, \delta_{I,t}, r_t) X_{I,t}}{Y_t}. \tag{C.10}$$

Note that by calculating the capital income share I did not need to impose any functional form on the production function.

Figures 1 and D.4-D.5 display the shares of investment and labor compensation. That is, the intangible share (green lines) is $\frac{R_{I,t}X_{I,t}}{R_{T,t}X_{T,t}+R_{I,t}X_{I,t}}$ and tangible (red lines) $\frac{R_{T,t}X_{T,t}}{R_{T,t}X_{T,t}+R_{I,t}X_{I,t}}$. Similarly, the skilled share of labor compensation (yellow lines) is $\frac{w_{s,t}L_{s,t}}{w_{s,t}L_{s,t}+w_{u,t}L_{u,t}}$ and unskilled share (purple lines) is $\frac{w_{u,t}L_{u,t}}{w_{s,t}L_{s,t}+w_{u,t}L_{u,t}}$.

C.3 Sector Level Production Function Estimation

As described in the main text, I am unable to credibly identify the production function elasticity parameters (σ, ρ) at the firm-level due to data limitations. However, given the assumptions in the model the elasticities can be estimated at the sector or aggregate level. Similar to the firm level production function from equation (1) in the model, the sector level production function with intangible-skill complementary is

$$Y_t = Z_t K_{T,t}^{\alpha} \left[(1-\varsigma)\, L_{u,t}^{\sigma} + \varsigma \left(\varrho L_{s,t}^{\rho} + (1-\varrho) K_{I,t}^{\rho} \right)^{\frac{\sigma}{\rho}} \right]^{\frac{(1-\alpha)\nu}{\sigma}} \tag{C.11}$$

where $K_{j,t}$ is the nominal net capital stock for type $j = \{T, I\}$, which is constructed by EUKLEMS-INTANProd and $L_{i,t}$ are labor hours by skill type $i = \{s, u\}$, gross value added is Y_t and Z_t is total factor productivity. The production function in real terms is

$$\widetilde{Y}_t = \widetilde{Z}_t \widetilde{K}_{T,t}^{\alpha} \left[(1-\varsigma)\, L_{u,t}^{\sigma} + \varsigma \left(\varrho L_{s,t}^{\rho} + (1-\varrho) \widetilde{K}_{I,t}^{\rho} \right)^{\frac{\sigma}{\rho}} \right]^{\frac{(1-\alpha)\nu}{\sigma}} \tag{C.12}$$

where output $\widetilde{Y}_t$ is deflated by the final output goods index and both j types of capital $\widetilde{K}_{j,t}$ are deflated by their respective capital price indices.

I first estimate the elasticity of substitution between intangible capital and skilled labor using the ratio of the first order conditions of $K_{I,t}$ and $L_{s,t}$

$$\ln\left(\frac{\widetilde{R_{I,t}K_{I,t}}}{\widetilde{w_{s,t}L_{s,t}}}\right) = \ln\left(\frac{1-\varrho}{\varrho}\right) + \rho \ln\left(\frac{\widetilde{K}_{I,t}}{L_{s,t}}\right) \tag{C.13}$$

where the gross return $R_{I,t}$ is found in the previous section. Real skilled labor compensation $\widetilde{w_{s,t}L_{s,t}}$ is deflated by the final output good index. Running OLS returns an estimate for ρ and the elasticity of substitution between intangible capital and skilled labor is $1/(1-\rho)$.

I proceed to the elasticity of substitution between unskilled labor and skilled labor. To do so, I rewrite the production function

$$\widetilde{Z}_t \widetilde{K}_{T,t}^{\alpha} \left[(1-\varsigma)\, L_{u,t}^{\sigma} + \varsigma\, (b_t L_{s,t})^{\sigma} \right]^{\frac{\nu(1-\alpha)}{\sigma}} \qquad \text{where } b_t = \varrho \left(\left(\frac{(1-\varrho)\widetilde{K}_{I,t}}{\varrho L_{s,t}} \right)^{\rho} + 1 \right)^{\frac{1}{\rho}} \tag{C.14}$$

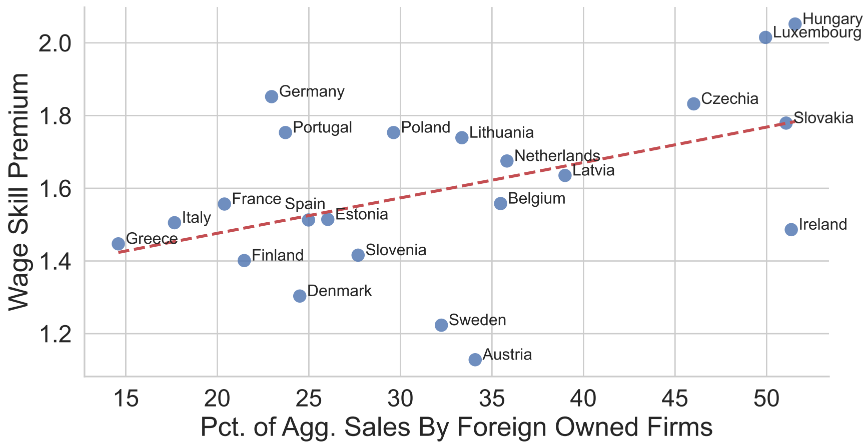
Plugging in the estimate ρ into b, I can estimate the elasticity of substitution between unskilled and skilled labor using the first order conditions

