Wage Bargaining and the Boundaries of the Multinational Firm*

Maria Bas† and Juan Carluccio‡

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Abstract

Do variations in labor market institutions across countries affect the cross-border organization of the firm? Using firm-level data on multinationals located in France, we show that firms are more likely to outsource the production of intermediate inputs to external suppliers when importing from countries with empowered unions. Moreover, this effect is stronger for firms operating in capital-intensive industries. We propose a theoretical mechanism that rationalizes these findings. The fragmentation of the value chain weakens the union's bargaining position, by limiting the amount of revenues that are subject to union extraction. The outsourcing strategy reduces the share of surplus that is appropriated by the union, which enhances the firm's incentives to invest. Since investment creates relatively more value in capital-intensive industries, increases in union power are more likely to be conducive to outsourcing in those industries. Overall, our findings suggest that multinational firms use their organizational structure strategically when sourcing intermediate inputs from unionized markets.

Keywords: wage bargaining, trade unions, sourcing, multinational firms.

JEL Classification: F10, J52, L22.

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†CEPII, 9, rue Georges Pitard, 75015, Paris, France.

‡**Job market paper.** Paris School of Economics, 48 Bd Jourdan, 74015, Paris, France. Corresponding author: juan.carluccio@pse.ens.fr, +33677357305.

1 Introduction

The globalization process is characterized by increasing international specialization of production and the organization of firms' activities on a global scale. Around one-third of total trade takes place within multinational firms' boundaries, with developed countries posting an even larger proportion.[1] Furthermore, trade in intermediate inputs has risen steadily in recent decades (Yeats, 2001; Hummels et al., 2001), to become a key feature of the current international trade structure.[2]

Given their predominant role in international trade, the study of vertical production networks has become essential to grasp the aggregate workings of the global economy. A key decision faced by firms when sourcing intermediate inputs in foreign locations is whether to engage in foreign direct investment (FDI) and import the inputs within their boundaries, or to outsource with independent foreign suppliers. A great deal of work has gone into the study of this organizational decision, because it constitutes a crucial determinant of the pattern of global multinational activity.[3]

In this paper, we ask how the cross-border organization of firms is affected by bargaining in the labor market. In particular, we are interested in the way trade unions in host countries affect sourcing decisions by multinational firms. Our aim is to broaden existing knowledge of global sourcing strategies, while providing new insight into the role of trade unions in the globalization process. We present an empirical analysis based on a unique firm-level dataset on the sourcing modes of multinationals located in France. The main results are the following. First, firms tend to rely on independent suppliers when sourcing from countries where the local workers' bargaining power is strong. Second, looking at sourcing modes in the aggregate masks non trivial cross-sector variation. In the data, the negative correlation between intra-firm imports and the bargaining power of labor is increasing in the capital intensity of the industry in which the multinational produces. Counterintuitively, the effect of collective bargaining on firms' organizational choices is stronger for firms operating with capital intensive technologies.

In order to explain these findings, we build a simple model that explicitly takes into account the role of wage bargaining in determining firms' boundaries. To develop our arguments, we consider a multinational firm with a two-stage production process. In an upstream stage, an intermediate component is manufactured by workers in a foreign location, who are organized in a trade union. In a downstream stage, the intermediate input is transformed into a consumption good by means of the firms' capital stock. The firm's organizational choice is whether keep the production of the component within its boundaries or to outsource it to a local independent supplier. A key difference emphasized in the model is that, when operating an integrated facility, the multinational bargains with the union over the sharing of total profits. Conversely, when production of the component is outsourced, the supplier and the union bargain over the profits of the subcontractor. Through this mechanism, outsourcing weakens the union's bargaining position. However, when subcontracting, the firm loses control over the production of the input and faces a risk of opportunistic behavior from the supplier. The model shows that, when union bargaining power is sufficiently strong, subcontracting is chosen in spite of the inefficiencies it entails.

The idea that vertical integration increases the multinational's exposure to the union contrasts with the widespread notion that globalization weakens union power. There is, however, empirical evidence of the mechanism we have in mind. Consider the two following anecdotal examples given by Budd et al.

[1] For example, about 67% of French imports and 75% of French exports in 1999 concerned manufacturing groups controlling at least 50% of a foreign affiliate. Similar patterns are observed for the US. Nearly half of US trade is intra-firm.

[2] Further evidence is provided in Feenstra (1998) and Campa and Goldberg (1997).

[3] Antras and Rossi-Hansberg (2009) survey the recent literature.

(2005). In the 1980's, the US labor union United Auto Workers granted concessions to help save the then US-owned Chrysler car company. Later on, after Chrysler had been taken over by the German company Daimler-Chrysler, the same union refused to help the struggling US affiliate on the basis that the German parent firm was making profits. Another example of a cross-border wage dispute concerns the Anglo-Dutch steel maker Corus. In 2002, attempt to impose a pay-freeze in the UK while increasing salaries of Dutch workers was blocked by the British union on the basis that "we all work for the same company, and we should all get the same deal". Budd et al. (2005) also present the first firm-level econometric analysis of international rent-sharing. They draw on panel data for European multinationals to show that wages paid by foreign affiliates are partially explained by the parent firms' profits, while the the opposite does not hold. They expand on the Budd and Koning (2002) results. Using data on union-firm wage contracts in Canadian manufacturing from 1980 to 2000, they find that higher US profits raised the wages of US subsidiaries while lowering those of domestic-owned firms.

Our model generates the result that union power create greater incentives to outsource to firms in capital intensive industries by accentuating a second, well-known aspect of unionization. The literature on industrial relations has long recognized the role of opportunistic union behavior in deterring firm investment (Grout, 1984; Baldwin, 1983). The prospect of expropriation by a trade union reduces the incentives to invest in capital that is sunk to any extent. Outsourcing reduces exposure to ex-post union opportunism and hence boosts investment. Since capital intensive industries are those in which investment creates relatively more value, increases in union power are more likely to be conducive to outsourcing in these industries.

In the empirical section of the paper we test the following two predictions. First, strong worker power in host countries should reduce the likelihood of multinational firms engaging in vertical integration and intra-firm imports. Second, this effect should be more likely to affect multinationals operating in capital intensive industries.

We use data on imports by multinational firms located in France (manufacturing groups with at least one affiliate abroad), detailed by firm, product and country of origin. An important feature of these data is that they provide the proportion of intra-firm trade for each observation. We use a new dataset presented in Botero et al. (2004) to measure the balance of power between firms and workers in exporting countries. Our preferred measure is an index that captures the power of workers by means of the extent to which industrial action is allowed by law. Our results show that the bargaining power of workers in exporting countries has a negative effect on the share of intra-firm trade by French multinationals. A one standard deviation increase in the collective bargaining power index decreases the share of intra-firm imports by 1%. By way of comparison, the positive effect of capital endowment on intra-firm imports ranges between 2% and 5% depending on the specification. When the estimating sample is restricted to OECD countries, the effect of the collective bargaining index increases to 1.6%, which equals the effect of capital endowment for the same sample. Our results indicate that the impact is heterogeneous across industries, depending on the relative importance of capital in the production process. For importers operating in industries with capital intensity above the median, a one standard deviation increase in the collective bargaining index reduces the share of intra-firm imports by 2.2%, whereas the effect is slightly less than 1% for firms in labor intensive industries. Overall, going from the lowest to the highest value of the index reduces intra-firm imports by 6% in the aggregate and by 12% for firms in capital intensive industries.

Our paper contributes to a growing body of literature that studies how the nature of industrial relations

affects multinational firms' strategies. Much of the attention has focused on the incentives that labor market imperfections in home economies provide for firms to engage in FDI (Zhao, 1998 and 2001; Eckel and Egger, 2009; Gaston, 2002; Lommerud et al, 2003) and in international outsourcing (Skaksen, 2004, Lommerud, et al 2008). The relationship between union power in host economies and sourcing strategies remains thus far unexplored, in spite of its strong empirical relevance. Furthermore, these works assume that the possibility of shifting production across borders enhances the bargaining positions of managers by providing a threat point. But our model highlights a new channel via which the nature of international linkages conditions how firms share profits with workers in host countries and which tends to go in the opposite direction.[4] A related group of studies analyzes the interactions between firms and labor in foreign locations, however to study firms' decisions to serve a foreign locations through horizontal FDI (e.g. Mukherjee, 2008; Haaland et al, 2003).

We also add to the literature on the determinants of intra-firm trade. Previous work has focused on the role of contractual frictions between firms and their foreign suppliers (Antràs, 2003; Antràs and Helpman, 2004 and 2008). Following Grossman and Hart (1986), these works predict that, when contracts are incomplete, ownership and ex post revenues must be allocated to the party that contributes relatively more to value creation. Hence, provided that headquarters are responsible for capital investments, efficiency dictates that firms in capital intensive industries should engage in vertical integration. A number of empirical studies have provided support for this claim (Antràs 2003; Yeaple, 2006; Nunn and Trefler, 2008; Bernard et al., 2008). But a key premise of our analysis is that labor market imperfections introduce a second source of contractual incompleteness. Absent the possibility of integrating their workers, firms tend to rely on external suppliers to alleviate this alternative hold-up problem. Since this incentive is stronger for firms in capital intensive industries, our empirical analysis provides a novel insight on the role of capital intensity. It shows that bargaining in the labor market counteracts the positive Grossman and Hart effect of capital intensity on vertical integration.[5]

Lastly, our paper can be seen as complementary to the literature on firm behavior in closed economies with imperfect labor markets. Examples include Bronars and Deree (1991), who highlight the strategic use of debt, and the above-mentioned studies by Baldwin (1983) and Grout (1984) on investment behavior. A paper close in spirit to ours is Lyons and Sekkat (1991). In their model, the presence of opportunistic trade unions provides an incentive to subcontract. Contrary to ours, their analysis is purely theoretical. Their finding on the effect of specific investments rely on numerical results, while we derive analytical conditions linking capital intensity and organizational choice. To the best of our knowledge, ours is the first attempt to empirically identify how collective bargaining institutions determine the organization of firms using detailed firm-level data. Notice that the international nature of our data allows for proper identification strategies absent in closed economy studies. Our analysis exploits observed variation in organizational modes for the same firm across countries that differ extensively in their labor market regulations. Hence, we view our results as informative of the impact of labor market institutions on corporate structure in closed economies.[6]

[4] Allowing for a higher bargaining power for multinationals corporations would temper the effects we point up in our theory. But our empirical results suggest that this channel is not strong enough to reverse the negative effects of labor power on vertical integration.

[5] In complementary work presented in Carluccio and Fally (2008), we provide theory and evidence for the notion that vertical integration can arise in industries where suppliers' investments are essential if the latter face credit constraints.

[6] Following a renewed interest in the determinants of firms' organizations across countries, a recent strand of papers has looked at the institutional determinants of the organization of firms in closed economies, based on cross-country data (Acemoglu et al 2009, Bloom et al, 2009, Marin and Verdier, 2008). None of them has studied the role of wage bargaining

The rest of the paper is organized as follows. Section II provides a first look at the empirical relationship between intra-firm trade and collective bargaining in host economies. Section III develops a model that studies the determination of the boundaries of the firm when labor markets are unionized. Section IV describes the two empirical predictions of the model in terms of multinational firms sourcing strategies. Section V presents econometric evidence in support of these predictions, based on firm-level data for multinationals located in France. Section VI concludes.

2 Motivation

In this section we briefly discuss two key features of the data that motivate our theoretical framework. The first, presented in Table 1, is a wide variation in labor market institutions across countries. We use two indexes provided by Botero el al. (2004).[7] The collective bargaining index is increasing in the protection of workers during collective disputes. The firing costs index is increasing in the economic costs faced by firms when firing part of their labor force. The table reveals a large variation in both indexes that does not seem to be driven by any clear pattern, be it geographical or by per capita income level. Quite strikingly, the variation is remarkably strong across OECD countries, which represent an otherwise homogeneous group in terms of economic development and institutional environment. Within the OECD countries, Italy has the highest level of the collective bargaining index (0.83) while Denmark has the lowest (0.13). Yet, they both post a very similar firing costs index value (0.45 and 0.51) providing an example that countries tend to deal differently with the different aspects of labor market regulation. In another example, the US scores very low in the firing costs index (0.07), while its collective bargaining index value is close to the median of 0.45. Labor market regulation varies a great deal across countries and development levels worldwide. We exploit this strong cross-country variation in our econometric analysis.

The second key feature is the variation in multinational firms' organizational modes across countries and sectors of affiliation. Table 2 provides some features of our main dataset (described in detail in the empirical section and the data appendix). It details the number of multinational firms in France reporting positive imports by country and the breakdown of their import transactions across sourcing modes. Due to space considerations we include the 16 origin countries with more than 500 firms. The data point up the prevalence of outsourcing, but then again variation across countries is wide. At the top of the distribution, 40% of import transactions from Japan are intra-firm whereas Belgium lies at the bottom with a figure of only 22%. It is of note that the only low income country in the group is China. Looking at product characteristics (not shown in the table) we find that around 60% of the imported products are differentiated as defined by the Rauch (1999) classification. Imports by multinationals in France are dominated by complex products from high income countries.[8]

How do the variation in labor market institutions and sourcing modes relate to each other? To provide a preliminary answer to this question we regress, in Table 3, the share of intra-firm imports at the transaction level on the collective bargaining index controlling for firm and imported product fixed effects. As shown in column (1) there is a strong and negative correlation between the share of intra-firm imports and the collective bargaining index. This result can be seen as a firm-level counterpart to Figure 1 in the

institutions.

