Contracting frictions, geography, and multinational firms: Evidence from Mexico*

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Abstract

In this paper, I explore how contracting frictions and geography influence the trade costs faced by multinationals in their affiliates located in Mexico relative to domestic firms. I document two key facts. First, distance to firm's home countries influences firms' sourcing patterns. Second, sectors with a larger presence of foreign affiliates are more intensive in relationship-specific inputs. I develop a small open economy model with multiple sectors, imperfect contracting, input relationship-specificity, global sourcing and multinational production. I compute a set of counterfactual equilibria to gauge the relative importance of contracting frictions, trade costs, and productivity in the price advantage of multinationals over domestic firms. My findings show that, contrary to priors, foreign firms seem to have a disadvantage relative to domestic firms in trade costs and contracting frictions. Eliminating all differences between foreign and domestic firms leads to reduction in real GNP of 2.7 percent, while doing so only for productivity reduces real GNP by 2.2 percent.

JEL codes: F23, F62, F63

Keywords: multinational firms, international trade, contract enforcement, developing countries

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1. Introduction

Affiliates of foreign firms often operate in different industries than domestic producers. For instance, Alviarez (2019) documented that multinational firms tend to operate in industries in which domestic firms are less productive. Since both groups of firms are in the same country, they face the same country fundamentals: same stock of human capital, same infrastructure, same regulations, same economic institutions, etc. How do foreign firms manage to thrive in industries where domestic firms cannot, despite being embedded in the same environment? The standard explanation is that foreign affiliates simply have a higher (exogenous) productivity in these sectors, usually because of differences in intangible assets, such as proprietary technologies or organizational know-how. Alternatively, it could be the case that, despite operating in the same country, foreign and domestic plants do not really work with the same fundamentals. For example, if (tradable) intermediate inputs account for an important part of production costs, then foreign firms can have an advantage over domestic firms if they have access to a better network of global suppliers, even if there were no differences in productivity.

In this paper, I use rich census and customs data to explore the relative importance of these mechanisms in the context of Mexico. First, I document that the aforementioned pattern is indeed present in this country. In fact, not only do foreign firms operate in different industries than their domestic counterparts, but some of these industries are almost completely constituted by them. Second, I show that sectors with a large presence of foreign affiliates are more intensive in relationship-specific inputs, which implies that costs in these industries should be more dependent on the quality of contract-enforcement institutions. Third, I document that trade flows not only respond to the geographic distance between foreign countries and Mexico, but also to that between the former and the *country of origin* of the foreign firms. I interpret this novel finding as reflecting the fact that some trade costs do not need to be tied to the location of *production*, such as those related to coordination of logistics. Fourth, I show evidence that differences in contract enforcement institutions across potential suppliers' countries are a relevant factor explaining the patterns of trade in the data and, most importantly, that foreign firms seem to have a lower sensitivity to them.

Informed by the empirical evidence, I consider three potential factors that could give foreign affiliates in Mexico an advantage over their domestic peers in contract-intensive industries: (1) higher productivity, (2) lower international trade costs, and (3) lower contracting frictions. I develop a small open economy model with multiple sectors, imperfect contracting, input relationship-specificity, and multinational production, based on the work of Antràs et al. (2017), in which each channel is represented by a different set of parameters. The first factor is represented by a Hicks-neutral productivity parameter that varies by home country and industry. The second factor is accounted for by a second set of bilateral trade costs, which varies in terms of the home countries of firms and their suppliers ("source" countries). The third factor is accounted for by an additional iceberg cost that also varies by in terms of the source and firms' home countries, but that only affects prices of relationship-specific inputs. Building on Acemoglu, Antràs and Helpman (2007), this result is derived within the model. A contribution of this paper is that, despite the inclusion of contracting frictions, the model preserves the main results of the standard approach of Eaton and Kortum (2002).

In the quantitative section of this paper, I assess the relative importance of these three factors. I do this by calculating three counterfactual scenarios using the hat-algebra approach of Dekle et al. (2008), in which I replace foreign firms' values of the corresponding parameter with that of Mexican firms. This way, I "turn off" any advantage that multinational firms may have in each factor. The fact that the counterfactual "shocks" are defined in terms of the relative values between foreign and domestic firms implies that I cannot pick their values exogenously (e.g. a "10% increase in trade costs"), as it is usual in the literature following Dekle et al. (2008)'s approach. Instead, I use the model to identify the shocks, following an approach similar in spirit to that in Head and Mayer (2014). With these measures in hand, I compute the counterfactual scenarios. I first calculate the "overall" joint effect as a benchmark, where I change multinational firms' productivity, communication costs and contracting friction parameters to match that of Mexican firms. I find a 2.7 percent reduction in welfare (measured by real expenditure) accompanied by a reallocation of value added and employment within the manufacturing sector away from multinational-dominated industries. When repeating the exercise only for trade or contracting friction shocks, I find that they reduce welfare by 0.2 percent, in both cases. In contrast, bringing foreign firms' productivities to the level of domestic firms reduces welfare by 3.6 percent. I interpret these results as indicating that, consistent with the priors in the field, it is "productivity" (net of any effect of contracting or trade frictions) the main factor behind the differences between domestic and foreign firms.

Contribution to the literature. This paper speaks to three strands of literature. First, it contributes to the large literature on multinational firms. On the theory side, there is a large body of work modeling firm decisions regarding location of production, input sourcing and sales (Antràs et al. (2023), Antràs et al. (2022), Arkolakis et al. (2018), Antràs et al. (2017) and Tintelnot (2016)). Most recent papers have focused on the extensive margin problem of multinational's optimal plant location, for example Antràs et al. (2023), Antràs et al. (2022), and Arkolakis et al. (2023). The model in this paper is based to a large extent on the one in Antràs et al. (2017), but I abstract from extensive margin considerations by turning their model of the global economy into one centered around a small open economy, following the criteria in Demidova et al. (2022). In exchange, I added communication costs and contracting frictions to their model. The latter required a generalization of the model in Acemoglu, Antràs and Helpman (2007) to an asymmetric case in which suppliers are in different locations. On the empirical side, most of the work on the effect of foreign multinational firms on the host economy has focused on how domestic firms and workers are affected via knowledge spillovers or economic linkages (Holmes et al. (2015), Lu et al. (2017), Jiang et al. (2018), Alfaro-Ureña et al. (2022), Sampson (2022)). This paper explores potential benefits to the host economy that are not mediated by knowledge transfers, but by foreign affiliates' ability to thrive in contract-intensive sectors that would have otherwise not been present in a host country such as Mexico.

Second, this paper also contributes to the literature on contract enforcement institutions and trade (Levchenko (2007), Nunn (2007), Costinot (2009), Nunn and Trefler (2014)). In line with this literature, I find that relationship-specific intermediate inputs tend to be purchased from countries with better contract-enforcement institutions. However, I also document that this relationship is weaker for foreign affiliates. Therefore, conclusions based on country-level data would underestimate the impact that contract enforcement institutions have on comparative advantage of domestic firms, especially in economies with a large presence of foreign multinationals.

Third, this paper contributes to the quantitative literature on contract enforcement institutions and development (Acemoglu, Antràs and Helpman (2007), Boehm (2022), Boehm and Oberfield (2020)). Most of this literature has focused on closed-economy models where the only relevant institutions are the local ones. This paper extends Acemoglu, Antràs and Helpman (2007)'s model of contracting frictions to a multi-country, multi-product international setting by embedding it into an Eaton and Kortum (2002) model of intermediate input sourcing by heterogeneous final-good firms, as Antràs et al. (2017). Hence, the model allows firms to avoid local contract-enforcement institutions via importing. More importantly, the model shows that contracting frictions can be accounted for by an additional friction parameter that behaves like an iceberg trade cost, a familiar object in the trade field. Moreover, by separately accounting for differences in contracting frictions and trade costs, this paper also contributes by opening the "black box" of differences in measured productivity between multinational and domestic firms.

Finally, Chor and Ma (2021) deserves special mention because it is theoretically the closest to this paper. Like this paper, they also embed contracting frictions into the global model of multinational firms and input sourcing of Antràs et al. (2017) and their paper also features a new "contracting frictions" term in import trade shares. However, there are also differences. First, their focus is on the global economy, while mine is on one small open economy. Second, they also model whether sourcing is conducted within or outside firm boundaries, while I do not make that distinction. Third, their model does not allow for multinational production nor export platforms, while mine does. Fourth, they model bargaining assuming simultaneous Nash bargaining, while I use asymptotic Shapley values. As discussed in Antràs (2016), the latter has the advantage that it is consistent with the possibility of moral hazard, while the former is not.

2. Empirical evidence

2.1 Data

The empirical exercise of this paper is based on two main datasets from Mexico's national statistical agency, INEGI: the economic census and firm-level customs data.

2.1.1 Economic census

I used data from the manufacturing section of the Mexican economic census of 2009, 2014 and 2019. The censuses are available for every five years and contain information at the *plant* level, which is defined as the "economic unit permanently located in a single physical location and delimited by a building, under the management of a single owner" (own translation). This means that it covers all economic establishments, regardless of whether they are legally incorporated or not. In terms of geographic coverage, they cover all localities with at least 2,500 people, all district capitals (*cabeceras municipales*) regardless of size, all industrial parks and corridors, and all rural localities and establishments deemed to have "economic importance". The remainder, rural areas of little economic activity but large geographic extension, was sampled. The information always corresponds to the economic activity during the previous last year, thus 2008, 2013 and 2018.

Each plant is assigned a unique plant identification code (id), a firm id (only for those part of a multi-plant firm), and an industry classification (Mexico's version of NAICS, SCIAN, at six digits) based on its main economic activity[1]. The censuses contain a wealth of information that is usual in this type of surveys. For each plant, there is information on employment, labor costs, intermediate consumption, fiscal and financial costs, sales, other sources of revenue, output, inventories and capital stock. Most importantly for my purposes, it also includes a question asking whether there is any foreign participation in the firm's equity, its percentage and country of origin. These three variables allow me to distinguish foreign affiliates (defined as those with 50 or more percent of foreign equity) from domestic-owned plants, and the country where the headquarters (HQ) is located[2].

The second most important information from the censuses is the product-level disaggregation of intermediate input purchases[3]. This more detailed information is not available for most plants, but it is for multi-plant firms and large plants, a group known as EGE (*Establecimientos Grandes y Empresas*)[4]. While not representative of overall employment, this group covers most of the Mexican manufacturing sector in terms of revenue, expenditures, and value added. For each intermediate input, there is information on its unit of measure, quantity and value, and for the last two, it also distinguishes between domestic purchases and imports. However, imports are not further disaggregated by the source country, which is something I need for this paper. To fill this informational gap, I linked the census information with that of firm-level customs data, which is described in the following section. Before doing so, I want to report that the reason I use the census instead of the annual economic survey (with higher frequency data) is that the latter does not include the variables needed to identify multinationals, nor the information at the product-level.

[1]Since I work at the firm level, I assigned to multi-plant firms the industrial code associated with the largest value added.

[2]In the few cases in which plants belonging to the same firm were classified differently in terms of their multinational status, or were assigned more than one HQ country, I picked the classification associated with the largest value added.

[3]This information unpacks the variable "intermediate consumption of raw materials and intermediate inputs owned by the establishment", available for each plant in the census main dataset. As the name suggests, it only covers intermediate inputs that were purchases by the plant for processing, but it does not include any materials handed by their contractors for contract manufacturing.

[4]To be part of EGE, a plant must satisfy at least one of the following requirements: (1) have an annual revenue of at least 50 million pesos or employ at least 50 people (regardless of whether they are employed directly by the plant or by a contractor), (2) be part of a multiplant firm with plants in more than one state, (3) be part of the non-probabilistic sample of the annual economic survey, (4) be part of the IMMEX (maquiladora) program, or (5) be classified as one of 25 industries (SCIAN-6D) that have full coverage (which are not listed).

2.1.2 Customs data

I used data from the **Profile of Export Manufacturing Firms (PEME)**, a statistical project that links information from the annual economic surveys, the economic censuses and the IMMEX (maquiladora) program with administrative custom data. Unlike the Census, this dataset is at the firm-level[5][6]. Since the census covers firms of all sizes, but PEME only those engaged in international trade, it is expected for the set of linked plants to only account for a small fraction of all census plants[7]. In fact, 99% of plants in the 2019 census were *not* matched with any firm in PEME. Nonetheless, in terms of economic aggregates, this one percent accounts for a very significant proportion of manufacturing activity, as the following table shows[8].

Table 1. Share of linked plants in the manufacturing sector totals of selected census variables, 2018.

							Employment		
Plant status	Sales	Exports	Expenses	Imports	Output	Value added	Direct	Indirect	Total
Only in census	0.34	0.09	0.32	0.13	0.34	0.38	0.65	0.37	0.62
In census and PEME	0.66	0.91	0.64	0.87	0.66	0.62	0.35	0.63	0.38

Note: The amounts for sales, expenses, exports and imports correspond are of "goods and services" aggregates, which excludes sources of income (e.g., resale of unprocessed goods, or subsidies) or expenditure (e.g., taxes or interest payments) not directly related to production. "Direct" labor expenses correspond to workers hired directly by the plant, while "indirect" corresponds to workers supplied by third-parties (e.g., outsourced cleaning services).

The information in PEME is at the year-firm-product-country level, for both exports and imports. For example, for any given firm f, I observe the amount (in current US$) sold to or purchased

[5] A big unresolved issue by INEGI is that the definition of a "firm" used in the construction of the PEME database and that used in the censuses are not the same and do not coincide. The main reason seems to be that PEME uses a tax id (RFC) to identify firms, while the census uses the national registry of firms. Hence, there are cases in which the census "firm" contains more than one PEME "firms", and others in which the opposite happens. INEGI functionaries from the relevant areas explained that these inconsistencies could be caused by firms changing their RFC (so both the old and the new would be linked to the same firm id from census), or firms having more than one RFC (which is more likely for large firms). In any case, I followed their recommendation to always prioritize the PEME classification in these instances.

[6] Despite the availability of correspondence tables between PEME's and census' firm ids, there are several remaining issues beyond my capacity to fix. For instance, while 100% of the output value and employment reported in PEME is accounted by firms that have a match in the 2019 economic census, these observations only accounted for 39% and 36% of total exports and imports in PEME, respectively. I was not able to obtain an explanation from INEGI about this nor figure out it myself.

[7] It is a known stylized fact in the literature that firms that import or export tend to be more productive and larger than those that do not.

[8] In some cases, the export/import totals from PEME did not coincide with those in the census. In fact, some firms that according to the former do not engage in international trade, do so in the latter, and viceversa. Given that the information in PEME comes from administrative databases, while that in the census is self reported, my rule of thumb was always to believe the former when discrepancies arised.

from country i of good g in year t. Combined, these two datasets give me detailed information on the complete vector of trade flows, by product and trade partner, for the largest manufacturing firms in Mexico.

2.1.3 Other datasets

While the census and the customs data constitute the main source of information for this project, I also used a set of publicly available auxiliary datasets, which I know describe.

Quality of contract enforcement institutions. I proxy for this variable with the *Rule of Law index* from the **Worldwide Governance Indicators (WGI)** database, Kaufmann and Kraay (2022). This is a "perception"-based indicator, based, according to its documentation, "on several hundred variables obtained from 31 different data sources", and it is meant to reflect the opinions of survey respondents, NGOs, commercial businesses and the public sector.

Typification of intermediate goods. I classified intermediate inputs in both the census (which has information on the domestic/imported split) and PEME (which disaggregates imports by country) as either *standardized* or *relationship-specific* using James Rauch's classification, which he constructed for his Rauch (1999) paper[9]. He classified all internationally trade goods (defined as a SITC rev.2 three or four digit code) into three categories, defined in terms of whether the good (1) is traded on organized exchange (such as the London Metal Exchange), (2) has 'reference prices' (i.e., "prices can be quoted without mentioning the name of the manufacturer"), or (3) neither. This last group is meant to capture those goods for which brands are relevant. Rauch considered goods in the first two groups to be "homogeneous" while those in the latter "differentiated". When focusing on intermediate inputs, I rename these categories as standardized and relationship-specific, respectively.[10]

Trade, gravity and concordances. All the variables commonly used in gravity regressions, as well as country-level international trade data used in this paper come from the *Gravity* and *BACI* datasets, Conte and Mayer (2022) and Gaulier and Zignago (2010), respectively. Both available online in the CEPII website. Finally, at different stages of the data cleaning process I used several correspondence tables to navigate the different product and industry classifications used by these

[9]The authors has a dedicated webpage from where the data can be downloaded, which also has detailed information regarding its construction and correct use.

[10]For more precise definitions and longer explanation, see section 3.5

datasets. For example, to typify goods in PEME (which defines a good according to different revisions of the *Harmonized System (HS)*) using Rauch's categories (who defined a good according to the *Standard International Trade Classification (SITC)*, revision 2) I used the correspondence tables published by the United Nations Statistics Division[11].

2.1.4 Comment on data limitation

I use 2008 shares on the other years total amounts to approximate the actual expenditure shares for each type of good, because of data limitations in the 2013 and 2018 censuses (discussed in more detail in Data Appendix A)

2.2 Empirical evidence

2.2.1 Aggregate descriptive statistics

According to the 2019 economic census, foreign firms only represented around 0.4 percent of manufacturing plants in Mexico. In contrast to their small number, their weight in the Mexican manufacturing sector is orders of magnitude higher: they represent 27 percent of employment, 44 percent of output and sales, and a staggering 73 and 75 percent of imports and exports, respectively[12]. In line with established stylized fact in the trade literature, foreign firms are trade intensive. While only 1 percent of domestic firms imports or exports, 94 percent of foreign plants engage in international trade. Among plants that trade, foreign ones represent 40 percent of plants, and 59 percent of employment and value added.

Table 2. Foreign presence in Mexico's manufacturing sector, 2018.

Group	Plants	Employment	Value added	Exports	Imports
Mexican, autarkic	559,861	1,974,258	286,893	0	0
Mexican, traders	3,243	657,582	329,090	271,110	138,645
Foreign plants	2,253	983,709	481,978	793,224	366,090
Total	565,357	3,615,549	1,097,962	1,064,334	504,736

Note: "Autarkic" groups plants that do not engage in international trade. Value added, exports and imports are in million of current pesos.

[11] Available online at this website.

[12] A similar pattern is present for domestic firms that engage in international trade: despite accounting for only 0.6 percent of plants in manufacturing, they represent 18 percent of employment, 30 percent of value added and 27 and 25 percent of imports and exports.

Among the group of plants that engage in international trade, several patterns exist. First, plants seem to be much more diversified for import sourcing than they are in terms of sale markets: the United States accounts for 67 percent of sales, while Mexico does for another 22 percent. In contrast, their combined share falls to 50 percent when it comes to materials purchases. Second, while domestic plants almost evenly divide their sales between Mexico and the U.S., American plants in Mexico generate 85 percent of their revenue in the latter. Other foreign firms also predominantly sell to the U.S. but less so than American plants (66 percent). Third, despite engaging in international trade, Mexico remains the most important source of inputs for Mexican plants, representing 47 percent of expenditures. In contrast, the Mexican market only accounts for 14 percent of materials purchases of foreign plants. Within foreign plants, American ones almost evenly divide their input expenses between the U.S. and other foreign countries, while plants from other countries mostly source their inputs from the latter.

Table 3. Sourcing and marketing patterns of Mexican and foreign traders, 2018.

Panel A. Sales

	Markets			
Nationality	Mexico	U.S.	Other	Total
Mexican	852,445	821,093	171,537	1,845,076
American	200,356	2,021,333	164,909	2,386,598
Other foreign	455,739	1,774,723	474,483	2,704,946
Total	1,508,540	4,617,150	810,929	6,936,619

Panel B. Expenditures

	Source countries			
Nationality	Mexico	U.S.	Other	Total
Mexican	651,968	367,255	357,198	1,376,421
American	209,276	860,053	870,446	1,939,776
Other foreign	410,528	307,626	1,632,389	2,350,543
Total	1,271,773	1,534,934	2,860,033	5,666,740

Note: Sales and expenditures are in million of current pesos.

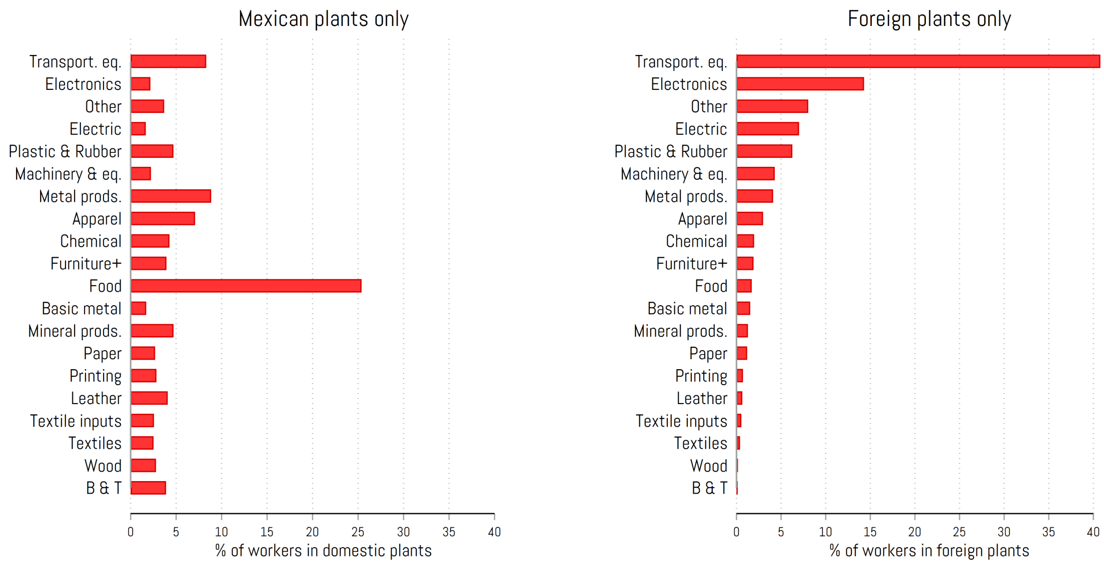
Overall, the basic facts of foreign firms in Mexico are consistent with evidence in other countries. First, they are few in number, but have an disproportional size in terms of both employment and value added. Second, they are more trade intensive than their domestic counterparts, even when compared against only Mexican traders. Both facts are consistent with multinationals being *more productive* than even the most productive domestic firms (those that trade internationally) in a world with internal increasing returns to scale due to fixed operating and trading costs, as in Krugman (1980) and Melitz (2003). Third, among firms engaged in trade, Mexican ones trade relatively more with Mexico than foreign firms, while American firms follow the same pattern but with the U.S. Since all plants are operating in the same country, this difference cannot be explained by the traditional bilateral trade costs that vary by country-pair. This is suggestive of some additional component that depends on the country of origin of the parent firm (the "HQ country").

2.2.2 Stylized facts

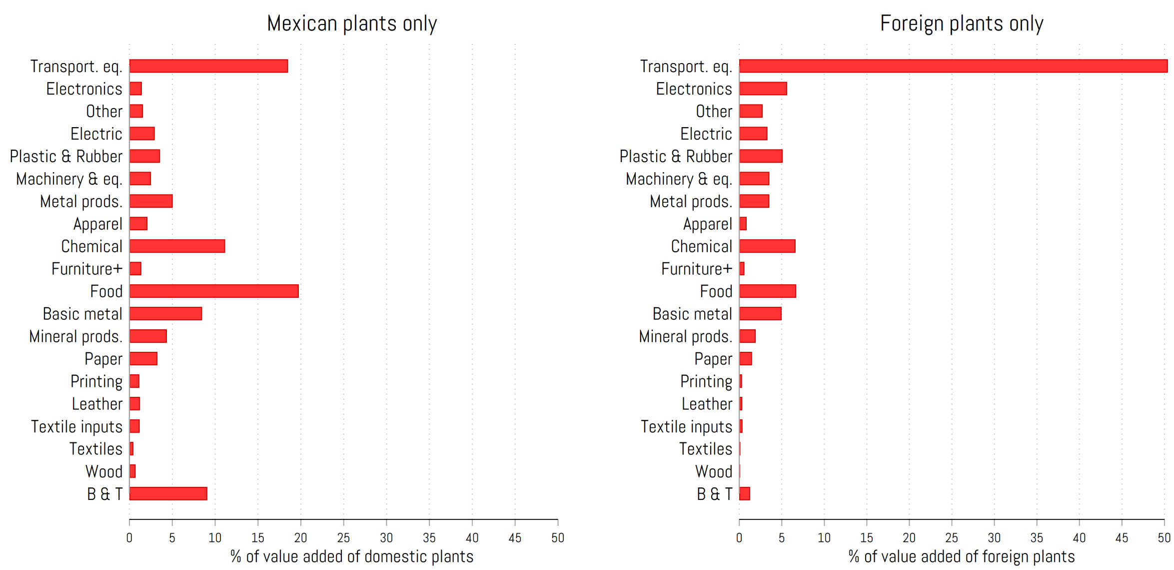
1. Foreign plants are located in different industries than domestic plants. Most economic activity by foreign firms is concentrated in one industry, *transportation equipment*, whether we measure it in terms of value added (50 percent) or employment (41 percent). In contrast, while most employment in Mexican plants is in the food industry (25 percent), when measured in terms of value added, it shares its predominance with the transportation equipment, with 20 and 19 percent, respectively.

Figure 1. Distribution of employment and value added across industries, 2018

(a) Employment



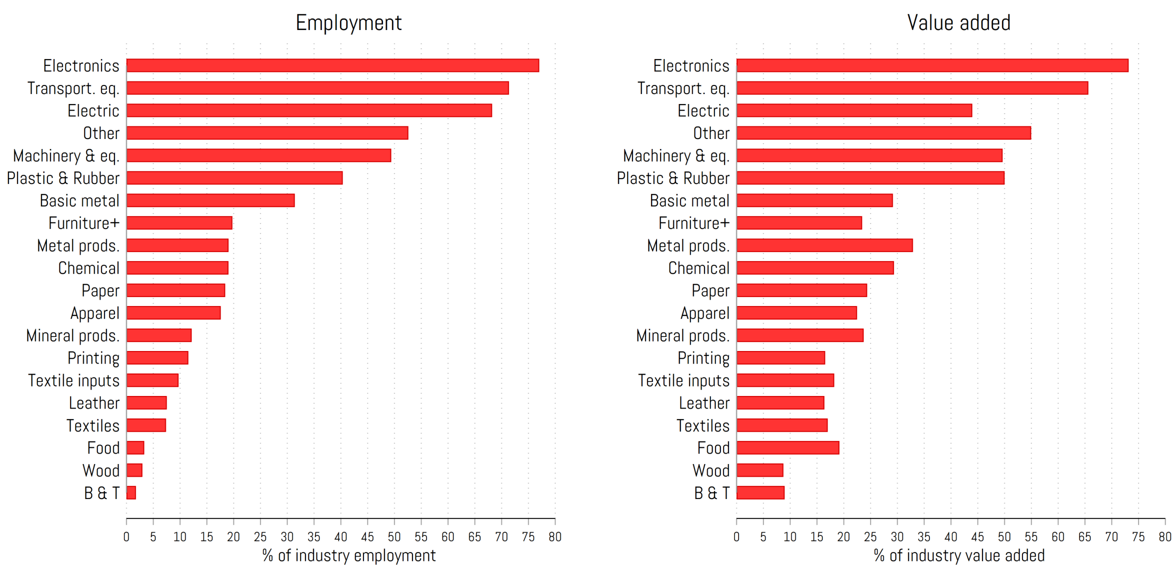
(b) Value added



Note: Industries are in descending order of foreign firms' employment in all graphs to facilitate comparison. *BT* stands for "Beverages and Tobacco".

2. Some industries are almost completely represented by foreign plants. Not only do foreign plants have a different distribution of economic activity across industries than Mexican plants, but in many cases they constitute most of the industry itself. For example, despite representing a small fraction of of foreign plants' total employment (14 percent) and value added (6 percent), 77 percent of workers and 73 of the value added in the *electronics* industry is employed and generated, respectively, in foreign establishments. A similar pattern is followed by the transportation equipment industry.

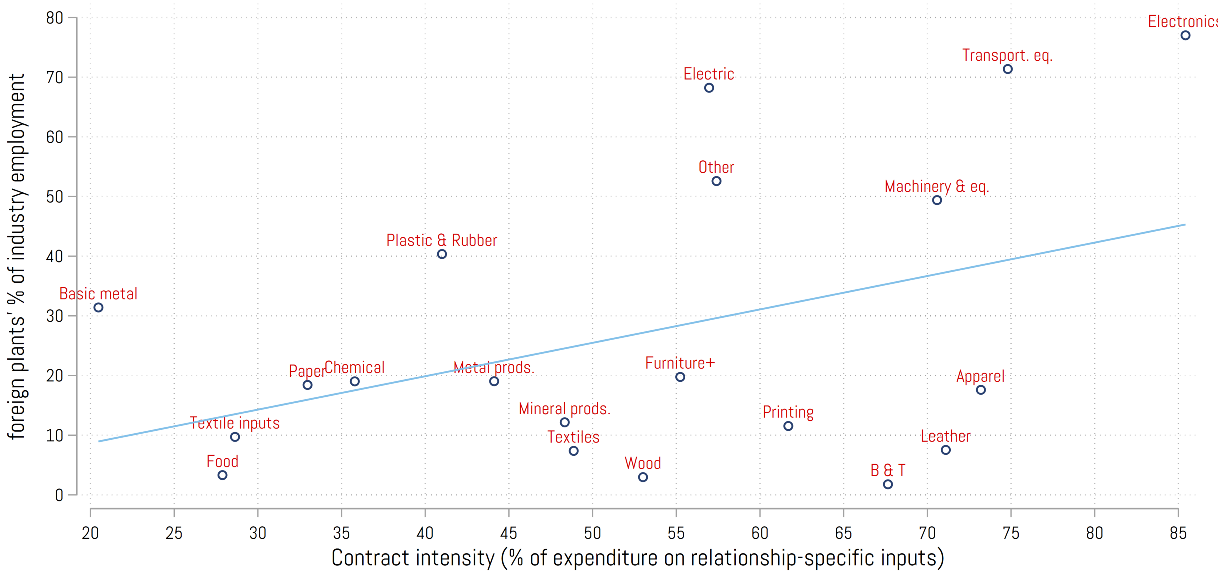
Figure 2. Share of foreign employment and value added by industry, 2018



Note: Industries 324 and 325110 are excluded because for most part foreign investment was restricted in them. *BT* stands for "Beverages and Tobacco".