$$\ln\left(\frac{\widetilde{R_{I,t}K_{I,t}} + \widetilde{w_{s,t}L_{s,t}}}{\widetilde{w_{u,t}L_{u,t}}}\right) = \ln\left(\frac{\varsigma}{1-\varsigma}\right) + \sigma\ln\left(\frac{b_t L_{s,t}}{L_{u,t}}\right) \tag{C.15}$$

where $R_{T,t}$ is found in the previous section and $\widetilde{w_{u,t}L_{u,t}}$ is unskilled labor compensation deflated by the final output goods index. Running OLS returns an estimate for σ and the elasticity of substitution between unskilled and skilled labor is $1/(1-\sigma)$.

Appendix D Additional Figures

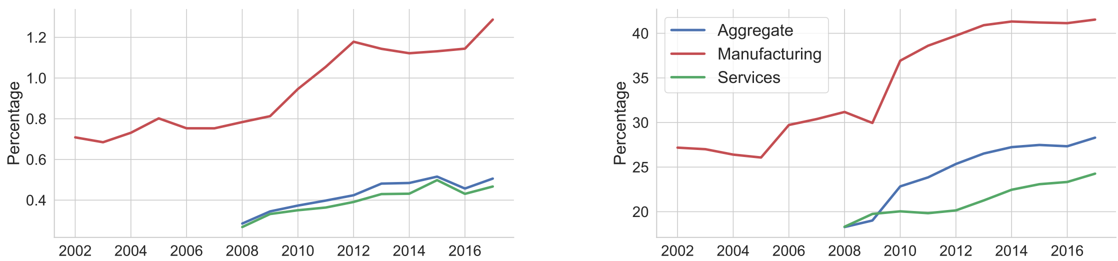
Figure D.1: Wage Skill Premium and Foreign Ownership in the EU (Avg. 2008-2019)



Notes: Click here to go back to introduction. The scatterplot displays the wage skill premium and share of aggregate sales revenue by foreign subsidies averaged between 2008 and 2019. The countries of Bulgaria, Cyprus, Malta and Romania do not report foreign ownership. Croatia does not appear as it joined the EU in 2013. A similar slope coefficient is found for the growth rates during this time.
Source: Author's calculations using EUKLEMS-INTANProd and OECD AMNE and SDBS Databases.