[7] Details of their exact definition and construction are provided in the empirical section and the data appendix.

[8] In a recent paper using data on over 650,000 affiliates worldwide, Alfaro and Charlton (*forthcoming*) show that when looking at the 4-digit SIC level, a large share of the world's FDI is vertical.

Table 1: Collective bargaining and firing costs indexes by country

OECD					
	Collective bargaining	Firing costs		Collective bargaining	Firing costs
Denmark	0.13	0.51	Germany	0.50	0.48
Finland	0.21	0.53	Hungary	0.50	0.35
Canada	0.25	0.05	Ireland	0.50	0.55
Austria	0.29	0.22	Netherlands	0.50	0.69
Korea	0.38	0.62	New Zealand	0.50	0.00
Turkey	0.38	0.41	Switzerland	0.50	0.17
UK	0.38	0.49	Greece	0.54	0.57
US	0.38	0.07	Japan	0.54	0.08
Belgium	0.42	0.16	Mexico	0.58	0.43
Poland	0.42	0.49	Norway	0.58	0.53
Australia	0.46	0.53	Portugal	0.58	0.61
Spain	0.46	0.36	Italy	0.83	0.45
Sweden	0.46	0.53			
Non OECD					
Nigeria	0.13	0.04	Tanzania	0.46	0.65
Jamaica	0.17	0.15	Zimbabwe	0.46	0.08
Kenya	0.17	0.55	Indonesia	0.50	0.68
Dominican	0.21	0.75	Madagascar	0.50	0.48
Egypt	0.25	0.49	Venezuela	0.50	0.67
Ghana	0.25	0.08	Bolivia	0.54	0.52
Taiwan	0.25	0.61	Colombia	0.54	0.55
Zambia	0.25	0.00	Romania	0.54	0.46
Chile	0.33	0.81	Singapore	0.54	0.60
Israel	0.33	0.25	Argentina	0.58	0.27
Jordan	0.33	0.61	Sri Lanka	0.58	0.48
Pakistan	0.33	0.49	Burkina Faso	0.63	0.50
Thailand	0.33	0.63	Hong Kong	0.63	0.18
Tunisia	0.33	0.67	India	0.63	0.62
Uganda	0.33	0.49	Panama	0.63	0.63
Brazil	0.38	0.61	Senegal	0.63	0.56
China	0.38	0.60	Peru	0.71	0.60
Malaysia	0.38	0.19	Ecuador	0.75	0.32
South Africa	0.38	0.51	Morocco	0.83	0.08
Uruguay	0.38	0.24	Mozambique	0.88	1.00

introduction.

In columns (2) and (3) we perform the same regressions on two subsamples. We divide importers in groups of high and low capital intensity, depending on whether they belong to an industry with a level of capital intensity above or below the median for 4-digit industries. The coefficient of collective protection is four times higher in the subsample of multinationals producing capital intensive goods. For reference we provide, column (4) displays the result of regressing the share of intra-firm imports on the the importer's capital intensity, which has a positive and significant coefficient.

Why do multinationals tend to import at arm's-lenght from countries with strong organized labor?

Table 2: Number of importers and total transactions by country of origin (countries with over 500 importers)

Country	Number of importers	Intra-firm #	%	Outsourcing #	%	Mixed #	%	Total
Japan	515	996	40	1202	49	280	11	2478
United States	1153	2549	40	3035	47	826	13	6410
Sweden	946	764	35	1061	48	363	17	2188
Denmark	725	532	34	717	45	338	21	1587
Ireland	542	354	33	512	48	199	19	1065
United Kingdom	2426	2986	31	5208	54	1363	14	9557
China	583	580	29	1300	64	143	7	2023
Switzerland	717	596	28	1296	62	206	10	2098
Netherlands	1957	1577	26	3534	59	858	14	5969
Germany	3160	5116	26	12090	62	2378	12	19584
Austria	963	555	26	1208	57	367	17	2130
Portugal	597	357	26	815	58	225	16	1397
Finland	534	259	24	661	61	156	14	1076
Spain	2040	1511	24	4019	63	868	14	6398
Italy	2674	2670	23	7800	67	1202	10	11672
Belgium	2397	1956	22	5697	65	1171	13	8824

Table 3: Collective bargaining, capital intensity and intra-firm trade

Dependent variable:	Share of intra-firm imports at the transaction level			
	Full sample	High capital intensity	Low capital intensity	Full sample
Collective bargaining	-0.066***	-0.109***	-0.025***	
	(0.006)	(0.010)	(0.010)	
Capital intensity (sector)				3.2***
				(1.23)
Imported product fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	No
Country fixed effects	No	No	No	Yes
Observations	81365	41021	40344	81365
R^2	0.635	0.561	0.573	0.0237

Notes: The regressions are OLS estimations."Collective bargaining" measures the power and protection of workers during industrial conflicts. This variable is obtained from Botero et al. (2004)- details are provided in the data appendix. High capital intensity is the subsample of firms operating in a 4-digit CPA industry with capital intensity above the median of all manufacturing industries (except for 15 NACE Rev1). Low capital intensity is the subsample of firms operating in a 4-digit CPA industry with capital intensity below the median. Capital intensity of an industry is calculated as the median of the natural logarithm of the ratio of the capital stock to total employment for all firms with available information. Robust standard errores in parentheses. ***,**, and * indicate significance at the 1, 5 and 10 percent levels respectively.

Why the counterintuitive result that this relationship is stronger for multinationals producing in capital

intensive industries? The next section develops a simple model consistent with these facts and helps steer the more formal econometric analysis that follows.

3 A simple model

Our theoretical framework shares basic features of the models in Antràs (2003 and 2005), but incorporates wage negotiations.

3.1 Setup

Technology and demand

A multinational firm owns the technology to produce a final good with downward-sloping demand curve $y = Ap^{-1/(1-\alpha)}$, where y is quantity, p is the price charged and A the level of demand, exogenous to the firm. The parameter $\alpha \in (0,1)$ measures the elasticity of demand. This demand schedule generates a revenue function $R = A^{1-\alpha}y^{\alpha}$. It can be derived from consumer preferences that feature constant elasticity of substitution between differentiated varieties of a generic consumption good (see Dixit and Stiglitz, 1977). Under this interpretation, α is an inverse index of the degree of differentiation across varieties.

In order to produce the good, the firm needs to combine two inputs: an investment in capital, k, and a manufactured component, m. Both need to be fully tailored to fit the particular requirements of the product and are hence assumed to be useless for other producers. Technology is represented by the following constant returns to scale Cobb-Douglas production function:

$$y(k,m) = \left(\frac{k}{\beta}\right)^{\beta}\left(\frac{m}{1-\beta}\right)^{(1-\beta)} \tag{1}$$

For simplicity we assume that one unit of labor is necessary to produce one unit of the intermediate good, according to the linear production function $m = l$.[9]

Organization of production

The firm can interact with two other types of agents: a supplier of manufactured components and a pool of workers of size L. Each worker is endowed with one unit of labor. The firm chooses the profit-maximizing organization of production from the following two alternative arrangements:

1. *Vertical Integration.* The firm undertakes investments in capital, hires labor to insource the production of the intermediate input and produces and markets the good.

2. *Vertical Fragmentation (Outsourcing).* The firm undertakes capital investments and outsources the production of the component by subcontracting with the independent supplier. The subcontractor hires labor, produces the intermediate and trades it to the firm, which then produces and markets the good.

[9] In the appendix we present a version of the model where production of the component requires an investment in capital. We show that the main mechanisms remain unchanged. We therefore choose this formulation for simplicity of exposition and to highlight that the existence of an input-specific investment is not essential to our results.

Notice that, in either case, the firm is responsible for the capital investment. We could use use the broader term "headquarter services" to refer to the same input.

Importantly, as is usual in the literature, organizational decisions are assumed to be irreversible. In modeling buyer-supplier relationships, the setting we consider is one of incomplete contracts. We assume that the precise nature and quality of the intermediate component is observable to both firms in the relationship but not verifiable by third parties. As argued by Hart and Moore (1999) and Segal (1999) among others, firms in this setting cannot commit not to renegotiate ex post any arrangement that has been agreed upon ex ante. Similarly, it is assumed that no contracts can be made specifying the amount of ex ante specific investments and of the manufactured component.[10] Following Grossman and Hart (1986), we assume that the only contractibles in the vertical relationship are the allocation of property rights over the component and any ex ante monetary transfer between firms. As is well known, the impossibility if enforcing quality-contingent contracts can lead to a potential hold-up problem (Klein et al., 1978; Williamson, 1985). Agents are exposed to ex post opportunism, which reduces their incentives to undertake relationship-specific actions. This underinvestment creates costly inefficiencies that plague the outsourcing strategy.

However, in spite of these inefficiencies, outsourcing can still be an attractive organizational form. As we shall see, bargaining in the labor market introduces additional costs of running an integrated plant and creates an incentive to subcontract. To focus on this effect and keep our analysis simple, we abstract from other well studied costs of vertical integration. In particular, we consider a situation where contractual frictions between internal divisions of the integrated firm are absent. Our approach to the firm is thus related to the transaction cost literature initiated by Coase (1937), and successively developed by Williamson (1985).[11] We also refrain from imposing an ad-hoc cost of governance under integration, although it would not alter any of the subsequent results.

Labor markets

A trade union encompasses the entire pool of workers (L). L is assumed to be large enough so that firms' input choices are not constrained by labor shortages. Irrespective of the prevailing organizational form, production of the intermediate component requires an agreement with the trade union.[12]

Right before starting to produce the intermediate component, either the firm or the supplier engages in negotiations with the trade union. The literature on industrial relations provides several possible ways of modeling the bargaining process between unions and firms, and of modeling unions' objectives. To keep the model as simple as possible we take a "right-to-manage" approach where wages are the subject of negotiation and firms decide unilaterally on the level of employment. Nevertheless, we stress that our model is fully equivalent to one where both wages and employment are the subject of negotiations (i.e. efficient bargains, McDonald and Solow, 1981) under the condition that the union values both arguments equally.

[10] Hart and Moore (1999) and Segal (1999) provide foundations for incomplete contracts that naturally apply in the present context.

[11] Applications of this theory of the firm to context similar to ours include Ethier (1986), Grossman and Helpman (2002a,b and 2005), and McLaren (2000)

[12] Note that we *assume* the existence of the trade union, taking it as a feature of the institutional environment where production takes place rather than deriving it as an equilibrium outcome. We have developed a version of the model in which unionization happens randomly according to an exogenous probability (which can be deemed to depend on the labor market institutions) and have obtained qualitatively similar results (available upon request). Readers interested in endogenous union formation might refer, for example, Horn and Wolinsky (1988).

We follow Grout (1984) and assume that the union maximizes the total income of its membership. Members who remain unemployed can obtain the exogenous reservation wage denoted by ω. Consistent with these assumptions, the utility function of the union is given by

$$U(w, l) = wl + \omega(L - l) \tag{2}$$

where w is the (endogenous) individual wage and l is total employment.

Importantly, union-firm contracts are assumed to be incomplete. In particular, the union cannot credibly commit to any wage agreement that has been signed ex ante, before investments take place. Union opportunism in collective bargaining has been widely studied.[13] It can occur for a number of reasons. Other than the cost of writing and enforcing contracts, it can also be the consequence of the long-lived nature of investments. The stream of returns associated with specific plant and equipment usually spans over a longer period of time than the typical union-firm contract (Bronars and Deere, 1993). Credible commitment beyond the span of a contract is at the least very difficult to ensure. Furthermore, later bargains are likely to involve union members who were not employed by the firm when the initial contract was signed.[14]

We do not model here the reasons for this "inherent" contract incompleteness of union-firm relationships. We rather take it as a relevant feature of the reality of industrial relations and study its implications for the determination of optimal firm scope.[15]

Timing

Before moving on to the solution of the model, we present the timing of events in the baseline model:

- $t = 0$: Organizational choices are taken and the ex ante transfer T takes place.
- $t = 1$: Choice of capital stock and manufactured component quantity.
- $t = 2$: Wage bargaining and production of the intermediate input.
- $t = 2'$: Under outsourcing, the firm and the supplier bargain over the division of the joint surplus.
- $t = 3$: The final good is produced from the combination of k and m and revenues are realized.

3.2 Solution

We start at stage 3 and work backwards to trace the subgame perfect equilibrium of the game. We henceforth use superscript v to refer to variables pertaining to the vertically integrated firm and o to those belonging to the outsourcing arrangement. We start with the case of vertical integration.

[13] Simons (1944) provides the earliest analysis. More recent work includes Baldwin (1983), Grout (1984), Hirsch (1989), Anderson and Devereux (1988), and Bronars and Deree (1991 and 1993).