3. Industries with larger presence of foreign firms are more contract intensive. The industries for which multinational firms are relatively more important in Mexico tend to be more *contract-intensive*, as the following figure shows. Following Nunn (2007), the contract intensity measure is meant to capture "the importance of relationship-specific investments" and it is measured as the proportion of intermediate inputs that are relationship-specific, where proportions can be obtained from input-output tables (as in Nunn (2007)'s original paper), and relationship-specificity is measured using Rauch (1999)'s measures. These patterns is robust to weighting industries by their size and to using Nunn's original contract-intensity measures (which were constructed based on data from the U.S.) or constructing similar measures using Mexican data.

Figure 3. Contract intensity and foreign share in employment, by industry, 2018



Note: Industries 324 and 325110 are excluded because for most part foreign investment was restricted in them. *BT* stands for "Beverages and Tobacco".

Relationship-specific inputs are those that need to be customized to the buyer's specifications. Customizing an input requires the supplier to make a "relationship-specific" investment, in the sense that its return is higher in the context of the relationship. This implies that, once the investment is made, it cannot be recovered (or it can only be partially recovered) or repurposed to be used with other buyers (or it can be at an extra cost). Because of this, a self-interested buyer would have an incentive to renegotiate the terms of the transaction in their favor after the supplier invests, taking advantage of the fact that the supplier's outside option is lower than it was at the moment of negotiating the original contract. Preempting this, suppliers may look for ways to get compensated for the risk they are taking, whether by asking for a higher price initially, or under-investing. Either way, the implication is that costs will be higher relative to a scenario in which the original contract is set in stone and cannot be renegotiated. In light of this, it is reasonable to expect that in countries with better *contract enforcement institutions* the risk of being taken advantage of by the buyer should be lower. Therefore, industries that rely to a large extent on these inputs will have lower costs, ceteris paribus, the better their contract enforcement environment. This implies that the quality of contract enforcement institutions can be a source of comparative advantage in contract-intensive industries, just like physical or human capital endowments are. This is exactly what the seminal papers of Nunn (2007), Levchenko (2007) and Costinot (2009) showed holds in international trade data: countries with better contract-enforcement institutions tend to export more goods from contract-intensive industries.

Implicitly, in these papers it is assumed that relationship-specific inputs are always sourced domestically or, if not, that the local institutions are always the relevant ones. However, once one considers that intermediate inputs can also be internationally traded, the previous conclusion requires some qualification. First of all, by definition an international transaction involves two countries, and thus two sets of contract enforcement institutions, which may be of very different quality. Second, the consensus in the literature is that it is the *exporter*'s institutions the ones that are expected to be more relevant, for reasons detailed in section 3.5.2. Therefore, a contract intensive industry may still be competitive in a country with bad contract enforcement institutions, as long as firms can source these inputs from abroad at a reasonable cost. Hence, a potential explanation for the pattern in figure 3 could be that foreign firms in Mexico have access to relationship-specific inputs at a lower cost than their domestic peers.

I consider two potential features that could in practice lower the costs faced by foreign firms when procuring relationship-specific inputs. The first one is that, conditional on the quality of contract enforcement in Mexico, foreign firms may face effectively **lower contracting frictions** than domestic firms. This can be rationalized with multinationals having better *reputational capital*[13], which implies that their suppliers have more trust in that they will not be cheated, which reduces under-investment and thus costs. Another explanation could be that, because it is the most productive firms that select into multinational production, which allows them to reduce their marginal cost by exploiting internal economies of scale (see Helpman et al. (2004)), the likelihood that they represent a large share of any given supplier's revenue is high. Given this, there is a higher probability that suppliers, even if *de jure* a separate entity from the buyer, would accept handing its major decisions to it, in what is known in the business literature as *quasi-hierarchical structures* or *centralized control*[14].

4. Geography and contract-enforcement institutions are relevant correlates for firms' import patterns. A second factor that could also give foreign firms an edge when sourcing relationship-specific inputs is that they may simply face **lower trade costs** when importing (see Anderson and

[13] On the relationship between reputation and contract enforcement, see MacLeod (2007).

[14] See Zhou and Xu (2012), Heide (2003) and Heide and John (1992). Areas in which this type of relationship are commonly reflected are product design, production processes, and quality control procedures.

van Wincoop (2004)). To the extent that some trade costs are related to tasks that can be undertaken from anywhere in the world (e.g., search costs, coordination of logistics, or shared social norms with suppliers and customers), by having plants in more than one location, multinational firms can reduce their trade costs by conducting these tasks from their lowest cost location. To back up this assertion, I document a novel fact: besides the distance between the exporting and importing countries, used as a proxy of traditional trade costs, there is another distance that also influences trade patterns: that from a supplier's or customer's location and the *plant network* of multinational firms[15]. The idea can be illustrated with the following example: if a Japanese firm wants to send South Korean inputs to its plant in Mexico, why should the coordination of logistics or the search for a suitable supplier be entirely the responsibility of the management team in Mexico when it could be arguably be easier to do it from Japan, given its proximity to South Korea? To reflect this idea, I call these second set of frictions *communication costs*. Given that I do not have information on the set of locations in which foreign firms operate besides Mexico, I use a restricted proxy using the distances to plant's HQ countries.

Evidence of both factors is given in the following regression table. I ran gravity regressions of firm's imports for each country and input type on explanatory variables representing contract enforcement and geography forces. In all cases, I used Poisson pseudo-maximum-likelihood (PPML) suggested by Santos Silva and Tenreyro (2006). Row 1 accounts for communication costs[16]. I used six commonly used variables to proxy for trade costs, of which I only report the log of the geographical distance between the HQ country (h) and the source country (j)[17]. To test for Hecksher-Ohlin determinants of trade, including the role of contract enforcement institutions, I included interaction between proxies for country-level endowments/fundamentals and input- or industry-level characteristics (rows 2-6). In particular, I included an input-level dummy for relationship-specificity (RS_v, where v indexes the inputs) and a country-level index of Rule of Law (μ_j), which proxies for the quality of contract enforcement[18]. Finally, to check whether foreign

[15]There is a third bilateral friction in the literature (called *multinational production (MP) costs*, but that is not used to study trade, but foreign direct investment flows. In empirical exercises, MP cost are proxied by the distance between the HQ country and the location of its plants. See Ramondo and Rodríguez-Clare (2013) and Ramondo (2014)

[16]Given that I only observe firms in Mexico, traditional trade costs are no longer a dyadic variable, and thus they are not part of the table since they are absorbed by the exporter fixed effect.

[17]The other variables are (1) a dummy for shared border to account for any discontinuities at borders, (2) dummies for common official language and (3) for common former colonizer, to account for non-geographical factors that could also affect the cost of communication (such as cultural or historical affinity), (4) a dummy for regional trade agreements, and (5) a dummy for when the firm is sourcing from its own HQ country, to control for the presence of any discontinuous "home bias".

[18]As in Nunn (2007) and Levchenko (2007), I also controlled for physical and human capital endowments interacted with industries' intensities in these factors.

firms have a different "sensitivity" than domestic firms to contracting frictions, I added interactions of the previous two variables with a dummy for multinationals (MN). I ran this regression over three subsets of firms: all firms, only domestic firms and only foreign firms. For each subgroup, I ran two specifications, one with fixed effects for the exporter-year and importer-year, and another one in which an additional country-pair dummy (which only leaves the time dimension as a source of variation) to test the robustness of the contracting-frictions estimates.

Table 4. Regression results

		PPML: firm f's imports of input v from country j				
		All firms		Domestic firms	Foreign firms	
		(1)	(2)	(3)	(4)	(5)
(1)	$\log dist_{hj}$	-0.452***			-0.464***	
		(0.0305)			(0.0368)	
(2)	RS_v	-1.744***	-1.639***	-1.403***	-0.509**	-0.503**
		(0.230)	(0.213)	(0.171)	(0.258)	(0.250)
(3)	$MN_f \times RS_v$	1.324***	1.201***			
		(0.114)	(0.179)			
(4)	$MN_f \times \mu_j$	-0.296**	0.366			
		(0.118)	(0.332)			
(5)	$RS_v \times \mu_j$	0.428***	0.390***	0.309***	0.209*	0.205*
		(0.101)	(0.101)	(0.113)	(0.126)	(0.122)
(6)	$MN_f \times RS_v \times \mu_j$	-0.242***	-0.202*			
		(0.0679)	(0.115)			
Observations		31,402,785	31,323,784	10,514,794	20,401,930	20,329,672
Exporter-Year FE		X	X	X	X	X
Importer-Year FE		X	X	X	X	X
Country-Pair FE			X			X

Clustered standard errors (firm's industry $k \times$ year t). *** p<0.01, ** p<0.05, * p<0.1. **Indices:** f denotes the firm, h denotes the country where the parent company of the plant is from (for Mexican firms, $h = MEX$), j denotes the source country of the good, v denotes a particular input (identified by its HS code at eight digits). **Fixed effects:** an *importer* is defined as a home country- downstream industry ($h \times k$) pair, while an *exporter* is defined as a source country-upstream industry pair ($j \times k'$). **Variables:** $\log dist_{hj}$ is the log of the population-weighted harmonic mean of the distances between all possible pairs of cities between countries h and j, RS_v is a binary variable equal to one if input v is relationship-specific according to Rauch (1999) typification, MN_f is a binary variable equal to one if firm f is foreign, and μ_j is the *Rule of Law index* of country j from Kaufmann and Kraay (2022). All regressions were estimated using the module for Poisson pseudo-maximum-likelihood with multiple levels of fixed effects `ppmlhdfe` of Correia et al. (2020) in Stata SE, version 17.0. Before estimation, for each downstream industry-input pair, the dataset was rectangularized to contain all HQ country h, source country j and year t combinations to account for zero trade flows.

There are three main take-aways from the table. First, the estimated coefficient associated with distance to HQ country is negative and statistically significant in both the full (column 1) and restricted sample (column 4) regressions[19]. It is also economically significant: an elasticity of -0.452 implies that, ceteris paribus, an American plant operating in Mexico's electronics sector would be predicted to import 54% less from Taiwan than an identical plant from Japan[20]. Second, row 5 echoes the the results in the literature of contract enforcement and comparative advantage: relationship-specific inputs tend to be purchased from countries with better contract enforcement institutions[21]. Third, the triple interaction in row 6 suggests that, when importing relationship-specific inputs, foreign firms may be less sensitive to contract enforcement institutions than their domestic counterparts.

5. Foreign firms have a geographical advantage when procuring relationship-specific inputs. While row 1 in the previous regression table shows that the distance between the HQ country and inputs markets is relevant for trade patterns, it is not enough to conclude that this fact benefits foreign firms. To explore this is so, I constructed a measure of the "distance" between any country and global markets for each input using CEPII's gravity and BACI datasets. The measure is the weighted average distance to all countries (including itself), where the weights are the countries' share in global exports:

$$\text{dist}_h^k = \sum_j \text{dist}_{h,j} \times s_j^k$$

where $\text{dist}_{h,j}$ is the weighted harmonic average distance between countries h and j, and s_j^k is country j's share in global exports of product k[22] The following figure compares Mexico's distribution of distances with that of foreign countries with plants in Mexico, for the three groups of products in Rauch's classification.

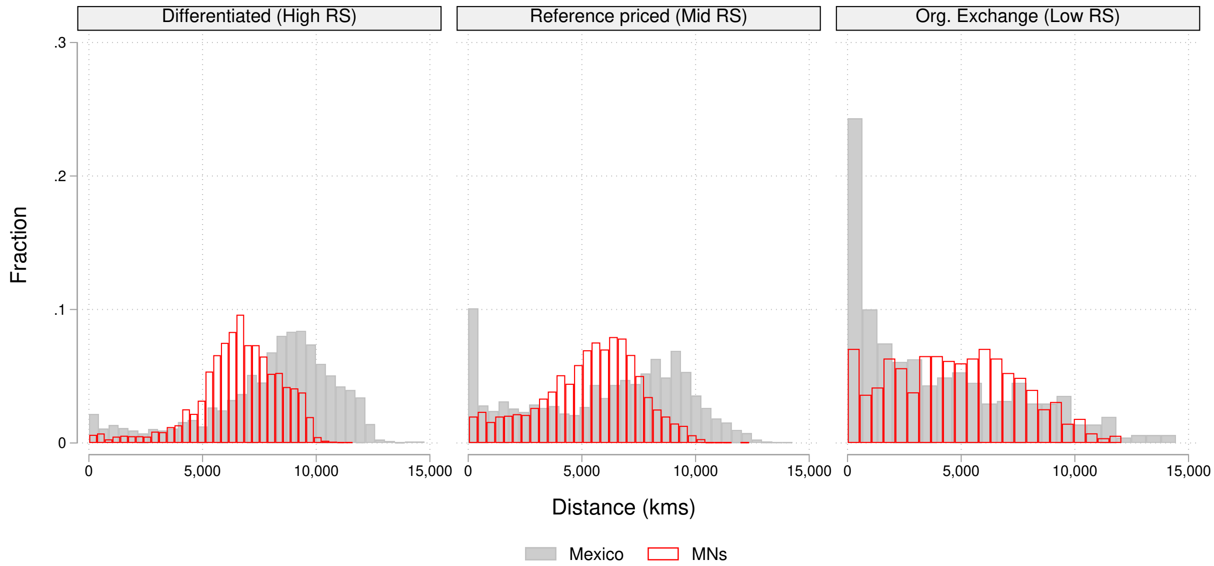
[19] It is also negative and significant when the sample is split between standardized and relationship-specific inputs, when the sample is restricted to either only U.S. or non-U.S. multinational firms.

[20] The distance between Taiwan and the U.S. (12,241 kms) is 5.66 times that of Japan (2,164 kms), which implies a percent change of $5.66^{-0.452} - 1 = -0.5431$.

[21] Despite the similar flavor, row 5 is not capturing the same pattern found in the earlier literature. While here the focus is on exporters of relationship-specific inputs, Nunn (2007) and Levchenko (2007) focused on the exporters of goods whose production is intensive in relationship-specific inputs.

[22] This measure is related to the *remoteness index*, which is also defined as a weighted average of distances, but that uses GDP shares as weights.

Figure 4. Distance to world suppliers: Mexico vs. foreign HQ



The main take-away from this picture is that while Mexico is relatively closer to global suppliers of commodities (those traded in organized exchanges) than the HQ countries of foreign affiliates are, this relative proximity erodes and even reverses when we focus on relationship-specific inputs (the "differentiated" ones). Although not conclusive evidence on its own, this figure together with the regression results suggest that foreign firms may have advantages over domestic competitors beyond exogenous productivity differences. Informed by these patterns, in the next section I develop a theoretical model that offers a tractable way to model contracting frictions and communication costs in an international trade setting, and that maps the three factors (productivity, contract frictions, and geography) to specific parameters that can, nonetheless, be identified using available data. This feature will then allow me to implement the appropriate counterfactual exercises that help answer the questions of this paper.

3. Model setup

3.1 Basic setup and notation

The model is centered on a small open economy (SOE), denoted by 0, which shares the world with other J countries, indexed by j, i, or h, depending on whether they represent an input source, a market, or a headquarters (HQ) country, respectively. The SOE is "small" in the sense that the domestic firms take foreign variables as given, but they still face a downward sloping demand curve for their goods domestically and abroad, as in Bartelme et al. (2020). The economy is composed of K manufacturing industries, one non-manufacturing tradables sector, indexed by T, and one non-tradables sector, indexed by N. Manufacturing industries are indexed by k and k'. Each manufacturing industry is composed by a continuum of firms $\omega \in \Omega^k$, each one producing a unique variety. There is only one factor of production, labor.

3.2 Demand

Each country i has a representative agent who supplies an exogenous measure L_i of labor inelastically and has preferences represented by a two tier utility function. The upper tier is a Cobb Douglas utility over all manufacturing industries and the two non-manufacturing sector bundles, where $\beta_k \geq 0$ is the expenditure share on industry k:

$$U_i = \left(\frac{Q_i^T}{\beta_T}\right)^{\beta_T} \left(\frac{Q_i^N}{\beta_N}\right)^{\beta_N} \prod_{k=1}^{K} \left(\frac{Q_i^k}{\beta_k}\right)^{\beta_k}, \quad \text{with} \quad \beta_T + \beta_N + \sum_{k=1}^{K} \beta_k = 1$$

The lower tier for a manufacturing industry aggregates varieties via a CES utility function with elasticity of substitution $\sigma_k > 1$:

$$Q_i^k = \left(\int_{\omega \in \Omega_i^k} q_i^k(\omega)^{\frac{\sigma_k - 1}{\sigma_k}} d\omega\right)^{\frac{\sigma_k}{\sigma_k - 1}}$$

where $\Omega_i^k \subseteq \Omega^k$ is the subset of industry k varieties that is available to consumers in country i. The lower tier for non-manufacturing tradables aggregates varieties also via a CES utility function with elasticity of substitution $\sigma_T \geq 1$. In this sector, each country has a representative firm producing a unique variety:

$$Q_i^T = \left(\sum_{h=0}^{J} (q_{hi}^T)^{\frac{\sigma_T - 1}{\sigma_T}}\right)^{\frac{\sigma_T}{\sigma_T - 1}}$$

Finally, the budget constraint is:

$$P_i^T Q_i^T + P_i^N Q_i^N + \sum_{k=1}^{K} P_i^k Q_i^k = E_i \equiv w_i L_i + \Pi_{ii} \tag{1}$$

where P_i^k is the Consumer Price Index (CPI) of industry k, E_i is aggregate nominal spending in country i, defined as the sum of the aggregate wage income ($w_i L_i$) and aggregate profits by *domestic* firms, which are assumed to accrue to the representative consumer (Π_{ii}).

3.3 Producers of final goods

3.3.1 Environment

There is a representative firm in sector T and in N, respectively, each producing a good priced at marginal cost. There is an endogenous mass N_0^k of domestic firms in each manufacturing industry k. Firms compete monopolistically in each market i they sell to. All domestic firms in industry k have a common productivity φ_0^k and there are no domestic-owned multinational firms (MNs). There is an exogenous number of foreign affiliates operating in each manufacturing industry k in the SOE, with productivities varying by industry and home country φ_h^k. The non-manufacturing sectors are closed off to foreign investment. Finally, consumers in the SOE can import final goods at exogenous prices.

3.3.2 Production function

Manufacturing firms. Final goods are assembled in plants that combine labor (L) with intermediate inputs using the following constant returns to scale (CRS) technology:

$$q_{h0}^k(\omega) = \varphi_h^k A_0^k \left(\frac{L^k}{\alpha_l^k}\right)^{\alpha_l^k} \left(\frac{M_s^k}{\alpha_s^k}\right)^{\alpha_s^k} \left(\frac{M_r^k}{\alpha_r^k}\right)^{\alpha_r^k} \left(\frac{M_N^k}{\alpha_N^k}\right)^{\alpha_N^k} \quad \text{with } \alpha_l^k + \alpha_r^k + \alpha_s^k + \alpha_N^k = 1$$

where A_0^k is an exogenous assembly productivity shifter for all firms in the SOE, L^k is the labor hired for assembly with a share in revenue equal to $\alpha_l^k \in [0,1]$, M_N^k is a composite of non-tradable inputs with a share in revenue equal to $\alpha_N^k \in [0,1]$, M_s^k is a composite of *standardized* intermediate inputs with a share in revenue equal to $\alpha_s^k \in [0,1]$, and M_r^k is a composite of *relationship-specific* intermediate inputs with a share in revenue equal to $\alpha_r^k \in [0,1]$[23]. M_s^k and M_r^k are CES aggregates of a unit mass of of intermediate inputs with elasticity of substitution $\zeta_s^k \geq 1$ and $\zeta_r^k \geq 1$, respectively:

$$M_x^k = \left(\int_0^1 m(\nu)^{\frac{\zeta_x^k - 1}{\zeta_x^k}} d\nu\right)^{\frac{\zeta_x^k}{\zeta_x^k - 1}}, \quad \text{for } x \in \{r, s\}$$

[23]The difference between a standardized and a relationship-specific input is explained in section 3.5.

Non-manufacturing sectors. Non-manufacturing goods are produced by representative firms with production functions linear in labor:

$$\begin{aligned} q_0^T &= A_0^T L_0^T \\ Q_0^N &= A_0^N L_0^N \end{aligned} \tag{2}$$

Both labor and intermediate input markets are perfectly competitive.

3.4 Producers of intermediate inputs

3.4.1 Environment

There is a competitive fringe of suppliers in each country j for both standardized and relationship-specific intermediate inputs, as in Antràs et al. (2017). Suppliers differ in two main aspects: the cost of labor in their location w_j, and their productivity $a_j^{xk}(\nu)$, for $x \in \{r, s\}$. Each potential supplier's productivity is a random draw from a Fréchet distribution with shape parameter θ_x, and scale parameter T_j^{xk}:

$$\Pr\left(\frac{1}{a_j^x(\nu)} \geq a\right) = \exp\left\{-T_j^{xk} a^{\theta_x}\right\}, \quad \text{for } x \in \{r, s\}$$

3.4.2 Production function

When a plant makes an order for an input, it not only specifies quantitative features (e.g., size, weight, number of units) but also qualitative ones (e.g., materials, durability, color, etc.). I call these features *specifications*. For tractability, I assume that an intermediate input ν is characterized by a continuum of specifications, as in Acemoglu, Antràs and Helpman (2007) and Antràs and Helpman (2008). Then, $m(\nu)$ is a quality-adjusted measure of input ν:

$$m(\nu) = \exp\left\{\int_0^1 \log m(\iota) d\iota\right\} \tag{3}$$

Each specification can be implemented using only labor:

$$m(\iota) = a_j^{xk}(\nu) l, \quad \text{for } x \in \{r, s\} \tag{4}$$

Note that the labor productivity $a_j^{xk}(\nu)$ is the same for all specifications $\iota \in [0, 1]$.

3.5 Relationship Specificity and Contractibility

3.5.1 Relationship Specificity

In section 3.3.2, I distinguished between standardized and relationship-specific inputs. An input is relationship-specific if it has to be customized to the needs of the customer. This characteristic implies that relationship-specific inputs lack thick spot markets, which has two consequences. On one hand, a firm can only procure this type of input by commissioning it from a specific supplier. On the other hand, once the input is produced (and the supplier has already incurred the costs of production), its value is always higher inside the relationship than in the market. This fact gives the buyer an incentive to take advantage of the supplier by renegotiating ex-post a lower price, which is known as the *hold-up problem*. In principle, higher customization requirements imply higher hold-up risk, but I abstract from differences in the level of input customization by assuming *full* relationship-specificity[24]:

Assumption 1. *Relationship-specific inputs are fully customized to the needs of their buyers and, thus, have no value for any other firm.*

By contrast, standardized inputs do not require any special customization and can be purchased on thick spot markets without the need of any formal contracts. This distinction is captured by the next assumption.

Assumption 2. *Standardized intermediate inputs are not affected by contracting frictions.*

This assumption, together with perfect competition, imply that standardized inputs are priced at the factory door at marginal cost.

3.5.2 Contractibility

The hold-up risk also depends on how enforceable is the initial agreement, which I call *contractibility*. This concept captures the viability of (1) putting into writing the specifications required by the buyer and (2) of inspecting and testing compliance of these requirements in a timely manner by the buyer (before money exchanges hands, for instance). It is reasonable to assume that the more intricate the specifications are, the more difficult it is to verify compliance. These two aspects are linked to the characteristics of the input being purchased.

[24]See Antràs (2016) for an example of a model with partial relationship specificity.

In addition, if a breach of contract is identified, it becomes important that its content is understood, the breach verified, the dispute resolved, and compliance enforced by the third-party imparting justice (whether courts and bailiffs, or arbitration tribunals). This means that contractibility also hinges on the strength of contract-enforcement institutions, which encompasses features such as accessibility (e.g. financial cost, geographical access), professionalism (e.g. availability of specialized courts), expediency (e.g. time required to enforce) and fairness (e.g. lack of corruption). This model focuses on this aspect of contractibility and abstracts from the first two.

When the transaction is international, it is not obvious which country's institutions are the relevant ones[25]. Berkowitz et al. (2004) and Berkowitz et al. (2006) show that there is an asymmetry between the risks that buyers and sellers face in international transactions. On one hand, exporters face the risk of not being paid by the importer, but they have at their disposal old tried-and-true tools to reduce this risk, like requesting pre-payment, or using bills of exchange and letters of credit. On the other hand, importers face the risk of getting defective goods. With this type of risk, mitigation implies hiring inspection and testing agents, who may not even be able to test every important specification, or be able to do so in a timely manner. The first implication of this asymmetry is that the *importer* is the party most likely to need strong contract-enforcement institutions. The second implication is that the relevant contract-enforcement institutions are that of the *exporter*'s country: if the latter loses the dispute, unless it voluntarily abides to the ruling, compliance can only be coerced in a country where the exporter has assets, which is most likely to be its home country.

Equation 3 expressed $m(v)$ as an aggregation of a continuum of specifications. I follow Acemoglu et al. (2007) and Antràs and Helpman (2008) in assuming that specifications in the range $[0, \mu_j]$ are "perfectly contractible", i.e., they can be fully specified ex-ante in a contract and this contract is costlessly enforceable ex-post, while tasks in the range $(\mu_j, 1]$ are "perfectly non-contractible". Hence, $\mu_j \in [0, 1]$ is the key parameter representing the degree of contractibility of any input

[25]It is not even obvious if *any* domestic institutions should matter at all since international transactions can leverage a set of international institutions created for them. First, contracts can specify a *Choice of Law* clause, where parties can opt in the law of any country (even a third one). Second, contracts can specify a *Choice of Forum* clause, where parties can agree on the jurisdiction that would resolve potential disputes (also, even a third country). Third, the parties could opt to solve their dispute via arbitration, instead of using the courts. Finally, if using courts, contract law has been standardized across countries via initiatives such as New York Convention of 1958 or the Vienna Convention of 1980. These features should dampen the effect that country differences in institutional strength has on cross-border transactions. However, they only impact the process of dispute *resolution*, not its *compliance*. If the losing party were to ignore the ruling, compliance can only be enforced by judicial execution organs in locations where that party has assets. Therefore, domestic institutions still influence international transactions, cf. Berkowitz et al. (2004) and Berkowitz et al. (2006).

sourced from country j.

$$m(\nu) = \exp\left\{ \underbrace{\int_0^{\mu_j} \log m(\iota) d\iota}_{\text{contractible}} + \underbrace{\int_{\mu_j}^1 \log m(\iota) d\iota}_{\text{non-contractible}} \right\}$$

Given that contractible specifications are symmetric to each other, they share the same optimal level in equilibrium, denoted by $m_c(\nu)$. The same applies to non-contractible specifications, whose optimal level is denoted by $m_n(\nu)$. Hence, we can rewrite the production function of an intermediate input as:

$$m(\nu) = m_c(\nu)^{\mu_j} m_n(\nu)^{1-\mu_j} \tag{5}$$

3.5.3 Multinational firms and contracting frictions

I hypothesize that, ceteris paribus, multinational firms are less likely to be affected by contracting frictions than domestic firms. This is based in the patterns found in section 2.2.2, which I rationalize in two ways. First, when sourcing from abroad foreign affiliates have the option to do so from another affiliate belonging to the same firm or from the firm HQ itself, in which case both parties' incentives are aligned and no hold-up problem arises. Second, even when the supplier is an unrelated party, they can use "quasi-hierarchical" structures to influence their behavior[26]. This second way of control is more likely to happen if the buyer's purchases represent a large share of the supplier's revenue[27]. Despite not having information on input suppliers in the data, multinational firms are the most likely candidates to satisfy this condition given the established empirical fact that they are among the largest and most productive firms. This idea is translated into the model by the following assumption:

Assumption 3. *Multinational firms face different contracting frictions when sourcing relationship-specific inputs than domestic firms.*

[26] See Zhou and Xu (2012) and Heide and John (1992).
[27] See Zhou and Xu (2012) and Heide (2003).

3.6 Fixed costs and variable frictions

3.6.1 Fixed costs

There is an infinitely large pool of potential entrants for each industry k and country h, and there are no constraints to entry except for a fixed cost of f_e^k units of home labor. The mass of domestic active firms N_0^k adjusts to guarantee that in equilibrium firms earn zero economic profits. In contrast, foreign affiliates can have positive profits. International trade doesn't entail extra fixed costs, so all firms will engage in international trade.