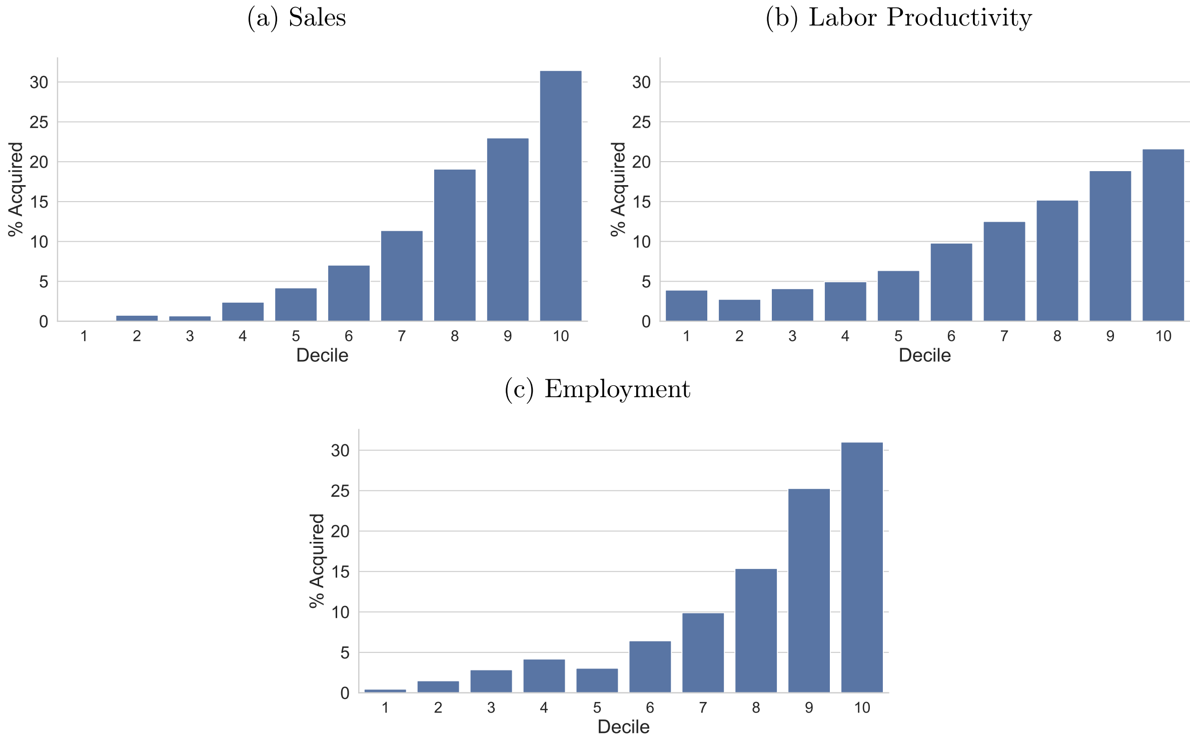
Figure D.2: Foreign Ownership in Spain

(a) % of Foreign Owned Firms (b) % of Total Sales By Foreign Owned Firms



Notes: A firm is considered to be foreign owned if it is a subsidiary or at least 50% or more of its capital is owned by a foreign entity. Both figures depict time series at the aggregate, manufacturing (ISIC Rev. sector code C) and business services (ISIC Rev. 4 sector codes $G - N$) levels. Data collection for the aggregate and all sectors starts in 2008, except for manufacturing. The left figure is the series of the percentage of foreign owned firms. Figure D.7 in Appendix D shows how the number of both domestic and foreign firms changed over time. By 2017 the total number of foreign subsidiaries in Spain was about 13,300. Among them, the majority are found in the business services sectors (9,700) and manufacturing (2,100). The right figure displays the percentage of aggregate sales revenue that is done by foreign owned firms.
Source: Author's calculations using OECD AMNE and SDBS Databases.

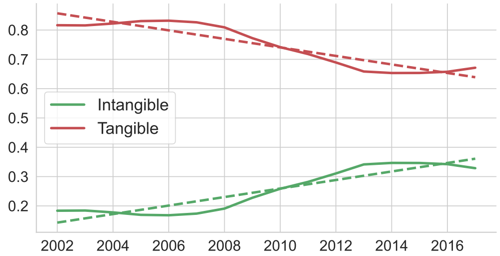
Figure D.3: Marginal Distributions of Acquired Firms (Prior to Acquisition)



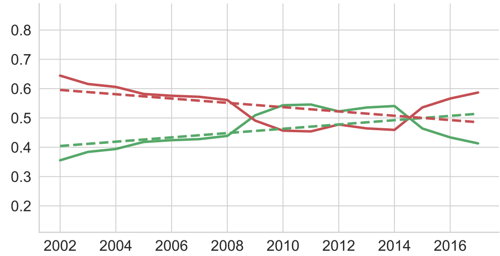
Notes: Author's calculations using ESEE. Figure displays the proportion of acquired firms that fall into each decile of its respective distribution: real sales, real value added (real value added over employment) and employment. Distributions exclude observations of firms under foreign ownership. I calculate the deciles of each distribution measured across all firms in each sector and year and count the proportion of acquired firms into each decile. The purpose of the figure is to emphasize the presence of positive selection in acquisition. If acquired firms were randomly selected then they would be distributed according to the population of firms (in their sector) and 10% of acquired firms would fall into each decile. This is clearly not the case as more than half of target firms at the time of acquisition are above the 70th percentile in their respective distributions suggesting foreign multinationals "cherry-pick" the best domestic firms.

Figure D.4: Share of Capital Investment in Spain

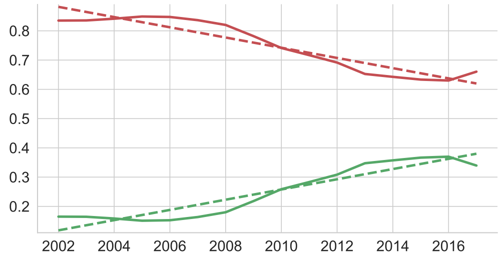
(a) Aggregate



(b) Manufacturing



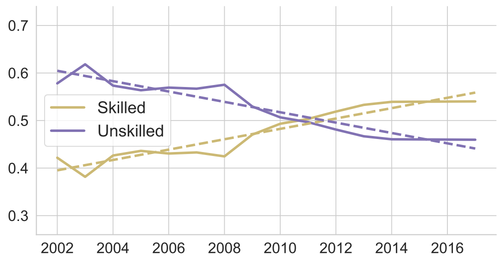
(c) Services



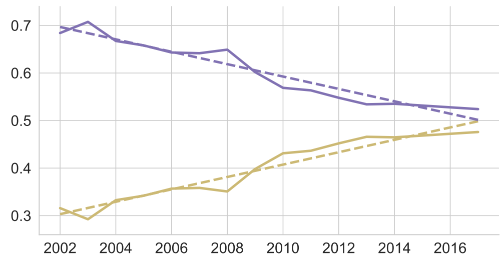
Notes: The figure displays the series of the investment share by capital type in Spain between 2002 to 2017. Intangible investment is expenditures of R&D, software, artistic originals, design, brand, organizational capital and training. Tangible investment is expenditures on traditional forms of physical capital: equipment, non-residential buildings and structures. Subfigure (a) is the aggregate share. Subfigure (b) contains the shares for manufacturing (ISIC Rev. 4 sector C). Subfigure (c) contains the share for business services (ISIC Rev. 4 sectors G-N). Details regarding how the shares are calculated are in Appendix C.2.
Source: Author's calculations using EUKLEMS-INTANProd database.