[14] Moreover, in some countries, labor contracts are not legally binding. Grout (1984) notes that in the UK, the Trade Union Immunity Laws prevent firms from suing a trade union to recover losses incurred during a collective dispute (e.g. the union can costlessly deviate from any predetermined employment commitment).

[15] There is, of course, reason to believe that workers can also be held up by firms. This would be the case where employment requires the acquisition of firm-specific skills. Williamson (1985, Ch. 10) notes that one of the purpose of unions is to protect employees' investment in human capital from firm opportunism. We absent from this possibility for the sake of analytical simplicity, based on two main reasons. First, we are interested in studying firms' organizational responses to expropriation from labor. Second, the existence of a wedge between the resale and purchase price seems more descriptive of the reality of firm-specific capital than unskilled labor.

3.2.1 Vertical integration

At $t = 3$, with the capital stock installed and the intermediate produced and given by $\{k^v, m^v\}$, the good is produced. Using (1), revenues write:

$$R(k^v, m^v) = A^{1-\alpha} \left(\frac{k^v}{\beta}\right)^{\beta\alpha} \left(\frac{m^v}{1-\beta}\right)^{(1-\beta)\alpha} \tag{3}$$

Wage bargaining

Just before production, the firm and the union engage in a wage bargaining process described by the generalized Nash bargaining solution (Nash, 1953; Binmore et al., 1986), where $\lambda \epsilon (0, 1)$ represents the firm's bargaining power. Throughout we think of λ as determined by the laws and regulations affecting the balance of power of firms and workers during industrial conflicts.

We need to calculate the utility that each party obtains from joint production, net of the utility that it would receive in the event of a breakdown in negotiations. Provided that either group can prevent production from taking place, these must be evaluated at the point of zero employment.

The union's fallback option is the utility obtained when all members receive the reservation wage: $U(0) = \omega L$. The payoff to the union net of its outside option is the surplus that employed members receive with respect to ω:

$$U(w, l^v) - U(0) = (w - \omega) l^v \tag{4}$$

Notice that given the linear production function for the input, employment equals the quantity of the component chosen one period before: $m^v = l^v$.

By closing a deal with the union the firm obtains revenues net of factor costs:

$$\Pi^v = R(k^v, l^v) - w l^v - r k^v \tag{5}$$

Because labor is essential for production, should negotiations fail, the firm will be left with zero revenues: $R(k^v, 0) = 0$. Evaluating profits (5) at $l^v = 0$ we obtain the outside option for the firm as equal to $-rk^v$. The firm's fallback option is negative because the specificity of the capital implies that its value once installed is nil without the specialized component. Therefore, if the agreement over wages remains unsettled, the firm receives zero revenues for having sunk resources amounting to rk^v.

Payoffs net of outside options for the firm are profits gross of the cost of capital:

$$\Pi^v(w, l^v) - \Pi^v(0) = R(k^v, l^v) - w l^v \tag{6}$$

Hence the wage is the solution to

$$max_{w^v} \Omega^v = \left[R(k^v, l^v) - w^v l^v\right]^{\lambda} \left[\left(w^v - \omega\right) l^v\right]^{1-\lambda}$$

subject to (6) and (4) being nonnegative. It gives

$$w^v = (1 - \lambda) R(k^v, l^v) \frac{1}{l^v} + \lambda\omega \tag{7}$$

Wages paid by the integrated firm are a weighted sum of revenues per worker and the reservation wage, with weights equal to the power of the union and the firm in the bargaining process. As expected, the greater the firm's bargaining power, the closer the wage to the competitive level and the smaller the extent of rent-sharing.

Optimal investment and profits for the vertically integrated firm

Let us now roll back to stage 1, when decisions on the capital stock and the quantity of the component are taken, foreseeing the wage bargaining. Plugging (7) into (5) the firm's problem becomes:

$$max_{k,m}\Pi^v = \lambda R(k,m) - \lambda m\omega - rk \tag{8}$$

subject to (3) and $m = l$.

The first order conditions of this maximization program write

$$R_k = \frac{r}{\lambda} \qquad R_m = \omega$$

where the subscripts (k, m) represent the derivative of the revenue function (3) with respect to the indicated variable.[16]

Two points are worth highlighting about the first order conditions. First, since $\lambda < 1$, the optimal solution features underinvestment in capital. This is a direct consequence of the incompleteness of union-firm contracts, which was first formalized (almost contemporaneously) by Baldwin (1983) and Grout (1984). Capital investments are discouraged because the final good producer is able to recover only a fraction λ of the marginal returns to her investments. Underinvestment reduces value but it constitutes a rational response to the threat of expropriation by organized labor.[17]

Second, the quantity of the intermediate component - and thereby employment - is only affected indirectly by the wage bargain, because the underinvestment in capital causes the firm to lower the quantity of the intermediate component.[18] Notice hence that, conditional on underinvestment on capital, the use of labor is efficient because the Nash bargaining process with the trade union is cooperative. This exact result would obtain in a efficient bargaining framework if the union did not value employment more than wages.

To understand the impact of wage bargaining on efficiency we can use optimal investments (see footnote 16) and the inverse demand function $p = y^{\alpha-1}A^{1-\alpha}$ to calculate the equilibrium price charged by the integrated producer:

$$p^v = \frac{r^\beta \omega^{1-\beta}}{\alpha\lambda^\beta} \tag{9}$$

In this framework where demand features a constant elasticity the price includes a fixed markup α^{-1} over unit costs (which equal $r^\beta\omega^{1-\beta}$). The markup is scaled-up by an extra factor $\frac{1}{\lambda^\beta} > 1$. This extra

[16] The solution to the system of two equations composed of the first-order conditions gives optimal quantities as:

$$k^v = \frac{\beta\alpha}{r}\left(\frac{r^\beta\omega^{1-\beta}}{\alpha\lambda^\beta}\right)^{\frac{-\alpha}{1-\alpha}}\lambda, \qquad m^v = \frac{(1-\beta)\alpha}{\omega}\left(\frac{r^\beta\omega^{1-\beta}}{\alpha\lambda^\beta}\right)^{\frac{-\alpha}{1-\alpha}}$$

[17] There is extensive evidence that unionization tends to alter firm investment behavior, see e.g. Hirsch, (1989); Abowd, (1989) and Bronars and Deere, (1989).

[18] k and m are complements in this Cobb-Douglas production function: $\frac{\partial^2 f}{\partial k \partial m} > 0$.

term is decreasing in λ because a larger share of rents retained by the firm in the negotiations reduces the hold-up problem, encouraging investment and reducing inefficiencies. It is, however, increasing in β. Intuitively, the greater the marginal contribution of capital, the more damaging underinvestment is to efficiency (and hence to profits). The implication is that changes in λ impact efficiency disproportionately more the more capital-intensive the technology is, as $\frac{\partial^2\left(\frac{1}{\lambda^\beta}\right)}{\partial\lambda\partial\beta} > 0$.

Plugging in equilibrium factor demands into (8) we obtain equilibrium profits for the vertically integrated firm:

$$\Pi^v = (1-\alpha)A^{1-\alpha}\left(\frac{r^\beta\omega^{1-\beta}}{\alpha\lambda^\beta}\right)^{\frac{-\alpha}{1-\alpha}}\lambda$$

This expression neatly shows the two effects that wage bargaining has on profits:

- The *efficiency effect*, as displayed by the presence of $\lambda^\beta < 1$ inside the parenthesis, reduces total profits.
- The *rent-sharing effect*, reduces the profits left to the firm because the union obtains a share $(1-\lambda)$.

As λ approaches 1, these two effects vanish and profits approach those that would obtain under a competitive labor market.

3.2.2 Outsourcing

We now turn to the case of outsourcing. At $t = 2'$, right before k^o and m^o can be combined to yield revenues $R(k^o, m^o)$, the firm and the supplier bargain over the split of revenues. We model this process with a generalized Nash bargaining where the bargaining power of firm is $\phi \in (0,1)$ and that of the supplier the complement $(1-\phi)$. Equilibrium payoffs are hence $\phi R(k^o, m^o)$ and $(1-\phi)R(k^o, m^o)$ for the firm and the supplier respectively.

Wage bargaining

As in the previous case, production of the intermediate requires the settlement of a collective agreement. However, now the supplier is responsible for manufacturing the component and hence negotiates with the workers. Notice that the institutional parameter λ is independent of the identity of the negotiator.[19] Solving for the equilibrium wage thus simply requires a recalculation of the payoffs to each party secured in this alternative organization of production.

For the union, gains from participating in the production of the component are qualitatively the same as before - expression (4). What the supplier, stands to gain from collaborating with the trade union are the gains associated with the production of the component. They equal the share of revenues he (correctly) anticipates will secure in the bargain at $t = 3$ net of labor costs: $(1-\phi)R(k^o, m^o) - w^o m^o$. Recalling that the quantity of labor employed is chosen unilaterally by the supplier and satisfies $l^o = m^o$, the negotiated wage solves:

[19] Since λ in our model is thought to describe features of the institutional profile of the economy determining the division of rents between firms and workers, there is no apparent reason to believe that λ should change across firms. One could easily adapt the model to understand λ as the equilibrium share obtained by firms. In this case, if the disagreement payoff varies across firms due, for example, to the possibility of shifting production across plants, then λ can become firm-specific.

$$max_{w^o}\Omega^o = \left[(1-\phi)R(k^o,l^o) - w^o l^o\right]^{\lambda}\left[(w^o-\omega)\,l^o\right]^{1-\lambda}$$

which gives

$$w^o = (1-\lambda)(1-\phi)R(k^o,l^o)\frac{1}{l^o} + \lambda\omega \tag{10}$$

A key difference with the integrated production case is that under outsourcing, the wage is a weighted sum between the reservation wage and the suppliers' per-worker revenues.

Optimal investment and profits under outsourcing

The non-contractibility of actions implies that investments in capital and the level of production of the intermediate component are decided unilaterally. The two firms play a game through which (perfectly observable) actions are taken independently and non-cooperatively.

The firm solves the following program, from which a reaction function $k(m)$ is derived:

$$max_k \Pi^F = \phi R(k,m) - rk \tag{11}$$

The supplier chooses the level of the component taking into account the firm's choice of capital stock. Using expression (10) for the wage, the quantity of the component is given by a reaction function $m(k)$, which is the solution to:

$$max_m \Pi^S = \lambda(1-\phi)R(k,m) - \lambda\omega m \tag{12}$$

The equilibrium conditions characterizing the non-cooperative game are:

$$R_k = \frac{r}{\phi} \qquad R_m = \frac{\omega}{(1-\phi)}$$

Unlike the vertical integration case, in the fragmented production chain, both capital and the component are distorted away from first-best levels. Since $\phi \in (0,1)$, both factors are underemployed compared with a complete contract situation.[20] Note, however, that in this case, and as will be discussed later, the incompleteness of labor contracts does not have any direct effects on the choice of capital stock. Rather, the underinvestment in capital is a reaction to the threat of opportunism from the supplier.[21]

The equilibrium price under outsourcing (see footnote 21 for optimal investments) writes:

$$p^o = \frac{r^{\beta}\omega^{1-\beta}}{\alpha\phi^{\beta}(1-\phi)^{1-\beta}} \tag{13}$$

In this case, the price is scaled-up by a factor $\frac{1}{\phi^{\beta}(1-\phi)^{1-\beta}} > 1$.

[20] Under complete contracts firms would recover the full marginal benefit of their investments, which would be first-best and characterized by $R_k = r$ and $R_m = \omega$.

[21] The intersection of the two resulting functions gives equilibrium factor usage:

$$k^o = \frac{\alpha\beta\phi}{r}\left(\frac{r^{\beta}\omega^{1-\beta}}{\alpha\phi^{\beta}\,(1-\phi)^{1-\beta}}\right)^{\frac{-\alpha}{1-\alpha}}, \qquad m^o = \frac{\alpha(1-\beta)(1-\phi)}{\omega}\left(\frac{r^{\beta}\omega^{1-\beta}}{\alpha\phi^{\beta}\,(1-\phi)^{1-\beta}}\right)^{\frac{-\alpha}{1-\alpha}}$$

The price of the final good is now affected by the bargaining power of firms but unaffected by λ.[22] Collective bargaining plays a purely distributional role between the supplier and the union. This point can be better appreciated using the equilibrium quantity of capital and the component to obtain equilibrium payoffs:

$$\Pi^F = \phi(1-\beta\alpha)A\left(\frac{r^\beta \omega^{1-\beta}}{\alpha\phi^\beta(1-\phi)^{1-\beta}}\right)^{\frac{-\alpha}{1-\alpha}}$$
$$\Pi^S = \lambda(1-\phi)(1-(1-\beta)\alpha)A\left(\frac{r^\beta \omega^{1-\beta}}{\alpha\phi^\beta(1-\phi)^{1-\beta}}\right)^{\frac{-\alpha}{1-\alpha}}$$

Only the payoff to the supplier is scaled down by a factor λ. This highlights one key advantage that the fragmentation of the production process offers. Under collective bargaining, wages become endogenous to the revenues derived from production. By vertically separating the stages of production that rely on labor, the firm forces workers to negotiate over a limited fraction of rents. That is, outsourcing provides a strategy for reducing the revenues available for the union to extract.