3.6.2 Variable frictions

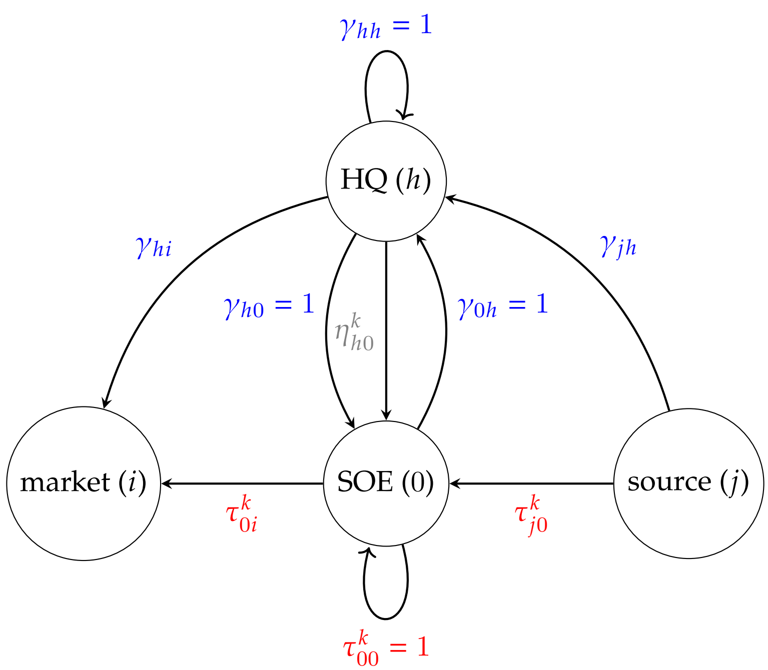
The model has three types of exogenous variable frictions: trade costs, multinational production (MP) costs, and communication costs. As it is usual in the literature, I model these three costs as (exogenous) "iceberg" frictions, meaning that for each unit sold in market i, a seller in country n must ship $t_{ni} > 1$ units to account for the fraction $t_{ni} - 1$ that is lost ("melts") in transit. These frictions also satisfy the triangle inequality, meaning that there are no indirect routes (via a third country) that are cheaper than direct trade, and their value for within-country trade is normalized to one ($t_{ii} = 1$).

Trade costs. Anderson and van Wincoop (2004) broadly define trade costs as those incurred in getting a good to final consumers on top of its marginal cost, such as transportation costs, policy barriers (e.g., tariffs), information costs, currency exchange costs, regulatory costs, and *contract enforcement costs*. In this paper, trade costs are defined in the same way, except for the contract enforcement component, which is modeled separately. Trade costs are denoted by τ_{j0}^k and τ_{0i}^k for imported inputs and exported goods, respectively.

MP costs. As in Ramondo and Rodríguez-Clare (2013) and Ramondo (2014), I also include a second set of iceberg-type costs that only affects multinational production. It represents the efficiency losses that happen when a firm transfers its technology to a new country. MP costs are denoted by $\eta_{h0}^k \geq 1$ and dampen the effect of firm-level productivity φ_h^k. Hence, the latter cannot be separately identified from the former without data on global MN activities.

Communication costs. Some trade costs, such a transportation costs, are intuitively related to the geographic distance between the exporter and importer locations, for domestic and foreign-owned firms alike. Others, such as information or logistical coordination costs, are not necessarily so if a firm has plants in multiple locations. For example, if a foreign affiliate is sourcing locally, it is reasonable to assume that information gathering and logistical coordination are conducted by its local agents. However, if instead it is sourcing from abroad, it is reasonable to assume that these activities are conducted from the *closest* location in which the firm has agents. The previous section showed evidence that the distance between the HQ and sourcing countries is negatively related to imports to their Mexican plants. To account for this, I include a second set of iceberg variable trade costs, which I call *communication costs* and denote by γ_{jh} and γ_{hi}, for input sourcing and final product sales, respectively[28]. Communication costs are normalized such that $\gamma_{hh} = 1$ and $\gamma_{0h} = \gamma_{h0} = 1$. The second normalization means that when sourcing or selling locally, foreign affiliates face the same trade and communication costs as domestic firms. The following figure summarizes the variable frictions in the model.

Figure 5. Variable frictions in the model: trade costs, MP costs, and communication costs.



[28] Antràs et al. (2023) also show that foreign affiliates in the U.S. import more from their HQ country and from countries in the HQ region (page 21, Table 5). However, given that their paper focuses on the extensive margin decision (which countries belong to firms "sourcing set"), they do not model this finding. Like them, I also found that foreign affiliates tend to import from countries closer to their HQ location. But unlike them, this effect does not seem to be driven by imports from their HQ country.

3.7 Contracting and bargaining

Given that final good producers face a perfectly competitive fringe of potential suppliers in every country, when sourcing relationship-specific inputs, they will offer a take-it-or-leave-it contract in each country. However, once the contract is signed and the input is manufactured, the power balance between the parties changes due to the following assumption.

Assumption 4. *After contracts are signed, the buyer is locked-in and cannot change suppliers.*

This assumption is a way to account for the fact that buyers may have delivery deadlines that need to be met and that by the time they are able to inspect the inputs, there is not enough time to search for a new supplier. This creates a risk that suppliers could try to take advantage of the buyer and renegotiate the terms of the exchange in their favor[29].

Sellers also face the risk of being taken advantage of by the buyer given that, by definition, relationship-specific inputs have zero value outside of the relationship, which gives incentives to the buyer to also try to "renegotiate" the terms of exchange. These features are reflected in the model by assuming that after contracts are signed but before trade happens, there is a renegotiation phase whose outcome determines the allocation of the rents from trade to all the parties involved.

3.7.1 Timing of contracting

1. Final-good firms (buyers) post take-it-or-leave-it contracts to source each input ν. These contracts stipulate two items:

    - The level of *contractible* specifications $m_c(\nu)$.
    - A fee to win the contract $f(\nu)$

2. Suppliers bid to get these contracts. Contracts are signed.

3. Simultaneously, buyers hire labor L, and suppliers choose how much to invest in *non-contractible* specifications $m_n(\nu)$ (contractible ones are conducted as stipulated in the contract).

4. Before handing their inputs to the buyer, the firm and its suppliers *bargain* over the distribution of the revenue $R(\varphi)$.

[29]"Renegotiation" doesn't have to be taken literally. As illustrated by Antràs (2016), suppliers can de facto "renegotiate" the terms of exchange by substituting high quality (but expensive) materials for low quality (but cheap) ones. This risk is more likely to happen the more difficult it is for the buyer - or a third party - to infer which materials were used in the production of the input.

5. Trade happens, the final good is produced and sold, and rents are distributed according to the agreement reached in step 4.

3.7.2 Bargaining

Since buyers source more than one input, bargaining must be modeled multilaterally. In multilateral bargaining settings, a commonly used solution concept from cooperative game theory is the **Shapley value**, which was shown by Lloyd Shapley in 1953 (see Winter (2002)) to be the *unique* solution that satisfies four axioms that, together, could be considered to characterize a "fair" distribution[30]. In addition, the allocation formula has an intuitive interpretation: it is the average marginal contribution of each player across all possible coalitions. For these reasons, I make the following assumption[31]:

Assumption 5. *The distribution of revenue between the buyer and its suppliers that arises in equilibrium as the outcome of the bargaining process is characterized by their Shapley values.*

4. Solving the model

4.1 Consumers' utility maximization

Manufactures. The preferences laid out in section 3.2 give rise to the following demand for good ω:

$$q_i^k(\omega) = p_i^k(\omega)^{-\sigma_k} (P_i^k)^{\sigma_k - 1} \beta_k E_i \tag{6}$$

where E_i is aggregate spending on country i, P_i^k is the CPI of industry k, defined as:

$$P_i^k \equiv \left(\int_{\omega \in \Omega_i^k} p_i^k(\omega)^{1-\sigma_k} d\omega \right)^{\frac{1}{1-\sigma_k}} \tag{7}$$

[30]The four axioms are: (1) efficiency (the players distribute among themselves the resources available to the grand coalition, i.e. no money left on the table), (2) symmetry (if two players' contribution to any coalition is always the same, they should receive equal shares), (3) dummy (if a player doesn't contribute to any coalition, it should receive nothing), and (4) additivity (the rule that distributes the resources to the coalition members should be an additive operator on the space of all games).

[31] Multilateral Nash bargaining (NB) is an alternative solution concept, but there are good reasons not to use it. First, the Shapley value allows for partial cooperation among subsets of agents while NB does not. Second, and more importantly, the NB solution is incompatible with moral hazard. This conclusion is a consequence of two features of the model. On one hand, given that relationship-specific inputs have zero outside value, the NB solution allocates a *constant* share of revenue to each agent, regardless of their actions. On the other hand, given that each supplier is infinitesimal, they do not internalize the effect of their choices in total revenue. Together, these two features imply that under the NB sharing rule all suppliers would try to free ride the others. In equilibrium, this leads to zero supply of inputs (equation 5) and zero revenue.

Non-manufactures. Similarly, the demands for non-manufacturing goods are:

$$q^T_{hi} = (p^T_{hi})^{-\sigma_T}(P^T_i)^{\sigma_T - 1}\beta_T E_i$$
$$Q^N_i = (P^N_i)^{-1}\beta_N E_i$$

with:

$$P^T_i \equiv \left(\sum_{h=0}^{J}(p^T_{hi})^{1-\sigma_T}\right)^{\frac{1}{1-\sigma_T}} \tag{8}$$

4.2 Plant's profit maximization

Note: Given that all plants in this model operate in the same domestic economy 0, I omit the assembly location index wherever I consider it does not affect clarity.

Manufactures. The marginal cost of any good ω is constant for all firms, with its value depending on the firm's home country, h:

$$c^k_h(\omega) = c^k_h \equiv \frac{\eta^k_h (w_0)^{\alpha^k_l}(P^{sk}_h)^{\alpha^k_s}(P^{rk}_h)^{\alpha^k_r}(P^N_0)^{\alpha^k_N}}{\varphi^k_h A^k_0} \tag{9}$$

where η^k_h is the MP efficiency loss incurred by firms from country h, A^k_0 is the SOE's productivity in assembly, P^N_0 is the price of domestic non-tradable inputs, and P^{sk}_h and P^{rk}_h are the price indices for standardized and relationship-specific inputs, respectively. The input price indices are CES aggregators equal to:

$$P^{xk}_h \equiv \left(\int_0^1 p_h(\nu)^{1-\zeta^k_x} d\nu\right)^{\frac{1}{1-\zeta^k_x}}, \quad x \in \{r, s\} \tag{10}$$

Given that the marginal cost of production is constant, profit maximization can be solved for each destination market independently. The optimal price to sell to market i, inclusive of trade and communication costs, is also constant and the same for all goods assembled by firms from the same home country:

$$p^k_{hi}(\omega) = p^k_{hi} = \left(\frac{\sigma_k}{\sigma_k - 1}\right)c^k_h \tau^k_{0i}\gamma_{hi} \tag{11}$$

This result and equation 6 imply that sales to any market i are also the same for all firms from the same country and assembly location. Given that there are no fixed costs for exporting, all active firms sell to all countries. Therefore, total revenue is also the same for all firms from a given home country h[32].

$$R_h^k = \left(\frac{\sigma_k}{\sigma_k - 1}\right)^{1-\sigma_k} (c_h^k)^{1-\sigma_k} \left[\beta_k E_0 (P_0^k)^{\sigma_k - 1} + FMA_h^k\right] \tag{12}$$

where FMA_h^k, which stands for "Foreign Market Access", represents the effective size of the global market for a firms from country h, and it is equal to:

$$FMA_h^k \equiv \sum_{i \neq 0} \beta_k E_i (P_i^k)^{\sigma_k - 1} (\tau_{0i}^k \gamma_{hi})^{1-\sigma_k}$$

Variable profits and the derived demands for labor and intermediate inputs, which are a constant proportion of revenues, are also the same for all firms from a given home country h:

$$\pi_h^k = \frac{R_h^k}{\sigma_k} \tag{13}$$

$$L_h^k = \left(\frac{\alpha_l^k}{w_0}\right)\left(\frac{\sigma_k - 1}{\sigma_k}\right) R_h^k \tag{14}$$

$$M_h^{Nk} = \left(\frac{\alpha_N^k}{P_0^N}\right)\left(\frac{\sigma_k - 1}{\sigma_k}\right) R_h^k \tag{15}$$

$$m_{jh}^{xk}(\nu) = (P_h^{xk})^{\zeta_x^k - 1} p_j^k(\nu)^{-\zeta_x^k} \alpha_x^k \left(\frac{\sigma_k - 1}{\sigma_k}\right) R_h^k, \quad x \in \{r, s\} \tag{16}$$

Non-manufactures. Non-manufactured goods are priced at marginal cost, so their prices and total revenue from final goods are[33]:

$$p_{0i}^T = \frac{w_0 \tau_{0i}^T \gamma_{0i}}{A_0^T} \quad \Rightarrow \quad R_0^T = \left(\frac{w_0}{A_0^T}\right)^{1-\sigma_T} \left[\beta_T E_0 (P_0^T)^{\sigma_T - 1} + FMA_0^T\right] \tag{17}$$

$$P_0^N = \frac{w_0}{A_0^N} \quad \Rightarrow \quad R_0^N = \beta_N E_0 \tag{18}$$

where FMA_0^T is defined in a similar way to FMA_h^k and it is equal to:

$$FMA_0^T \equiv \sum_{i \neq 0} \beta_T E_i (P_i^T)^{\sigma_T - 1} (\tau_{0i}^T \gamma_{0i})^{1-\sigma_T}$$

[32] When mapping the model to the data to conduct counterfactual exercises, I have to take a stand regarding which industries produce the intermediate inputs. I allocate the demand for standardized and relationship-specific inputs across all tradable sectors using information from firm-level input purchases and industry-level input-output tables. Strictly speaking, this means that equation 12 only represents revenue from *final good* sales, not total revenue. I postpone the inclusion of intermediate good sales until section 5.

[33] The same observation in the previous footnote applies for the non-manufacturing tradable sector T.

4.3 Standardized inputs

Perfect competition in the standardized inputs market implies that they are priced at marginal cost plus trade and communication frictions. For example, if input ν is sourced from country j, its price would be:

$$p_{jh}^{sk}(\nu) = \frac{w_j \gamma_{jh} \tau_{j0}^k}{a_j^{sk}(\nu)} \tag{19}$$

Given that standardized inputs are homogeneous, firms always source from the cheapest location, so the *actual* price paid in equilibrium for input ν is:

$$p_h^{sk}(\nu) = \min_j \left\{ p_{jh}^{sk}(\nu) \right\}$$

The assumption that productivities are drawn from a Fréchet distribution imply that potential and actual prices are random variables distributed Weibull.

4.3.1 Price index

By taking advantage of the properties of the Weibull distribution, we can get a closed-form expression for the price index without having to determine the source country of each input. The closed-form of equation 10 is:

$$P_h^{sk} = \left[\int_0^\infty p^{1-\zeta_s^k} d\Pr\left(p_h^{sk}(\nu) \leq p \right) \right]^{\frac{1}{1-\zeta_s^k}} = B_s^k \Theta_h^{sk} \tag{20}$$

where:

$$B_s^k \equiv \Gamma\left(\frac{\theta_s + 1 - \zeta_s^k}{\theta_s} \right)^{\frac{1}{1-\zeta_s^k}}$$

$$\Theta_h^{sk} \equiv \left[\sum_j T_j^{sk} (w_j \gamma_{jh} \tau_{j0}^k)^{-\theta_s} \right]^{-\frac{1}{\theta_s}}$$

4.3.2 Expenditure share

Similarly, the properties of the Weibull distribution imply that the share of expenditure in standardized inputs from country j is equal to the probability that an input is sourced from that country

(χ_{jh}^{sk}):

$$\frac{X_{jh}^{sk}}{\sum_{j'} X_{j'h}^{sk}} = \chi_{jh}^{sk} \equiv \frac{T_j^{sk}(w_j \gamma_{jh} \tau_{j0}^k)^{-\theta_s}}{\sum_{j'} T_{j'}^{sk}(w_{j'} \gamma_{j'h} \tau_{j'0}^k)^{-\theta_s}} \tag{21}$$

4.4 Relationship-specific inputs

Unlike standardized inputs, the "marginal-cost-plus-trade-costs" formula is not the price paid for relationship-specific inputs. Instead, prices are an outcome of the sourcing game played by the buyer and its suppliers. First, I show how to calculate the players' revenue shares, which are modeled as their (asymptotic) Shapley values. Then, I use backward induction to determine the equilibrium level of any input $m_j(\nu)$. Third, I characterize the equilibrium quantities with contracting frictions relative to a friction-less benchmark. Finally, I get an expression for the price, inclusive of contracting frictions, that rationalizes trade flows and characterize it.

4.4.1 Bargaining solution

As was stated in assumption 5, I assume that revenue is distributed among the agents according to their Shapley values. Thus, the first step is to obtain these functions. However, the Shapley value was originally defined for a *finite* number of players, while this model features a *continuum* of suppliers. I follow Acemoglu, Antràs and Helpman (2007) in adapting it to a game with a continuum of players, what is known as the *asymptotic* Shapley value.

Proposition 1 (Revenue shares)

Let input ν be produced by a supplier in country j.

1. *The supplier's share of rents is:*

$$s_j^k(\nu) = \left(\frac{\alpha_r^k \rho_k}{\alpha_r^k \rho_k + \rho_r^k}\right)\left(\frac{m_j^k(\nu)}{M_r^k}\right)^{\rho_r^k} \tag{22}$$

   where $\rho_r^k \equiv \frac{\zeta_r^k - 1}{\zeta_r^k}$ and $\rho_k \equiv \frac{\sigma_k - 1}{\sigma_k}$.

2. *The buyer's share of rents is:*

$$s_b^k = \frac{\rho_r^k}{\alpha_r^k \rho_k + \rho_r^k} \tag{23}$$

Proposition 1 shows that the buyer gets a larger share when (1) it is easy to substitute across inputs ($\uparrow \zeta_r^k$), (2) the technological need for inputs is low ($\downarrow \alpha_r^k$), and (3) there is low competitive pressure to reduce costs ($\downarrow \sigma_k$). Moreover, note that because the revenue share of supplier v ($s_j(v)$) depends on the value of $m_j(v)$, it has an incentive to pick a non-zero level of non-contractible specifications (see footnote 31).

4.4.2 Solution to the buyer-supplier game

Given that suppliers know the share they will be able to extract from their buyer in advance (equation 22), they take this into account when choosing how much to invest in non-contractible specifications[34]. Likewise, given that the buyer also knows beforehand the revenue shares and the behavior of its suppliers, it takes that into account when designing the contract. The following proposition summarizes the levels of contractible and non-contractible specifications, as well as the equilibrium level of a relationship-specific input v:

Proposition 2 (Equilibrium levels of specifications and of input)
Let input v be produced by a supplier in country j.

1. *The optimal level of non-contractible specifications is:*

$$m^k_{n,j}(v) = \left[\frac{\alpha^k_r \rho_k R M_r^{-\rho^k_r}}{c^k_j(v)}\right]^{\frac{1}{1-\rho^k_r}} \underbrace{\left\{ s_b{}^{1-\mu_j \rho^k_r} \left[\frac{1-s_b(1-\mu_j)\rho^k_r}{1-(1-\mu_j)\rho^k_r}\right]^{\mu_j \rho^k_r} \right\}^{\frac{1}{1-\rho^k_r}}}_{\equiv \Gamma^k_{n,j}} \tag{24}$$

2. *The optimal level of contractible specifications is:*

$$m^k_{c,j}(v) = \left[\frac{\alpha^k_r \rho_k R M_r^{-\rho^k_r}}{c^k_j(v)}\right]^{\frac{1}{1-\rho^k_r}} \underbrace{\left\{ s_b{}^{(1-\mu_j)\rho^k_r} \left[\frac{1-s_b(1-\mu_j)\rho^k_r}{1-(1-\mu_j)\rho^k_r}\right]^{1-(1-\mu_j)\rho^k_r} \right\}^{\frac{1}{1-\rho^k_r}}}_{\equiv \Gamma^k_{c,j}} \tag{25}$$

3. *The optimal level of input v is:*

$$m^k_j(v) = \left[\frac{\alpha^k_r \rho_k R M_r^{-\rho^k_r}}{c^k_j(v)}\right]^{\frac{1}{1-\rho^k_r}} \underbrace{\left\{ s_b{}^{1-\mu_j} \left[\frac{1-s_b(1-\mu_j)\rho^k_r}{1-(1-\mu_j)\rho^k_r}\right]^{\mu_j} \right\}^{\frac{1}{1-\rho^k_r}}}_{\equiv \Gamma^k_j = \left(\Gamma^k_{c,j}\right)^{\mu_j} \left(\Gamma^k_{n,j}\right)^{1-\mu_j}} \tag{26}$$

[34] Given the atomistic nature of suppliers, they take R and M_r as given when maximizing their payoff.

where $c_j(\nu)$ is the marginal cost plus trade costs of input ν. For example, if the input is sourced from country j then $c_j(\nu)$ is:

$$c_j^k(\nu) = \frac{w_j \gamma_{jh} \tau_{j0}^k}{a_j^{rk}(\nu)}$$

The expression in square brackets on the right-hand-side (RHS) of equations 24, 25 and 26 is the benchmark result when inputs are standardized or there is perfect contractibility. In that case, the distinction between contractible and non-contractible specifications is no longer meaningful since $m_j(\nu) = m_{c,j}(\nu) = m_{n,j}(\nu)$. The following proposition summarizes the main effects that incomplete contracting has on the level relationship-specific inputs:

Proposition 3 (Effects of incomplete contracting on the equilibrium levels of relationship-specific inputs)

1. *Contracting frictions (CF) reduce the quality-adjusted equilibrium level of relationship-specific inputs relative to the perfect contracting (PC) benchmark:*

$$\Gamma_j^k \in [0,1] \quad \Rightarrow \quad m_j^{CF}(\nu) \leq m_j^{PC}(\nu)$$

2. *Non-contractible specifications are relatively more affected by contracting frictions than contractible ones:*

$$m_{n,j}^{CF}(\nu) \leq m_{c,j}^{CF}(\nu) \leq m_{n,j}^{PC}(\nu) = m_{c,j}^{PC}(\nu)$$

3. *The contracting frictions parameter Γ_j^k decreases with (1) the strength of contract enforcement in the supplier's country (μ_j) and (2) the elasticity of substitution among relationship-specific inputs (ζ_r^k). On the other hand, it increases with (1) the buyer's technological need for these inputs (α_r^k) and (2) the elasticity of demand the buyer faces for its products (σ_k):*

$$\Gamma_j^k(\overbrace{\zeta_r^k}^{+}, \overbrace{\alpha_r^k}^{-}, \overbrace{\sigma_k}^{-}, \overbrace{\mu_j}^{+})$$

4. *The contracting frictions parameter Γ_j^k converges to one (contracting frictions disappear) as (1) contract enforcement (μ_j) becomes perfect, (2) the buyer's technological need for relationship-specific inputs (α_r^k) goes to zero, or (3) the elasticity of demand the buyer faces for its products (σ_k) becomes unit elastic. On the other hand, it converges to zero (trade collapses) as elasticity of substitution among*

relationship-specific inputs (ζ_r^k) becomes unit elastic

$$\lim_{\mu_j \nearrow 1} \Gamma_j^k = \lim_{\alpha_r^k \searrow 0} \Gamma_j^k = \lim_{\sigma_k \searrow 1} \Gamma_j^k = 1, \quad \textit{and} \quad \lim_{\zeta_r^k \searrow 1} \Gamma_j^k = 0$$

4.4.3 Effective price

Proposition 2 shows how contracting frictions affect the quality-adjusted equilibrium level of an input. In order to be able to use the approach of Eaton and Kortum (2002) with relationship-specific inputs the same way I do with standardized inputs, I need find an expression for how (implicit) prices are affected by contracting frictions. The following proposition introduces a second parameter for contracting frictions (Λ_j^k) that works through prices, instead of quantities.

Proposition 4 (Price for relationship-specific inputs)
Let input ν be produced by a supplier in country j. The price that rationalizes trade flows from country j is:

$$p_{jh}^{rk}(\nu) = \frac{w_j \gamma_{jh} \tau_{j0}^k \Lambda_j^k}{a_j^{rk}(\nu)} \tag{27}$$

where:

$$\Lambda_j^k \equiv \frac{1}{s_b{}^{1-\mu_j} \left[\frac{1-s_b(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k}\right]^{\mu_j} \left[\mu_j \left[\frac{1-s_b(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k}\right] + (1-\mu_j)s_b\right]^{\frac{1-\rho_r^k}{\rho_r^k}}}$$

The following proposition characterizes the contracting frictions parameter Λ_j^k:

Proposition 5 (Properties of the contracting frictions parameter Λ_j^k)

1. *Λ_j^k behaves likes an iceberg variable cost, in the sense that it is bounded from below by one and it is unbounded from above:*

$$\Lambda_j^k \in [1, +\infty)$$

2. *Λ_j^k decreases (contracting frictions are lower) with (1) the strength of contract enforcement in the supplier's country (μ_j) and (2) the elasticity of substitution among relationship-specific inputs (ζ_r^k). On the other hand, it increases with (1) the buyer's technological need for these inputs (α_r^k) and (2) the elasticity of demand the buyer faces for its products (σ_k):*

$$\Lambda_j^k(\overbrace{\zeta_r^k}^{-}, \overbrace{\alpha_r^k}^{+}, \overbrace{\sigma_k}^{+}, \overbrace{\mu_j}^{-})$$

3. *Λ_j^k converges to one (contracting frictions disappear) as (1) contract enforcement becomes perfect (μ_j), (2) the buyer's technological need for relationship-specific inputs goes to zero (α_r^k), or (3) the elasticity of demand the buyer faces for its products becomes unit elastic (σ_k). On the other hand, it diverges (trade collapses) as the elasticity of substitution among relationship-specific inputs becomes unit elastic (ζ_r^k).*

$$\lim_{\mu_j \nearrow 1} \Lambda_j^k = \lim_{\alpha_r^k \searrow 0} \Lambda_j^k = \lim_{\sigma_k \searrow 1} \Lambda_j^k = 1, \quad \textit{and} \quad \lim_{\zeta_r^k \searrow 1} \Lambda_j^k = +\infty$$

4.4.4 Price index

The closed-form expression for this price index is obtained following the same steps as the standardized inputs case: first, rewrite the integral in equation 10 in terms of prices, and then use their cumulative density function to get:

$$P_h^{rk} = \left[\int_0^\infty p^{1-\zeta_r^k} d\Pr\left(p_h^{rk}(\nu) \le p\right) \right]^{\frac{1}{1-\zeta_r^k}} = B_r^k \Theta_h^{rk} \tag{28}$$

where:

$$B_r^k \equiv \Gamma\left(\frac{\theta_r + 1 - \zeta_r^k}{\theta_r}\right)^{\frac{1}{1-\zeta_r^k}}$$

$$\Theta_h^{rk} \equiv \left[\sum_j T_j^{rk} (w_j \gamma_{jh} \tau_{j0}^k \Lambda_j^k)^{-\theta_r} \right]^{-\frac{1}{\theta_r}}$$

The main difference between the two indices is that relationship-specific inputs are affected by the contracting frictions term Λ_j^k.

4.4.5 Expenditure share

Similarly, the closed-form expression for the share of expenditure in relationship-specific inputs from country j is equal to the probability that an input is sourced from that country (χ_{jh}^{rk}):

$$\frac{X_{jh}^{rk}}{\sum_{j'} X_{j'h}^{rk}} = \chi_{jh}^{rk} \equiv \frac{T_j^{rk}(w_j \gamma_{jh} \tau_{j0}^k \Lambda_j^k)^{-\theta_r}}{\sum_{j'} T_{j'}^{rk}(w_{j'} \gamma_{j'h} \tau_{j'0}^k \Lambda_{j'}^k)^{-\theta_r}} \tag{29}$$

4.5 Aggregation

There are two main groups of firms: "domestic", defined as those whose parent firm is Mexico ($h = 0$), and "foreign", those whose parent firm is from abroad ($h \neq 0$). Since I am assuming away any fixed costs to export and import, all active firms trade globally. I am not modelling the foreign investment decisions of foreign firms, so I will take their presence as exogenously given. Given that empirically I cannot identify which domestic-owned firms are multinationals, I assume that they can only assemble in the SOE:

Assumption 6. *Domestic firms cannot open plants abroad.*

4.5.1 Revenue, profit and disposable income

Given that all firms in the same group are identical by assumption, aggregate revenue and profits of domestic firms in industry k are equal to equations 12 and 13 multiplied by the mass of firms N_0^k:

$$R_0^k = N_0^k \left(\frac{\sigma_k}{\sigma_k - 1}\right)^{1-\sigma_k} (c_0^k)^{1-\sigma_k} \left[\beta_k E_0 (P_0^k)^{\sigma_k - 1} + FMA_0^k\right] \tag{30}$$

$$\Pi_0^k = \frac{R_0^k}{\sigma_k} - N_0^k w_0 f_e^k$$

Aggregate revenue for foreign firms is similar, but their profits are not. I assume that foreign firms paid the entry costs and the fixed cost related to multinational production in their home countries, thus their aggregate profits are equal to:

$$\Pi_h^k = \frac{R_h^k}{\sigma_k} \tag{31}$$

Finally, as was stated in section 3.2, consumer's disposable income (or aggregate nominal spending) is equal to the sum of the aggregate wage bill and aggregate profits from *domestic* firms. The last emphasis is a consequence of assuming that profits of foreign affiliates in the SOE are sent abroad. In addition, since the non-manufacturing sectors and the fringe of domestic manufacturing suppliers operate in perfectly competitive markets, they do not earn economic profits. Putting all together, the disposable income for domestic consumers is:

$$E_0 = w_0 L_0 + \sum_k \Pi_0^k + D_0 \tag{32}$$

where D_0 is an exogenous variable to account for current account deficits in the data.