Figure D.5: Skill and Unskill Labor Share in Spain

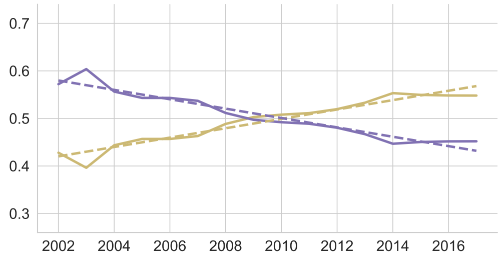
(a) Aggregate



(b) Manufacturing



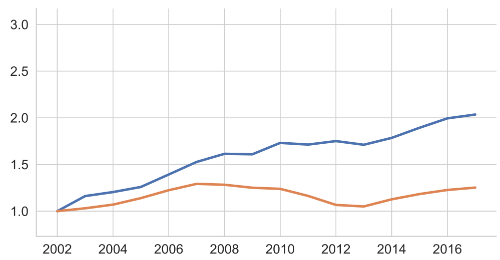
(c) Services



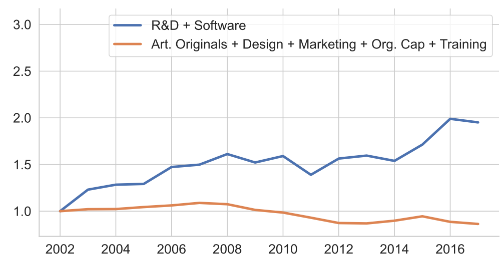
Notes: The figure displays the series of the labor compensation share in Spain by skill type between 2002 to 2017. The skilled share is the share of total labor compensation paid to workers with a tertiary degree or higher and unskilled are those with no tertiary degree. Subfigure (a) is the aggregate share. Subfigure (b) contains the shares for manufacturing (ISIC Rev. 4 sector C). Subfigure (c) contains the shares for business services (ISIC Rev. 4 sectors G-N). Details regarding how the shares are calculated are in Appendix C.2.
Source: Author's calculations using EUKLEMS-INTANProd database.

Figure D.6: Growth of Intangible Investment In Spain

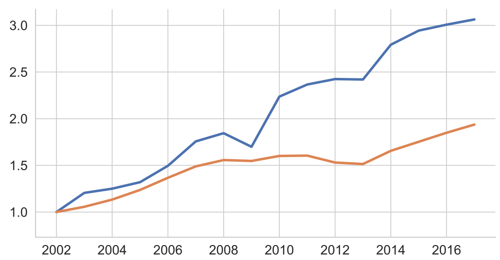
(a) Aggregate



(b) Manufacturing



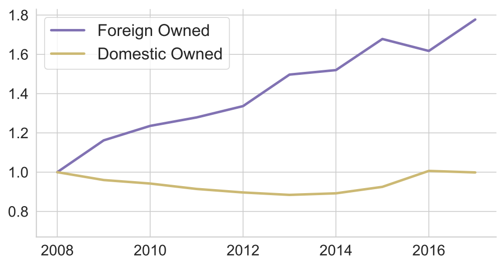
(c) Services



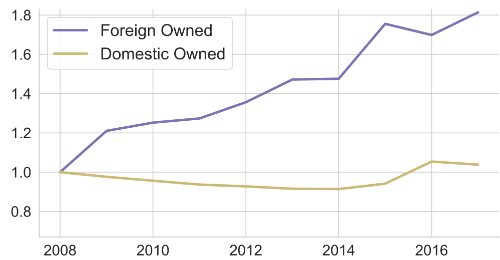
Notes: Intangible investment is expenditures of R&D, software, artistic originals, design, brand, organizational capital and training. This figures shows that much of the change in the intangible share of investment comes from R&D and software. The figures depict the investment levels normalized to 2002. Subfigure (a) is the aggregate. Subfigure (b) is manufacturing (ISIC Rev. 4 sector C). Subfigure (c) is business services (ISIC Rev. 4 sectors G-N).
Source: Author's calculations using EUKLEMS-INTANProd database.

Figure D.7: Nbr. of Firms By Ownership Relative To Reference Year

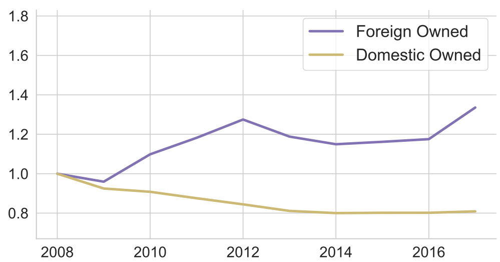
(a) Aggregate (Relative to 2008)



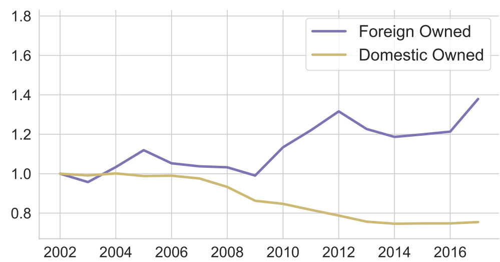
(b) Services (Relative to 2008)



(c) Manufacturing (Relative to 2008)

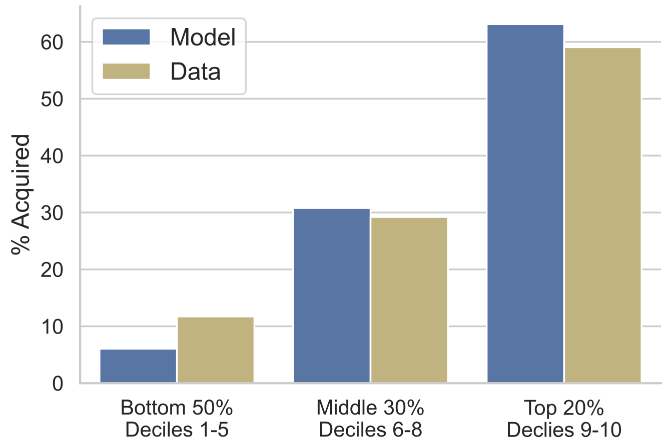


(d) Manufacturing (Relative to 2002)