The outsourcing strategy has the second advantage of reducing the efficiency effect of wage bargaining. This is because under outsourcing the firm does not bargain with labor, but with the supplier instead. By the time these negotiations take place, the supplier has already produced the component and remunerated the workers, who no longer have any power to stop production. Hence, the returns to capital investments are to be shared with the supplier, who has a claim on them due to the specificity of the component and the complementarities it has with installed capital. This implies the counterintuitive result that outsourcing of the component can be used strategically by the firm to ensure high-powered incentives to invest for itself.

Profits under outsourcing include the ex ante transfer T, which can be positive or negative. In the absence of credit constraints, it is optimal for the firm to set it as to make the supplier indifferent between participating or not in the outsourcing partnership. Put differently, the firm maximizes its total payoff $\Pi^F + T$ subject to the supplier's participation constraint $\Pi^S - T \geq 0$. Hence, in equilibrium $T = \Pi^S$.

Equilibrium profits under outsourcing equal $\Pi^o = \Pi^F + \Pi^S$:

$$\Pi^o = \left[\phi(1-\beta\alpha) + \lambda(1-\phi)(1-(1-\beta)\alpha)\right] A\left(\frac{r^\beta \omega^{1-\beta}}{\alpha\phi^\beta\left(1-\phi\right)^{1-\beta}}\right)^{\frac{-\alpha}{1-\alpha}} \tag{14}$$

The possibility of a compensating ex ante transfer ensures that the firm will choose the organizational form that maximizes total surplus net of labor costs. The upfront transfer can be interpreted as a royalty fee for the use of the input's technology, or more generally as the price of the "right to supply". It equals the supplier's ex post payoff profits because the firm has all the ex ante bargaining power. This assumption reflects what Oliver Williamson termed the "Fundamental Transformation": the idiosyncratic nature of the input turns an ex ante competitive supplier into an ex post monopolist (Williamson, 1985). It highlights a key difference between the union and the supplier since the former's monopolistic position holds both ex ante and ex post. Hence, in the absence of financial constraints, the firm can use the ex ante bargaining power to demand a compensation for the losses associated to the potential ex post opportunistic behavior of the supplier. Carluccio and Fally (2008) develop this intuition further to study the role of financial development in global sourcing. Microevidence on the use of compensating upfront

[22]The result that λ does not affect incentives to invest under outsourcing is a consequence of the sequence of moves and of the assumption that production does not require the supplier to undertake any investment. In the appendix we show that introducing an investment by the supplier changes the solution under outsourcing, but does not interfere with organizational choices.

transfers when contracts are incomplete is provided, for example, in Iyer and Schoar (2008). Notice however that all of our qualitative results would hold in case upfront payments were absent (e.g. if the supplier faces credit constraints).

Having derived the equilibrium profits under the two possible organizational arrangements, we now turn to the analysis of the determination of the optimal organization of the firm under noncompetitive labor markets.

3.3 Wage bargaining and the boundaries of the firm

Roll now the clock back to $t = 0$. At this point in time, the firm decides on the organizational form by comparing the profits it perfectly anticipates it will derive from each strategy. Using expressions (8) and (14), we can express the ratio of profits under both organizational forms as a function of the exogenous parameters of the model:

$$\frac{\Pi^v}{\Pi^o} = \frac{\lambda^{\frac{1-(1-\beta)\alpha}{1-\alpha}}(1-\alpha)}{[\phi(1-\beta\alpha)+\lambda(1-\phi)(1-(1-\beta)\alpha)]\left(\phi^{\beta}(1-\phi)^{1-\beta}\right)^{\frac{\alpha}{1-\alpha}}} \tag{15}$$

We are now able to study how the relative strength of firms and workers in industrial relations shape the optimal boundaries of the firm. This amounts to analyzing how the value of λ determines whether the ratio (15) is higher or lower than one. The result is stated in the following proposition:

Proposition 1 *(Collective bargaining and organizational choice) There exists a unique cutoff* $\lambda^*(\beta,\phi,\alpha) \epsilon (0,1)$ *such that for* $\lambda > \lambda^*$ *the firm chooses to setup a vertically integrated plant, for* $\lambda < \lambda^*$ *the firm chooses to outsource the intermediate component, and for* $\lambda = \lambda^*$ *the firm is indifferent between the two organizational forms.*

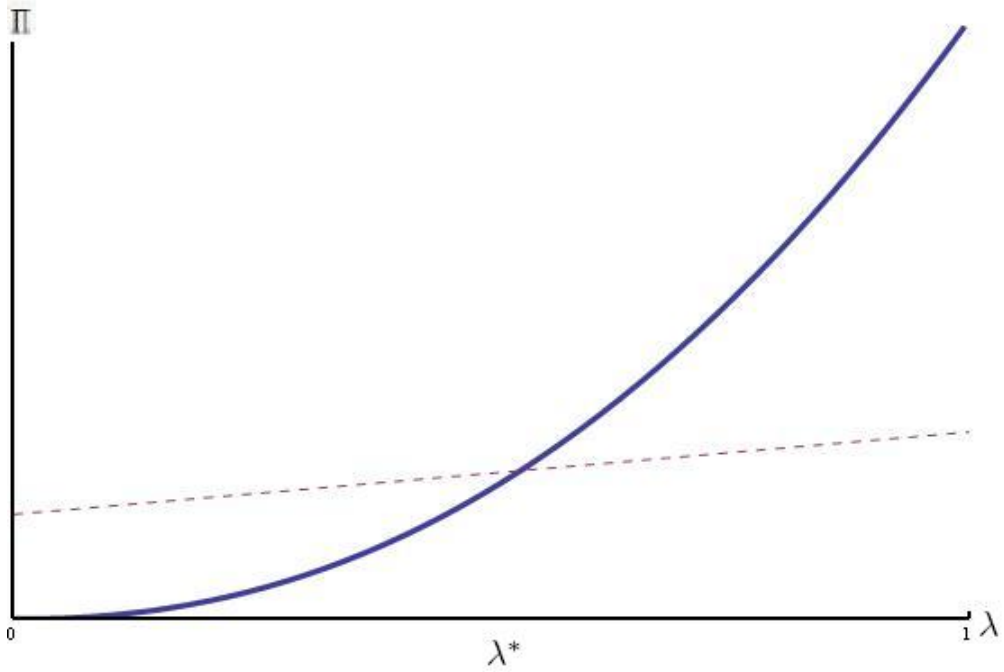
Proof. *See the appendix.*

Empowered unions increase the profitability of outsourcing over vertical integration. Figure 1 provides an illustration by plotting both (Π^v, Π^o) as a function of λ.[23] When the power of firms in wage negotiations is high, the optimal organizational form is that of vertical integration. Decreases in λ force the firm to share revenues with the union, up to a point where it prefers to outsource the production of the component in spite of the inefficiencies entailed by subcontracting under incomplete contracts.

Proposition 1 shows that bargaining in the labor market provides a motive for vertical fragmentation. Its intuition hinges on the rent-sharing effect of the labor market institutions. Our model also emphasizes the differential effect of contractual frictions in the labor market across organizational forms. This can be seen graphically in Figure 1. The Π^v curve is convex due to the presence of the *efficiency effect*: increases in λ boost investment and this effect adds to the reduction of the rent-sharing effect conferred by higher bargaining power. Put simply, higher values of λ result in the firm creating a larger "pie" *and* giving away smaller shares of it. The absence of the efficiency effect under outsourcing is the reason behind the linearity of the Π^o curve. In a model where production of the component requires an additional investment, an efficiency effect would persist under outsourcing, giving Π^o a convex shape. However, it would also strengthen the efficient effect under vertical integration to the same extent, leaving relative profits unchanged (see the appendix).

[23] Values used are $\alpha = 0,75$, $\phi = 0.5$, $\beta = 0.4$, $r = \omega = 2$.

Figure 1: Collective bargaining power and organizational choice



From the previous discussion, we know that the strength of the efficiency effect depends on the extent to which production relies on capital - see (9). Hence the impact of wage negotiations on organizational choices should be sensitive to the capital intensity of the production technology. In particular, the following result holds:

Proposition 2 *(Capital intensity) The cutoff* $\lambda^*(\beta, \phi, \alpha)$ *is:*

i. increasing in β *for* $\lambda < \frac{\phi}{1-\phi}$

ii. decreasing in β *for* $\lambda > \frac{\phi}{1-\phi}$

iii. independent of β *for* $\lambda = \frac{\phi}{1-\phi}$

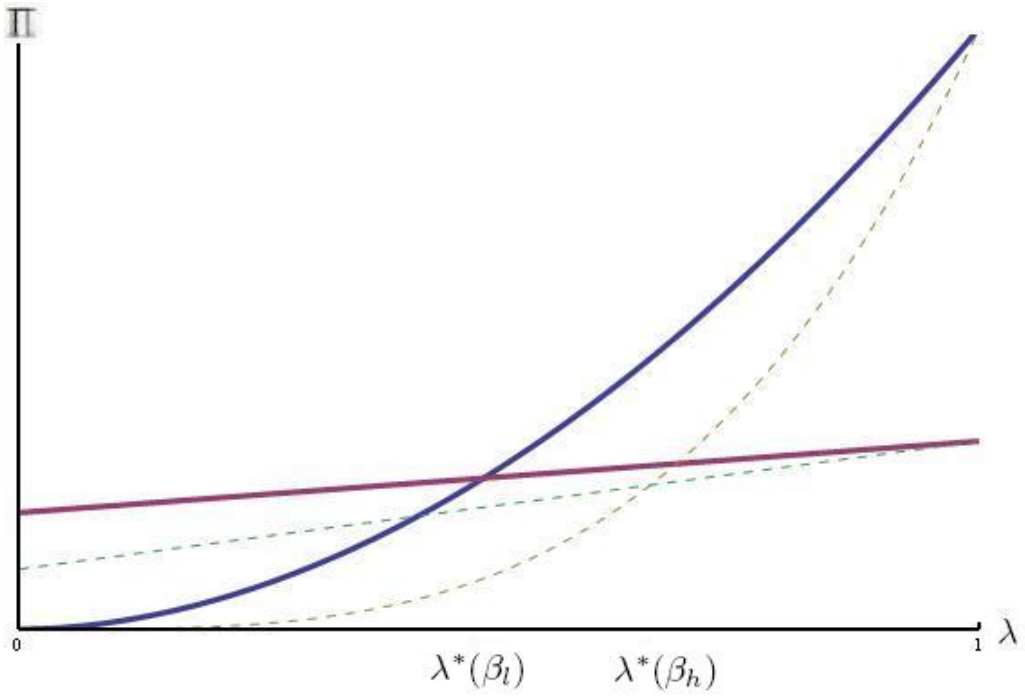
Proof. *See the appendix.*

Corollary 1 $\phi \geq \frac{1}{2}$ is a sufficient condition for $\frac{\partial \lambda^*}{\partial \beta}(\beta, \phi, \alpha) > 0$

Outsourcing is more likely when the technology is capital intensive and the power of firms in wage negotiations is weak. Intuitively, outsourcing is a way of trading away one risk of opportunism (that of the union) for another risk of opportunism (that of the supplier). When λ is sufficiently low with respect to ϕ union opportunism is relatively stronger and underinvestment is severe under integration. This problem is aggravated when the firm operates a capital intensive technology. When, on the contrary, λ is high relative to ϕ, the attractiveness of vertical integration is increasing in capital intensity because the hold-up problem is relatively stronger in the commercial partnership.

To understand the logic behind Corollary 1, note that the effect of capital intensity on efficiency under outsourcing naturally depends on the value of ϕ. For $\phi > \frac{1}{2}$, the markup in (13) is decreasing in β. Increasing the relative importance of capital in production decreases overall underinvestment when the firm has relatively strong bargaining power. For $\phi < 1/2$ the markup is increasing in β: when the hold-up problem from the firm's perspective is relatively stronger, an increase in the importance of capital in production results in larger inefficiencies.

Figure 2: Collective bargaining power, capital intensity and organizational choice



The case of Nash bargaining (i.e. $\phi = \frac{1}{2}$) is an interesting one because with symmetric bargaining power the efficiency effects of β in outsourcing cancel each other out. Hence, the efficiency impact of β on λ^* is driven solely by the power of the efficiency effect of wage bargaining. Figure 2 shows a numerical example of equilibrium profits contrasting the cases of two production technologies: one capital-intensive (β_h, dashed lines) and the other labor-intensive (β_l, heavy lines).[24] Profit curves from both strategies lie to the right for the capital-intensive technology. Π^o shifts right with β because the rent-sharing advantages of outsourcing decrease with capital intensity. Bear in mind that under outsourcing the trade union captures a share of the rents accruing to the supplier. But profits retained by the supplier are higher the more capital intensive the production is. Hence, a larger amount of profits is given away to the trade union - see (3.2.2). The net effect on relative profits results from the relative strength of these two forces. The numerical example shows graphically the general result that the distance between the curves is greatest for Π^v. Because the ratio (15) is increasing in λ, it implies that the the cutoff value λ^* is higher for the capital-intensive technology. As mentioned, for $\phi > \frac{1}{2}$, the markup in (13) is decreasing, adding an

[24] Values used are $\alpha = 0,75$, $\phi = 0.5$, $\beta_l = 0.3$, $r = \omega = 2$ and $\beta_h = 0.8$.

additional positive effect of β to the profits from outsourcing. Hence, for $\phi \geq \frac{1}{2}$ Proposition 2 always holds.[25]

Robustness: an alternative timing structure.