4.5.2 Consumer Price Index

The CPI was defined in equation 7. Given that all firms in the same group are identical, we can write the CPI in terms of their respective "group CPIs":

$$P_0^k = \Bigg[\underbrace{N_0^k \left(p_{00}^k\right)^{1-\sigma_k}}_{\text{Domestic firms}} + \underbrace{\sum_{h \neq 0} N_h^k \left(p_{h0}^k\right)^{1-\sigma_k}}_{\text{Foreign affiliates}} + \underbrace{\sum_{n \neq 0} N_n^k \left(p_{n0}^k\right)^{1-\sigma_k}}_{\text{Imports}} \Bigg]^{\frac{1}{1-\sigma_k}}$$

$$\Rightarrow P_0^k = \left[\left(P_{00}^k\right)^{1-\sigma_k} + \sum_{h \neq 0} \left(P_{h0}^k\right)^{1-\sigma_k} + CMA_0^k \right]^{\frac{1}{1-\sigma_k}} \tag{33}$$

where CMA_0^k stands for "Consumer Market Access" and represents both the size and cost efficiency of foreign exporters as it is expressed in their prices, which given the SOE assumption, are exogenous in the model. The other two CPIs have the same interpretation (for domestic firms and foreign firms' affiliates producing and selling domestically) but they are endogenous and equal to:

$$\left(P_{h0}^k\right)^{1-\sigma_k} = N_h^k \left[\left(\frac{\sigma_k}{\sigma_k - 1} \right) c_h^k \right]^{1-\sigma_k} \tag{34}$$

where I am normalizing both the trade (τ) and communications (γ) costs of plants operating in the SOE to one (regardless of the home country).

4.6 Equilibrium

A **small open economy equilibrium** is defined as the vector of domestic wage (w_0), mass of domestic firms per industry ($\{N_0^k\}_k$), and consumer price indices per industry ($\{P_0^k\}_k$, P_0^T, P_0^N) such that (1) domestic consumers maximize utility, (2) all firms with plants in the SOE maximize profits, (3) all markets clear, and (4) the zero profit condition is met.

4.6.1 Optimization

Consumer optimization is accounted for by the product demand and firm's revenue functions (equations 6 and 12), which leads to the aggregate revenue function (equation 30). Firm's optimization is accounted for by their prices (equations 11, 17, and 18 for consumer goods, and equations 19 and 27 for inputs), which lead to the aggregate revenue function and the price indices for consumer goods (equations 33 and 34) and intermediate inputs (equations 20 and 28 for standardized and relationship-specific, respectively).

4.6.2 Market clearing of goods and inputs

Final goods markets always clear as long as consumers meet their budget constraint (equation 1) subject to disposable income being equal to equation 32. Intermediate input markets clearing is also implicit in the input demand function (equations 14 and 15 for labor and intermediate inputs, respectively) and the fact that total expenditure is always equal to a proportion $\left(1 - \frac{1}{\sigma_k}\right)$ of total revenue.

4.6.3 Market clearing of labor

The labor market clears if aggregate labor demand equals aggregate labor supply L_0, an exogenous parameter. Aggregate labor demand is equal to the sum of sector labor demands ($L_0 = \sum_k L_0^k + L_0^T + L_0^N$), which in turn are equal to the sum of the firms' labor demands. For ease of exposition, let me unpack these components one by one before aggregating them up.

Manufacturing industries. Manufacturing firms generate a direct and an indirect labor demand. The direct demand comes from equation 14 and it reflects the labor used in the assembly of manufacturing consumer goods. The indirect demand comes from equations 15 and 16, together with equation 4, which implies that the labor used by suppliers is proportional to their sales. Part of this demand goes to foreign suppliers when firms import inputs, so the total (direct and indirect) *domestic* labor demand generated by firms with home country h in industry k is:

$$L_{0h}^k = \underbrace{\left(\frac{\alpha_l^k}{w_0}\right)\left(\frac{\sigma_k - 1}{\sigma_k}\right) R_h^k}_{\text{direct: assembly}} + \underbrace{\left(\frac{\alpha_s^k \chi_{0h}^{sk}}{w_0}\right)\left(\frac{\sigma_k - 1}{\sigma_k}\right) R_h^k}_{\text{indirect: standardized inputs}} + \underbrace{\left(\frac{\alpha_r^k \chi_{0h}^{rk}}{w_0}\right)\left(\frac{\sigma_k - 1}{\sigma_k}\right) R_h^k}_{\text{indirect: relationship-specific inputs}} + \underbrace{\left(\frac{\alpha_N^k}{w_0}\right)\left(\frac{\sigma_k - 1}{\sigma_k}\right) R_h^k}_{\text{indirect: non-tradable inputs}}$$

$$= \left(\frac{\alpha_l^k + \alpha_s^k \chi_{0h}^{sk} + \alpha_r^k \chi_{0h}^{rk} + \alpha_N^k}{w_0}\right)\left(\frac{\sigma_k - 1}{\sigma_k}\right) R_h^k \tag{35}$$

Non-manufacturing industries. The representative firm in the non-manufacturing tradable sector only sells to final consumers (domestically and abroad), with sector-level revenue as in equation 17. Given that this sector is perfectly competitive, revenue equals expenditure, and since production only uses labor (equation 2), then revenue equals the wage bill, which implies the following labor demand[35]:

$$L_0^T = \frac{R_0^T}{w_0} \tag{36}$$

The representative firm in the non-tradable sector only sells domestically (it does not export by definition), but to both the representative consumer and firms in the manufacturing sector. The employment derived from its sales to other industries has already been accounted by the "indirect: non-tradable inputs" component in equation 35, while that derived from its sales to the final consumer is similar to that of the previous sector, with sales being an exogenous share of national disposable income, as in equation 18:

$$L_0^N = \frac{\beta_N E_0}{w_0} \tag{37}$$

Labor market clearing. Putting these pieces together, the labor market clearing condition is:

$$L_0 = \sum_{k=1}^{K} \left\{ L_{00}^k + \sum_{h \neq 0} L_{0h}^k \right\} + L_0^T + L_0^N \tag{38}$$

4.6.4 Zero profit condition

Free entry and exit of firms in the manufacturing sectors imply that, despite operating under monopolistic competition, profits for domestic firms are zero in equilibrium (thus equation 32 becomes simply $E_0 = w_0 L_0 + D_0$), conditional on an exogenous number of foreign affiliates operating in the SOE:

$$\Pi_0^k = \frac{R_0^k}{\sigma_k} - N_0^k w_0 f_e^k = 0 \tag{39}$$

This condition implies that all variable profits of domestic firms goes to pay for the fixed cost (f_e^k). Given that this cost is measured in labor units, this constitutes an additional source of labor demand.

5. Counterfactual exercises

The empirical goal of this paper is to estimate the relative "importance" of the three potential advantage channels that foreign multinationals may have relative to domestic firms in the manufacturing sector. Each channel is represented in the theoretical model by a specific parameter.

[35]There is only direct labor demand since this sector does not use intermediate inputs.

First, contracting frictions are represented by the parameter Λ_j^k. By allowing international trade in inputs, firms are not constrained to local contract enforcement institutions since these can be avoided by importing relationship-specific inputs[36]. Since this is a prerogative of both domestic and foreign firms, to allow for the possibility of a *contracting frictions channel*, I let the parameter to vary by HQ country (Λ_{jh}^k), although this was not explicitly modeled. Second, international trade costs are represented by $\{\tau_{j0}^k, \tau_{0i}^k\}$ and $\{\gamma_{jh}, \gamma_{hi}\}$. Since the parameters in the first group (the traditional trade costs) are indexed by the place in which production takes place (the SOE), foreign and domestic firms sourcing from the same country necessarily face the same wedge. On the contrary, communication parameters are indexed by the HQ country, which allows for differences between domestic and foreign firms. Hence, this is the set of parameters that embody the *geographical channel*, which can exist in sourcing (γ_{jh}) and in marketing (γ_{hi}). Finally, any other source of advantage unrelated to geography or contracting frictions (such as technology) is represented by the productivity parameter φ_h^k.

To isolate and compare the quantitative effects of these three channels, I follow the exact-hat algebra approach of Dekle et al. (2008) to estimating counterfactual equilibria. This method has the advantage of reducing the amount of parameters that need to be estimated/calibrated by focusing only on those that are relevant to the exercise at hand. This approach has been extensively used in the literature to conduct counterfactual exercises in which the size of the shock (defined percent change) is chosen by the researcher, such as "a 10% reduction in trade costs." One reason to frame counterfactual exercises this way is that the objects that are being shocked are unobservable. This paper is different because the size of a shock is implicitly defined as the percent change that "turns off" of a specific channel, which requires knowledge of its current size. For example, "turning off the productivity channel" means calculating an equilibrium in which φ_h^k becomes φ_0^k for all foreign firms. Whether this is a 10% or 50% reduction in φ_h^k hinges on the size of φ_0^k/φ_h^k. Given that none of the three parameters are directly observable, I need to devise a strategy to back out these relative sizes using observable empirical moments. In the next sections, I go over the details of each counterfactual exercise. I follow the convention in the literature of using $\hat{x}$ to represent $\frac{x'}{x}$, where x and x' are the initial and final values of variable x, respectively. I use colors to highlight the shocks to the contracting, geography and productivity channels, and the empirical moments.

[36]This is true as long as the relevant contract enforcement institutions are those of the *exporter's*. The argument behind this is elaborated in section 3.5.2.

5.1 Shocks

The three channels discussed above imply three different shocks to the equilibrium equations. I isolate each channel by shocking one parameter at the time and solving the model to obtain its corresponding counterfactual equilibrium. I can gauge the channels' relative "importance" by choosing an outcome (say, the change in real GDP) and comparing its value with respect to the case when *all* parameters are shocked simultaneously. The shocks are:

1. *Contracting frictions:* if foreign affiliates faced the same contracting frictions than domestic firms when sourcing inputs:

$$\Lambda_{jh}^{k} \rightarrow \Lambda_{j0}^{k}, \quad \forall h \in \mathcal{J}_{0}^{k}$$

2. *Geography:* if foreign affiliates faced the same communication frictions than domestic firms when...

   (a) ...sourcing inputs:

$$\gamma_{jh} \rightarrow \gamma_{j0}, \quad \forall h \in \cup_{k} \mathcal{J}_{0}^{k}$$

   (b) ...marketing their products:

$$\gamma_{hi} \rightarrow \gamma_{0i}, \quad \forall h \in \cup_{k} \mathcal{J}_{0}^{k}$$

3. *Productivity:* if foreign affiliates had the same productivity as domestic firms:

$$\tilde{\varphi}_{h}^{k} \equiv \frac{\varphi_{h}^{k}}{\eta_{h}^{k}} \rightarrow \varphi_{0}^{k}, \quad \forall h \in \mathcal{J}_{0}^{k}$$

where $\mathcal{J}_{0}^{k}$ is the subset of countries that have plants in the SOE. Note that in the case of the productivity shock, I cannot separately identify the "pure" productivity that foreign firms bring from home (φ_{h}^{k}) from the efficiency loss from producing in a different country, represented by η_{h}^{k}. Therefore, this counterfactual exercise is defined in terms of their ratio ($\tilde{\varphi}_{h}^{k}$), which can be interpreted as the "effective" productivity that foreign firms have when operating in the SOE.

5.2 Equilibrium in relative changes

In this section, I show the equations that determine the equilibrium in relative changes (hats) when *all* shocks happen simultaneously. The exercises with single shocks are special cases in which the other shocks are set to be equal to one.

5.2.1 Changes in manufacturing unit costs

Unit costs for manufacturing goods are shown in equation 9. Their change is determined by the following four equations:

$$\widehat{c}^k_h = \frac{(\widehat{w}_0)^{\alpha^k_l}(\widehat{P}^{sk}_h)^{\alpha^k_s}(\widehat{P}^{rk}_h)^{\alpha^k_r}(\widehat{P}^N_0)^{\alpha^k_N}}{\widehat{\tilde{\varphi}}^k_h} \qquad \widehat{P}^{sk}_h = \left[\chi^{sk}_{0h}(\widehat{w}_0)^{-\theta_s} + \sum_{j\neq 0}\chi^{sk}_{jh}(\widehat{\gamma}_{jh})^{-\theta_s}\right]^{-\frac{1}{\theta_s}}$$

$$\widehat{P}^N_0 = \widehat{w}_0 \qquad \widehat{P}^{rk}_h = \left[\chi^{rk}_{0h}(\widehat{w}_0\widehat{\Lambda}^k_{0h})^{-\theta_r} + \sum_{j\neq 0}\chi^{rk}_{jh}(\widehat{\Lambda}^k_{jh}\widehat{\gamma}_{jh})^{-\theta_r}\right]^{-\frac{1}{\theta_r}}$$

These equations illustrate how the three channels affect different components of unit costs, which is what allows me to separately identify them (see section 5.3). The first difference is between productivity and the frictions: the former affects unit costs directly, while the other two do so via the input price indices, which in turn reflect firms' intensive margin expenditure decisions, as shown in equations 21 and 29. This implies that while expenditure shares have information on contracting and communication frictions, they are not informative regarding differences in productivity[37]. The second difference is between contracting and communication frictions: the former affect all sourcing countries, including the SOE, but are only relevant for relationship-specific inputs, while the latter affects both types of inputs, but only foreign source countries.

5.2.2 Changes in consumer price indices

CPIs for manufacturing goods are shown in equations 33 and 34, while for non-manufacturing goods are shown in equations 8 and 18. Their change is determined by the following two equations:

$$\widehat{P}^k_0 = \left[\left(\frac{R^{k,f}_{00}}{E^k_0}\right)\widehat{N}^k_0(\widehat{c}^k_0)^{1-\sigma_k} + \sum_{h\neq 0}\left(\frac{R^{k,f}_{h0}}{E^k_0}\right)(\widehat{c}^k_h)^{1-\sigma_k} + \left(\frac{IMP^k_0}{E^k_0}\right)\right]^{\frac{1}{1-\sigma_k}}$$

[37]The theoretical literature on multinational firms' global sourcing decisions has shown that differences in productivity are reflected in the set of countries firm's source from (for example, see Antràs et al. (2017) and Antràs et al. (2022)). Nonetheless, given that all these models (as well as this one) rely on Fréchet distributional assumptions to obtain closed-form expressions for the expenditure shares, even if the set of countries a firm sources from depends on its productivity, the *relative* share between two source countries does not, conditional on being included in the sourcing set. This implies that ignoring the extensive margin should not be a source of bias for the measured shocks, given that all the expressions identifying these parameters are functions of these ratios (see proposition 7).

$$\widehat{P}_0^T = \left[\left(\frac{R_{00}^{T,f}}{E_0^T} \right) (\widehat{w}_0)^{1-\sigma_T} + \left(\frac{IMP_0^T}{E_0^T} \right) \right]^{\frac{1}{1-\sigma_T}}$$

where $R_{h0}^{k,f}$ and $R_{00}^{T,f}$ represent *domestic final* sales of manufacturing industry k (and HQ country h) and non-manufacturing tradable sector T, respectively; IMP_0^k and IMP_0^T represent imports in the same sectors; and E_0^k and E_0^T represent aggregate final expenditure on these sectors.

5.2.3 Changes in the labor market equilibrium

The change in the labor market equilibrium can be obtained from equations 36-35. However, first I need to address the issue mentioned in footnote 32: the labor market clearing condition in relative changes requires that "value added weights" are assigned to the changes in labor demands if I am to follow standard national accounting practices. However, this would leave out the indirect labor demands since they are not part of value added, but of intermediate consumption. In a model with multiple sectors and *input-output linkages*, these indirect flows show up in the value added of upstream industries. Instead, this model features a competitive fringe of suppliers, which does not have an obvious mapping into actual industries. To solve this model-data mapping issue, I make the following assumptions:

Assumption 7. *For the sake of the counterfactual exercises, expenditures on standardized and relationship-specific inputs are distributed among all tradable industries based on observable input-output linkages ($\lambda_{kk'}^{sh}$ and $\lambda_{kk'}^{rh}$).*

Assumption 8. *Foreign affiliates only produce final goods. Thus, all domestic intermediate inputs are produced by domestic firms.*

The first assumption allows me to split the total change in indirect labor demand of any industry k among its upstream industries by combining information from publicly available input-output tables (at the industry-pair level) with that from plant-level data to construct separate input-output tables for standardized and relationship-specific inputs, respectively[38]. The second assumption is necessary because the available data does not have enough information to determine which portion of manufacturing intermediate inputs are sold by foreign affiliates. I get rid of this problem by simply assuming that only domestic firms sell to other industries. The derivation of

[38] Assumption 7 is ad-hoc change that is invoked to facilitate the mapping from model to data in the context of counterfactual exercises. It is not a proper modification of the model: unit costs are still a function of just two input price indices.

the labor market clearing condition in relative change requires some adjustments to the equilibrium equations that I leave for the appendix. The following proposition summarizes the result:

Proposition 6 (Labor market clearing condition in relative changes)

The labor market clearing condition in relative changes is:

$$\widehat{GNP}_0 \equiv \widehat{w}_0 = \sum_{k=1}^{K} \left\{ \left(\frac{VA_0^k}{E_0} \right) \widehat{R}_0^k + \sum_{h \neq 0} \left(\frac{W_h^k}{E_0} \right) \widehat{R}_h^k \right\} + \left(\frac{VA_0^T}{E_0} \right) \widehat{R}_0^T + \left(\frac{VA_0^N}{E_0} \right) \widehat{R}_0^N$$

where VA_0^k, VA_0^T and VA_0^N are the value added of domestic manufacturing industry k, non-manufacturing tradable sector T and non-tradable sector N, respectively, E_0 is the SOE's Gross National Product, and W_h^k is the wage bill of foreign manufacturing industry k. The relative change in revenue reflects the change in sales to final consumers and, in the case of domestic industries, also sales to downstream manufacturing industries:

$$\begin{aligned}
\widehat{R}_0^k &= \widehat{N}_0^k \left(\widehat{c}_0^k\right)^{1-\sigma_k} \left[\left(\frac{R_{00}^{k,f}}{R_0^k} \right) \widehat{E}_0 \left(\widehat{P}_0^k\right)^{\sigma_k - 1} + \left(\frac{EXP_0^k}{R_0^k} \right) \right] + \sum_{k'} \sum_{h} \left[\left(\frac{R_{00,h}^{k,sk'}}{R_0^k} \right) \widehat{\chi}_{0h}^{sk'} + \left(\frac{R_{00,h}^{k,rk'}}{R_0^k} \right) \widehat{\chi}_{0h}^{rk'} \right] \widehat{R}_h^{k'} \\
\widehat{R}_h^k &= \left(\widehat{c}_h^k\right)^{1-\sigma_k} \left[\left(\frac{R_{h0}^{k,f}}{R_h^k} \right) \widehat{E}_0 \left(\widehat{P}_0^k\right)^{\sigma_k - 1} + \sum_{i \neq 0} \left(\frac{R_{hi}^{k,f}}{R_h^k} \right) \left(\widehat{\gamma}_{hi}\right)^{1-\sigma_k} \right], \quad \text{for} \quad h \neq 0 \qquad (40) \\
\widehat{R}_0^T &= \left(\widehat{w}_0\right)^{1-\sigma_T} \left[\left(\frac{R_{00}^{T,f}}{R_0^T} \right) \widehat{E}_0 \left(\widehat{P}_0^T\right)^{\sigma_T - 1} + \left(\frac{EXP_0^T}{R_0^T} \right) \right] + \sum_{k'} \sum_{h} \left[\left(\frac{R_{00,h}^{T,sk'}}{R_0^T} \right) \widehat{\chi}_{0h}^{sk'} + \left(\frac{R_{00,h}^{T,rk'}}{R_0^T} \right) \widehat{\chi}_{0h}^{rk'} \right] \widehat{R}_h^{k'} \\
\widehat{R}_0^N &= \left(\frac{R_{00}^{N,f}}{R_0^N} \right) \widehat{E}_0 + \sum_{k'} \sum_{h} \left(\frac{R_{0h}^{N,k'}}{R_0^N} \right) \widehat{R}_h^{k'}
\end{aligned}$$

where $R_{hi}^{k,f}$ and R_h^k are the sales of final goods to market i and total sales of firms in industry k and HQ in country h, while EXP_0^k is total exports of domestic firms; $R_{00,h}^{k,sk'}$ and $R_{00,h}^{k,sk'}$ are the domestic sales of standardized and relationship-specific inputs from industry k to firms in industry k' and HQ in country h; $R_{00}^{T,f}$, EXP_0^T, $R_{00,h}^{T,sk'}$, and $R_{00,h}^{T,rk'}$ represent domestic sales of final goods, total exports, domestic sales of standardized inputs, and domestic sales of relationship-specific inputs of non-manufacturing tradable sector goods to firms in industry k' with HQ in country h; $R_{00}^{N,f}$ and R_0^N are the domestic and total sales of non-tradable services to final consumers; and $R_{0h}^{N,k'}$ are the domestic sales of non-tradable services to firms in industry k' with HQ in country h. The relative change in expenditure shares for standardized and *relationship-specific inputs, respectively, are:*

$$\widehat{\chi}_{0h}^{sk} = \left(\frac{\widehat{w}_0}{\widehat{P}_h^{sk}}\right)^{-\theta_s} \qquad \widehat{\chi}_{0h}^{rk} = \left(\frac{\widehat{w}_0 \widehat{\Lambda}_{0h}^{k}}{\widehat{P}_h^{rk}}\right)^{-\theta_r}$$

Finally, the changes in aggregate expenditure and in the number of domestic firms are:

$$\widehat{E}_0 = \left(\frac{GNP_0}{E_0}\right)\widehat{w}_0 + 1 - \frac{GNP_0}{E_0} \qquad \textit{and} \qquad \widehat{N}_0^k = \frac{\widehat{R}_0^k}{\widehat{w}_0}$$

I use GNP instead of GDP because foreign affiliates' profits (which are part of value added, and thus, of GDP) are sent to their home countries by assumption. In contrast, since all domestic firms' profits are used to pay for entry costs according to the ZPC (equation 39), and entry costs require hiring labor, the full value added of domestic firms ends up in workers' pockets.

5.2.4 Welfare

I will use the change in real expenditure as the yardstick to compare the different counterfactual scenarios. From consumer optimization, this is equal to:

$$\widehat{rE}_0 \equiv \frac{\widehat{E}_0}{\left(\widehat{P}_0^T\right)^{\beta_T}\left(\widehat{P}_0^N\right)^{\beta_N}\Pi_k\left(\widehat{P}_0^k\right)^{\beta_k}}$$

5.3 Identification

To compute the counterfactual exercises, I need to measure the empirical moments, to estimate or calibrate the parameters, and identify the shocks from the equations in last section. In this section I explain how this is done.

5.3.1 Empirical moments

The counterfactual exercises require three types of moments: expenditure shares (for inputs and consumption goods), revenue shares, and aggregate shares in GNP.

Expenditure shares. To compute the change in input price indices, I need to measure the country expenditure shares for standardized and relationship-specific inputs, for both domestic- and foreign-owned firms (χ_{jh}^{xk}). For each HQ country and input type type, I observe the share of expenditures that comes from the domestic market in the Economic Census data, and the share of imports that come from each country in the customs data. After re-scaling the latter using the former, I get the complete vectors of shares.

To compute the change in consumer price indices of manufacturing industries, I need the share in aggregate final expenditure of domestic firms' ($R_{00}^{k,f}$), foreign affiliates' ($R_{h0}^{k,f}$), and imported goods (IMP_0^k). Domestic purchases and imports by industry are directly observable in official input-output tables. I split the former between domestic- and foreign-owned firms by combining information from the input-output table with that of the Economic Census, together with assumption 8[39]. For the non-manufacturing tradable sector, domestic purchases by final consumers ($R_{00}^{T,f}$) and imports (IMP_0^T) by industry are directly observable in official input-output tables.

Revenue shares. To compute the change in revenues for manufacturing industries, I need to observe two sets of revenue shares: sales to final consumers and sales of intermediate inputs. For the first set, I need to disaggregate final sales by destination market and by HQ country ($R_{hi}^{k,f}$). For each HQ country, I observe total domestic sales in the economic census, and disaggregated exports by market in the customs data. I isolate the part of total domestic sales that corresponds to *final consumer goods* following the same strategy from footnote39. I use the exports share in revenue from Census to re-scale the shares from customs to get the complete vector of shares of final goods in total revenue. For non-manufacturing sectors, domestic final sales ($R_{00}^{T,f}$ and $R_{00}^{N,f}$) and total exports ($\sum_{i \neq 0} R_{0i}^{T,f}$) are directly observable in the input-output tables.

For the second set, I need to disaggregate the total intermediate sales among downstream industries k' and between input types (the latter only for tradable sectors). To do so, I used the auxiliary census dataset with information on input purchases at the product level for a subset of plants, which was described in section 2.1.1[40]. This rich information allowed me to construct a

[39] Let the domestic sales of intermediate and final goods by domestic firms be x and y, respectively, and the sales by foreign firms (which by assumption only sell to final consumers) be a. I need to distinguish between x and y, but in the Economic Census I can only observe their sum, $b = x + y$. Since in the input-output table I observe the industry's (domestic and foreign firms together) intermediate, C, and final sales, D, I can back out domestic firms' intermediate and final sales using $x = \left(\frac{C}{C+D}\right)(a+b)$, which implies $\frac{R_{00}^{k,f}}{E_0^k} = \left[\frac{b}{a+b} - \left(\frac{a}{a+b}\right)\left(\frac{C}{D}\right)\right]\frac{R_0^{k,f}}{E_0^k}$, where the second ratio is observable in the input-output table. This strategy works as long as the $y > 0$. If $y < 0$, I assume that all sales of domestic firms are intermediate inputs ($x = b$), thus $\frac{R_{00}^{k,f}}{E_0^k} = 0$.

[40]The economic census does not use any international standard system to classify goods. I was only able to exploit the information in the auxiliary dataset because INEGI shared with me the internal correspondence tables (one for each Census year) that they use to construct the official input-output tables. These tables assign a 6 digit SCIAN industry-of-origin to each input (including non-manufacturing ones), which allowed me construct industry-to-industry transactions. However, to differentiate between standardized and relationship-specific transactions, I also needed to group inputs according to Rauch's classification. For this, only the 2009 table was useful, since it was the only one that

separate input-output matrix for standardized and relationship-specific inputs[41].

GNP shares. Industry-level value added and wage bill are available in the input-output tables. To disaggregate them by HQ country, I use the HQ country shares in the industry totals (for instance, $VA_0^k / \sum_h VA_h^k$), which can be calculated with data from the Economic Census. For the denominator of these shares, I use aggregate expenditure (E_0) from the input-output tables.

5.3.2 Parameter calibration

The counterfactual exercises require technology parameters (the α's), trade elasticities for inputs (the θ's), and demand elasticities for final goods (the σ's). In addition, to calculate the counterfactual change in real GNP, I also need to know the preferences parameters (the β's).

Technology parameters. To calibrate the technology parameters, I rely on the Cobb-Douglas production function, which implies that, in equilibrium, inputs' shares in total cost are equal to their respective production function exponents. Hence, for each industry k, I calibrated the the technology parameters according to the following formulas[42]:

$$\alpha_l^k = \frac{W_k}{W_k + IC_k} \qquad \alpha_s^k = \left(\frac{IC_g^{sk}}{IC_g^k}\right)\left(\frac{IC_g^k}{W_k + IC_k}\right)$$

$$\alpha_N^k = \frac{IC_N^k}{W_k + IC_k} \qquad \alpha_r^k = \left(\frac{IC_g^{rk}}{IC_g^k}\right)\left(\frac{IC_g^k}{W_k + IC_k}\right)$$

where W_k is the industry-level aggregate wage bill; IC_k is the industry-level intermediate consumption; IC_g^k and IC_N^k are the industry-level intermediate consumption of tradable and non-tradable goods and services, respectively; and IC_g^{sk} and IC_g^{rk} are the industry-level intermediate consumption of tradable standardized and relationship-specific inputs, respectively. The first four are directly observable in the Economic Census. The last two were obtained following the strategy used to disaggregate total intermediate sales between input types.

also assigned a CPC Rev.2 code to each input. Using publicly available correspondence tables to go from CPC to SITC classification (the one used by Rauch), I was able to classify inputs as standardized or relationship-specific.

[41] I could have also obtained these matrices for each HQ country with firms in the downstream industry. I did not do this because the large amount of missing observations, which implies that these tables are less reliable or representative the more disaggregated they are.

[42] Since I assume that foreign affiliates and domestic firms use the same technology (allowing for different TFPs), I pool all firms in an industry when making these calculations.

Elasticities. I assume that trade in standardized and trade in relationship-specific inputs are governed by the same trade elasticity, which I make equal to $\theta = 4$, in line with the main result in Simonovska and Waugh (2014). For the demand elasticity σ_k, I rely on the model result that profits are proportional to total revenue (equation 31). This implies that the elasticity can be calibrated using the following formula:

$$\sigma_k = \frac{R_k}{R_k - (W_k + IC_k)}$$

where R_k is the industry-level aggregate revenue[43].

Preference parameters. To calibrate the preference parameters, I rely on the Cobb-Douglas utility function, which implies that, in equilibrium, industries' shares in final expenditure are equal to their respective utility function exponents. Hence, for each industry k, I calibrated the the preference parameters according to the following formulas:

$$\beta_k = \frac{E_0^k}{E_0} \qquad \beta_T = \frac{E_0^T}{E_0} \qquad \beta_N = \frac{E_0^N}{E_0}$$

where E_0^k, E_0^T, and E_0^N are the industry-level aggregate final expenditures, and E_0 is the total aggregated final expenditure, all of which are observed in the input-output tables.

Calibrated values. The following table reports the values for these parameters for each industry:

[43] I use this same formula to calibrate the demand elasticity of the non-manufacturing sector σ_T, in spite of being a competitive sector with a representative firms.

Table 5. Calibrated parameter values by industry.