Notes: Figure is the relative number of firms classified by ownership relative to a reference year (2008 in subfigures (a)-(c) and 2002 in (d)). The purple line depicts foreign subsidiaries while the yellow is domestically owned firms. A firm is foreign owned if it is a subsidiary or at least 50% or more of its capital is owned by a foreign entity. Both figures depict time series at the aggregate, manufacturing (ISIC Rev. sector code C) and business services (ISIC Rev. 4 sector codes $G - N$) levels. Data collection for the aggregate and all sectors starts in 2008, except for manufacturing.
Source: Author's calculations using OECD AMNE and SDBS Databases.

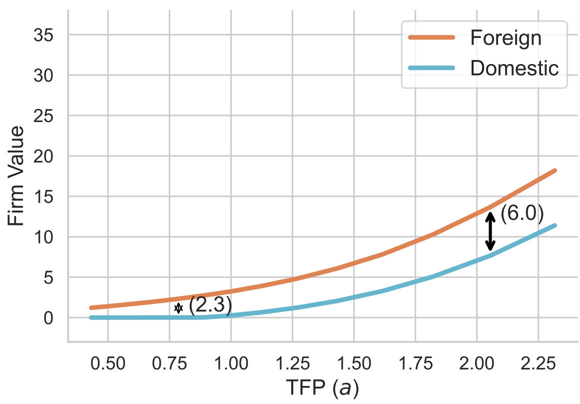
Figure D.8: Marginal Distribution of Acquired Firms



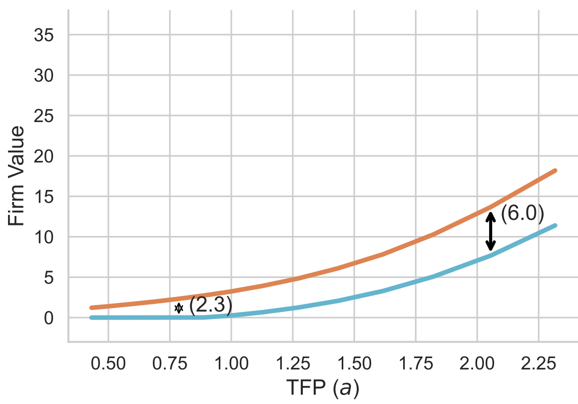
Notes: The figure displays the proportion of acquired domestic firms that fall into each decile of the firm size distribution (measured by employment). The empirical distribution (in yellow) is from the ESEE where I calculate the deciles of the marginal employment distribution across all firms in each sector and year and count the proportion of acquired firms that fall into each decile. The top 20% is the share of acquired firms (in pp.) that are in the 9th and 10th deciles. The middle 30% is the share of acquired firms that are in the 5th, 6th, and 7th deciles. The bottom 50% is the share of acquired firms below the median firm size. The firm size distribution is only of domestic firms prior to acquisition. The shares generated by the model are the blue bars. The top 20% and middle 30% shares are targeted moments.

Figure D.9: Firm Value $V(a, k_{I,p}, k_{T,p}, o)$ At Different Capital Percentiles p