The timing structure of the outsourcing case - both firms bargain after the supplier have bargained with workers and produced the component - is the natural one following the assumption that contracts between firms are incomplete. We now discuss the case of an inverse timing. Imagine that both firms bargain over a compensation to the supplier before the latter bargains with the union. Call this compensation P. Notice that this would imply that a commitment on P is possible before the component is produced. In this alternative setting, the negotiated wage in the final period just before production is conditional on P and equals $w^o = (1-\lambda)P\frac{1}{l^o} + \lambda\omega$. Hence, the supplier is left with $\lambda(P - \omega l^o)$ after having paid wages. Anticipating this, both firms bargain over P following a generalized Nash bargaining process:

$$max_P \Psi = [R(k^o, m^o) - P]^{\phi} [\lambda(P - \omega m^o)]^{1-\phi}$$

with solution $P = (1-\phi)R(k^o, m^o) + \phi\omega m^o$.

The ex-ante payoffs are given by $\phi(R(k^o, m^o) - \omega m^o)$ for the firm and $\lambda(1-\phi)(R(k^o, m^o) - \omega m^o)$ for the supplier. A comparison with expressions (11) and (12) shows that, as expected, the possibility of committing on P before wages are bargained increases the ex-ante payoff to the supplier by $\phi\omega m^o$. This is due to the fact that the solution to the first bargaining problem internalizes the cost of ensuring the workers' participation in production, which equals ω times the amount of labor employed. But, with the union's participation ensured, λ continues to play a redistributive role between the supplier and the union. Notice that, in this case, the first-order conditions defining the solution at $t = 1$ are given by

$$R_k = \frac{r}{\phi} \qquad R_m = \omega$$

Hence, in this alternative setting, the incentives to invest are unaffected by λ for the same reason as before: in choosing the capital stock, the firm is concerned only with the negotiation with the supplier. The fact that production of the component is efficient follows from the fact that commitments over P are possible. Notice that the solution would be the same if input quantity were also bargained with the supplier. As in the baseline model, there exists a unique cutoff $\lambda^*(\beta, \phi, \alpha)\ \epsilon\ (0, 1)$ determining organizational choice. The appendix presents the conditions under which this threshold increases with β.

3.4 Individual wage bargaining

In this subsection we present the main results from a version of the model where workers remain unorganized and wage bargaining takes place at the individual level instead (see the appendix for details on the full derivation). This case is empirically relevant as the employment relationship is typically plagued by specificities that make the costs of dismissing workers economically relevant. Costly separation can be the consequence of firm-specific training or human capital (most plausibly for white-collar workers), can be induced by policy through hiring and firing costs, or can arise due to matching frictions. Irrespective of

[25] Feenstra and Hanson (2005) provide an empirical investigation on the property rights theory of the firm. Their estimates suggest a bargaining power of 0.7 for the multinational firm and 0.3 for the supplier firm. These values, however, are not statistically different from 0.5.

its origin, together with the ex ante inability to commit to future wage and employment levels, it implies that wages are to be determined through ex post bargaining.

To characterize the equilibrium wage solution in this setting, we make use of the theory of intra-firm bargaining developed in Stole and Zwiebel (1996a,b). It constitutes a natural counterpart to our main model, because it extends standard wage bargaining solutions to the case of individual bargaining with multiple employees.[26] In this section we keep our partial equilibrium approach. For the sake of simplicity, we assume as in Stole and Zwiebel (1996a,b), that once hired, workers are irreplaceable. At any moment before production starts, either the firm or any arbitrary employee can call the other party into individual wage negotiations. The outside option for the worker is the reservation wage. The outside option of the firm is, in contrast to the case of collective bargaining, given by the payoff obtained in a similar bargaining process involving one less worker.[27] We continue to call λ the relative power of the firm in each of these pair-wise negotiations. We show in the appendix that under these assumptions the expression for the equilibrium wage as a function of organizational mode is

$$w^i = \frac{(1-\beta)\alpha}{(1-\beta)\alpha(1-\lambda)+\lambda}\frac{(1-\phi O(i))R(k^i,l^i)}{l} + \lambda\omega \qquad \textit{with } i \in \{V,O\} \textit{ and } O(i) \in \{0,1\}$$

where $R(k^i,l^i)$ is the revenue function and $O(i)$ is a binary indicator taking the value of one when outsourcing is the prevailing organizational form and zero otherwise.

Wages are as before the sum of a fraction of per-worker revenues and a fraction λ of the reservation wage. The share of rents captured by workers now depends on the parameters α and β. This follows from the fact that the subject of the negotiations is not total revenues but marginal revenues accruing to a single worker. Intuitively, an increase in market power (lower α) reduces the marginal value of an additional worker (higher α makes the revenue function more concave). Similarly, the marginal product of labor is decreasing in the elasticity of output with respect to capital, β. Both reduce the ability of individual workers to extract rents by reducing their threat points. The share of rents captured by the firm in the round of individual negotiations, which we term the "effective bargaining power", is $\widetilde{\lambda}(\lambda,\beta,\alpha) = \frac{\lambda}{(1-\beta)\alpha(1-\lambda)+\lambda}$.

In the appendix we show that the ratio of profits from integration to outsourcing now writes:

$$\frac{\Pi^v}{\Pi^o} = \frac{\widetilde{\lambda}^{\frac{1-(1-\beta)\alpha}{1-\alpha}}(1-\alpha)}{\left[\phi(1-\beta\alpha)+\widetilde{\lambda}(1-\phi)(1-(1-\beta)\alpha)\right]\left(\phi^\beta(1-\phi)^{1-\beta}\right)^{\frac{\alpha}{1-\alpha}}} \tag{16}$$

Given that $\widetilde{\lambda}$ is an increasing function of λ, the main result from the previous section (i.e. Proposition 1) holds in the intra-firm wage bargaining case. Formally,

Proposition 3 *(Intra-firm bargaining and organizational choice) In the game with individual wage bargaining, there exists a unique cutoff $\lambda^*(\beta,\phi,\alpha) \in (0,1)$ such that for $\lambda > \lambda^*$ the firm chooses to setup a vertically integrated plant, for $\lambda < \lambda^*$ the firm chooses to outsource the intermediate component, and for $\lambda = \lambda^*$ the firm is indifferent between the two organizational forms.*

[26] The foundations of the theory are laid out in Stole and Zwiebel (1996a). One advantage of this bargaining theory is its generality. In particular, it is shown that the non-cooperative solution is identical to the Shapley value of the corresponding cooperative game (under the plausible assumption that in any coalition not involving the firm workers obtain a payoff equal to the reservation wage). Hence, the equilibrium outcome presented here can be given either interpretation. A series of economic applications is discussed in Stole and Zwiebel (1996b).

[27] One important property of the equilibrium outcome of this multi-person game is that the ordering in which negotiations take place is irrelevant. Each worker is treated as the marginal worker.

Proof. *See the appendix.*

The intuition for this result is the same as in the baseline model. Given sufficiently low bargaining power against workers, the firm prefers to subcontract out the production of the intermediate component in order to bound wage demands.

However, contrary to the case of collective bargaining, the effect of capital intensity on organizational choices is less straightforward. An increase in β makes underinvestment costlier but at the same time enhances the firms' bargaining power. Because the latter effect reduces underinvestment, the net effect of a change in β on the threshold $\lambda^*(\beta, \alpha, \phi)$ is complex and not possible to be derived analytically. Numerical simulations suggest nonetheless that the attractiveness of outsourcing tends to increase with β for high values of α. This is intuitive, since tougher competition makes the loss in profits associated to the inefficiencies caused by underinvestment costlier. The concern is thus how to reduce capital underinvestment, which as suggested by the baseline model, might be done by outsourcing the intermediate component. For low levels of α, the increase in bargaining power conferred by β tends to reduce the incentives to outsource. These effects imply that $\phi \geq 1/2$ is no longer a sufficient condition for the cutoff value $\lambda^*(\beta, \alpha, \phi)$ to be increasing in β. The numerical analysis suggests that the threshold is systematically higher.

4 Foreign sourcing under imperfect labor markets

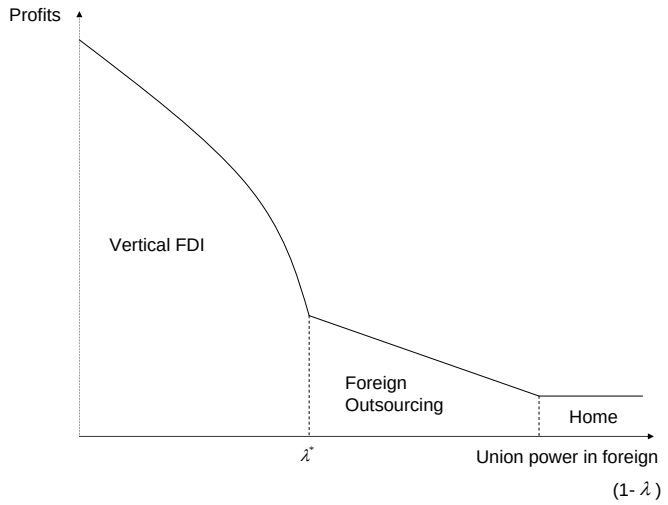
The insights gleaned from with the previous analysis can be applied to the study how the power of workers in industrial relations determines the internal organization of global firms.

Consider the following simple set-up. The firm now operates in a world composed of two countries, Home and Foreign. Both are similar in terms of factor endowments and size, except that workers in Foreign enjoy a comparative advantage of the ricardian type in the industry where the intermediate component is produced. The productivity advantage is large enough for the profit gains from producing in Foreign to outweigh trade frictions and any fixed-cost entailed in cross-border production. However, the labor force in Foreign is organized in a trade union and hence production there necessitates the settlement of a collective agreement. Industrial relations take place as in the model presented in Section 2. To continue with the notation of the theoretical section, we call λ the power of the firm when bargaining with the union. Hence, the power of the trade union during collective disputes is given by $(1 - \lambda)$. The power of the union is assumed to be determined by the institutions regulating the labor markets in Foreign.

Using the ratio (15) we can study how the international organization of production depends on the power of organized labor in Foreign. Figure 4 shows equilibrium profits of the firm as a function of the union's bargaining power (corresponding to $1 - \lambda$). When the bargaining power of the union is weak, the firm optimally sets up a plant in Foreign to secure control over production and avoid the costly contractual frictions associated with outsourcing.

As the union's power increases (moving to the right along the x-axis) the costs of running a vertically integrated plant start to appear. The union captures a larger share of profits, and this *international rent-sharing* reduces the profitability of the FDI strategy. Moreover, the prospect of opportunistic behavior by the union depresses firm's incentives to invest, further reducing the returns from production. For sufficiently high union power (i.e. above the threshold λ_f^*), the firm still finds it profitable to source in Foreign but optimally chooses to subcontract production of the component to the local supplier. Outsourcing introduces costly inefficiencies but enables the firm to divert part of its rents away from the union's reach. It eliminates

Figure 3: Foreign sourcing with trade unions

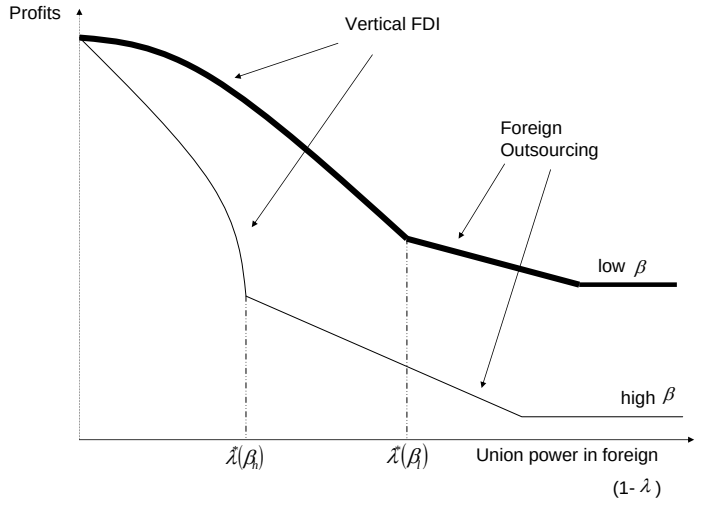


the international scope of rent-sharing and provides the firm with higher profits. This leads us to the first empirical prediction of our model:

Empirical prediction 1: *Foreign direct investment and intra-firm trade flows are less likely from countries with strong unions.*

International outsourcing provides a strategic way of accessing the higher productivity workers in Foreign while avoiding the exposure of worldwide profits to extraction by the union.