Industry	α_l^k	α_s^k	α_r^k	α_N^k	β_k	σ_k
Food	0.06	0.37	0.36	0.20	0.08	2.93
Beverages & Tobacco	0.09	0.36	0.36	0.19	0.01	2.12
Textile inputs	0.14	0.36	0.29	0.21	<0.01	4.51
Non-apparel textiles	0.17	0.31	0.31	0.21	<0.01	4.24
Apparel	0.23	0.30	0.31	0.17	0.01	4.13
Leather	0.21	0.32	0.32	0.15	<0.01	4.82
Wood	0.17	0.35	0.31	0.17	<0.01	3.14
Paper	0.10	0.33	0.32	0.25	<0.01	3.53
Printing	0.15	0.31	0.31	0.23	<0.01	5.98
Petrochemicals	0.02	0.42	0.42	0.14	0.02	4.52
Chemicals	0.07	0.37	0.35	0.21	0.02	3.65
Plastics & rubber	0.10	0.34	0.34	0.22	0.01	5.09
Non-metal mineral goods	0.10	0.34	0.34	0.23	<0.01	2.97
Basic metals	0.04	0.37	0.37	0.22	0.01	3.75
Metal goods	0.14	0.34	0.34	0.19	0.01	4.32
Machinery	0.13	0.34	0.34	0.18	0.03	3.99
Electronics	0.11	0.39	0.43	0.06	0.03	8.76
Electric equip.	0.12	0.38	0.38	0.12	0.01	5.08
Transport equip.	0.06	0.36	0.39	0.19	0.06	4.06
Furniture	0.21	0.31	0.31	0.17	<0.01	4.09
Other	0.14	0.40	0.39	0.07	0.01	5.56
Non-Mnf tradables					0.02	1.74
Non-tradables					0.68	1.99

5.3.3 Identification of shocks

In section 5.1, I showed that each counterfactual scenario involves a shock to a specific parameter, and that in all cases, the shock is defined in terms of the relative value between foreign and domestic firms. This means that I do not need to identify the parameter *levels* from the data. It is enough for me to back out, for each foreign HQ country $h \neq 0$, their relative size with respect to their domestic counterparts. The following proposition summarizes how this is done.

Proposition 7 (Identification of parameter shocks)

The parameter shocks associated with each counterfactual scenario can be identified using the following formulas:

1. ***Contracting frictions:***

$$\left(\widehat{\Lambda}^k_{jh}\right)^{-\theta_r} \equiv \left(\frac{\Lambda^k_{j0}}{\Lambda^k_{jh}}\right)^{-\theta_r} = \left(\frac{x^{rk}_{j0}/x^{rk}_{j^*0}}{x^{rk}_{jh}/x^{rk}_{j^*h}}\right)\left(\frac{x^{sk}_{jh}/x^{sk}_{j^*h}}{x^{sk}_{j0}/x^{sk}_{j^*0}}\right)^{\frac{\theta_r}{\theta_s}} \tag{41}$$

   where j^* refers to any country with close to "perfect" contract enforcement institutions ($\mu_{j^*} \approx 1$).

2. ***Geography (input purchases):***

$$\left(\widehat{\gamma}_{jh}\right)^{-\theta_s} = \left(\frac{\gamma_{j0}}{\gamma_{jh}}\right)^{-\theta_s} = \left(\frac{x^{sk}_{j0}/x^{sk}_{00}}{x^{sk}_{jh}/x^{sk}_{0h}}\right) \tag{42}$$

   Alternatively:

$$\left(\widehat{\gamma}_{jh}\right)^{-\theta_r} = \left(\frac{\gamma_{j0}}{\gamma_{jh}}\right)^{-\theta_r} = \left(\frac{x^{rk}_{j0}/x^{rk}_{00}}{x^{rk}_{jh}/x^{rk}_{0h}}\right)\left(\frac{\widehat{\Lambda}^k_{0h}}{\widehat{\Lambda}^k_{jh}}\right)^{-\theta_r} \tag{43}$$

3. ***Geography (sales):***

$$\left(\widehat{\gamma}_{hi}\right)^{1-\sigma_k} \equiv \left(\frac{\gamma_{0i}}{\gamma_{hi}}\right)^{1-\sigma_k} = \frac{R^{k,f}_{h0}/R^{k,f}_{00}}{R^{k,f}_{hi}/R^{k,f}_{0i}} \tag{44}$$

4. ***Productivity:***

$$\left(\widehat{\tilde{\varphi}}^k_h\right)^{\sigma_k-1} \equiv \left(\frac{\varphi^k_0}{\varphi^k_h/\eta^k_h}\right)^{\sigma_k-1} = \frac{R^{k,f}_{00}/N^k_0}{R^{k,f}_{h0}/N^k_h}\left\{\left(\frac{x^{sk}_{0h}}{x^{sk}_{00}}\right)^{\frac{\alpha^k_s+\alpha^k_r}{\theta_s}}\left(\frac{x^{rk}_{j^*h}}{x^{rk}_{j^*0}}\right)^{\frac{\alpha^k_r}{\theta_r}}\left(\frac{x^{sk}_{j^*0}}{x^{sk}_{j^*h}}\right)^{\frac{\alpha^k_r}{\theta_s}}\right\}^{1-\sigma_k} \tag{45}$$

   Alternatively:

$$\left(\widehat{\tilde{\varphi}}^k_h\right)^{\sigma_k-1} \equiv \left(\frac{\varphi^k_0}{\varphi^k_h/\eta^k_h}\right)^{\sigma_k-1} = \frac{R^{k,f}_{00}/N^k_0}{R^{k,f}_{h0}/N^k_h}\left\{\left[\sum_j x^{sk}_{jh}\left(\widehat{\gamma}_{jh}\right)^{-\theta_s}\right]^{\frac{\alpha^k_s}{\theta_s}}\left[\sum_j x^{rk}_{jh}\left(\widehat{\gamma}_{jh}\widehat{\Lambda}^k_{jh}\right)^{-\theta_r}\right]^{\frac{\alpha^k_r}{\theta_r}}\right\}^{1-\sigma_k} \tag{46}$$

5.4 Implied shocks

5.4.1 Contracting frictions

To back out contracting frictions using equation 41, many coincidences happen simultaneously: firms from HQ country *h and* Mexico must source from *j and* j^* for *both* standardized and relationship-specific inputs. This is a requirement that many observations do not satisfy, mostly because firms source standardized and relationship-specific inputs from different countries. I worked around this issue by making the following assumptions. First, instead of picking only one country as j^* (that is, with contract enforcement institutions that are strong enough for contracting frictions not to be present, for both MN and Mexican firms), I used many which are at the top of the Rule of Law ranking[44]. Second, I exploited the assumption that the second term in parenthesis in the formula does not vary by industry:

$$\left(\frac{\chi_{jh}^{sk}/\chi_{j^*h}^{sk}}{\chi_{j0}^{sk}/\chi_{j^*0}^{sk}}\right)^{\frac{\theta_r}{\theta_s}} = \left(\frac{\gamma_{jh}/\gamma_{j^*h}}{\gamma_{j0}/\gamma_{j^*0}}\right)^{\theta_r}$$

This means that I can also consider matches for which the ratios for relationship-specific and standardized inputs come from different industries (but same year and country pair). Third, I also considered matches between ratios from different years. However, when there was more than one measurement available, I gave preference to the one from the same year, with the idea that it is more likely that communication costs are the same across industries than constant in time. Finally, to increase the chance of finding a measurement based on ratios from the same year and industry, I pooled all the measures from the three years of data and picked only one per industry and HQ-source country pair. The result is a highly heterogeneous set of candidate measures, even for the same industry and country-pair. In some cases, these measures reach very extreme values, which I interpret as most likely representing noise, as opposed to real differences in effective contracting frictions. Since there is not an obvious or established set of criteria to filter the most accurate measures, I devised one. I sequentially applied nine criteria to filter the competing measures. The first three were the most important, in the sense that they discarded the

[44] The source locations for 2018 are, in rank order: Finland, Norway, Switzerland, Austria, New Zealand, Singapore, Sweden, Denmark, Luxembourg, Netherlands, Hong Kong, Canada, Greenland, Jersey, Iceland, Australia, Liechtenstein, Gibraltar, United Kingdom, Germany, Andorra, Japan, United States, Ireland, France and Belgium. The lowest location included, Belgium, was percentile 88.5.

largest amount of candidates. First, I kept the measures with the best quality match[45]. Among the remaining candidates, I kept those "closest" (from either left or right) to one[46]. The goal was to avoid selecting extreme values without giving preference to the smallest measures. This second criterion hopefully reduced the level of noise in measurement, although it is true that, by reducing variation, this method attenuates the quantitative effect of the contracting frictions channel. Third, among the remaining values, I preferred the one associated with the j^* country with the best position in Rule of Law ranking, under the idea that the highest the rank, the more closer to the ideal of a country with perfect contract enforcement institutions.

Table 6 shows summary statistics of the distribution of measured ratios for foreign firms disaggregated by industry. Overall, foreign firms enjoy advantages with some countries but disadvantages with others. The last row ("Total") shows a median ratio of one (neither advantage nor disadvantage). However, this is not one enjoyed across the board: the minimum ratio is 0.10 (domestic firms face only 10% of the contracting friction faced by foreign firms) and a maximum of 6.16 (some foreign firms face 16% of the contracting friction faced by domestic firms), with a mean value of 1.05.

[45]I assigned the matches to three categories: (1) the "best" corresponds to instances in which both types of inputs were sourced from country j in the same year, (2) the "middle" category corresponds to cases in which there is a match of either the year (but different industry) or industry (but different year), and (3) the "worst" category corresponds to matches between different years and industries.

[46] I measured "distance" as the absolute value of the difference between the measure and one. For measures that are less than one (i.e., domestic firms have an advantage), I first inverted their value to get rid of the bias that the zero lower bound creates. Before applying this criterion, the ratios $\Lambda^k_{j0}/\Lambda^k_{jh}$ ranged from 0.01 to 70.91, with a mean of 1.60 and a median of one. After this step, the values ranged from 0.18 to 6.16, with a mean of 1.05 and a median of one.

Table 6. Model-implied values for $\Lambda_{j0}^{k}/\Lambda_{jh}^{k}$ for foreign firms in Mexico by industry, 2018.

Industry	Min	p1	p5	p10	p25	median	p75	p90	p95	p99	Max	Mean	Obs
Food	0.27	0.27	0.86	0.92	1.00	1.00	1.03	1.17	1.41	1.66	1.66	1.02	35
Textile inputs	0.92	0.92	0.92	0.92	0.92	0.96	1.00	1.00	1.00	1.00	1.00	0.96	2
Non-apparel textiles	0.91	0.91	0.91	0.96	1.00	1.00	1.00	1.01	1.03	1.03	1.03	0.99	13
Apparel	0.84	0.84	0.88	0.93	0.98	1.00	1.00	1.11	1.16	1.27	1.27	1.00	30
Leather	0.59	0.59	0.59	0.98	0.99	1.00	1.00	1.01	1.01	1.01	1.01	0.97	14
Wood	0.95	0.95	0.95	1.00	1.00	1.00	1.01	1.02	3.94	3.94	3.94	1.27	11
Paper	0.18	0.18	0.89	0.91	0.99	1.00	1.00	1.02	1.03	1.18	1.18	0.97	27
Printing	0.89	0.89	0.98	1.00	1.00	1.00	1.02	1.07	1.17	1.20	1.20	1.02	25
Chemicals	0.71	0.72	0.91	0.95	1.00	1.00	1.00	1.16	1.27	1.96	2.53	1.04	120
Plastics & rubber	0.53	0.63	0.86	0.93	1.00	1.00	1.00	1.10	2.95	4.57	4.87	1.15	136
Non-metal mineral goods	0.74	0.74	0.96	0.99	1.00	1.00	1.04	1.18	1.20	1.48	1.48	1.03	33
Basic metals	0.34	0.34	0.74	0.92	1.00	1.00	1.00	1.18	1.42	2.49	2.49	1.04	61
Metal goods	0.51	0.51	0.68	0.85	1.00	1.00	1.01	1.09	1.25	1.70	1.70	1.00	95
Machinery	0.43	0.74	0.92	0.93	1.00	1.00	1.01	1.11	1.29	2.80	5.99	1.09	102
Electronics	0.58	0.63	0.78	0.92	1.00	1.00	1.00	1.09	1.60	2.93	6.16	1.09	114
Electric equip.	0.43	0.43	0.82	0.89	1.00	1.00	1.01	1.06	1.14	1.98	1.98	1.00	87
Transport equip.	0.47	0.71	0.86	0.97	1.00	1.00	1.00	1.10	1.19	2.46	4.37	1.05	229
Furniture	0.10	0.10	0.40	0.76	0.99	1.00	1.00	1.41	1.84	2.12	2.12	1.03	33
Other	0.33	0.33	0.64	0.91	0.99	1.00	1.00	1.16	1.38	4.05	4.05	1.05	72
Total	0.10	0.53	0.85	0.93	1.00	1.00	1.00	1.10	1.27	2.95	6.16	1.05	1,239

Notes: The column "Obs" counts the number of ratios identified in each industry, not the total number of observations in the data. "Beverages and Tobacco" is omitted because there were no observations. "Petrochemicals" is omitted because it is an industry where there are still restrictions in place for foreign direct investment.

5.4.2 Communication frictions

Given that *inward* communication costs affect imports of both types of inputs, they can be identified using expenditure shares of both types separately, i.e., we no longer need firms to source both types from the same country j. Instead, the requirement is for a group of firms to source their standardized inputs domestically in addition to import them from j, and for domestic-owned firms to also buy from both locations (see equation 42). Unfortunately, given that firms source their standardized inputs from different countries than they do their relationship-specific ones, I need to also use equation 43 if I am to identify the ratio for a country from which standardized inputs are not imported. The downside of using the second equation is that it requires to control for contracting frictions differences, many of which were measured based on the additional assumptions described previously. Unlike contracting frictions, the goal is to have one measure per HQ-source country pair common to all industries in a given year. Just like with contracting frictions, the measures are very heterogeneous and encompass a large range of values. Therefore, I applied the same strategy of choosing the value closest to one to filter out extreme values[47].

Table 7 shows summary statistics of the distribution of ratios of inward communication cost between domestic and foreign firms disaggregated by industries[48]. Overall, foreign firms enjoy advantages with some countries but disadvantages with others. The last row ("Total") shows a median ratio of one (neither advantage nor disadvantage) and extreme values that mirror each other: a minimum of 0.16 means domestic firms facing only 16% of the communication costs faced by domestic firms, while a maximum of 6.17 means the exact same difference favoring foreign firms.

[47] I measured "distance" in the same way as I did with contracting frictions (see footnote 46). Before applying this criterion, the ratios γ_{j0}/γ_{jh} ranged from 0.09 to 9.33, with a mean of 1.22 and a median of 1.02. After this step, the values ranged from 0.16 to 6.17, with a mean of 1.06 and a median of 0.99.

[48] I exclude domestic purchases given that they are normalized to one for all firms.

Table 7. Model-implied values for γ_{j0}/γ_{jh} for foreign firms in Mexico by industry, 2018.

Industry	Min	p1	p5	p10	p25	median	p75	p90	p95	p99	Max	Mean	Obs
Food	0.90	0.90	0.92	0.95	0.98	1.00	1.01	1.07	1.10	1.21	1.21	1.00	34
Textile inputs	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	1
Non-apparel textiles	0.90	0.90	0.90	0.97	0.98	0.99	1.01	1.01	1.08	1.08	1.08	0.99	15
Apparel	0.90	0.90	0.92	0.94	0.97	0.99	1.00	1.01	1.01	1.08	1.08	0.99	30
Leather	0.93	0.93	0.93	0.98	0.99	0.99	1.00	1.01	1.08	1.08	1.08	1.00	13
Wood	0.90	0.90	0.90	0.93	0.98	1.00	1.01	1.01	1.10	1.10	1.10	0.99	13
Paper	0.90	0.90	0.92	0.93	0.98	1.00	1.01	1.01	1.08	1.10	1.10	0.99	27
Printing	0.90	0.90	0.92	0.93	0.98	1.00	1.01	1.01	1.08	1.21	1.21	1.00	27
Chemicals	0.40	0.66	0.78	0.92	0.97	1.00	1.08	1.40	2.08	5.94	6.17	1.21	115
Plastics & rubber	0.38	0.49	0.66	0.86	0.95	1.00	1.05	1.18	1.36	2.08	2.19	1.01	129
Non-metal mineral goods	0.90	0.90	0.92	0.95	0.97	0.99	1.01	1.07	1.10	1.21	1.21	1.00	37
Basic metals	0.38	0.38	0.76	0.90	0.97	1.00	1.01	1.10	1.23	2.89	2.89	1.03	63
Metal goods	0.57	0.57	0.83	0.93	0.97	1.00	1.05	1.12	1.28	2.08	2.08	1.02	94
Machinery	0.18	0.28	0.60	0.84	0.96	0.99	1.01	1.09	1.22	1.44	1.49	0.97	100
Electronics	0.16	0.43	0.61	0.78	0.95	1.00	1.03	1.16	1.32	1.83	2.53	1.00	106
Electric equip.	0.20	0.20	0.61	0.90	0.97	1.00	1.02	1.10	1.36	2.02	2.02	1.01	85
Transport equip.	0.18	0.29	0.43	0.60	0.90	1.00	1.07	1.37	1.49	3.41	3.97	1.02	221
Furniture	0.90	0.90	0.93	0.95	0.97	0.99	1.00	1.01	1.07	1.10	1.10	0.99	43
Other	0.77	0.77	0.92	0.94	0.97	1.00	1.04	1.08	1.11	1.30	1.30	1.01	69
Total	0.16	0.38	0.66	0.89	0.97	1.00	1.03	1.13	1.36	2.08	6.17	1.02	1,222

Notes: The column "Obs" counts the number of ratios identified in each industry, not the total number of observations in the data. "Beverages and Tobacco" is omitted because there were no observations. "Petrochemicals" is omitted because it is an industry where there are still restrictions in place for foreign direct investment.

Outward communication costs are more straightforward to identify, and they only require firms to export and sell domestically, and for domestic-owned firms to do so as well, as in equation 44. Table 8 shows summary statistics of the distribution of ratios of outward communication cost between domestic and foreign firms disaggregated by industry[49]. In this case, it is more clear that foreign firms may enjoy an advantage over domestic firms when selling to foreign markets. The last row ("Total") shows a median ratio of 1.47 and a mean ratio of 1.97, which means that Mexican firms face marketing costs that are almost 50% higher than that of foreign multinationals at the median market.

[49]I exclude domestic sales given that they are normalized to one for all firms.

Table 8. Model-implied values for $\gamma^k_{0i}/\gamma^k_{hi}$ for foreign firms in Mexico by HQ country, 2018.

Industry	Min	p1	p5	p10	p25	median	p75	p90	p95	p99	Max	Mean	Obs
Food	0.17	0.17	0.17	0.37	0.60	0.71	1.34	1.44	1.79	1.79	1.79	0.87	13
Textile inputs	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1
Non-apparel textiles	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1
Apparel	0.80	0.80	0.80	0.98	1.31	1.71	1.95	2.77	3.52	3.52	3.52	1.76	10
Leather	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	1
Wood	3.62	3.62	3.62	3.62	3.62	3.62	3.62	3.62	3.62	3.62	3.62	3.62	1
Paper	0.77	0.77	0.77	0.77	1.45	2.29	4.30	6.12	6.12	6.12	6.12	2.87	4
Printing	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1
Chemicals	0.30	0.42	0.63	0.75	1.22	1.72	2.67	3.90	5.91	6.57	10.70	2.16	101
Plastics & rubber	0.46	0.46	0.68	0.80	1.16	1.42	1.98	2.44	3.14	5.10	5.10	1.60	80
Non-metal mineral goods	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42	1
Basic metals	0.14	0.14	0.14	0.58	1.32	1.49	1.94	2.48	3.82	3.82	3.82	1.64	13
Metal goods	0.43	0.43	0.63	0.87	1.28	1.69	2.46	6.42	10.61	10.89	10.89	2.66	37
Machinery	0.34	0.34	0.39	0.44	0.50	0.77	1.29	1.86	2.10	2.83	2.83	0.98	45
Electronics	0.59	0.59	0.59	0.71	0.98	1.20	1.46	1.90	2.10	2.28	2.28	1.27	33
Electric equip.	0.35	0.35	0.41	0.52	0.80	1.24	1.64	2.74	3.38	5.50	5.50	1.51	32
Transport equip.	0.09	0.09	0.31	0.47	1.04	1.69	3.09	6.18	9.76	14.81	15.81	2.74	110
Furniture	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	1
Other	0.86	0.86	0.86	0.95	1.36	1.55	2.33	2.98	3.55	3.55	3.55	1.83	17
Total	0.09	0.27	0.45	0.62	0.96	1.47	2.14	3.67	5.35	10.70	15.81	1.97	502

Notes: The column "Obs" counts the number of ratios identified in each industry, not the total number of observations in the data. "Beverages and Tobacco" is omitted because there were no observations. "Petrochemicals" is omitted because it is an industry where there are still restrictions in place for foreign direct investment.

5.4.3 Productivity differences

In proposition 7 I showed two ways to isolate productivity differences from the other two channels. In principle, it should not matter which equation I use given that they are equivalent, but the data limitations detailed in sections 5.4.1 and 5.4.2 mean that equation 46 is preferable in terms of increasing the number of usable observations. Table 9 shows summary statistics of the distribution of the ratio of inferred productivity, disaggregated by industry. With a median of 0.60 and mean of 0.62, **foreign firms have an advantage in productivity in most industries**. Another salient feature is that the industries with the largest presence of foreign firms (transportation equipment, electronics, and electric equipment) are *not* the ones with the largest gaps in productivity. On the contrary, while foreign firms in these industries are between 9% and 13% more productive than their domestic peers at the median, in other industries, such as "food" and "beverages and tobacco", the gap is around 1000%.

Table 9. Estimates of $\varphi_0^k/(\varphi_h^k/\eta_h^k)$ for foreign firms in Mexico by industry, 2018.

Industry	Min	p1	p5	p10	p25	median	p75	p90	p95	p99	Max	Mean	Obs
Food	0.04	0.04	0.04	0.07	0.08	0.11	0.22	0.27	1.11	1.11	1.11	0.21	11
Beverages & Tobacco	0.01	0.01	0.01	0.01	0.01	0.05	0.73	2.50	2.50	2.50	2.50	0.56	6
Textile inputs	0.25	0.25	0.25	0.25	0.28	0.37	0.45	0.46	0.46	0.46	0.46	0.36	6
Non-apparel textiles	0.22	0.22	0.22	0.22	0.22	0.23	0.25	0.25	0.25	0.25	0.25	0.23	2
Apparel	0.23	0.23	0.23	0.23	0.29	0.35	0.63	0.91	0.91	0.91	0.91	0.46	4
Leather	0.34	0.34	0.34	0.34	0.44	0.57	0.64	0.68	0.68	0.68	0.68	0.53	5
Wood	0.05	0.05	0.05	0.05	0.05	0.17	0.24	0.24	0.24	0.24	0.24	0.16	3
Paper	0.21	0.21	0.21	0.21	0.29	0.39	0.59	0.95	0.95	0.95	0.95	0.46	8
Printing	0.54	0.54	0.54	0.54	0.54	0.62	0.78	0.88	0.88	0.88	0.88	0.66	4
Chemicals	0.34	0.34	0.34	0.46	0.53	0.63	0.96	1.11	1.28	1.28	1.28	0.74	15
Plastics & rubber	0.47	0.47	0.47	0.56	0.59	0.65	0.71	0.99	1.13	1.13	1.13	0.70	18
Non-metal mineral goods	0.10	0.10	0.10	0.10	0.15	0.18	0.25	0.26	0.26	0.26	0.26	0.19	6
Basic metals	0.33	0.33	0.33	0.65	0.66	0.81	1.08	1.13	2.04	2.04	2.04	0.90	11
Metal goods	0.16	0.16	0.16	0.24	0.26	0.29	0.35	0.42	0.60	0.60	0.60	0.32	15
Machinery	0.36	0.36	0.36	0.38	0.41	0.56	0.89	1.00	1.60	1.60	1.60	0.67	15
Electronics	0.75	0.75	0.75	0.80	0.81	0.88	0.95	1.13	1.24	1.24	1.24	0.92	13
Electric equip.	0.65	0.65	0.65	0.67	0.83	0.92	1.06	1.16	1.16	1.16	1.16	0.92	10
Transport equip.	0.39	0.39	0.39	0.61	0.73	0.88	1.11	1.51	1.56	1.56	1.56	0.94	17
Furniture	0.34	0.34	0.34	0.34	0.34	0.36	0.37	0.37	0.37	0.37	0.37	0.36	3
Other	0.33	0.33	0.33	0.33	0.38	0.47	0.50	1.02	1.02	1.02	1.02	0.51	9
Total	0.01	0.01	0.10	0.19	0.34	0.60	0.88	1.08	1.16	2.04	2.50	0.63	181

Note: The column "Obs" counts the number of ratios identified in each industry, not the total number of observations in the data. "Petrochemicals" is omitted because it is an industry where there are still restrictions in place for foreign direct investment.

5.5 Results

In this section I present the quantitative results of the counterfactual exercises. For each scenario, I go over three things: the change in real expenditure per capita, the change in unit costs, and the reallocation of value added and employment across manufacturing industries.

5.5.1 Benchmark scenario: joint shocks

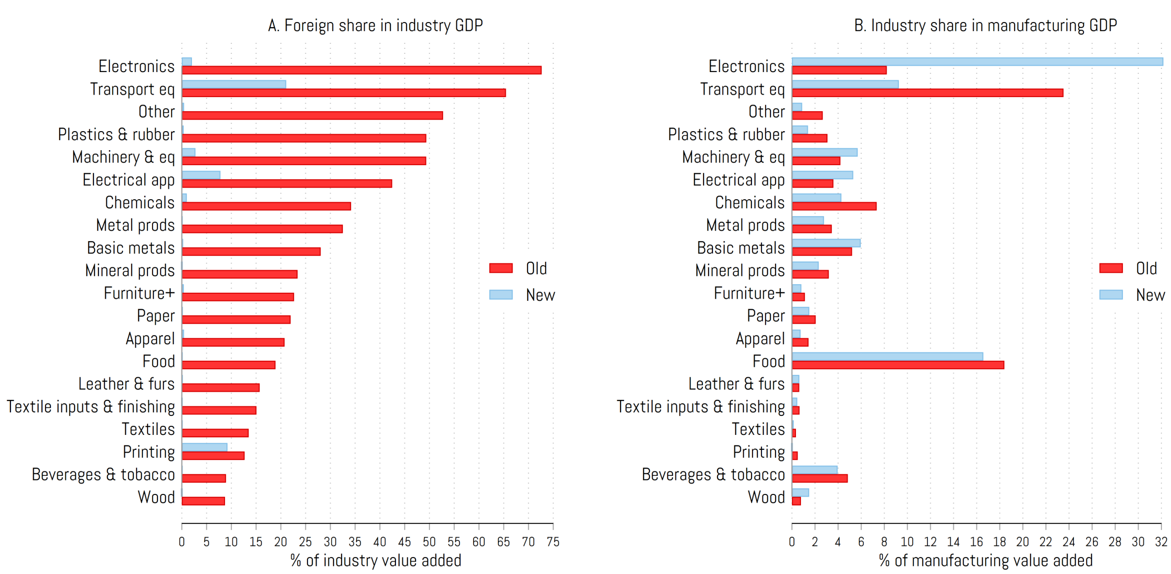
The benchmark scenario is one where I ask: what if foreign affiliates were *identical* to domestic firms? To implement this scenario I shock *all* parameters simultaneously. Its implementation is the least data-intensive since many of the expressions in proposition 7 cancel each other to deliver simplified expression for the counterfactual equations. For example, the counterfactual change in prices, which reflects all shocks except for that to marketing communication costs, is:

$$(\widehat{c}_h^k)^{1-\sigma_k} = \left(\frac{R_{00}^{k,f}/N_0^k}{R_{h0}^{k,f}/N_h^k}\right)\left\{(\widehat{w}_0)^{\alpha_l^k+\alpha_N^k}\left[\chi_{00}^{sk}(\widehat{w}_0)^{-\theta_s}+1-\chi_{00}^{sk}\right]^{-\frac{\alpha_s^k}{\theta_s}}\left[\chi_{00}^{rk}(\widehat{w}_0)^{-\theta_r}+1-\chi_{00}^{rk}\right]^{-\frac{\alpha_r^k}{\theta_r}}\right\}^{1-\sigma_k}$$

This equation does not depend on the calibrated shocks, since they cancelled each other. This means that these results do not rely on any of the assumptions used when calibrating them. I find that the effect of the joint shocks is a **2.7 percent** reduction in real expenditure (welfare).

The role of foreign firms in the Mexican economy drops considerably, as part A in figure 6 shows. This has an uneven effect on the industrial structure of Mexico's manufacturing sector, which is shown in part B.

Figure 6. All shocks: industrial adjustment in the manufacturing sector.



Three changes are salient. First, despite a large loss in foreign firms' productivity, their small initial share in the industry and a sizeable entry of domestic firms (22 percent) leads to a modest reduction in the *food industry*'s share of manufacturing value added. Second, a modest increase in foreign firm's prices (10 and 13 percent at the median and mean, respectively) in *transportation equipment* manufacturing leads to an reduction of this industry's share in the manufacturing sector's GDP of 14 percentage points. Third, another modest increase in foreign firm's prices (12 and 8 percent at the median and mean, respectively) in the manufacturing of *electronics* leads to an *increase* of this industry's share in the manufacturing sector's GDP by 24 percentage points. The reason behind the different effect of similar price increases in these two industries is explained by their different demand elasticicties (8.76 for electronics and 1.29 for transportation equipment). This implies that a similar increase in foreign prices lead to much higher profits for the incumbent domestic firms in the electronics industry. In fact, while costs of *Mexican* firms drop by 8 percent in both industries in the new equilibrium, their effect on sales (conditional on market size) is 29 percent in the transportation equipment industry, but a staggering 97 percent in electronics. In the long run, this large increase in domestic competitiveness in the electronics industry results in massive entry of new domestic firms (1445 percent).