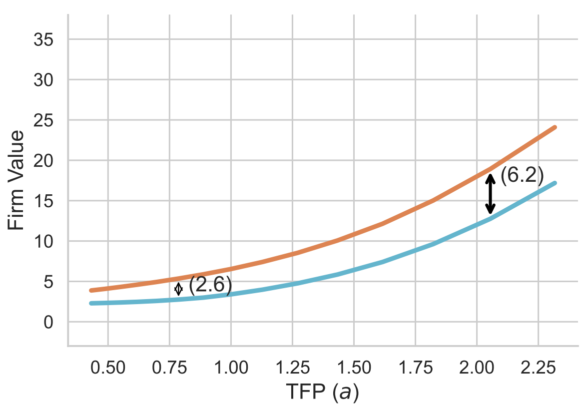
(a) $K_{I,10}$ and $K_{T,10}$



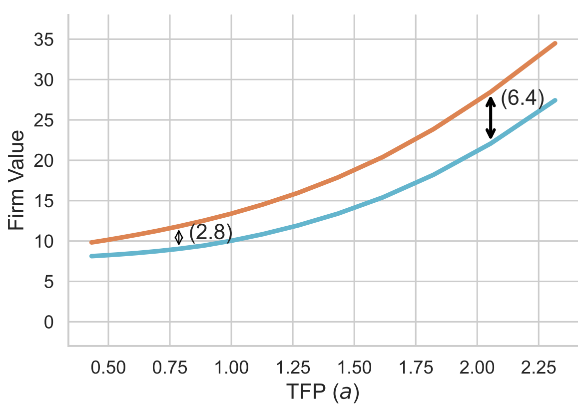
(b) $K_{I,25}$ and $K_{T,25}$



(c) $K_{I,75}$ and $K_{T,75}$



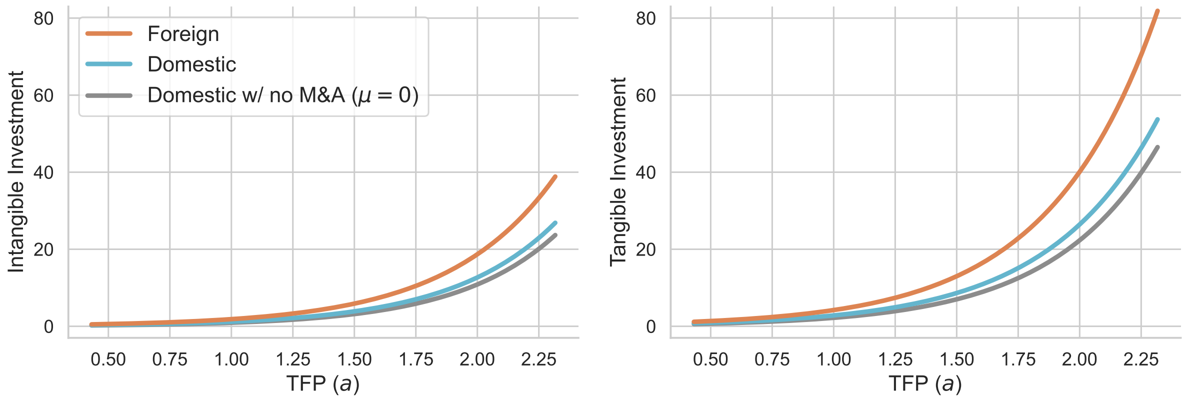
(d) $K_{I,90}$ and $K_{T,90}$



Notes: The figure displays firm value as a function of TFP at the percentile values $p = \{10, 25, 75, 90\}$ of intangible and tangible capital from the stationary distribution: $V(a, k_{I,p}, k_{T,p}, o)$. Domestic firm value is the teal line and foreign is the orange. The black arrows marked the difference in parenthesis between the two at a given TFP level. Firm value is convex in TFP and the figure shows that the absolute difference is larger for higher TFP levels.

Figure D.10: Capital Investment $x_j(a, k_{I,p}, k_{T,p}, o)$

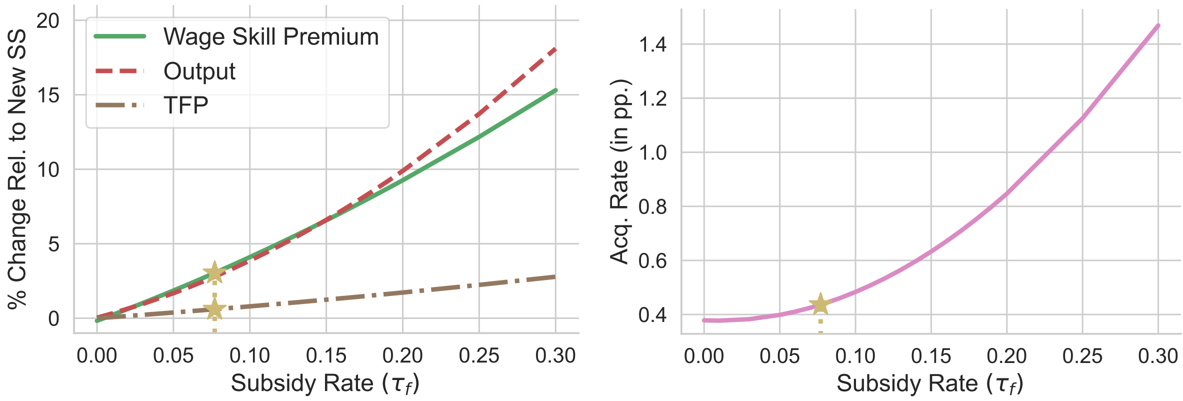
(a) Intangible Investment (b) Tangible Investment



Notes: The figure displays investment function of TFP at the median values of capital from the stationary distribution: $x_j(a, med(k_I), med(k_T), o)$ for both capital types $j = \{I, T\}$. Domestic firm value is the teal line and foreign is the orange. The gray line indicates the investment level of a domestic incumbent in a model without acquisitions and no foreign ownership. Subfigure (a) is intangible investment, which is the same as Figure **??**, but with a different y-axis. Subfigure (b) is tangible investment.

Figure D.11: Changes and Foreign Intangible Investment Subsidy

(a) Change Relative To New S.S. (b) Acquisition Rate



Notes: Subfigure (a) plots the percentage change of aggregate equilibrium objects relative to the new steady state at different intangible investment subsidy τ_f levels. Subfigure (b) is the acquisition rate in percentage points where it equals 0.378% when $\tau_f = 0$, its value in the new steady state. The gold stars are the values at the optimal policy rate.