Figure 4: Foreign sourcing with trade unions across industries



Our theoretical model also highlights differential effects of industrial relations on organizational choices across industries depending on factor intensity in production. It shows that the incentives to subcontract

created by a union presence are stronger in capital intensive industries. Figure 4 reproduces the previous analysis, plotting equilibrium profits depending on the firm's sectoral affiliation. The thick line depicts profits for a firm operating in a capital intensive industry, whereas the thin line illustrates the case of a firm operating in a labor intensive industry. The threshold λ^* for the firm in the capital-intensive industry is lower, indicating that combinations of high importance of capital in production and strong power of organized labor favor the outsourcing strategy.

Empirical prediction 2: *The power of unions is more likely to reduce intra-firm imports in capital intensive industries.*

5 Empirical analysis

5.1 Data description

Trade data on multinational firms located in France

Our main dataset is the *Enquete Echanges Internationaux Intra-Groupe* produced by the French Office of Industrial Studies and Statistics (SESSI). It is based on a firm-level survey of manufacturing firms belonging to groups with at least one affiliate in a foreign country and with international transactions totaling at least one million euros. The survey year is 1999. The data provide a good representation of the activity of international groups located in France. They account for around 82% of total trade flows by multinationals, and 55% and 61% of total French imports and exports respectively.[28]

The SESSI dataset provides, for each firm, details of all the international transactions carried out in 1999 including product, country of origin or destination and value. Products are classified both at the 4-digit CPA level (Classification of Products by Activity, corresponding to the NACE Rev1 Classification) and at the 4-digit level of the harmonized system (HS4). The survey provides the share of the value that was traded with affiliated firms versus independent firms. This information is detailed by importing firm, product traded, and exporting country. It should be noted that the trading partner is considered to be an affiliate when the group controls at least 50% of equity.[29]

Industry-level data

We combine the data available in the SESSI database with another firm-level dataset, the EAE (*Enquete Annuel d'Entreprises*). It is an annually conducted survey that provides detailed firm-level data for all French firms with more than 20 employees whose main activity is in manufacturing. In spite of the size threshold the data remains highly representative. Eurostat reports that firms in the EAE accounted for around 87% of manufacturing production value in 1999. We use this information to construct a measure of capital intensity in the production function, an empirical proxy for the parameter β in the theoretical section. We first use the firms in the sample with available information on capital stock to calculate the

[28] The SESSI dataset was crossed-referenced with alternative sources to check their validity. The trade flow data were found to be consistent with customs data and the intra-firm trade flows consistent with data on the location of the French affiliate (INSEE's Financial Links Survey "LIFI", Bank of France and French General Treasury and Economic Policy Directorate (DGTPE) data).

[29] Thus, the database considers only cases where there is a relationship of control over the affiliate. This contrasts with other datasets where the equity threshold is typically 10%, if not 6% as in the case of US Customs data.

log of the ratio of the capital stock to total employment. The median of this firm-level measure is then calculated for each of the 254 4-digit NAF industries in our sample.[30] By way of an illustration, Table 14 provides a list of the five industries with the highest value of capital intensity and the five industries with the lowest value of capital intensity.

A similar procedure is used to compute a rough measure of skill intensity at the industry-level by computing the logarithm of the ratio of wages to total employment at firm level and then using the median for the industry.[31] We define size as the total number of employees per firm, and compute the median of the logarithm of size for firms in each industry. The aggregated measures are then matched with the SESSI data to recover the characteristics of the importer's sector of activity. We use other industry variables as controls. The Rauch (1999) classification aggregates commodities according to whether they are differentiated, have their prices referenced in trade publications or are traded in organized exchanges. We use a concordance table to convert the Rauch (1999) HS4 classification to the 4-digit NAF Rev. 1 industry classification. We also use an index of R&D intensity taking firm-level data from the 1999 Third Community Innovation Survey (CIS 3). It is constructed as the 75th percentile of R&D expenditure to sales for firms in a 3-digit industry to accommodate for the many zeros in the data. Details are provided in Carluccio and Fally (2008).

Table 12 in the appendix provides the correlations between these industry-level measures. Because the R&D index is at a more aggregated level, we do not include it in the table. The correlation of R+D and capital intensity at the 3-digit level is of 0.42.

Data on collective bargaining across countries

Testing the model's implications calls for an empirical counterpart to λ, the measure of the relative bargaining power of employers and employees in wage negotiations. An important determinant of the balance of power between firms and workers is the regulations governing the labor markets. Industrial relations laws regulate relationships between firms and organized workers, providing the framework within which the bargaining process takes place. Employment protection laws affect the individual bargaining process indirectly, by affecting the costs firms face when hiring and firing their employees.

The most comprehensive database on labor market regulations across countries is the one developed by Botero et al. (2004). These authors have assembled data in 85 countries on three different categories of labor law for the year 1997.[32] Our main empirical focus is on the regulation of collective relations. Botero et al. (2004) provide two sub-indexes that aim to capture the extent to which workers are protected from employers by collective action. These, as well as the other indexes, are constructed with higher values representing increased regulation and power on the workers' side. The first covers laws governing collective disputes. We call it the collective bargaining index. It considers several aspects of labor law that determine the balance of power between employees and employers during conflicts. These include whether the right to collective action is permitted by law, whether strikes are legal and, if so, the ease with which they can

[30] NAF: *Nomenclature d'Activités Française*. It corresponds closely to the 4-digit NACE Rev 1 Classification (although it is slightly more disaggregated), which in turn is close to the 4-digit ISIC Rev3 Classification.

[31] Clearly, this is an imperfect measure of skill intensity. Unfortunately, other commonly used measures such as the relative importance of non-production workers are not available. Using the same dataset, Corcos et al. (2008) perform a robustness check on how well this variable captures differences in skills. Aggregating this measure at the 2 digit NACE Rev 1 industries, they report a correlation coefficient of 0.67 with the share of the workforce having at least secondary education.

[32] The data are available online at http://www.economics.harvard.edu/faculty/shleifer/files/. The World Bank has updated some of these data for the 2004-2008 period, available at http://www.doingbusiness.org. Previous works using this database include Cunat and Melitz (2006), Lafontaine and Sivasadan (2007) and Caballero, Cowan, Engel and Micco (2006).

take place, and the extent to which employers can react with lockouts or by replacing striking workers. The second is the union power index, constructed to capture the statutory protection and power of unions. Throughout the empirical analysis we focus on the collective bargaining index because it displays more variability than the union power index. Nevertheless, in robustness checks we show that the main results hold when we use the union power index instead.

We run a subset of regressions using the sub-index of firing costs from Botero et al. (2004) to proxy for relative power of workers in the bargaining process. This index measures the cost of firing 20% of workers of a standardized firm, calculated as the sum of the notice period, severance pay and penalties established by the law for a worker with 3 years of tenure with the firm.

The Botero et al.(2004) indexes are purely cross-sectional and vary between 0 and 1. The data appendix provides a detailed description of the construction of these indices. Our empirical analysis focuses solely on manufacturing imports from countries for which measures of labor market regulations and other country-level controls are available.[33] The list of these countries (corresponding to positive imports), is provided in Table 1 (see Section 2).

Using the detailed HS4 classification we obtain a baseline estimating dataset comprising 4,163 firms that import 1,045 HS4 products from 65 origin countries, including both developing and developed economies. The average number of imported products by firm is 10, with a standard deviation of 12 and a maximum of 190. The average firm imports from 7 countries (standard deviation 5) and the maximum number of countries by firm in the data is 38. The average number of product-country pairs by firm is 23 (standard deviation 39) and the maximum number of product-country pairs by firm is 762. The estimating dataset contains 112,488 firm-product-country cells with information on the share of intra-firm imports. Of these, 60% are pure outsourcing, 28% are pure intra-firm and 12% are a combination of both (mixed sourcing strategies). The average share of intra-firm trade by firm is 0.35 (standard deviation 0.39). Around half of the firms in the sample reports imports using both sourcing modes (2,015).

Table 4 provides summary statistics on the main variables used in the analysis.

In the robustness checks we use data on labor market institutions from alternative sources. Nickell (2006) provides data on labor market institutions for a group of OECD countries. We use the measure of union coverage, defined as the number of workers covered by collective agreements normalized on employment for 1999 and 1980, the earliest with good country coverage. We have also constructed a dummy variable that equals one if the exporting country has ratified the ILO convention on the Right to Organize and Collective Bargaining (the C98 convention). The ratification of an ILO convention by a government gives it legal status. This information was obtained from the ILO's website.[34]

The data appendix provides a detailed description of the variables used in the empirical analysis is provided. Correlations are shown in Table 13.

[33] We exclude imports classified as Tobacco (NACE 16) and Coke and 23 (NACE 23) since, as pointed out by Antràs (2003), sourcing modes in these industries are likely to be determined by other factors such as national sovereignty. Our main results are robust to their inclusion. Furthermore, Tables 9 and 10 use manufacturing industries (corresponding to NACE Rev1 classification sectors 17-37) excluding sector 15 (Food and Beverages) due to lack of information on capital intensity for this sector in the EAE.

[34] http://www.ilo.org/ilolex/english/docs/declworld.htm

Table 4: Summary statistics of main variables

	Mean	Std. Dev.	Min	Max	Obs.
Dependent variable					
Share of intra-firm imports	0.34	0.45	0	1	112488
Labor market variables					
Collective bargaining	0.45	0.17	0.13	0.88	65
Firing costs	0.44	0.22	0	1	65
Union power	0.42	0.20	0	0.71	65
Union coverage 1980	0.69	0.21	0.23	0.98	18
Union coverage 1999	0.65	0.28	0.14	0.98	18
Ratification of ILO's C98 convention	0.89	0.32	0	1	63
Country-level variables					
Log of capital endowment	10	1.50	6.55	12.03	65
Trade openness	67	15	24	90	65
FDI openness	64	13	30	90	65
Rule of law	0.62	0.21	0.24	0.97	64
Log of skill endowment	15	10	0.80	43	59
IPR protection	352	90	106	488	65
Log of entry costs	2	0.57	0.69	3.00	65
Private credit / GDP	0.62	0.50	0.04	2.01	61
Corporate tax	31	6	15	45	64
Civil law	0.64	0.48	0.00	1.00	64
Minimum wage incidence	5	2	2.50	8.40	46
Industry-level variables					
Capital intensity	5.05	0.18	4.67	5.84	284
Skill intensity	5.42	0.83	3.67	8.74	284
Median size	4.29	0.64	2.96	8.07	284

Notes: The dependent variable is the share of intra-firm imports at the firm level of each HS4 product by country of origin. Industry level variables are calculated at the 4-digit NAF level (close to NACE Rev1 4-digit level).

5.2 Results

We now proceed with an econometric test of the prediction derived from our theoretical model in terms of optimal sourcing strategies by multinational firms.

5.2.1 Collective bargaining power and intra-firm trade

We start by confronting *Empirical Prediction 1* with the data. We estimate the following equation:

$$I_{ipc} = \alpha CB_c + \beta X_c + \theta_p + \phi_i + \epsilon_{ipc} \tag{17}$$

where the dependent variable I_{ipc} is defined as the share of intra-firm imports of (HS4) product p from country c by firm i. CB is the measure of the worker's bargaining power in wage negotiations. Our theory predicts a negative sign for α: firms are expected to engage in less vertical integration and intra-firm trade

when offshoring in destinations where labor market regulations enhance workers' bargaining power. X_c are controls at the country level, and $\{\theta_p, \phi_i\}$ are respectively a full set of imported product and firm fixed effects.[35]

The inclusion of firm and product fixed effects focuses the analysis on the impact of country-level variation in the labor market institutions, while controlling for any imported products and firm characteristics (observables and unobservables) that might affect intra-firm shares.

Notice that failing to control for product and firm characteristics can generate misleading results. The literature on the internal organization of the multinational firm has found theoretical and empirical grounds for the notion that firms' integration decisions vary according to the characteristics of the imported inputs (Antràs, 2003 and Antràs and Helpman, 2004 provide good examples). Furthermore, empirical evidence has corroborated this idea and shown that some type of inputs are more likely to be imported through intra-firm trade, as is the case with high-skill inputs (Alfaro and Newton, *forthcoming*; Bernard et al., 2008). Thus, failing to control for the composition of trade can lead to an spurious relationship between country characteristics and firms' organizational choices. Similarly, the literature has identified firm-level characteristics that impact systematically on their organizational choices. Antràs and Helpman (2004 and 2008) provide theoretical support for a sorting of firms into different organizational choices based on their total factor productivity.[36]

In our preferred specification, equation (17) is estimated by ordinary least squares. However, we have performed estimations using alternative econometric methodologies to take into account the specific nature of the dependent variable (see Table 15 in the appendix).[37]

In Table 5 we look at the role of labor market regulations in determining intra-firm import shares by multinationals based in France. Heteroskedasticity-robust standards errors are shown in parentheses. Disturbances are corrected for clustering across countries and within products since the error term in (17) reflects unobserved variation in organizational costs across countries and products. As can be seen in column (1), the collective bargaining index has a negative and statistically significant effect, at the 1% confidence level, on the share of intra-firm imports. We then add a set of basic controls at the level of the exporting country. Following the literature on the determinants of intra-firm trade, we include capital endowment as explanatory variable. We find that, consistent with the theoretical prediction by Antràs (2003) - corroborated by Nunn and Trefler (2008) and Bernard et al. (2008) using US data-, multinationals based in France tend to engage more in intra-firm trade with capital abundant countries. We also include FDI and trade openness indicators from the Heritage Foundation. Their inclusion does not affect the sign or statistical significance of the coefficients associated with the collective bargaining index. As expected, in the case of France, intra-firm import shares are higher from countries with policies favoring foreign investors. Openness to trade, however, is associated with larger values of arm's length trade. Bernard et al. (2008) find qualitatively similar effects for US-based multinationals using the same policy variables.