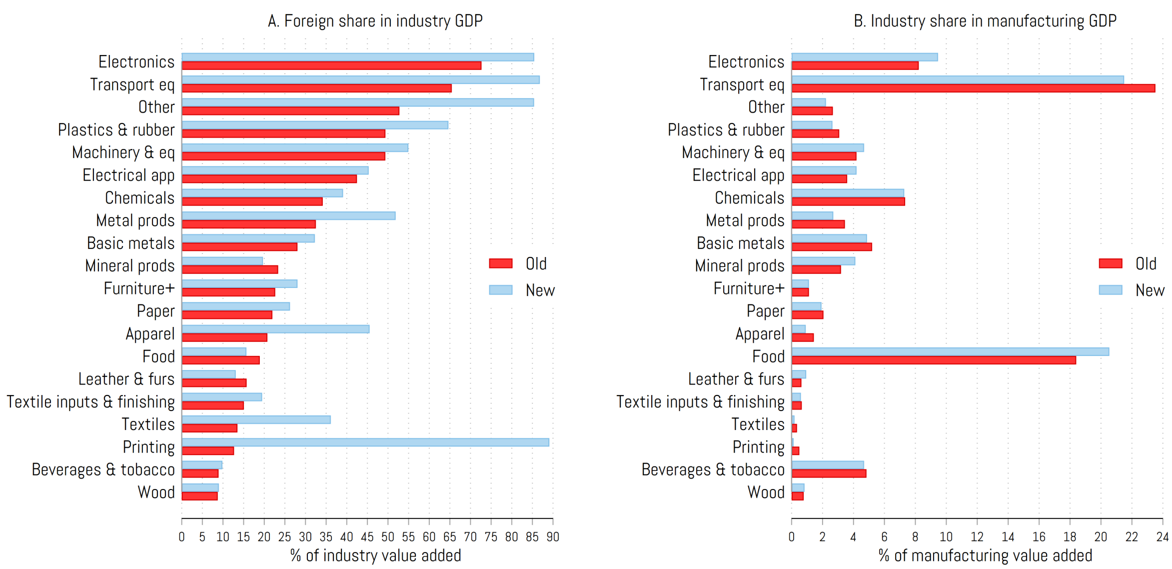
5.5.2 CF1: shock to contracting frictions

In general, bringing foreign firms' contracting frictions to that of domestic firms actually *decreases* unit costs (at the mean and median). Given this, it is not surprising that when only **contracting frictions** are changed, real GDP increases by 9.7 percent. However, real expenditure is predicted to fall by **0.18 percent**. Why would the economy contract if foreign firms' prices *decrease*? This is general equilibrium effect of the assumption that foreign firms send their all their profits to their home countries: 70 percent of foreign firms' value added are profits, which by assumption are sent abroad. Therefore, the increase in foreign share in the manufacturing sector leads to a *reduction* in labor demand. In this scenario, foreign firms' share in their respective industries' GDP increases in almost every industry, in particular *printing*, in which it goes from 13 to 89 percent (Panel A of figure 7). This explosive increase of foreign share is the result of (1) a large elasticity of demand (5.98), which takes a 6 percent reduction in prices and transforms it into a 36 percent increase in revenue (conditional on market size), and (2) important forward linkages, which implies that despite a 86 percent reduction in final sales, total sales go up by 27 percent[50]. Despite foreign firms widespread expansion, in this scenario the industrial structure of Mexico's manufacturing sector

[50] A similar overcompensating input-output effect, although of lower magnitude, is found in the leather, food, electric and wood industries.

does not change much. This is because this increase is at the expense of domestic firms: Mexican firms exit all industries but four (food, leather products, non-metal mineral products, machinery and equipment, and electric equipment). Hence, Mexico's manufacturing sector becomes more dependent on foreign firms. Finally,

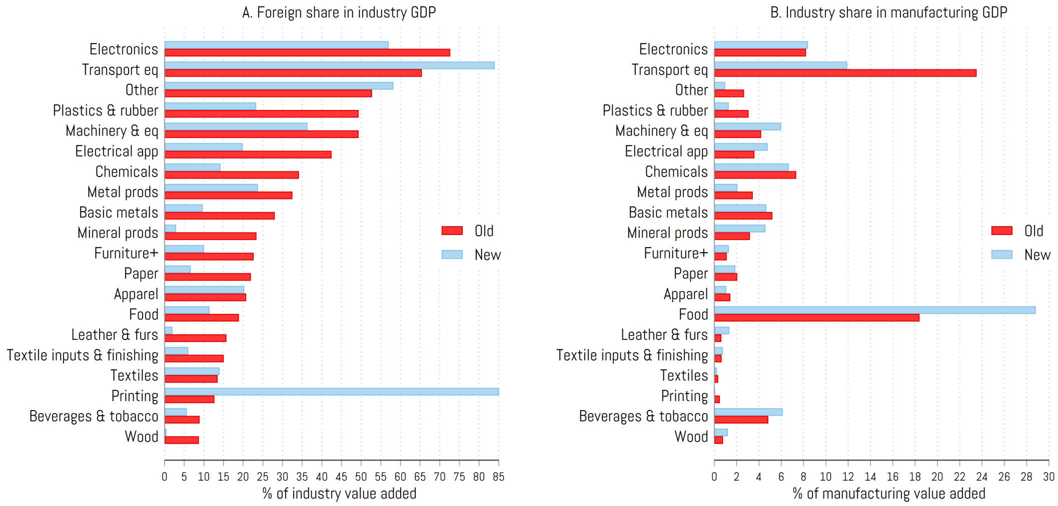
Figure 7. Contracting frictions shock: industrial adjustment in the manufacturing sector.



5.5.3 CF2: shock to communication costs

Similarly to the previous scenario, bringing foreign firms' communication costs to that of domestic firms *decreases* unit costs (at the mean and median). Given this, when only **communication costs** are changed, real GDP increases by 4.9 percent. However, real expenditure is predicted to fall by **0.17 percent**. The difference is due to profits being sent abroad by foreign firms. Although crowding-out of domestic firms is not found across all industries as before, it is still present in the *printing* industry, for the same reasons as in scenario 0.

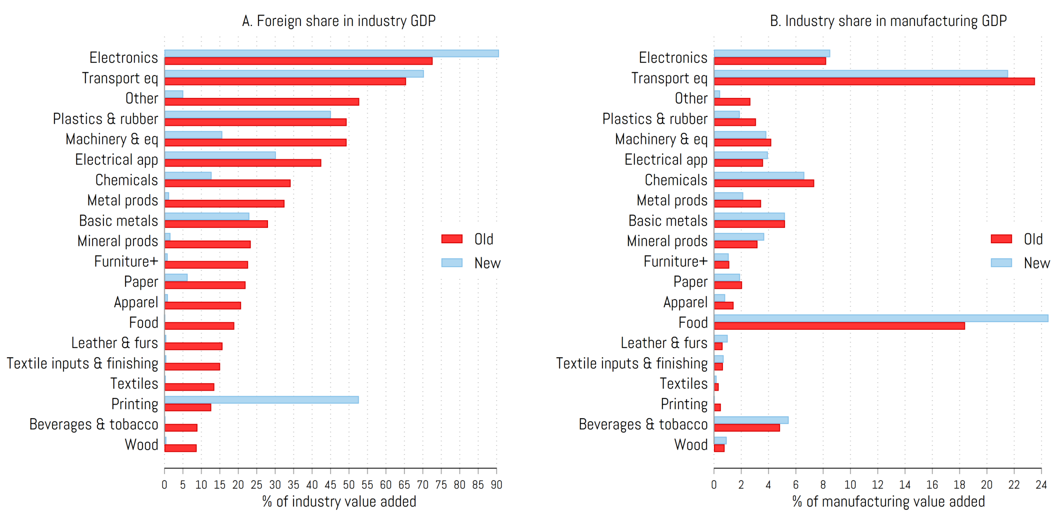
Figure 8. Communication costs shock (total): industrial adjustment in the manufacturing sector.



5.5.4 Shock to productivities

Given the small aggregate effect of the other two channels, it is expected that most of the effect found in the benchmark scenario was driven by differences in productivity. Indeed, real expenditure is predicted to fall by **2.2 percent**. Clearly, this accounts for most of the joint effect in scenario 0.

Figure 9. Productivity shock (total): industrial adjustment in the manufacturing sector.



6. Conclusion

How are foreign firms able to thrive in sectors where local firms cannot despite facing the same country fundamentals? While the "off-the-shelf" answer is to always explain these patterns in terms of exogenous differences in productivity, in this paper I show that, at least in the case of Mexico, there are other channels that also benefit foreign firms and that are not related to productivity. I want to conclude the paper going over the areas that I consider have potential for future research and a comment regarding policy implications.

The first candidate for improvement is related to the data issues that were detailed in section 2.1.4: the lack of a standardized product classification system forced me to rely on assumptions to back out some of the empirical moments of the data, which reduces the level of confidence in the results obtained with them. Applying this approach to a different country, or getting INEGI to fix the issue, would constitute progress in this regard. Second, while the nature of the question asked in this paper required working with a multisector model, the theoretical results regarding the modelling of contracting friction do not rely on this. Therefore, they could be applied to more aggregate models of the global economy. Third, progress could be made by experimenting with alternative assumptions. For example, this model simplified things by assuming homogeneous firms within a country and a sector, but it would be interesting to see how results are affected if one changes the model to account for heterogeneous firms, as in Melitz (2003). Another example is the assumption that all firms in the same industry use the same technology, which could be relaxed to allow for multiple techniques per industry and their optimal choice, as in Boehm and Oberfield (2020). I leave these extensions for future research.

Finally, a comment about policy. Most papers in the recent literature on contracting frictions and development typically conclude emphasizing the importance that judicial reform has for developing countries' development (for instance, see Boehm (2022)). However, asking to improve a country's institutions is not only a tall order that may take several years, if not decades, for progress to be made (Haley (2006), Hammergren (2005), Messitte (2005)), but it also has a circular flavor if one considers "development" is synonym of "having good institutions". While agreeing on the importance of improving the judicial system in the long run, the results from this paper give some credibility to the idea that a policy of attracting of foreign firms could help ameliorate the negative effects that weak contract enforcement have in an economy.

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A. Data Appendix

A.1 Comment on data limitation

To conduct most of the empirical work of this paper, I need to have information on the expenditure shares by country for both standardized and relationship-specific inputs. While the typification of *imported* products, which comes from PEME, was conducted without any major issues, the corresponding exercise for *domestic* shares, which uses the product-level census dataset, was challenging. The main reason is that, unlike PEME, the census uses its own ad-hoc system to identify goods. This system is not only unrelated to any of the standard international systems used, but it is also inconsistent between different years. At the same time, there are no publications documenting the changes to it across time. I was able to move forward only because INEGI shared with me internal correspondence tables, which they use for the construction of the official input-output tables. The main additional information in these files is the assignment of an industry of origin for most inputs. Given that INEGI uses the Mexican NAICS classification of industries, this was a step in the direction of being able to map these products to an international standard classification system, although a coarse one[51]. Fortunately, the table for the 2009 census assigned a *Central Product Classification (CPC)* revision 2 code, a standard system, to each input. This information allowed me to group most inputs into the two categories and calculate their domestic vs. imported expenditure shares. Unfortunately, the tables for 2013 and 2018 do not include that information, and the lack of consistency across time (or of any document describing the changes from one year to another), meant that only a small fraction of inputs in the other years could be matched with those in 2008 and that, among those that did, it is not guaranteed that the code represented the same good in both years. Given this situation, I chose to apply the 2008 shares on the other years total amounts to approximate the actual expenditure shares for each type of good.

[51] There are around 18 thousand different intermediate inputs codes in the census datasets, but there are only 538 six-digit NAICS industries associated with tradable goods in the 2013 revision.

A. Proofs for Section 4 (Solving the model)

Proposition 1 (Revenue shares)
Let input ν be produced by a supplier in country j.

1. *The supplier's share of rents is:*

$$s_j^k(\nu) = \left(\frac{\alpha_r^k \rho_k}{\alpha_r^k \rho_k + \rho_r^k}\right)\left(\frac{m_j^k(\nu)}{M_r^k}\right)^{\rho_r^k} \tag{22}$$

where $\rho_r^k \equiv \frac{\zeta_r^k - 1}{\zeta_r^k}$ and $\rho_k \equiv \frac{\sigma_k - 1}{\sigma_k}$.

2. *The buyer's share of rents is:*

$$s_b^k = \frac{\rho_r^k}{\alpha_r^k \rho_k + \rho_r^k} \tag{23}$$

Proof. Suppose the number of intermediate suppliers is finite and equal to $\mathcal{I}$, and that each one of them controls a range $\varepsilon = 1/\mathcal{I}$ of the continuum of inputs. The Shapley value for a supplier ν is equal to its "average" marginal contribution across all possible coalitions of agents. The marginal contribution to a coalition of $n \leq \mathcal{I}$ suppliers plus the buyer is the increase in revenue from adding the $n+1$ supplier (supplier ν).

Revenue with n suppliers. The presence of iceberg frictions imply that for every unit sold in market i, plants need to manufacture and ship $\tau_{0i}^k \gamma_{hi} \geq 1$ units. This and equation 6 allow us to write the *global* demand function faced by a plant as:

$$\overbrace{q_h^k}^{\substack{\text{global}\\\text{demand}}} = \sum_i \underbrace{\overbrace{q_{hi}^k}^{\text{sold}} (\tau_{0i}^k \gamma_{hi})}_{\text{produced}} = \left[\left(\frac{\sigma_k}{\sigma_k - 1}\right) c_h^k\right]^{-\sigma_k} \left[\beta_k E_0 (P_0^k)^{\sigma_k - 1} + FMA_h^k\right]$$

Defining the plant's FOB price as $p_h^k \equiv \left(\frac{\sigma_k}{\sigma_k - 1}\right) c_h^k$, we can write the global inverse demand function as:

$$p_h^k = (q_h^k)^{-\frac{1}{\sigma_k}} \left[\beta_k E_0 (P_0^k)^{\sigma_k - 1} + FMA_h^k\right]^{\frac{1}{\sigma_k}}$$

We can multiply by q_h^k to express the plant's total revenue in terms of its relationship-specific input bundle:

$$\begin{aligned} R_h^k &= (q_h^k)^{\frac{\sigma_k - 1}{\sigma_k}} \left[\beta_k E_0 (P_0^k)^{\sigma_k - 1} + FMA_h^k\right]^{\frac{1}{\sigma_k}} \\ &= \underbrace{\left[\frac{\varphi_h^k A_0^k}{\eta_h^k}\left(\frac{L^k}{\alpha_l^k}\right)^{\alpha_l^k}\left(\frac{M_s^k}{\alpha_s^k}\right)^{\alpha_s^k}\left(\frac{1}{\alpha_r^k}\right)^{\alpha_r^k}\left(\frac{M_N^k}{\alpha_N^k}\right)^{\alpha_N^k}\right]^{\frac{\sigma_k - 1}{\sigma_k}} \left[\beta_k E_0 (P_0^k)^{\sigma_k - 1} + FMA_h^k\right]^{\frac{1}{\sigma_k}}}_{A_h^k} (M_r^k)^{\alpha_r^k \left(\frac{\sigma_k - 1}{\sigma_k}\right)} \end{aligned}$$

Finally, omitting the plant's industry and home country indices, the total revenue of a coalition between the buyer and n suppliers is defined as:

$$R(n) = A\left(\sum_{i=1}^{n} m_i^{\rho_r^k}\right)^{\frac{\alpha_r^k \rho_k}{\rho_r^k}} \tag{47}$$

where $\rho_r^k \equiv \frac{\zeta_r^k - 1}{\zeta_r^k}$ and $\rho_k \equiv \frac{\sigma_k - 1}{\sigma_k}$.

Marginal contribution. If the coalition includes the buyer and $n-1$ other suppliers, the marginal contribution of supplier ν is:

$$\Delta R_\nu(n;\varepsilon) = A\left[\left(\sum_{i=1}^{n-1} \varepsilon \cdot m_i{}^{\rho_r^k} + \varepsilon \cdot m_\nu{}^{\rho_r^k}\right)^{\frac{\alpha_r^k \rho_k}{\rho_r^k}} - \left(\sum_{i=1}^{n-1} \varepsilon \cdot m_i{}^{\rho_r^k}\right)^{\frac{\alpha_r^k \rho_k}{\rho_r^k}}\right]$$

If the coalition does not includes the buyer, then there is no production and no revenue. In this case, the value of a coalition would have simply been the sum of the outside value of the inputs and, therefore, the marginal contribution of supplier ν would have been its outside value. However, assumption 1 makes this outside value zero so the marginal contribution will only be positive if the buyer is in the coalition.

The Shapley value. As was defined in section 3.7.2, the Shapley value has an intuitive interpretation: it is the average marginal contribution of each player across all coalitions. Since for any coalition size, the marginal contribution of a player may depend on the "order" in which the player is added, this average must take into account all possible orders.

In our model there are $\mathcal{I}$ suppliers and one buyer ("player 0"), numbered $0, 1, 2, \cdots, \mathcal{I}$. Let g represent one particular sequence of these $\mathcal{I}+1$ players. g can be thought of a function that assigns a position n to each player i:

$$\begin{aligned} g &: \{0, 1, \cdots, \mathcal{I}\} \to \{0, 1, \cdots, \mathcal{I}\} \\ g(i) &= n \end{aligned}$$

Denote by z_g^ν the set of players in sequence g that were added before player ν. Under this notation, $v(z_g^\nu)$ is the value of the coalition before player ν joined, while $v\left(z_g^\nu \cup \nu\right)$ is the value after ν joined. Given that there are $(\mathcal{I}+1)!$ possible sequences (permutations) of players, the Shapley value for player ν is:

$$S_\nu = \frac{1}{(\mathcal{I}+1)!}\sum_{g\in G}\left[v\left(z_g^\nu \cup \nu\right) - v(z_g^\nu)\right]$$

This expression is directly connected to the definition, but it is more useful to rewrite it in terms of all possible *positions* of player ν. To do so, first note that if we fix player ν in some position n, there will be $\mathcal{I}$ positions to fill (n positions to fill before and $\mathcal{I}-n$ positions after) with $\mathcal{I}$ players. Hence, the total number of possible sequences where player ν is in position n is $\mathcal{I}$!

Second, note that player ν's marginal contribution depends on whether the buyer is in the coalition or not. Hence, we need to calculate the probability that player 0 is already in the coalition, conditional on player ν's position in the coalition (n). If we fix player 0 in some position $n' \neq n$, there are $(\mathcal{I}-1)!$ possible sequences where players ν and 0 are in positions n and n', respectively. Given that there are n positions in the coalition before ν's is added (positions $0, 1, \cdots, n-1$), the probability that the buyer was already in the coalition is $\frac{\sum_{n'=0}^{n-1}(\mathcal{I}-1)!}{\mathcal{I}!} = \frac{n(\mathcal{I}-1)!}{\mathcal{I}!} = \frac{n}{\mathcal{I}}$.

Putting all these pieces together, we can rewrite the Shapley value as[52]:

$$
\begin{aligned}
S_\nu &= \frac{1}{(\mathcal{I}+1)!}\sum_{n=1}^{\mathcal{I}}(\mathcal{I}!)\left(\frac{n}{\mathcal{I}}\right)\Delta R_\nu(n;\varepsilon) \\
&= \frac{1}{(\mathcal{I}+1)\mathcal{I}}\sum_{n=1}^{\mathcal{I}} n\cdot\Delta R_\nu(n;\varepsilon) \\
&= \left(\frac{1}{1+\varepsilon}\right)\sum_{n=1}^{1/\varepsilon}(n\varepsilon)\cdot A\left[\left(\sum_{i=1}^{n-1}\varepsilon\cdot {m_i}^{\rho_r^k}+\varepsilon\cdot {m_\nu}^{\rho_r^k}\right)^{\frac{\alpha_r^k\rho_k}{\rho_r^k}}-\left(\sum_{i=1}^{n-1}\varepsilon\cdot {m_i}^{\rho_r^k}\right)^{\frac{\alpha_r^k\rho_k}{\rho_r^k}}\right]\cdot\varepsilon
\end{aligned}
\tag{48}
$$

where in the last step, $\mathcal{I}$ was replaced by $1/\varepsilon$.

Approximation to the Shapley value. I will approximate equation 48 using a linear McLaurin expansion, where S_ν is defined as a function of variable ${m_\nu}^{\rho_r^k}$:

$$
S_\nu \approx \left[\left(\frac{\alpha_r^k\rho_k}{\rho_r^k}\right)A{m_\nu}^{\rho_r^k}\cdot\varepsilon\right]\left(\frac{1}{1+\varepsilon}\right)\sum_{n=1}^{1/\varepsilon}(n\varepsilon)\left(\sum_{i=1}^{n-1}\varepsilon\cdot {m_i}^{\rho_r^k}\right)^{\frac{\alpha_r^k\rho_k}{\rho_r^k}-1}\cdot\varepsilon
$$

Asymptotic Shapley value. The final step is to divide both sides by ε and take limits as the number of suppliers $\mathcal{I}\to\infty$ (which implies that $\varepsilon\to 0$). The outside summation with respect to n, going from 1 to $1/\varepsilon$ converges to an integral with respect to $x\equiv n\varepsilon$, going from 0 to 1, with $dx\equiv\varepsilon$ [53]. The inside summation from $\varepsilon\cdot m_1^{\rho_r^k}$ to $\varepsilon\cdot m_{n-1}^{\rho_r^k}$ converges to an integral of $m(\nu)^{\rho_r^k}$, where ν goes from 0 to x[54].

$$
\begin{aligned}
S(\nu)\equiv\lim_{\varepsilon\to 0}\left(\frac{S_\nu}{\varepsilon}\right) &= \left[\left(\frac{\alpha_r^k\rho_k}{\rho_r^k}\right)Am(\nu)^{\rho_r^k}\right]\left[\int_0^1 x\left(\int_0^x m(\nu)^{\rho_r^k}d\nu\right)^{\frac{\alpha_r^k\rho_k}{\rho_r^k}-1}dx\right] \\
&= \left[\left(\frac{\alpha_r^k\rho_k}{\rho_r^k}\right)Am(\nu)^{\rho_r^k}\right]\left[\int_0^1 x\left(x\int_0^1 m(\nu)^{\rho_r^k}d\nu\right)^{\frac{\alpha_r^k\rho_k}{\rho_r^k}-1}dx\right] \\
&= \left[\left(\frac{\alpha_r^k\rho_k}{\rho_r^k}\right)Am(\nu)^{\rho_r^k}\right]\underbrace{\left(\int_0^1 x^{\frac{\alpha_r^k\rho_k}{\rho_r^k}}dx\right)}_{\frac{\rho_r^k}{\alpha_r^k\rho_k+\rho_r}}\underbrace{\left(\int_0^1 m(\nu)^{\rho_r^k}d\nu\right)^{\frac{\alpha_r^k\rho_k}{\rho_r^k}-1}}_{M_r^{\alpha_r^k\rho_k}M_r^{-\rho_r^k}}
\end{aligned}
$$

[52]Note that the summation only need to start at $n=1$ since when player ν is the first in the coalition (position 0), its marginal contribution must be zero since necessarily the buyer hasn't been added yet: $v\left(z_g^\nu\cup\nu\right)=v(z_g^\nu)=0$.

[53]At $n=1$, $x=\varepsilon\to 0$, and at $n=\frac{1}{\varepsilon}$, $x=\frac{\varepsilon}{\varepsilon}=1$.

[54]$(n-1)$ in terms of x is $(n-1)\varepsilon=(n\varepsilon)-\varepsilon\to x$.

$$\underbrace{=}_{\text{eq. 47}} \left(\frac{\alpha_r^k \rho_k}{\alpha_r^k \rho_k + \rho_r} \right) \cdot \left(\frac{m(\nu)}{M_r} \right)^{\rho_r^k} \cdot R$$

The buyer's asymptotic Shapley value is the residual from subtracting the sum of suppliers' Shapley values from total revenue:

$$S_b = R - \int_0^1 S(\nu) d\nu = R - \left(\frac{\alpha_r^k \rho_k}{\alpha_r^k \rho_k + \rho_r} \right) \cdot R$$
$$= \left(\frac{\rho_r^k}{\alpha_r^k \rho_k + \rho_r} \right) \cdot R$$

□

Proposition 2 (Equilibrium levels of specifications and of input)
Let input ν be produced by a supplier in country j.

1. *The optimal level of non-contractible specifications is:*

$$m_{n,j}^k(\nu) = \left[\frac{\alpha_r^k \rho_k R M_r^{-\rho_r^k}}{c_j^k(\nu)} \right]^{\frac{1}{1-\rho_r^k}} \underbrace{\left\{ s_b{}^{1-\mu_j \rho_r^k} \left[\frac{1 - s_b(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k} \right]^{\mu_j \rho_r^k} \right\}^{\frac{1}{1-\rho_r^k}}}_{\equiv \Gamma_{n,j}^k} \tag{24}$$

2. *The optimal level of contractible specifications is:*

$$m_{c,j}^k(\nu) = \left[\frac{\alpha_r^k \rho_k R M_r^{-\rho_r^k}}{c_j^k(\nu)} \right]^{\frac{1}{1-\rho_r^k}} \underbrace{\left\{ s_b{}^{(1-\mu_j)\rho_r^k} \left[\frac{1 - s_b(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k} \right]^{1-(1-\mu_j)\rho_r^k} \right\}^{\frac{1}{1-\rho_r^k}}}_{\equiv \Gamma_{c,j}^k} \tag{25}$$

3. *The optimal level of input ν is:*

$$m_j^k(\nu) = \left[\frac{\alpha_r^k \rho_k R M_r^{-\rho_r^k}}{c_j^k(\nu)} \right]^{\frac{1}{1-\rho_r^k}} \underbrace{\left\{ s_b{}^{1-\mu_j} \left[\frac{1 - s_b(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k} \right]^{\mu_j} \right\}^{\frac{1}{1-\rho_r^k}}}_{\equiv \Gamma_j^k = \left(\Gamma_{c,j}^k\right)^{\mu_j} \left(\Gamma_{n,j}^k\right)^{1-\mu_j}} \tag{26}$$

Proof. All agents can predict the result of the bargaining, thus when suppliers have to choose how much to invest in non-contractible specs, they will do so taking into account their post-bargaining payoff.

Non-contractible specifications. Let input ν be sourced from a supplier in country j. The supplier's optimization problem is (I am omitting the superscript k again)[55]:

$$\begin{aligned}\max_{m_{n,j}(\nu)} \pi_j(\nu) &= S_j(\nu) - c_j(\nu)(1-\mu_j)m_{n,j}(\nu) - c_j(\nu)\mu_j m_{c,j}(\nu)\\ &= \left(\frac{\alpha_r^k\rho_k}{\alpha_r^k\rho_k+\rho_r^k}\right)R\left[\frac{m_j(\nu)}{M_r}\right]^{\rho_r^k} - c_j(\nu)(1-\mu_j)m_{n,j}(\nu) - c_j(\nu)\mu_j m_{c,j}(\nu)\\ &= \left(\frac{\alpha_r^k\rho_k}{\alpha_r^k\rho_k+\rho_r^k}\right)RM_r^{-\rho_r^k} m_{c,j}(\nu)^{\mu_j\rho_r^k} m_{n,j}(\nu)^{(1-\mu_j)\rho_r^k} - c_j(\nu)(1-\mu_j)m_{n,j}(\nu) - c_j(\nu)\mu_j m_{c,j}(\nu)\end{aligned}$$

Solving the FOC, we get:

$$m_{n,j}(\nu) = \left[\rho_r^k\left(\frac{\alpha_r^k\rho_k}{\alpha_r^k\rho_k+\rho_r^k}\right)\frac{RM_r^{-\rho_r^k}}{c_j(\nu)}\right]^{\frac{1}{1-(1-\mu_j)\rho_r^k}} m_{c,j}(\nu)^{\frac{\mu_j\rho_r^k}{1-(1-\mu_j)\rho_r^k}} \tag{49}$$

This result translates into the following expression for $m_j(\nu)$:

$$m_j(\nu) \equiv m_{n,j}(\nu)^{1-\mu_j} m_{c,j}(\nu)^{\mu_j} \Rightarrow m_j(\nu) = \left[\rho_r^k\left(\frac{\alpha_r^k\rho_k}{\alpha_r^k\rho_k+\rho_r^k}\right)\frac{RM_r^{-\rho_r^k}}{c_j(\nu)}\right]^{\frac{1-\mu_j}{1-(1-\mu_j)\rho_r^k}} m_{c,j}(\nu)^{\frac{\mu_j}{1-(1-\mu_j)\rho_r^k}} \tag{50}$$

Contractible specifications. Knowing the previous result, the buyer's problem is to pick $m_c(\nu)$ and $f_(\nu)$ to maximize its payoff:

$$\max_{\{m_c(\nu), f(\nu)\}} \pi_b = S_b - \int_0^1 f(\nu)d\nu \quad \text{s.t.} \quad \pi_(\nu) + f(\nu) \geq 0, \forall \nu \in [0,1]$$

Given that the buyer is able to offer a take-it-or-leave-it contract, it will choose the fee $f(\nu)$ to make the supplier just indifferent between accepting or rejecting the contract, i.e. the constraint will bind. The buyer problem becomes:

$$\begin{aligned}&\max_{\{m_c(\nu)\}} \pi_b = S_b + \int_0^1 \pi(\nu)(\nu)d\nu\\ \Rightarrow &\max_{\{m_c(\nu)\}} \pi_b = S_b + \int_0^1 \Big[S(\nu) - c(\nu)(1-\mu_{j(\nu)})m_n(\nu) - c(\nu)\mu_{j(\nu)}m_c(\nu)\Big]d\nu\\ \Rightarrow &\max_{\{m_c(\nu)\}} \pi_b = R - \int_0^1 \Big[c(\nu)(1-\mu_{j(\nu)})m_n(\nu) + c(\nu)\mu_{j(\nu)}m_c(\nu)\Big]d\nu\\ &\text{s.t.} \quad R \equiv A\left(\int_0^1 m(\nu)^{\rho_r^k}d\nu\right)^{\frac{\alpha_r^k\rho_k}{\rho_r^k}}\end{aligned}$$

and equations 49 and 50

[55] $S_j(\nu)$ depends on $m_j^k(\nu)$, which should be interpreted as the amount of input that *effectively* contributes to revenue. Since there are trade costs, for every $m_j(\nu)$ that makes it into production, the supplier must ship $\gamma_{jh}\tau_{j0}^k m(\nu)$. Thus, $c_j^k(\nu)$ should be interpreted as the marginal cost of production *inclusive* of the trade costs.