Appendix E Additional Tables

Table E.1: Extended ESEE Summary Statistics (1990-2017)

Avg. Variable (in logs)	Domestic Never Acquired	Foreign *Before*	Foreign *After*	Obs.
Sales	15.40	17.57	17.96	39,011 / 2,271 / 1,727
Value Added	14.33	16.38	16.72	38,456 / 2,231 / 1,711
Employment	3.78	5.40	5.66	39,011 / 2,271 / 1,727
Wage Bill	14.03	16.00	16.36	39,011 / 2,271 / 1,727
Labor Hours	4.34	5.94	6.20	39,011 / 2,271 / 1,727
Labor Productivity (Value Added/Emp.)	10.54	10.97	11.06	38,456 / 2,231 / 1,711
Total Factor Productivity (TFP)	-0.051	0.027	0.039	32,791 / 1,853 / 1,640
Tangible Fixed Assets (Gross Value)	14.61	16.97	17.39	36,691 / 2,067 / 1,712
Intangible Fixed Assets (Gross Value)	12.10	14.67	15.11	27,603 / 1,730 / 1,576
Intangibility (Intangible Assets/Tangible+Intangible Assets)	-3.10	-2.64	-2.63	27,427 / 1,710 / 1,563
Total R&D	12.08	13.15	13.29	10,640 / 1,343 / 1,076
In-House R&D	11.99	13.02	13.15	9,241 / 1,198 / 970
Patent Stock	1.38	1.75	2.11	7,290 / 714 / 685
Tangible Inv.	11.86	13.87	14.18	27,593 / 1,988 / 1,485
Skilled Emp.	1.44	2.54	3.00	12,580 / 681 / 504
Unskilled Emp.	3.71	5.30	5.51	12,580 / 681 / 504
Exports	14.07	16.00	16.51	21,214 / 1,890 / 1,561

Notes: Variables in constant 2015 prices.

Source: Author's calculations using ESEE.

Table E.2: Wage Skill Premium Change in Spain (2002-2017)

	Avg. 2002-2006	Avg. 2013-2017	Change (in pp.)
Aggregate	1.489	1.523	2.299
Manufacturing	1.426	1.560	9.419
Services	1.414	1.479	4.607
Other	1.618	1.579	-2.427

Notes: The table contains the beginning (2002-2006) and end of sample (2013-2017) averages of the wage skill premium. The final column is the change in percentage points. Aggregate includes all sectors except "Other Services" S and "Employed by Household" T due to inconsistent data. Manufacturing is ISIC Rev. 4 sector code C and business services are ISIC Rev. 4 sector codes $G-N$. Other consists of remaining sectors (ISIC Rev. 4 sector codes $A-B, D-F, O-R$) like agriculture, construction, public administration and more. The wage skill premium broken down by sector is in Table E.3.
Source: Author's calculations using EUKLEMS-INTANProd database.

Table E.3: Wage Skill Premium Change in Spain By Sector (2002-2017)

		Avg. 2002-2006	Avg. 2013-2017	Change (in pp.)
Manufacturing	Manufacturing (C)	1.426	1.560	9.419
Services	Retail (G)	1.370	1.554	13.426
	Transportation and Storage (H)	1.410	1.416	0.413
	Accomodation (I)	1.296	1.378	6.339
	Information and Communication, Real Estate, Professional and Support Services (J,L,M,N)	1.588	1.536	-3.295
	Financial Services (K)	1.017	1.131	11.237
Other	Agriculture (A)	1.673	1.724	3.037
	Mining (B)	1.310	1.912	45.896
	Utilities (D-E)	1.326	1.298	-2.092
	Construction (F)	1.412	1.676	18.715
	Public Administration (O)	1.640	1.269	-22.635
	Education (P)	1.849	1.692	-8.455
	Health and Social Work (Q)	1.948	1.870	-4.005
	Arts and Entertainment (R)	1.678	1.310	-21.929

Notes: The table contains the beginning (2002-2006) and end of sample (2013-2017) averages of the wage skill premium by sector (ISIC Rev. 4 sector codes $A-R$). The table does not contain sectors "Other Services" S and "Employed by Household" T due to inconsistent data.
Source: Author's calculations using EUKLEMS-INTANProd database.

Table E.4: Determinants of Foreign Acquisitions (Logit)

	(1) Foreign Ownership Indictator
Lag Logged Sales	0.490***
	(0.115)
Lag Logged Labor Productivity	-0.353**
	(0.142)
Lag Sales Growth	-0.202
	(0.124)
Lag Labor Productivity Growth	0.108
	(0.078)
Lag Logged Average Wage	1.988***
	(0.332)
Lag Logged Total Assets	0.093
	(0.095)
Lag R&D Status	-0.174
	(0.170)
Obs.	29710
Psuedo R-squared	.252

Notes: * p<0.10; ** p<0.05; *** p<0.01. Standard errors clustered by firm in parentheses.

Table E.5: P.S. Reweighted Regressions: Additional Variables

	(1) Value Added	(2) Labor Prod.	(3) Total R&D	(4) Patent Stock
Lag Foreign	0.153***	0.079**	0.216**	0.170*
	(0.049)	(0.031)	(0.103)	(0.088)
Obs.	32892	32892	10523	7616
R-squared	.914	.643	.166	.454

Notes: * p<0.10; ** p<0.05; *** p<0.01. Standard errors clustered by firm in parentheses. All regressions include firm and industry-year effects. All dependent variables are in logs. Lag foreign is a dummy variable for foreign ownership in previous period (equal to one if at least 50% the firm's capital is foreign owned by and zero otherwise). The characteristics used to obtain the propensity score are log sales, log labor productivity (value added over employment), sales growth, labor productivity growth, log average wage, log total fixed assets (tangible plus intangible), R&D status, and a year trend. All the previously mentioned variables are lagged one period relative to acquisition. I allow for this relationship to vary across industries by estimating the propensity score separately for each industry. I ensured that only observations within the region of common support are included. I performed the standard tests to check that the balancing hypothesis holds within each industry and found that all covariates are balanced between treated and control observations for all blocks in all industries.