We now allow for the possibility that other exporting country features then their labor market institu-

[35] As in other studies on the determinants of intra firm trade (Bernard et al., 2008; Defever and Toubal, 2007; Corcos, Irac, Mion and Verdier; 2008) we consider only observations with positive imports. We thus analyze the determinants of sourcing modes conditional on the firm having chosen the host country. The appendix presents the estimation of a Heckman selection model where gravity variables are used to identify the country selection equation. We find similar results to the main analysis, reducing concerns about the effects of a potential endogeneity of sourcing modes and country choices on the reported coefficients.

[36] Defever and Toubal (2007) and Corcos et al. (2008) lend empirical support to this claim using the SESSI dataset.

[37] Table 15 reports the results of Tobit and Fractional logit estimations on the share of intra-firm imports, as well as linear probability and conditional logit estimations using only "pure" strategies: i.e. those for which the share of intra-firm imports equals either 100% or zero for a firm-product-country triplet.

tions are driving the results. We thus extend the set of country-level controls to include variables that, if omitted, might bias the OLS estimates of α.

Our measure of workers' bargaining power of workers are based on statutory laws and regulations. Regulations are effective as long as the law is enforced in the exporting countries.[38] We control for the general level of contract enforcement with the rule of law index taken from Kaufmann, Kraay and Mastruzzi (2003). This variable comes out positive but not significant in column (3). Note, however, that the rule of law is largely correlated with the log of capital abundance (over 0.8). We also add the measure of skill endowment from Barro and Lee (2000).

Next, we next address an important concern. Countries that impose tighter regulations on the labor markets might tend to actively regulate other aspects of economic life as well (Botero et al., 2004). Hence, a negative sign of the labor market regulations variables might simply be picking up the effects of stricter overall regulatory systems. We control for the propensity to regulate firms' activities including, in column (4), the natural logarithm of the number of steps required by law to start a business (Entry costs) drawn from Djankov et al. (2002). As expected, this variable comes out negative and significant at the 1% level. Its inclusion does not affect the significance of the collective bargaining index, despite the positive correlation between the two variables. We also include, in the same column, the log of the ratio of private credit over GDP. Credit constraints faced by local entrepreneurs have been shown to be a determinant of sourcing modes (Carluccio and Fally, 2008) and a determinant of multinational firms' activity (Antràs, Desai and Foley, 2009). In the same column we include the top corporate tax rate from the World Tax Database. In addition, we include the Ginate and Park (2000) index of intellectual property rights protection (IPR). In column (5), we further account for differences in the incidence of minimum wages across countries. Results on the collective bargaining index remain robust to the inclusion of an extensive set of controls related to the regulatory and institutional profiles of exporting countries.

In column (6) we run the same specification using country random effects. This enables us to control for unobservable country characteristics that might affect intra-firm import shares in our cross-sectional data. Furthermore, the random effect estimator controls for potential correlations of the error term across countries.[39]

We finally propose a further simple way to test whether the observed effects of tighter labor market regulations are not driven instead by the effects of general regulatory frameworks. Defendants of the "legal theory" of institutional evolution argue that the legal origin of a country is a determinant of the inclination of the state to intervene and regulate different areas of the economy (La Porta, Lopez-de-Silanes and Schleifer, 2008). Common law countries tend to rely on the market system relatively more that civil law countries. Because most countries have inherited their legal structures from conquest and colonization, legal origins can be used to isolate exogenous variation in countries' institutional profiles (Nunn, 2007). In column (7), we make use of this theory in a simple way, by introducing a dummy variable equal to 1 if the exporting country's legal system is that of the civil law, as opposed to common law. We include the basic set of controls augmented with the rule of law and the ratio of private credit to GDP because legal origins have also been shown to be strong predictors of contract enforcement (Acemoglu and Johnson,

[38] using data from Botero el al (2004) Caballero et al., 2006 find that labor market regulations strongly deter productivity growth in countries with good judicial systems, but have no effects in countries where governance is week)

[39] This estimator is a two-way error components model with product and firm fixed effects and random country effects. In the first step, we remove the product and firm means from the share of intra-firm trade. In the second step we run the generalized least squares on the transformed data with country random effects. Harrigan (2005) and Harrigan and Baldwin (2007) use the same specification.

2004; Djankov et al., 2003) and of the level of financial development (La Porta et al., 1997). As can be seen, accounting for the exporting country's legal origin does not affect the sign or significance of the labor market institutions in the determination of intra-firm import shares.

[Table 5 about here]

Identifying vertical production networks

We now endeavor to improve the identification of vertical relationships in our data by creating an intermediate goods sample. We restrict our analysis to imported inputs which are different, in their 4-digit CPA classification, to the main product of the importing business within the group. We also drop importing business units whose main activity is not in manufacturing.[40] The results of estimating (17) on the intermediate goods sample are shown in column (1). Our coefficient of interest remains statistically significant. In column (2) we further restrict the estimating sample solely to multinationals with headquarters registered in France,[41]confirming that our results hold for more refined definitions of vertical production chains.

[Table 6 about here]

Robustness checks: alternative subsamples and labor market measures

We now present, in Table 7, a series of tests on the robustness of our results. The first column includes only OECD countries.[42] These countries constitute a homogeneous group in terms of economic development. They still display a large variation in the collective bargaining index (mean of 0.45 and std. dev. of 0.14) enabling us to check if the results provided so far are not driven by broad differences in income or institutional development.[43] The collective bargaining index appears statistically significant and with a higher coefficient than obtained in the full sample. In column (2), we restrict the estimating sample solely to firms that report positive imports under both sourcing modes across countries and products ("Switchers"). The significant and large coefficient associated with the collective bargaining index alleviates concerns about our results being driven by firm self-selection.

The rest of the table presents results using alternative empirical proxies for the collective bargaining power of workers. In column (3) we use the union power index from Botero et. al (2004). In the next column we introduce the union coverage for 1999 and in column (5) we run an IV regression with the same measure for 1980 as instrument. Union coverage in 1980 is a good predictor of union coverage in 1999, while it is largely uncorrelated with sourcing decisions in 1999. In the last column we use the dummy that

[40]A similar methodology, using input-output tables to identify vertical relationships between industries, has been applied by Feenstra and Hanson (1996). Unfortunately, suitable I-O are not available tables for the French economy.

[41]In our sample, 1,115 firms have headquarters on the French soil and report manufacturing as their main activity, with explains the drop in the number of observations.

[42]Excluding the Czech Republic and Iceland because they are not included in the Botero et al (2004) dataset.

[43]As noted by Nunn (2007), a second advantage is that data for OECD countries (especially our country level controls) tend to be better. This means the results can be checked for robustness to the omission of lesser quality data.

takes the value of one if the exporting country has ratified the ILO convention on the Right to Organize and Collective Bargaining (the C98 convention). As shown, the results remain robust to these sensitivity tests.

[Table 7 about here]

What is the quantitative impact of collective bargaining on the share of intra-firm imports? The coefficients in Table 5 indicate that the negative impact of a one standard deviation increase in the collective bargaining index on the share of intra-firm imports ranges from 1% (column 2) to 1.4% (column 4). By means of comparison, the impact of a one standard deviation increase in the log of the capital endowment ranges from 2% (column 2) to 4.6% (column 4). In the case of FDI openness, these magnitudes vary between zero and 3.9%. Notice that given the linear specification, the interpretation of our coefficients is straightforward: going from the lowest (0,125) to the highest value of the index (0,833), reduces the share of intra-firm trade by 6.6% (using the estimates in column 4). Interestingly, this magnitude increases to 9.4% when the sample is restricted to OECD countries (column 1 of Table 7).

Individual bargaining

We now perform a set of regressions to investigate whether our prediction holds for the case of individual bargaining. As a proxy for the individual bargaining power of workers, we use the firing costs sub-index from Botero et al. (2004). Firing costs increase the equilibrium share obtained by workers when the wage bargaining process happens after being hired, by reducing the value of the firms' disagreement option. Therefore, higher firing costs are associated with weaker effective bargaining power of firms. Strand (2000) provides an example of individual wage bargaining with different types of firing costs.

As can be seen in column (1) of Table 8, firing costs have a negative and statistically significant coefficient at of 1% on the share of intra-firm imports, when the set of basic controls at the exporting country level is included. In the next column, we extend the set of controls by including institutions that affect the regulatory environment in host countries.

We then test the sensitivity of the results to the use of alternative samples. Column (3) presents the results for the OECD countries. The coefficient of the firing costs index has a negative sign but its significance is reduced at 10%. Notice, however, that when we exclude entry regulation costs, the coefficient becomes significant at the 1% confidence level. This is not surprising as both indexes are positively correlated. Finally, we restrict our analysis to imported intermediate goods sample (column 4) and to French MNEs importing intermediate inputs (column 5). The results hold using our definition of vertical production chains.

[Table 8 about here]

5.2.2 Collective bargaining, capital intensity and intra-firm trade

We now proceed with an investigation of *Empirical Prediction 2*. We first use the following estimating equation to test whether the negative effects found of wage bargaining on intra-firm trade are conditional on the capital intensity of the industry in which the importer operates:

$$I_{ipc} = \gamma(CB \times k\_int(s)) + \beta(X_c \times Z_s) + \zeta_c + \theta_p + \phi_i + \epsilon_{ipc} \quad (18)$$

where the dependent variable I_{ipc} is defined as in the previous regressions as the share of intra-firm imports of product p from exporting country c by firm i. $CB \times k\_int(s)$ is an interaction term between the measures of the labor market institutions and the median capital intensity of the 4-digit CPA industry that the multinational firm reports as its main activity. Our theory predicts again a negative sign for our coefficient of interest γ: the negative effects of labor market regulations on intra-firm import shares should be stronger for importers producing in capital intensive industries.

In addition to the full set of imported product and firm fixed effects given by θ_p and ϕ_i, we now also introduce a full set of country fixed effects, ζ_c. The fixed effects subsume all the direct effects of the different country, product, and firm characteristics on the share of intra-firm imports. Therefore we do not any longer need to control for the direct effect of country characteristics as in the previous exercises. Notice also that ϕ_i automatically controls for the characteristics of sector s where firm i produces. We are now instead concerned with controlling for variables that might be correlated with the labor market institutions of the exporting countries and have a differential effect on organizational choices based on the capital intensity in production. These are included in the interacted controls between country and sector variables $Xc * Zs$. This empirical specification was introduced by Rajan and Zingales (1998) in their study on the relationship between dependence on external finance and financial development.[44]

Notice that we proxy the relative importance of capital in the production process (parameter β in the theoretical model) with an industry-level measure. As our model shows, the choice of capital stock by multinational firms is endogenous to the organizational form, the dependent variable in (18). Further, this effect depends on the strength of the bargaining power of workers during negotiations. If, as the theory suggests, firms choose outsourcing in countries with high worker bargaining power to protect the returns to their investments and consequently have greater capital stocks in equilibrium, then the magnitude of γ would be overestimated. Under the assumption that industries' technological characteristics determine to a large extent the relative importance of capital in production at the firm level, using industry-level provide a measure of β that reduces concerns about this potential endogeneity bias.

The results of the estimation of (18) are given in Table 6. The number of observations is reduced, since we restrict the sample to importers with manufacturing as their main activity and we have no information on capital intensity for the Food and Beverages industry (corresponding to ISIC 15). In line with the model's empirical prediction, the interaction term between the collective bargaining index and the industry's capital intensity turns out negative and significant within a 5% interval of confidence (column 1). This effect is robust to the inclusion of an interaction between the exporting country's capital abundance and the industry's capital intensity. The sign of the latter shows that French firms in capital intensive sectors prefer to trade via intra-firm from capital abundant countries.

In the next column, we first add an interaction term between skill endowment and skill intensity, which comes out positive and significant. This provides further support to similar results by Bernard et al. (2008)

[44]This approach was applied to international trade by Romalis (2004) and subsequently by Nunn (2007) and Levchenko (2005) to study the differential impact of contract enforcement institutions across differentiated industries, by Manova (2006) to look at the differential impact of financial development based on the extent of industry's dependence in external finance, and by Cuñat and Melitz (2007) to study how labor market rigidities interact with volatility at the industry level in the determination of comparative advantage. In Carluccio and Fally (2008) we adopt it to analyze how financial development interacts with product complexity in the determination of global sourcing strategies.

for the case of the US.[45] We next look at whether the results are driven by other industry characteristics that might by correlated with capital intensity. In particular, as the correlations in Table 12 show, capital intensive industries tend to be skill intensive and also to be populated by larger firms. Size can confer a bargaining advantage that might induce vertical integration in countries with strong collective bargaining power. This idea is not supported as the coefficient interaction term is negative and reveals no statistically significant relationship (column 2). The same column controls for an interaction between skill intensity and the collective bargaining index, which turns out to be positive and significant at 1%. Since capital intensive industries tend to be those with the higher levels of complexity, we introduce both the Rauch index and a measure of R&D intensity (measured at the 3-digit level). Their inclusion does not affect the significance of our coefficient of interest.