Using the expression for the buyer's share from equation 23, the optimal contractible specifications bundle for an input sourced from country j is:

$$m_{c,j}(\nu) = \left[\frac{\alpha_r^k \rho_k R M_r^{-\rho_r^k}}{c_j(\nu)}\right]^{\frac{1}{1-\rho_r^k}} \left\{ s_b{}^{(1-\mu_j)\rho_r^k} \left[\frac{1 - s_b(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k}\right]^{1-(1-\mu_j)\rho_r^k} \right\}^{\frac{1}{1-\rho_r^k}}$$

We can plug this result back into equation 49 to get:

$$m_{n,j}(\nu) = \left[\frac{\alpha_r^k \rho_k R M_r^{-\rho_r^k}}{c_j(\nu)}\right]^{\frac{1}{1-\rho_r^k}} \left\{ s_b{}^{1-\mu_j\rho_r^k} \left[\frac{1 - s_b(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k}\right]^{\mu_j\rho_r^k} \right\}^{\frac{1}{1-\rho_r^k}}$$

Finally, We can plug the result back into equation 50 to get:

$$m_j(\nu) = \left[\frac{\alpha_r^k \rho_k R M_r^{-\rho_r^k}}{c_j(\nu)}\right]^{\frac{1}{1-\rho_r^k}} \left\{ s_b{}^{1-\mu_j} \left[\frac{1 - s_b(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k}\right]^{\mu_j} \right\}^{\frac{1}{1-\rho_r^k}}$$

□

Proposition 3 (Effects of incomplete contracting on the equilibrium levels of relationship-specific inputs)

1. *Contracting frictions (CF) reduce the quality-adjusted equilibrium level of relationship-specific inputs relative to the perfect contracting (PC) benchmark:*

$$\Gamma_j^k \in [0,1] \quad \Rightarrow \quad m_j^{CF}(\nu) \le m_j^{PC}(\nu)$$

2. *Non-contractible specifications are relatively more affected by contracting frictions than contractible ones:*

$$m_{n,j}^{CF}(\nu) \le m_{c,j}^{CF}(\nu) \le m_{n,j}^{PC}(\nu) = m_{c,j}^{PC}(\nu)$$

3. *The contracting frictions parameter Γ_j^k decreases with (1) the strength of contract enforcement in the supplier's country (μ_j) and (2) the elasticity of substitution among relationship-specific inputs (ζ_r^k). On the other hand, it increases with (1) the buyer's technological need for these inputs (α_r^k) and (2) the elasticity of demand the buyer faces for its products (σ_k):*

$$\Gamma_j^k(\overbrace{\zeta_r^k}^{+}, \overbrace{\alpha_r^k}^{-}, \overbrace{\sigma_k}^{-}, \overbrace{\mu_j}^{+})$$

4. *The contracting frictions parameter Γ_j^k converges to one (contracting frictions disappear) as (1) contract enforcement (μ_j) becomes perfect, (2) the buyer's technological need for relationship-specific inputs (α_r^k) goes to zero, or (3) the elasticity of demand the buyer faces for its products (σ_k) becomes unit elastic. On the other hand, it converges to zero (trade collapses) as elasticity of substitution among relationship-specific inputs (ζ_r^k) becomes unit elastic*

$$\lim_{\mu_j \nearrow 1} \Gamma_j^k = \lim_{\alpha_r^k \searrow 0} \Gamma_j^k = \lim_{\sigma_k \searrow 1} \Gamma_j^k = 1, \quad \textit{and} \quad \lim_{\zeta_r^k \searrow 1} \Gamma_j^k = 0$$

Proof. To abbreviate notation, define $[\cdot] \equiv \left[\frac{1-s_b(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k}\right]$.

Lower bound of Γ_j^k.- Since $\zeta_r^k \geq 1$ and $\sigma_k \geq 1$ by assumption, then:

$$\rho_r^k \equiv \frac{\zeta_r^k - 1}{\zeta_r^k} \in [0,1) \quad \text{and} \quad \rho_k \equiv \frac{\sigma_k - 1}{\sigma_k} \in [0,1)$$

This result and the assumption that $\alpha_r^k \geq 0$, imply that the buyer's share in revenue is indeed between zero and one:

$$s_b \equiv \frac{\rho_r^k}{\alpha_r^k \rho_k + \rho_r^k} \in [0,1] \tag{51}$$

Finally, given that $\mu_j \in [0,1]$, the previous result implies that:

$$[\cdot] \equiv \frac{1 - s_b(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k} = 1 + \frac{(1-s_b)(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k} \geq 1$$

The lower bound for Γ_j^k can be immediately be determined taking into account the bound of its components:

$$\Gamma_j^k \equiv \underbrace{(s_b)}_{\geq 0}{}^{1-\mu_j} \underbrace{\left[\frac{1 - s_b(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k}\right]^{\mu_j}}_{\geq 1} \geq 0$$

First derivatives and limits of Γ_j^k with respect to fundamental parameters.

- *Elasticity of substitution among inputs ζ_r^k*

  The derivative of Γ_j^k with respect to ζ_r^k is a function of the following components:

$$\begin{aligned}
&\frac{\partial \Gamma_j^k}{\partial s_b} = \frac{(1-\mu_j)\Gamma_j^k}{s_b} \geq 0 && \frac{ds_b}{d\rho_r^k} = \frac{1-s_b}{\alpha_r^k \rho_k + \rho_r^k} \geq 0 \\
&\frac{\partial \Gamma_j^k}{\partial [\cdot]} = \frac{\mu_j \Gamma_j^k}{[\cdot]} \geq 0 && \frac{d[\cdot]}{d\rho_r^k} = \frac{(1-\mu_j)(1-s_b)[(1-s_b) + s_b(1-\mu_j)\rho_r^k]}{[1-(1-\mu_j)\rho_r^k]^2} \geq 0
\end{aligned} \tag{52}$$

  Together, these results imply that Γ_j^k is increasing in ζ_r^k:

$$\frac{d\Gamma_j^k}{d\zeta_r^k} = \left(\frac{d\Gamma_j^k}{d\rho_r^k}\right)\left(\frac{d\rho_r^k}{d\zeta_r^k}\right) = \left[\underbrace{\left(\frac{\partial \Gamma_j^k}{\partial s_b}\right)}_{\geq 0}\underbrace{\left(\frac{ds_b}{d\rho_r^k}\right)}_{\geq 0} + \underbrace{\left(\frac{\partial \Gamma_j^k}{\partial [\cdot]}\right)}_{\geq 0}\underbrace{\left(\frac{d[\cdot]}{d\rho_r^k}\right)}_{\geq 0}\right]\left(\frac{1}{\zeta_r^k}\right)^2 \geq 0 \tag{53}$$

  The limits of Γ_j^k with respect to the bounds of ζ_r^k are equivalent to those with respect to ρ_r^k. These limits are:

$$\lim_{\zeta_r^k \to 1} \Gamma_j^k = \lim_{\rho_r^k \to 0} \Gamma_j^k = 0$$

$$\lim_{\zeta_r^k \to +\infty} \Gamma_j^k = \lim_{\rho_r^k \to 1} \Gamma_j^k = \left(\frac{\mu_j + \alpha_r^k \rho_k}{1 + \alpha_r^k \rho_k}\right)\left[\frac{1}{{\mu_j}^{\mu_j}(\mu_j + \alpha_r^k \rho_k)^{1-\mu_j}}\right] \in [0.5, 1]$$

- *Technological intensity α_r^k or product demand elasticity σ_k*

  The sign of the derivative of Γ_j^k with respect to $(\alpha_r^k \rho_k)$ is determined by the sign of the relationship between the buyer's share in revenue (s_b) and $(\alpha_r^k \rho_k)$, which is negative:

$$\frac{d\Gamma_j^k}{d(\alpha_r^k \rho_k)} = \left(\frac{ds_b}{d(\alpha_r^k \rho_k)}\right) \left[\frac{(1-\mu_j)\Gamma_j^k(1-s_b\rho_r^k)}{s_b[1-s_b(1-\mu_j)\rho_r^k]}\right] = -\frac{\rho_r^k}{(\alpha_r^k \rho_k + \rho_r^k)^2} \left[\frac{(1-\mu_j)\Gamma_j^k(1-s_b\rho_r^k)}{s_b[1-s_b(1-\mu_j)\rho_r^k]}\right] \leq 0$$

  Given that ρ_r^k is an increasing function of σ_k, the derivative of Γ_j^k with respect to σ_k is also positive. The limits of Γ_j^k with respect to the bounds of α_r^k or σ_k are:

$$\lim_{\alpha_r^k \to 0} \Gamma_j^k = \lim_{\sigma_k \to 1} \Gamma_j^k = \lim_{\rho_k \to 0} \Gamma_j^k = 1$$

$$\lim_{\alpha_r^k \to 1} \Gamma_j^k = \lim_{\sigma_k \to +\infty} \Gamma_j^k = \lim_{\rho_k \to 1} \Gamma_j^k = \left(\frac{\rho_r^k}{1+\rho_r^k}\right)^{1-\mu_j} \left[\frac{1-\left(\frac{\rho_r^k}{1+\rho_r^k}\right)(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k}\right]^{\mu_j} \in [0,1]$$

- *Contractibility μ_j^k*

  The derivative of Γ_j^k with respect to μ_j is:

$$\frac{d\Gamma_j^k}{d\mu_j} = \Gamma_j^k \left\{\log[\cdot] - \log s_b - \frac{(1-s_b)\mu_j\rho_r^k}{[1-s_b(1-\mu_j)\rho_r^k][1-(1-\mu_j)\rho_r^k]}\right\} \geq 0$$

  To justify the last inequality, we need to follow three steps. First, since both s_b and $[\cdot]$ are non-negative, the properties regarding bounds of logarithmic functions imply the following lower bound for $\log[\cdot] - \log s_b$[56]:

$$\log[\cdot] - \log s_b \geq \frac{(1-s_b)[1+(1-s_b)(1-\mu_j)\rho_r^k]}{1-s_b(1-\mu_j)\rho_r^k}$$

  Second, given that $\rho_r^k \leq 1$, then:

$$\frac{\mu_j\rho_r^k}{1-(1-\mu_j)\rho_r^k} = \frac{\mu_j\rho_r^k}{(1-\rho_r^k)+\mu_j\rho_r^k} \in (0,1)$$

  Putting these pieces together, we get:

$$\log[\cdot] - \log s_b \geq \left[\frac{1-s_b}{1-s_b(1-\mu_j)\rho_r^k}\right] \underbrace{\left[1+(1-s_b)(1-\mu_j)\rho_r^k\right]}_{\geq 1} \geq \left[\frac{1-s_b}{1-s_b(1-\mu_j)\rho_r^k}\right] \underbrace{\left[\frac{\mu_j\rho_r^k}{1-(1-\mu_j)\rho_r^k}\right]}_{\leq 1} \geq 0$$

$$\Rightarrow \log[\cdot] - \log s_b - \frac{(1-s_b)\mu_j\rho_r^k}{[1-s_b(1-\mu_j)\rho_r^k][1-(1-\mu_j)\rho_r^k]} \geq 0$$

[56] I am using the following property of logarithmic functions: $1 - \frac{1}{x} \leq \log x \leq x - 1$.

The limits of Γ_j^k with respect to the bounds of μ_j are:

$$\lim_{\mu_j \to 0} \Gamma_j^k = \frac{\rho_r^k}{\alpha_r^k \rho_k + \rho_r^k} \in [0, 1]$$
$$\lim_{\mu_j \to 1} \Gamma_j^k = 1$$

Upper bound of Γ_j^k. To prove that Γ_j^k is bounded from above by one, note that Γ_j^k is increasing in s_b (see equation 52) and that s_b is bounded from above by one (see equation 51). Together, they imply that Γ_j^k is bounded from above by its value when $s_b = 1$:

$$\Gamma_j^k \leq \Gamma_j^k \Big|_{s_b=1} = 1$$

Comparing $m_j(\nu)$ with and without contracting frictions. Given that $m_j(\nu)$ is increasing in Γ_j^k, and that Γ_j^k is bounded from above by one, then $m_j(\nu)$ is also bounded from above by its value when $\Gamma_j^k = 1$:

$$m_j^{CF}(\nu) \leq m_j^{CF}(\nu)\Big|_{\Gamma_j^k=1} = \left[\frac{\alpha_r^k \rho_k R M_r^{-\rho_r^k}}{c_j(\nu)}\right]^{\frac{1}{1-\rho_r^k}} \equiv m_j^{PC}(\nu)$$

Non-contractible vs contractible specifications. If we divide the equilibrium level of non-contractible specifications by that of contractible ones, we find that the ratio is less than one:

$$\frac{m_n(\nu)}{m_c(\nu)} = \underbrace{s_b}_{\leq 1} \underbrace{\left[\frac{1-(1-\mu_j)\rho_r^k}{1-s_b(1-\mu_j)\rho_r^k}\right]}_{\leq 1} \leq 1$$

□

Proposition 4 (Price for relationship-specific inputs)
Let input ν be produced by a supplier in country j. The price that rationalizes trade flows from country j is:

$$p_{jh}^{rk}(\nu) = \frac{w_j \gamma_{jh} \tau_{j0}^k \Lambda_j^k}{a_j^{rk}(\nu)} \tag{27}$$

where:

$$\Lambda_j^k \equiv \frac{1}{{s_b}^{1-\mu_j}\left[\frac{1-s_b(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k}\right]^{\mu_j}\left[\mu_j\left[\frac{1-s_b(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k}\right]+(1-\mu_j)s_b\right]^{\frac{1-\rho_r^k}{\rho_r^k}}}$$

Proof. The goal is to find a closed-form expression for the (implicit) input prices that firms compare when making their sourcing choices. The first step towards this is to determine the *net* payment to a supplier. On one hand, it receives $s(\nu)R$ as a result of bargaining. On the other hand, to win the contract in the first place, it had to pay the buyer $f(\nu) = s(\nu)R - c(\nu)\left[\mu_{j(\nu)} m_c(\nu) + (1-\mu_{j(\nu)}) m_n(\nu)\right]$. Therefore, the net payment to a supplier from country j is:

$$X_j(\nu) = c_j(\nu)\left[\mu_j m_{c,j}(\nu) + (1-\mu_j) m_{n,j}(\nu)\right]$$

Using equations 24 and 25, this expression becomes[57]:

$$X_j(v) = c_j(v)^{1-\zeta_r^k}\left[\alpha_r^k \rho_k RM_r^{-\rho_r^k}\right]^{\zeta_r^k}\left[\mu_j(\Gamma_{c,j}^k)^{\zeta_r^k} + (1-\mu_j)(\Gamma_{n,j}^k)^{\zeta_r^k}\right]$$
$$= c_j(v)^{1-\zeta_r^k}\left[\alpha_r^k \rho_k RM_r^{-\rho_r^k}\right]^{\zeta_r^k}(\Gamma_j^k)^{\zeta_r^k-1}\left\{\mu_j[\cdot] + (1-\mu_j)s_b\right\} \tag{54}$$

One intuitive way to get the price is to divide this expression by the quality-adjusted quantity of $m_j(v)$ found in equation 26. This gives us the implicit price per unit of quality of input v:

$$p_j(v) \equiv \frac{X_j(v)}{m_j(v)} = c_j(v)\left\{\frac{\mu_j[\cdot] + (1-\mu_j)s_b}{\Gamma_j^k}\right\}$$

This approach has two disadvantages. First, the expression in brackets is not a monotonic function of μ_j nor ζ_r^k, which leads to less intuitive and clear insights[58]. Second, while it is still possible to get closed-forms expressions for the price index and for the share of *inputs* purchased from a country j, the latter is not equal to the share of *expenditure* in inputs from country j, as in Eaton and Kortum (2002), which unnecessarily complicates the analysis.

An alternative approach is to define prices as the those that *rationalize* the expenditure flows $X_j(v)$ "as if" buyers were able to optimally choose $m_j(v)$ and contracting frictions affected these quantities only *indirectly* via their prices. To implement this, we just need to rewrite equation 54 as:

$$X_j(v) = \Big[\underbrace{c_j(v)\Lambda_j^k}_{p_j^k(v)}\Big]^{1-\zeta_r^k}\left[\alpha_r^k \rho_k RM_r^{-\rho_r^k}\right]^{\zeta_r^k}$$

where:

$$\Lambda_j^k \equiv \frac{1}{s_b{}^{1-\mu_j}\left[\frac{1-s_b(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k}\right]^{\mu_j}\left[\mu_j\left[\frac{1-s_b(1-\mu_j)\rho_r^k}{1-(1-\mu_j)\rho_r^k}\right] + (1-\mu_j)s_b\right]^{\frac{1-\rho_r^k}{\rho_r^k}}}$$

□

Proposition 5 (Properties of the contracting frictions parameter Λ_j^k)

1. Λ_j^k *behaves likes an iceberg variable cost, in the sense that it is bounded from below by one and it is unbounded from above:*

$$\Lambda_j^k \in [1, +\infty)$$

[57] I have replaced $\frac{1}{1-\rho_r^k}$ by its equivalent ζ_r^k.

[58] For example, $p_j(v)$ is increasing in contract enforcement quality (μ_j) at low levels of μ_j (i.e., among countries with weak institutions, those with relatively stronger ones are *less* attractive sources of inputs, while among countries with a minimum quality of contract enforcement, the relationship reverses), and increasing in input elasticity of substitution (ζ_r^k) at high levels of ζ_r^k and low levels of μ_j (i.e., in countries with weak contract enforcement institutions, industries for which it is "too" easy to substitutes inputs would face higher frictions than industries for which it is less easy to do so). These patterns can be a consequence of the fact that the contracting frictions parameters for $X_j(v)$ and $m_j(v)$ have the same qualitative relation with the fundamental parameters (increasing in μ_j, concave in ζ_r^k and decreasing in α_r^k and σ_k).

2. Λ_j^k *decreases (contracting frictions are lower) with (1) the strength of contract enforcement in the supplier's country* (μ_j) *and (2) the elasticity of substitution among relationship-specific inputs* (ζ_r^k). *On the other hand, it increases with (1) the buyer's technological need for these inputs* (α_r^k) *and (2) the elasticity of demand the buyer faces for its products* (σ_k):

$$\Lambda_j^k(\overbrace{\zeta_r^k}^{-}, \overbrace{\alpha_r^k}^{+}, \overbrace{\sigma_k}^{+}, \overbrace{\mu_j}^{-})$$

3. Λ_j^k *converges to one (contracting frictions disappear) as (1) contract enforcement becomes perfect* (μ_j), *(2) the buyer's technological need for relationship-specific inputs goes to zero* (α_r^k), *or (3) the elasticity of demand the buyer faces for its products becomes unit elastic* (σ_k). *On the other hand, it diverges (trade collapses) as the elasticity of substitution among relationship-specific inputs becomes unit elastic* (ζ_r^k).

$$\lim_{\mu_j \nearrow 1} \Lambda_j^k = \lim_{\alpha_r^k \searrow 0} \Lambda_j^k = \lim_{\sigma_k \searrow 1} \Lambda_j^k = 1, \quad \text{and} \quad \lim_{\zeta_r^k \searrow 1} \Lambda_j^k = +\infty$$

Proof. Let's start by establishing Λ_j^k's lower and upper bounds.

Lower and upper bounds of Λ_j^k.- Since $\mu_j \in [0,1]$, the expression below is a linear combination between $[\cdot] \geq 1$ and $s_b \in [0,1]$, thus it is between zero and one:

$$\mu_j[\cdot] + (1-\mu_j)s_b = 1 - \frac{(1-\mu_j)(1-s_b)(1-\rho_r^k)}{1-(1-\mu_j)\rho_r^k} \in [0,1] \tag{55}$$

Given that $\rho_r^k \in [0,1]$, then $\frac{1-\rho_r^k}{\rho_r^k} \geq 0$ and $\left[\mu_j[\cdot] + (1-\mu_j)s_b\right]^{\frac{1-\rho_r^k}{\rho_r^k}} \in [0,1]$, too. Finally, given that $\Gamma_j^k \in [0,1]$, also, then:

$$\Lambda_j^k \equiv \Bigg\{\underbrace{\Gamma_j^k\left[\mu_j[\cdot] + (1-\mu_j)s_b\right]^{\frac{1-\rho_r^k}{\rho_r^k}}}_{\in[0,1]}\Bigg\}^{-1} \in [1,+\infty]$$

First derivatives and limits of Λ_j^k with respect to fundamental parameters.

- *Elasticity of substitution among inputs* ζ_r^k

  The results in equations 52, 53 and 55 imply:

$$\frac{d\Lambda_j^k}{d\zeta_r^k} = -\Lambda_j^k\left\{\underbrace{\frac{1}{\Gamma_j^k}\left(\frac{d\Gamma_j^k}{d\zeta_r^k}\right)}_{\geq 0} + \underbrace{\left(\frac{1-\rho_r^k}{\rho_r^k}\right)\left(\frac{1}{\mu_j[\cdot]+(1-\mu_j)s_b}\right)\left[\mu_j\frac{d[\cdot]}{d\zeta_r^k} + (1-\mu_j)\frac{ds_b}{d\zeta_r^k}\right]}_{\geq 0} \underbrace{-\frac{\log\left(\mu_j[\cdot]+(1-\mu_j)s_b\right)}{(\zeta_r^k-1)^2}}_{\geq 0}\right\} \leq 0$$

  The limits of Λ_j^k with respect to the bounds of ζ_r^k are:

$$\lim_{\zeta_r^k \to 1} \Lambda_j^k = \lim_{\rho_r^k \to 0} \Lambda_j^k = +\infty$$

$$\lim_{\zeta_r^k \to +\infty} \Lambda_j^k = \lim_{\rho_r^k \to 1} \Lambda_j^k = \left(\lim_{\zeta_r^k \to +\infty} \Gamma_j^k \right)^{-1} \in [1, 2]$$

- *Technological intensity α_r^k or product demand elasticity σ_k*

  The sign of the derivative of Λ_j^k with respect to $(\alpha_r^k \rho_k)$ is determined by the sign of the term in square brackets:

$$\frac{d\Lambda_j^k}{d(\alpha_r^k \rho_k)} = -\Lambda_j^k \Bigg\{ \underbrace{\frac{1}{\Gamma_j^k} \frac{d\Gamma_j^k}{d(\alpha_r^k \rho_k)}}_{\leq 0} + \overbrace{\left(\frac{1-\rho_r^k}{\rho_r^k}\right)\left(\frac{1}{\mu_j[\cdot] + (1-\mu_j)s_b}\right)}^{\geq 0} \underbrace{\left[\mu_j \overbrace{\frac{d[\cdot]}{d(\alpha_r^k \rho_k)}}^{\geq 0} + (1-\mu_j) \overbrace{\frac{ds_b}{d(\alpha_r^k \rho_k)}}^{\leq 0} \right]}_{?} \Bigg\}$$

$$= -\Lambda_j^k \Bigg\{ \underbrace{\frac{1}{\Gamma_j^k} \frac{d\Gamma_j^k}{d(\alpha_r^k \rho_k)}}_{\leq 0} \underbrace{- \left(\frac{1-\rho_r^k}{\rho_r^k}\right)\left(\frac{1}{\mu_j[\cdot] + (1-\mu_j)s_b}\right)\left[\frac{(1-\mu_j)(s_b)^2(1-\rho_r^k)}{[1-(1-\mu_j)\rho_r^k]\rho_r^k}\right]}_{\leq 0} \Bigg\} \geq 0$$

  Given that ρ_r^k is an increasing function of σ_k, the derivative of Λ_j^k with respect to σ_k is also positive. The limits of Λ_j^k with respect to the bounds of α_r^k or σ_k are:

$$\lim_{\alpha_r^k \to 0} \Lambda_j^k = \lim_{\sigma_k \to 1} \Lambda_j^k = \lim_{\rho_k \to 0} \Lambda_j^k = 1$$

$$\lim_{\alpha_r^k \to 1} \Lambda_j^k = \lim_{\sigma_k \to +\infty} \Lambda_j^k = \lim_{\rho_k \to 1} \Lambda_j^k$$

$$= \frac{1+\rho_r^k}{\rho_r^k} \left\{ \frac{\rho_r^k\left[1-(1-\mu_j)\rho_r^k\right]}{1+\rho_r^k\left[1-(1-\mu_j)\rho_r^k\right]} \right\}^{\mu_j} \left\{ \frac{(1+\rho_r^k)\left[1-(1-\mu_j)\rho_r^k\right]}{(1+\rho_r^k)\left[1-(1-\mu_j)\rho_r^k\right] - (1-\mu_j)(1-\rho_r^k)} \right\}^{\frac{1}{\rho_r^k}-1} \geq 1$$

- *Contractibility μ_j^k*

  The derivative of Λ_j^k with respect to μ_j is:

$$\frac{d\Lambda_j^k}{d\mu_j} = -\Lambda_j^k \left\{ \log[\cdot] - \log s_b - \frac{\mu_j(1-s_b)}{\left[1-s_b(1-\mu_j)\rho_r^k\right]\left[\mu_j + (1-\mu_j)s_b(1-\rho_r^k)\right]} \right\} \leq 0$$

  The last inequality comes from using the same inequality used in proposition 3:

$$\log[\cdot] - \log s_b \geq \left[\frac{1-s_b}{1-s_b(1-\mu_j)\rho_r^k}\right] \underbrace{\left[1+(1-s_b)(1-\mu_j)\rho_r^k\right]}_{\geq 1} \geq \left[\frac{1-s_b}{1-s_b(1-\mu_j)\rho_r^k}\right] \underbrace{\left[\frac{\mu_j}{\mu_j + (1-\mu_j)s_b(1-\rho_r^k)}\right]}_{\leq 1}$$

  The limits of Λ_j^k with respect to the bounds of μ_j are:

$$\lim_{\mu_j \to 0} \Lambda_j^k = \left(\frac{\alpha_r^k \rho_k + \rho_r^k}{\rho_r^k}\right)^{\frac{1}{\rho_r^k}} \geq 1$$

$$\lim_{\mu_j \to 1} \Lambda_j^k = 1$$

□

B. Proofs for Section 5 (Counterfactual exercises)

Proposition 6 (Labor market clearing condition in relative changes)
The labor market clearing condition in relative changes is:

$$\widehat{GNP}_0 \equiv \widehat{w}_0 = \sum_{k=1}^{K} \left\{ \left(\frac{VA_0^k}{E_0} \right) \widehat{R}_0^k + \sum_{h \neq 0} \left(\frac{W_h^k}{E_0} \right) \widehat{R}_h^k \right\} + \left(\frac{VA_0^T}{E_0} \right) \widehat{R}_0^T + \left(\frac{VA_0^N}{E_0} \right) \widehat{R}_0^N$$

where VA_0^k, VA_0^T and VA_0^N are the value added of domestic manufacturing industry k, non-manufacturing tradable sector T and non-tradable sector N, respectively, E_0 is the SOE's Gross National Product, and W_h^k is the wage bill of foreign manufacturing industry k. The relative change in revenue reflects the change in sales to final consumers and, in the case of domestic industries, also sales to downstream manufacturing industries:

$$\begin{aligned}
\widehat{R}_0^k &= \widehat{N}_0^k (\widehat{c}_0^k)^{1-\sigma_k} \left[\left(\frac{R_{00}^{k,f}}{R_0^k} \right) \widehat{E}_0 (\widehat{P}_0^k)^{\sigma_k - 1} + \left(\frac{EXP_0^k}{R_0^k} \right) \right] + \sum_{k'} \sum_{h} \left[\left(\frac{R_{00,h}^{k,sk'}}{R_0^k} \right) \widehat{\chi}_{0h}^{sk'} + \left(\frac{R_{00,h}^{k,rk'}}{R_0^k} \right) \widehat{\chi}_{0h}^{rk'} \right] \widehat{R}_h^{k'} \\
\widehat{R}_h^k &= (\widehat{c}_h^k)^{1-\sigma_k} \left[\left(\frac{R_{h0}^{k,f}}{R_h^k} \right) \widehat{E}_0 (\widehat{P}_0^k)^{\sigma_k - 1} + \sum_{i \neq 0} \left(\frac{R_{hi}^{k,f}}{R_h^k} \right) (\widehat{\gamma}_{hi})^{1-\sigma_k} \right], \quad \textit{for} \quad h \neq 0 \qquad (40) \\
\widehat{R}_0^T &= (\widehat{w}_0)^{1-\sigma_T} \left[\left(\frac{R_{00}^{T,f}}{R_0^T} \right) \widehat{E}_0 (\widehat{P}_0^T)^{\sigma_T - 1} + \left(\frac{EXP_0^T}{R_0^T} \right) \right] + \sum_{k'} \sum_{h} \left[\left(\frac{R_{00,h}^{T,sk'}}{R_0^T} \right) \widehat{\chi}_{0h}^{sk'} + \left(\frac{R_{00,h}^{T,rk'}}{R_0^T} \right) \widehat{\chi}_{0h}^{rk'} \right] \widehat{R}_h^{k'} \\
\widehat{R}_0^N &= \left(\frac{R_{00}^{N,f}}{R_0^N} \right) \widehat{E}_0 + \sum_{k'} \sum_{h} \left(\frac{R_{0h}^{N,k'}}{R_0^N} \right) \widehat{R}_h^{k'}
\end{aligned}$$

where $R_{hi}^{k,f}$ and R_h^k are the sales of final goods to market i and total sales of firms in industry k and HQ in country h, while EXP_0^k is total exports of domestic firms; $R_{00,h}^{k,sk'}$ and $R_{00,h}^{k,sk'}$ are the domestic sales of standardized and relationship-specific inputs from industry k to firms in industry k' and HQ in country h; $R_{00}^{T,f}$, EXP_0^T, $R_{00,h}^{T,sk'}$, and $R_{00,h}^{T,rk'}$ represent domestic sales of final goods, total exports, domestic sales of standardized inputs, and domestic sales of relationship-specific inputs of non-manufacturing tradable sector goods to firms in industry k' with HQ in country h; $R_{00}^{N,f}$ and R_0^N are the domestic and total sales of non-tradable services to final consumers; and $R_{0h}^{N,k'}$ are the domestic sales of non-tradable services to firms in industry k' with HQ in country h. The relative change in expenditure shares for standardized and relationship-specific inputs, respectively, are:

$$\widehat{\chi}_{0h}^{sk} = \left(\frac{\widehat{w}_0}{\widehat{P}_h^{sk}} \right)^{-\theta_s} \qquad \widehat{\chi}_{0h}^{rk} = \left(\frac{\widehat{w}_0 \widehat{\Lambda}_{0h}^k}{\widehat{P}_h^{rk}} \right)^{-\theta_r}$$

Finally, the changes in aggregate expenditure and in the number of domestic firms are:

$$\widehat{E}_0 = \left(\frac{GNP_0}{E_0} \right) \widehat{w}_0 + 1 - \frac{GNP_0}{E_0} \qquad \textit{and} \qquad \widehat{N}_0^k = \frac{\widehat{R}_0^k}{\widehat{w}_0}$$

Proof. First, I show how they affect the revenue equations in levels, and then in changes. After that I circle back to the labor market equilibrium.