Table E.6: P.S. Reweighted Regressions: Different TFP Measures

	Hours as Labor Input		Wage Bill as Labor Input	
	(1) TFP	(2) TFP (Firm Price Index)	(3) TFP	(4) TFP (Firm Price Index)
Lag Foreign	0.039***	0.043***	0.020***	0.026***
	(0.012)	(0.014)	(0.008)	(0.009)
Obs.	32064	27508	32558	27879
R-squared	.659	.689	.818	.696

Notes: * p<0.10; ** p<0.05; *** p<0.01. Standard errors clustered by firm in parentheses. The table shows total factor productivity (TFP) estimates using different labor inputs in the production function: hours and the wage bill. Details regarding firm-level TFP estimation are in Appendix B.2. The columns labeled TFP are estimated TFP when value added is deflated by an sector-specific price index. This measure is sometimes referred to as revenue total factor productivity. Column (1) is the TFP that appears in Table 2 in the main text. The columns TFP (Firm Price Index) display estimated TFP when value added is deflated by a firm-specific price index. All regressions include firm and industry-year effects. All dependent variables are in logs. Lag foreign is a dummy variable for foreign ownership in previous period (equal to one if at least 50% the firm's capital is foreign owned by and zero otherwise). The characteristics used to obtain the propensity score are log sales, log labor productivity (value added over employment), sales growth, labor productivity growth, log average wage, log total fixed assets (tangible plus intangible), R&D status, and a year trend. All the previously mentioned variables are lagged one period relative to acquisition. I allow for this relationship to vary across industries by estimating the propensity score separately for each industry. I ensured that only observations within the region of common support are included. I performed the standard tests to check that the balancing hypothesis holds within each industry and found that all covariates are balanced between treated and control observations for all blocks in all industries.

Appendix F Computation

This section describes the algorithm that I use to solve the stationary economy in general equilibrium. The basic structure is to first guess prices, solve the firm problem, obtain the stationary firm distribution and then check if the equilibrium conditions are satisfied. Given a set of model parameters, the algorithm is as follows

1. Guess prices (w_s, w_u).

2. Given prices, solve incumbent firm's problem in equation (5) with brute force value function iteration. Take the domestic incumbent's value function and solve the domestic entrant's problem in equation (6).

3. Using the policy functions of incumbents and entrants, approximate the stationary firm distribution λ^0 by forward iteration (assume that the mass of entrants $M = 1$). As described in Section 3.6, there are four components in the firm distribution that one must keep track of.

4. Inner loop: Iterate on M to clear the unskilled labor market.

   (a) If first inner loop iteration, guess hours supplied by unskilled workers $h_u \in (0,1)$. Otherwise, set hours to that obtained from previous inner loop iteration $h_u = h_u^{\text{new}}$.

   (b) Set the mass of entrants M such that the unskilled labor market clears

   $$M = \frac{N_u h_u}{\int l_u(s) d\lambda^0(s)}. \tag{F.1}$$

   Then rescale the stationary firm distribution

   $$\lambda(s) = M\lambda^0(s). \tag{F.2}$$

   (c) Get aggregate domestic profits and acquisition sale price

   $$\Pi_d = \int \pi_d d\lambda(a, k_I, k_T, d) \tag{F.3}$$

   $$P_d = \mu \int \mathbb{1}_{\{S(a,k_I,k_T,d)>0\}} p(a, k_I, k_T, d) d\lambda(a, k_I, k_T, d) \tag{F.4}$$

   (d) Taking the unskilled wage w_u and business income (Π_d, P_d), solve the unskilled household problem from equations (12) and (13) and obtain the optimal hours supplied by unskilled workers h_u^{new}.

   (e) Check the distance between the mass of entrants just obtained M and from the previous inner iteration M^{old}. If first iteration then set $M^0 = 0$.

      i. If

      $$\left| M - M^{\text{old}} \right| < \text{tolerance} \tag{F.5}$$

then exit inner loop and proceed to step 5.

ii. Otherwise, return to step 4.a. I set the tolerance to 1e-12 and convergence occurs within about 12 iterations.

5. Solve the skilled household problem and obtain the optimal hours supplied by skilled workers h_s.

6. Evaluate the following equilibrium conditions

   - Free entry condition: $V_e = 0$.
   - Skill labor market clearing: $N_s h_s = \int l_s(s) d\lambda(s)$.

   and check if they are satisfied.

   (a) If both conditions

   $$V_e < \text{tolerance} \qquad\qquad \left| N_s h_s - \int l_s(s) d\lambda(s) \right| < \text{tolerance} \tag{F.6}$$

   then we are done.

   (b) If one or both conditions not satisfied then return to step 1. I set the tolerance for these conditions to 1e-6. To update the guess I use a downhill simplex method (aka Nelder-Mead).