Revenues in levels. Aggregate revenue for manufacturing firms is shown in equation 30, while that of the other two sectors is shown in equations 17 and 18. Assumptions 7 and 8 imply that total revenue must also include sales to other sectors. In addition, assumption 8 implies that foreign affiliates' revenue function does not change. The new aggregate revenue for the domestic k industry is:

$$R_0^k = \overbrace{N_0^k \left(\frac{\sigma_k}{\sigma_k - 1}\right)^{1-\sigma_k} (c_0^k)^{1-\sigma_k} \left[\beta_k w_0 L_0 (P_0^k)^{\sigma_k - 1} + FMA_0^k\right]}^{\text{sales to final consumers}} + \overbrace{\sum_{k'} \sum_h \lambda_{kk'}^{sh} \alpha_s^{k'} \left(\frac{\sigma_{k'} - 1}{\sigma_{k'}}\right) \chi_{0h}^{sk'} R_h^{k'}}^{\text{domestic sales of std. inputs}}$$
$$+ \underbrace{\sum_{k'} \sum_h \lambda_{kk'}^{rh} \alpha_r^{k'} \left(\frac{\sigma_{k'} - 1}{\sigma_{k'}}\right) \chi_{0h}^{rk'} R_h^{k'}}_{\text{domestic sales of RS inputs}}$$

Similarly, the non-manufacturing sectors also sell inputs to the manufacturing industries (I do not allow for intra-sector linkages)[59]. Hence, their new revenue functions are:

$$R_0^T = \overbrace{\left(\frac{w_0}{A_0^T}\right)^{1-\sigma_T} \left[\beta_T w_0 L_0 (P_0^T)^{\sigma_T - 1} + FMA_0^T\right]}^{\text{sales to final consumers}} + \overbrace{\sum_{k'} \sum_h \lambda_{Tk'}^{sh} \alpha_s^{k'} \left(\frac{\sigma_{k'} - 1}{\sigma_{k'}}\right) \chi_{0h}^{sk'} R_h^{k'}}^{\text{domestic sales of std. inputs}} + \overbrace{\sum_{k'} \sum_h \lambda_{Tk'}^{rh} \alpha_r^{k'} \left(\frac{\sigma_{k'} - 1}{\sigma_{k'}}\right) \chi_{0h}^{rk'} R_h^{k'}}^{\text{domestic sales of RS inputs}}$$
$$R_0^N = \underbrace{\beta_N w_0 L_0}_{\substack{\text{sales to final}\\\text{consumers}}} + \underbrace{\sum_{k'} \sum_h \alpha_N^{k'} \left(\frac{\sigma_{k'} - 1}{\sigma_{k'}}\right) R_h^{k'}}_{\text{domestic sales of inputs}}$$

Revenues in relative changes. The change in foreign multinational's revenue is:

$$\widehat{R}_h^k = \left(\widehat{c}_h^k\right)^{1-\sigma_k} \left[\left(\frac{R_{h0}^k}{R_h^k}\right) \widehat{w}_0 \left(\widehat{P}_0^k\right)^{\sigma_k - 1} + \sum_{i \neq 0} \left(\frac{R_{hi}^k}{R_h^k}\right) \left(\widehat{\gamma}_{hi}\right)^{1-\sigma_k}\right]$$

where R_{hi}^k and R_h^k represent sales to market i and total sales, respectively. Next, we can write the change in revenue for domestic manufacturing firms using matrix algebra:

$$\widehat{\boldsymbol{R}}_{\boldsymbol{0}} = \left(\boldsymbol{I} - \widehat{\boldsymbol{A}}_{\boldsymbol{00}}\right)^{-1} \left[\widehat{\boldsymbol{F}}_{\boldsymbol{0}} + \sum_{h \neq 0} \widehat{\boldsymbol{A}}_{\boldsymbol{0h}} \widehat{\boldsymbol{R}}_{\boldsymbol{h}}\right]$$

where $\widehat{\boldsymbol{R}}_{\boldsymbol{0}}$, $\widehat{\boldsymbol{F}}_{\boldsymbol{0}}$, and $\widehat{\boldsymbol{R}}_{\boldsymbol{h}}$ are the $K \times 1$ vectors of changes in total revenue and final revenue for domestic firms, respectively, and total revenue for foreign affiliates from HQ country h. The $K \times K$ matrices $\widehat{\boldsymbol{A}}_{\boldsymbol{00}}$ and $\widehat{\boldsymbol{A}}_{\boldsymbol{0h}}$ account for input-output linkages between industries, for domestic and foreign downstream industries, respectively. They are written in hats to emphasize that they

[59] This assumption is innocuous for the non-manufacturing tradable sector (which groups agriculture, mining and oil) since most of its domestic intermediate sales go to the manufacturing sector (87% in 2018). However, this is not the case for the non-tradable sector: 62% of its sales were intra-sector in 2018. Nonetheless, ignoring this feedback is expected to ameliorate the quantitative results, not to exacerbate them. Thus, we can take them as relatively conservative estimates.

depend on the shares of domestic purchases χ^{xk}_{0h}, which are also changing. A representative element for these matrices is:

$$\widehat{a}^{kk'}_{0h} = \left(\frac{R^{k,sk'}_{00,h}}{R^k_0}\right)\widehat{\chi}^{sk'}_{0h} + \left(\frac{R^{k,rk'}_{00,h}}{R^k_0}\right)\widehat{\chi}^{rk'}_{0h}$$

where $R^{k,sk'}_{00,h}$ and $R^{k,rk'}_{00,h}$ are the domestic sales to firms from HQ country h in industry k' of standardized and relationship-specific inputs, respectively. $\widehat{\boldsymbol{F}}^{\boldsymbol{k}}_{\boldsymbol{0}}$ is the vector with the changes in sales to final consumers:

$$\widehat{F}^k_0 = \widehat{N}^k_0\left(\widehat{c}^k_0\right)^{1-\sigma_k}\left[\left(\frac{R^{k,f}_{00}}{R^k_0}\right)\widehat{w}_0\left(\widehat{P}^k_0\right)^{\sigma_k-1} + \left(\frac{EXP^k_0}{R^k_0}\right)\right]$$

where $R^{k,f}_{00}$ and EXP^k_0 represent domestic sales and total exports, respectively. Finally, the revenue changes for the non-manufacturing sectors are:

$$\widehat{R}^T_0 = \left(\widehat{w}_0\right)^{1-\sigma_T}\left[\left(\frac{R^{T,f}_{00}}{R^T_0}\right)\widehat{w}_0\left(\widehat{P}^T_0\right)^{\sigma_T-1} + \left(\frac{EXP^T_0}{R^T_0}\right)\right] + \sum_{k'}\sum_{h}\left[\left(\frac{R^{T,sk'}_{00,h}}{R^T_0}\right)\widehat{\chi}^{sk'}_{0h} + \left(\frac{R^{T,rk'}_{00,h}}{R^T_0}\right)\widehat{\chi}^{rk'}_{0h}\right]\widehat{R}^{k'}_h$$

$$\widehat{R}^N_0 = \left(\frac{R^{N,f}_0}{R^N_0}\right)\widehat{w}_0 + \sum_{k'}\sum_{h}\left(\frac{R^{N,k'}_{0h}}{R^N_0}\right)\widehat{R}^{k'}_h$$

where $R^{T,f}_{00}$ and EXP^T_0 represent domestic sales and exports, respectively; $R^{T,sk'}_{00,h}$ and $R^{T,rk'}_{00,h}$ the domestic sales to firms from HQ country h in industry k' of standardized and relationship-specific inputs, respectively; and $R^{N,f}_0$ and $R^{N,k'}_{0h}$ the domestic sales of non-tradable services to final consumers and to firms from country h in industry k', respectively.

New labor market clearing condition. By distributing the "indirect" labor demands of manufacturing firms among *observable* industries, the previous assumptions simplify the accounting of the labor market clearing condition in relative changes. Specifically, since the indirect effects now show up as inter-industry sales, I can redefine the components of equation 38 as reflecting only "direct" labor demands. In addition, if I multiply both sides of the equation by w_0, the labor market condition is equivalent to the national accounting definition of Gross National Product (GNP), denoted by E_0:

$$\underbrace{w_0 L_0}_{GNP_0} = \sum_{k=1}^{K}\left\{\underbrace{w_0 L^k_{00}}_{VA^k_0} + \sum_{h\neq 0}\underbrace{w_0 L^k_{0h}}_{W^k_h}\right\} + \underbrace{w_0 L^T_0}_{VA^T_0} + \underbrace{w_0 L^N_0}_{VA^N_0}$$

where VA stands for "value added" and W for "wage bill". Taking into account this new labor market clearing condition, together with equations 35, 36 and 37, the equation in relative changes is:

$$\widehat{w}_0 = \sum_{k=1}^{K}\left\{\left(\frac{VA^k_0}{E_0}\right)\widehat{R}^k_0 + \sum_{h\neq 0}\left(\frac{W^k_h}{E_0}\right)\widehat{R}^k_h\right\} + \left(\frac{VA^T_0}{E_0}\right)\widehat{R}^T_0 + \left(\frac{VA^N_0}{E_0}\right)\widehat{R}^N_0$$

Finally, the relative change in expenditure shares can be written as follows:

$$\widehat{\chi}_{0h}^{sk} = \frac{\left(\widehat{w}_0\right)^{-\theta_s}}{\chi_{0h}^{sk}\left(\widehat{w}_0\right)^{-\theta_s} + \sum_{j\neq 0}\chi_{jh}^{sk}\left(\widehat{\gamma}_{jh}\right)^{-\theta_s}} = \frac{\left(\widehat{w}_0\right)^{-\theta_s}}{\left(\widehat{P}_h^{sk}\right)^{-\theta_s}}$$

$$\widehat{\chi}_{0h}^{rk} = \frac{\left(\widehat{w}_0\widehat{\Lambda}_{0h}^{k}\right)^{-\theta_r}}{\chi_{0h}^{rk}\left(\widehat{w}_0\widehat{\Lambda}_{0h}^{k}\right)^{-\theta_r} + \sum_{j\neq 0}\chi_{jh}^{rk}\left(\widehat{\gamma}_{jh}\widehat{\Lambda}_{jh}^{k}\right)^{-\theta_r}} = \frac{\left(\widehat{w}_0\widehat{\Lambda}_{0h}^{k}\right)^{-\theta_r}}{\left(\widehat{P}_h^{rk}\right)^{-\theta_r}}$$

□

Proposition 7 (Identification of parameter shocks)
The parameter shocks associated with each counterfactual scenario can be identified using the following formulas:

1. ***Contracting frictions:***

$$\left(\widehat{\Lambda}_{jh}^{k}\right)^{-\theta_r} \equiv \left(\frac{\Lambda_{j0}^{k}}{\Lambda_{jh}^{k}}\right)^{-\theta_r} = \left(\frac{\chi_{j0}^{rk}/\chi_{j^*0}^{rk}}{\chi_{jh}^{rk}/\chi_{j^*h}^{rk}}\right)\left(\frac{\chi_{jh}^{sk}/\chi_{j^*h}^{sk}}{\chi_{j0}^{sk}/\chi_{j^*0}^{sk}}\right)^{\frac{\theta_r}{\theta_s}} \tag{41}$$

where j^* refers to any country with close to "perfect" contract enforcement institutions ($\mu_{j^*} \approx 1$).

2. ***Geography (input purchases):***

$$\left(\widehat{\gamma}_{jh}\right)^{-\theta_s} = \left(\frac{\gamma_{j0}}{\gamma_{jh}}\right)^{-\theta_s} = \left(\frac{\chi_{j0}^{sk}/\chi_{00}^{sk}}{\chi_{jh}^{sk}/\chi_{0h}^{sk}}\right) \tag{42}$$

Alternatively:

$$\left(\widehat{\gamma}_{jh}\right)^{-\theta_r} = \left(\frac{\gamma_{j0}}{\gamma_{jh}}\right)^{-\theta_r} = \left(\frac{\chi_{j0}^{rk}/\chi_{00}^{rk}}{\chi_{jh}^{rk}/\chi_{0h}^{rk}}\right)\left(\frac{\widehat{\Lambda}_{0h}^{k}}{\widehat{\Lambda}_{jh}^{k}}\right)^{-\theta_r} \tag{43}$$

3. ***Geography (sales):***

$$\left(\widehat{\gamma}_{hi}\right)^{1-\sigma_k} \equiv \left(\frac{\gamma_{0i}}{\gamma_{hi}}\right)^{1-\sigma_k} = \frac{R_{h0}^{k,f}/R_{00}^{k,f}}{R_{hi}^{k,f}/R_{0i}^{k,f}} \tag{44}$$

4. ***Productivity:***

$$\left(\widehat{\widetilde{\varphi}}_{h}^{k}\right)^{\sigma_k-1} \equiv \left(\frac{\varphi_0^k}{\varphi_h^k/\eta_h^k}\right)^{\sigma_k-1} = \frac{R_{00}^{k,f}/N_0^k}{R_{h0}^{k,f}/N_h^k}\left\{\left(\frac{\chi_{0h}^{sk}}{\chi_{00}^{sk}}\right)^{\frac{\alpha_s^k+\alpha_r^k}{\theta_s}}\left(\frac{\chi_{j^*h}^{rk}}{\chi_{j^*0}^{rk}}\right)^{\frac{\alpha_r^k}{\theta_r}}\left(\frac{\chi_{j^*0}^{sk}}{\chi_{j^*h}^{sk}}\right)^{\frac{\alpha_r^k}{\theta_s}}\right\}^{1-\sigma_k} \tag{45}$$

Alternatively:

$$\left(\widehat{\widetilde{\varphi}}_{h}^{k}\right)^{\sigma_k-1} \equiv \left(\frac{\varphi_0^k}{\varphi_h^k/\eta_h^k}\right)^{\sigma_k-1} = \frac{R_{00}^{k,f}/N_0^k}{R_{h0}^{k,f}/N_h^k}\left\{\left[\sum_j \chi_{jh}^{sk}\left(\widehat{\gamma}_{jh}\right)^{-\theta_s}\right]^{\frac{\alpha_s^k}{\theta_s}}\left[\sum_j \chi_{jh}^{rk}\left(\widehat{\gamma}_{jh}\widehat{\Lambda}_{jh}^{k}\right)^{-\theta_r}\right]^{\frac{\alpha_r^k}{\theta_r}}\right\}^{1-\sigma_k} \tag{46}$$

Proof. The identification of parameter shocks is based on different sets of assumptions. Let us delve into the details of each one.

Contracting frictions.- The identification of the contracting friction shock is based on exploiting two features of the model. The first one is that the relative expenditure shares between two countries, regardless on whether inputs are standardized or relationship-specific, has the same functional form and depends on almost the same variables: relative productivities (T_j^{xk}/T_0^{xk}), labor costs (w_j/w_0) and bilateral trade and communication frictions ($\tau_{j0}^k \gamma_{jh}/\tau_{00}^k \gamma_{0h}$). The exception is that contracting frictions do not affect standardized inputs (assumption 2). This implies that the double difference (domestic vs. foreign firms and standardized vs. relationship-specific inputs) in expenditure shares from some country j reveals information about the relative contracting frictions faced by domestic firms and foreign affiliates when sourcing from that country (assuming firms in both groups source from this place):

$$\frac{\chi_{j0}^{rk}/\chi_{jh}^{rk}}{\left(\chi_{j0}^{sk}/\chi_{jh}^{sk}\right)^{\frac{\theta_r}{\theta_s}}} = \left(\frac{\Lambda_{j0}^k}{\Lambda_{jh}^k}\right)^{-\theta_r} \left[\frac{\Theta_h^{rk}/\Theta_0^{rk}}{\left(\Theta_h^{sk}/\Theta_0^{sk}\right)^{\frac{\theta_r}{\theta_s}}}\right] \tag{56}$$

This double ratio would be sufficient if the terms Θ_h^{xk} and Θ_0^{xk}, known in the literature as *sourcing capabilities*[60], were identical. Unfortunately, even I were to assume that foreign firms source from the same set of countries than domestic firms (i.e., shutting down extensive margin differences), these objects will be different as long as domestic and foreign firms face different contracting and communication frictions:

$$\frac{\Theta_h^{rk}}{\Theta_0^{rk}} = \frac{\sum_{j'} T_{j'}^{rk}(w_{j'}\gamma_{j'h}\tau_{j'0}^k \Lambda_{j'h}^k)^{-\theta_r}}{\sum_{j'} T_{j'}^{rk}(w_{j'}\gamma_{j'0}\tau_{j'0}^k \Lambda_{j'0}^k)^{-\theta_r}}$$

The second model feature is introduced to solve this issue. The third numeral in proposition 5 states that the contracting friction parameter disappears ($\Lambda_j^k \rightarrow 1$) as contract enforcement institutions approach "perfection" ($\mu_j \rightarrow 1$). Let j^* denote a country with perfect contract enforcement institutions. For such a country, equation 56 becomes:

$$\frac{\chi_{j^*0}^{rk}/\chi_{j^*h}^{rk}}{\left(\chi_{j^*0}^{sk}/\chi_{j^*h}^{sk}\right)^{\frac{\theta_r}{\theta_s}}} = \frac{\Theta_h^{rk}/\Theta_0^{rk}}{\left(\Theta_h^{sk}/\Theta_0^{sk}\right)^{\frac{\theta_r}{\theta_s}}}$$

This means that I can use the same double difference in expenditure shares from some country j^* to control for differences in sourcing capabilities between domestic and foreign firms, as long as this is a country with "almost perfect" contract enforcement institutions, which can be inferred from any of the publicly available rankings of institutional quality:

$$\left(\frac{\chi_{j0}^{rk}/\chi_{j^*0}^{rk}}{\chi_{jh}^{rk}/\chi_{j^*h}^{rk}}\right)\left(\frac{\chi_{jh}^{sk}/\chi_{j^*h}^{sk}}{\chi_{j0}^{sk}/\chi_{j^*0}^{sk}}\right)^{\frac{\theta_r}{\theta_s}} = \left(\frac{\Lambda_{j0}^k}{\Lambda_{jh}^k}\right)^{-\theta_r} \equiv \left(\widehat{\Lambda}_{jh}^k\right)^{-\theta_r}$$

Geography (input purchases).- The identification of the *inward* communication costs shock is based on the assumption that communications costs are equal between domestic and foreign firms when they source domestically ($\gamma_{0h} = \gamma_{00} = 1$). This implies that the difference in their relative expenditure shares (for standardized inputs) between some country j and the SOE reveals

[60] see Antràs et al. (2017).

information of the different inward communication costs faced by these two groups of firms:

$$\left.\begin{array}{l}\dfrac{\chi_{jh}^{sk}}{\chi_{0h}^{sk}} = \dfrac{T_j^{sk}\left(w_j\tau_{j0}^k\right)^{-\theta_s}}{T_0^{sk}\left(w_0\right)^{-\theta_s}}(\gamma_{jh})^{-\theta_s} \\ \dfrac{\chi_{j0}^{sk}}{\chi_{00}^{sk}} = \dfrac{T_j^{sk}\left(w_j\tau_{j0}^k\right)^{-\theta_s}}{T_0^{sk}\left(w_0\right)^{-\theta_s}}(\gamma_{j0})^{-\theta_s}\end{array}\right. \Rightarrow \left(\frac{\gamma_{j0}}{\gamma_{jh}}\right)^{-\theta_s} = \frac{\chi_{j0}^{sk}/\chi_{00}^{sk}}{\chi_{jh}^{sk}/\chi_{0h}^{sk}}$$

The alternative specification is theoretically equivalent to this one, but its implementation involves an extra step given that it requires that the contracting friction shocks to be previously calibrated. A reason to take into account is that the set of source countries for standardized inputs and that for relationship-specific inputs overlap but differ considerably. Having two theoretically equivalent ways to back out the same object increases the number of parameters that can be estimated in practice.

Geography (sales).- The identification of the *outward* communication costs shock is based on the fact that firm characteristics interact with destination market features to determine sales in a multiplicative manner (see equation 30). This means that the component associated with firm characteristics is the same for markets, so dividing exports to market i by domestic sales isolates the market access differences. Therefore, the difference in their relative sales between some market i and the SOE reveals information of the different outward communication costs faced by these two groups of firms:

$$\left.\begin{array}{l}\dfrac{R_{hi}^k}{R_{h0}^k} = \dfrac{E_i(P_i^k)^{\sigma_k-1}\left(\tau_{0i}^k\gamma_{hi}\right)^{1-\sigma_k}}{E_0(P_0^k)^{\sigma_k-1}} \\ \dfrac{R_{0i}^k}{R_{00}^k} = \dfrac{E_i(P_i^k)^{\sigma_k-1}\left(\tau_{0i}^k\gamma_{0i}\right)^{1-\sigma_k}}{E_0(P_0^k)^{\sigma_k-1}}\end{array}\right. \Rightarrow \frac{R_{h0}^{k,f}/R_{00}^{k,f}}{R_{hi}^k/R_{0i}^k} = \left(\frac{\gamma_{0i}}{\gamma_{hi}}\right)^{1-\sigma_k} \equiv \left(\widehat{\gamma}_{hi}\right)^{1-\sigma_k}$$

Productivity.- The identification of productivity differences is based on putting together some of the approaches used for the previous shocks. First, it exploits the multiplicative nature of the revenue function by using the relative sales between foreign and domestic firms to isolate the underlying factors behind cost differences between them. Second, it focuses on *domestic* sales because all firms face the same communication costs when selling to the SOE, thus isolating marginal cost differences from trade cost differences. Third, the model predicts that these cost differences are the outcome of differences in productivity, contracting frictions and inward communication costs, so to isolate the first one, we need to write the ratio in terms of the other shocks:

$$\frac{R_{h0}^{k,f}}{R_{00}^{k,f}} = \frac{N_h^k(c_h^k)^{1-\sigma_k}}{N_0^k(c_0^k)^{1-\sigma_k}} \underbrace{=}_{\text{eq. 9}} \frac{N_h^k}{N_0^k}\left[\left(\frac{P_h^{sk}}{P_0^{sk}}\right)^{\alpha_s^k}\left(\frac{P_h^{rk}}{P_0^{rk}}\right)^{\alpha_r^k}\frac{\varphi_0^k}{\varphi_h^k/\eta_h^k}\right]^{1-\sigma_k}$$

$$\underbrace{=}_{\substack{\text{eq. 20}\\ \text{eq. 28}}} \frac{N_h^k}{N_0^k}\left\{\left[\frac{\sum_j T_j^{sk}(w_j\gamma_{j0}\tau_{j0}^k)^{-\theta_s}}{\sum_j T_j^{sk}(w_j\gamma_{jh}\tau_{j0}^k)^{-\theta_s}}\right]^{\frac{\alpha_s^k}{\theta_s}}\left[\frac{\sum_j T_j^{rk}(w_j\gamma_{j0}\tau_{j0}^k\Lambda_{j0}^k)^{-\theta_r}}{\sum_j T_j^{rk}(w_j\gamma_{jh}\tau_{j0}^k\Lambda_{jh}^k)^{-\theta_r}}\right]^{\frac{\alpha_r^k}{\theta_r}}\right\}^{1-\sigma_k} \left(\widehat{\widetilde{\varphi}}_h^k\right)^{1-\sigma_k}$$

$$= \frac{N_h^k}{N_0^k}\left\{\left[\sum_j \chi_{jh}^{sk}\left(\widehat{\gamma}_{jh}\right)^{-\theta_s}\right]^{\frac{\alpha_s^k}{\theta_s}}\left[\sum_j \chi_{jh}^{rk}\left(\widehat{\gamma}_{jh}\widehat{\Lambda}_{jh}^k\right)^{-\theta_r}\right]^{\frac{\alpha_r^k}{\theta_r}}\right\}^{1-\sigma_k}\left(\widehat{\tilde{\varphi}}_h^k\right)^{1-\sigma_k}$$

If we replace the parameter shocks in this equation by their formulas and simplify, we get:

$$\frac{R_{h0}^{k,f}}{R_{00}^{k,f}} = \frac{N_h^k}{N_0^k}\left\{\left[\left(\frac{\chi_{0h}^{sk}}{\chi_{00}^{sk}}\right)\sum_j \chi_{j0}^{sk}\right]^{\frac{\alpha_s^k}{\theta_s}}\left[\left(\frac{\chi_{0h}^{rk}}{\chi_{00}^{rk}}\right)\left(\widehat{\Lambda}_{0h}^k\right)^{-\theta_r}\sum_j \chi_{j0}^{rk}\right]^{\frac{\alpha_r^k}{\theta_r}}\right\}^{1-\sigma_k}\left(\widehat{\tilde{\varphi}}_h^k\right)^{1-\sigma_k}$$

$$= \frac{N_h^k}{N_0^k}\left\{\left(\frac{\chi_{0h}^{sk}}{\chi_{00}^{sk}}\right)^{\frac{\alpha_s^k}{\theta_s}}\left[\left(\frac{\chi_{j^*h}^{rk}}{\chi_{j^*0}^{rk}}\right)\left(\frac{\chi_{0h}^{sk}}{\chi_{00}^{sk}}\right)^{\frac{\theta_r}{\theta_s}}\left(\frac{\chi_{j^*0}^{sk}}{\chi_{j^*h}^{sk}}\right)^{\frac{\theta_r}{\theta_s}}\right]^{\frac{\alpha_r^k}{\theta_r}}\right\}^{1-\sigma_k}\left(\widehat{\tilde{\varphi}}_h^k\right)^{1-\sigma_k}$$

$$= \frac{N_h^k}{N_0^k}\left[\left(\frac{\chi_{0h}^{sk}}{\chi_{00}^{sk}}\right)^{\frac{\alpha_s^k+\alpha_r^k}{\theta_s}}\left(\frac{\chi_{j^*h}^{rk}}{\chi_{j^*0}^{rk}}\right)^{\frac{\alpha_r^k}{\theta_r}}\left(\frac{\chi_{j^*0}^{sk}}{\chi_{j^*h}^{sk}}\right)^{\frac{\alpha_r^k}{\theta_s}}\right]^{1-\sigma_k}\left(\widehat{\tilde{\varphi}}_h^k\right)^{1-\sigma_k}$$

Finally, rearranging terms to solve for $\left(\widehat{\tilde{\varphi}}_h^k\right)^{\sigma_k-1}$, we get:

$$\left(\widehat{\tilde{\varphi}}_h^k\right)^{\sigma_k-1} = \frac{R_{00}^{k,f}/N_0^k}{R_{h0}^{k,f}/N_h^k}\left[\left(\frac{\chi_{0h}^{sk}}{\chi_{00}^{sk}}\right)^{\frac{\alpha_s^k+\alpha_r^k}{\theta_s}}\left(\frac{\chi_{j^*h}^{rk}}{\chi_{j^*0}^{rk}}\right)^{\frac{\alpha_r^k}{\theta_r}}\left(\frac{\chi_{j^*0}^{sk}}{\chi_{j^*h}^{sk}}\right)^{\frac{\alpha_r^k}{\theta_s}}\right]^{1-\sigma_k}$$

□