We next examine the possibility that omitted country-level variables with differential effects on organizational choices depending on capital intensity are affecting the results. Column (3) shows that we are not picking up the interactions of capital intensity with other variables measuring the institutional environment. In particular the results remain robust after controlling for the effects of FDI and trade policies.

Finally, we investigate the role of the level of contract enforcement (column 4). As already mentioned, the rule of law is also an important control given that we focus our analysis on formal regulations. As this variable increases, the contractibility of activities abroad improves. The interaction term between the rule of law and capital intensity turns out negatively signed and significant. Importantly, its inclusion does not affect our coefficient of interest. We further interact the rule of law with the Rauch index to test whether the effects of better contracting environments are conditional on the level of contractibility of the final product. The coefficient comes out negative but not significant. In the same column we also control for regulations measuring barriers to entry.

Controlling for the direct effects of firm, industry, and country characteristics plus a large set of interactions that are plausible determinants of intra-firm trade shares, our coefficient of interest, γ, remains negative and significant within a 1 percent interval confidence (column 4). These results provide strong support to the second prediction of the model. The negative impact of collective wage negotiations on vertical integration and intra-firm trade appears to be conditional on the capital intensity of the industries where importers operate.

[Table 9 about here]

Splitting the sample across high and low capital intensity industries

We now propose a second test of the differential effect of labor market institutions on intra-firm imports across levels of capital intensity. We divide the firms into groups of high and low capital intensity, depending on whether they belong to an industry with capital intensity above or below the median of 4-digit CPA industries. In the appendix we present the breakdown of high- and low-capital intensive industries based on this criterion.

[45] Interestingly, when entered on its own, as in Table 5, the exporting country's skill abundance tends to have a negative effect on intra-firm import shares.

We then interact the collective bargaining variables with two dummy variables. "high k(s)" takes the value of one if the firm belongs to a high capital intensity industry as defined above, and zero otherwise. "low k(s)" takes the value of one if the firm belongs to a low capital intensity industry, and zero otherwise. This method allows testing whether the coefficients associated with the interactions are statistically different from each other.

In particular, we estimate the following equation:

$$I_{ipc} = \alpha_1(CB \times high\ k(s)) + \alpha_2(CB \times low\ k(s)) + \beta X_c + \theta_p + \phi_i + \epsilon_{ipc} \tag{19}$$

where the coefficients other than α_1 and α_2 have the same interpretation than in equation (17). We expect negative signs for the coefficients associated with the CB variable , and $\alpha_1 > \alpha_2$ in absolute terms.[46]

Table 10 presents the results. As in all the regressions using industry-level measures, the number of observations is reduced due to the lack of firm-level data in the Food and Beverages industry (corresponding to ISIC 15). In order to check that our results are not biased by the reduction in the estimating sample, column (1) reports the estimation of equation (17) using the collective bargaining index for the full sample of firms bearing information on capital intensity at the 4-digit CPA industry level.

Column (2) reports the result for the interaction terms using the collective bargaining index, and where the only controls are the imported product and firm fixed effects. Both coefficients are negative. However, the coefficient of the interaction with the high capital intensity dummy is significant at the 1% confidence level, while the coefficient of the interaction with the low capital intensity dummy is only significant at the 10% confidence level. That corresponding to the interaction term with the high capital intensity dummy is substantially higher than for the interaction with the low capital intensity dummy. As expected, a Wald test under the null hypothesis $\alpha_1 = \alpha_2$ reveals a p_value below 0.01 leading us to reject equality between the two coefficients with at a 1% confidence interval.

The introduction of country level controls in column (3) increases the magnitude of both coefficients and the statistical significance of the interaction with the low capital intensity dummy. Nevertheless, the coefficient corresponding to firms in capital intensive industries continues to be more than two times larger. Equality between the two coefficients is again rejected at a confidence level of 1%. For information, in the last column we report the estimation of equation (17) using the collective bargaining index and the country level controls without splitting the sample. As can be seen from the differences in the coefficients, looking at the average effect of collective bargaining masks strong heterogeneity across industries depending to their capital intensity. Going from the lowest to the higher level of the index reduces the share of intra-firm imports by 13% for the subsample of capital intensive industries, and by 5.9% for the subsmaple of labor intensive ones.

[Table 10 about here]

In results available upon request, we performed estimations on the sample broken down by in industries above and below the median of skill intensity and the median size of firms. We find no evidence of distinct labor market indexes coefficients when the estimating sample is split using these alternative criteria, providing further support for the theoretical model's predictions.

[46] We do not include the variable CB on its own to avoid perfect collinearity.

Other robustness checks

In non-reported estimations, available from the authors upon request, we have confirmed that the results presented in the empirical section are not due to the particularities of the countries or industries included in the sample. The results are robust to dropping the 15 leading trade partners one at a time, to dropping each 2-digit industry one at a time and to dropping groups of imported products at the 2-digit CPA level one at a time.

In the appendix, we present two additional estimations. First, the results from the estimation of a Heckman selection model. A potential selection bias could arise because we only observe the organizational choice if the firm has positive import values. To correct for this bias, we use gravity variables as instruments. We find that, after correcting for the probability of observing positive imports, the index of collective bargaining power continues to have a negative impact on intra-firm import shares. Furthermore, the magnitude of the coefficients does not changes by much (notice that the sign of the coefficient of the private credit variable is reversed in the selection equation). Secondly, we present the results of a simple falsification exercise. We use the share of intra-firm exports by each multinational producing in France as the dependent variable and find no statistical relationship between the collective bargaining index and this alternative dependent variable. This result also hold when we restrict to MNEs with headquarter in France. The fact that wage bargaining only affects import strategies further supports our model.

6 Concluding Remarks

Variations in institutions worldwide shape the international organization of production. In this paper we have developed a model of foreign sourcing under imperfect labor markets to study how the balance of bargaining power between management and labor shape global firms' organizational choices. Our model shows that firms prefer to subcontract out a part of the production process when the bargaining power of trade unions or individual workers is large. Emphasizing the contractual frictions in management-labor relationships, the model also shows that the effect of wage bargaining on organizational choices vary by production technology. Under quite general conditions, the relative profitability of outsourcing increases with capital intensity. This result contrasts the theoretical predictions of models based purely on incomplete contracts between firms, which have been the focus of the literature.

Our theoretical analysis generates two predictions. First, firms should be less likely to import via intra-firm from countries where institutions grant workers a strong bargaining power. Second, this effect should be more pronounced for firms affiliated to capital intensive sectors. We use detailed firm-level data that allows a direct test of the internalization decision by multinational firms operating in France we find results that are highly consistent with our theory. These results hold for alternative measures of the labor market institutions, for detailed definitions of vertical production networks and for alternative samples.

While our work is illuminating in terms the strategies pursued by multinational firms, we focused on a partial equilibrium model for simplicity in the exposition. Future work should enrich the model with a study of how general equilibrium feedback effects determine trade patterns and the boundaries of multinational firms in the trade equilibrium.

Appendix

Specific investment to produce the component

Assume that production of the component requires a second capital investment, labeled k_m:

$$I = k_m^{\xi} l^{1-\xi}, \qquad 0 < \xi < 1$$

Let k_f be the capital required to produce the final good. The production function is

$$f(k_f, k_m, l) = \left(\frac{k_f}{\beta}\right)^{\beta} \left(\frac{k_m}{\gamma}\right)^{\gamma} \left(\frac{l}{\theta}\right)^{\theta} \tag{20}$$

where $\gamma = \xi(1-\beta)$, $\theta = (1-\xi)(1-\beta)$. $\beta \,\epsilon\, [0,1]$ implies $\beta + \gamma + \theta = 1$. Notice that under outsourcing the responsibility of investing in k_m is transferred to the supplier.

The firm's problem under **vertical integration** is described by the following program:

$$\begin{aligned} \max_{k,m,l} \quad & \Pi^v = R(k_f, k_m, l) - w^v l - r k_f - c k_m \\ \text{s.t.} \quad & w^v = (1-\lambda) R(k^v, m^v, l^v) \tfrac{1}{l^v} + \lambda\omega \\ & R(k_f, k_m, l) = A^{1-\alpha} \left(\tfrac{k_f}{\beta}\right)^{\alpha\beta} \left(\tfrac{k_m}{\gamma}\right)^{\alpha\gamma} \left(\tfrac{l}{\theta}\right)^{\alpha\theta} \end{aligned}$$

where c is the unit cost of k_m. Equilibrium factor demands are

$$k_f^v = \frac{\beta\alpha}{r} \left(\frac{r^{\beta} c^{\gamma} \omega^{\theta}}{\alpha\lambda^{(\beta+\gamma)}}\right)^{\frac{-\alpha}{1-\alpha}} \lambda \qquad k_m^v = \frac{\gamma\alpha}{c} \left(\frac{r^{\beta} c^{\gamma} \omega^{\theta}}{\alpha\lambda^{(\beta+\gamma)}}\right)^{\frac{-\alpha}{1-\alpha}} \lambda \qquad l^v = \frac{\theta\alpha}{\omega} \left(\frac{r^{\beta} c^{\gamma} \omega^{\theta}}{\alpha\lambda^{(\beta+\gamma)}}\right)^{\frac{-\alpha}{1-\alpha}}$$

Profits: $\Pi^v = \left(\frac{r^{\beta} c^{\gamma} \omega^{\theta}}{\alpha\lambda^{(\beta+\gamma)}}\right)^{\frac{-\alpha}{1-\alpha}} \lambda(1-\alpha)$.

The firm's problem under **outsourcing** is described by the following program:

$$\begin{aligned} \max_{k_f, T} \quad & \Pi^F = \phi R(k_f, k_m, l) - r k_f + T \\ \text{s.t.} \quad & T \leq (1-\phi) R(k_f, k_m, l) - w^o l - c k_m \\ & \{k_m, l\} = argmax_{k_m, l}\{(1-\phi) R(k_f, k_m, l) - w^o l - c k_m\} \\ & w^o = (1-\lambda)(1-\phi) R(k_f, k_m, l) \tfrac{1}{l} + \lambda\omega \\ & R(k_f, k_m, l) = A^{1-\alpha} \left(\tfrac{k_f}{\beta}\right)^{\alpha\beta} \left(\tfrac{k_m}{\gamma}\right)^{\alpha\gamma} \left(\tfrac{l}{\theta}\right)^{\alpha\theta} \end{aligned}$$

Note that the first constraint will be binding in equilibrium. The solution is characterized by

$$k_f^o = \frac{(1-\phi)\beta\alpha}{r} \left(\frac{r^{\beta} c^{\gamma} \omega^{\theta}}{\alpha\lambda^{\gamma}\phi^{\beta}(1-\phi)^{1-\beta}}\right)^{\frac{-\alpha}{1-\alpha}} \qquad k_m^o = \frac{(1-\phi)\gamma\alpha}{r} \left(\frac{r^{\beta} c^{\gamma} \omega^{\theta}}{\alpha\lambda^{\gamma}\phi^{\beta}(1-\phi)^{1-\beta}}\right)^{\frac{-\alpha}{1-\alpha}} \lambda$$

$$l^o = \frac{(1-\phi)\theta\alpha}{r} \left(\frac{r^{\beta} c^{\gamma} \omega^{\theta}}{\alpha\lambda^{\gamma}\phi^{\beta}(1-\phi)^{1-\beta}}\right)^{\frac{-\alpha}{1-\alpha}} \qquad T = \lambda(1-\phi)[1-\alpha(1-\beta)] \left(\frac{r^{\beta} c^{\gamma} \omega^{\theta}}{\alpha\lambda^{\gamma}\phi^{\beta}\,(1-\phi)^{1-\beta}}\right)^{\frac{-\alpha}{1-\alpha}}$$

Profits: $\Pi^o = [\phi(1-\beta\alpha) + \lambda(1-\phi)(1-(\gamma+\theta)\alpha)] \left(\frac{r^{\beta} c^{\gamma} \omega^{\theta}}{\alpha\lambda^{\gamma}\phi^{\beta}(1-\phi)^{1-\beta}}\right)^{\frac{-\alpha}{1-\alpha}}$

Organizational choice Using the above the ratio of profits is:

$$\frac{\Pi^v}{\Pi^o} = \frac{\lambda(1-\alpha)\left(\frac{r^\beta c^\gamma \omega^\theta}{\alpha\lambda^{(\beta+\gamma)}}\right)^{\frac{-\alpha}{1-\alpha}}}{[\phi(1-\beta\alpha)+\lambda(1-\phi)(1-(\gamma+\theta)\alpha)]\left(\frac{r^\beta c^\gamma \omega^\theta}{\alpha\lambda^\gamma\phi^\beta(1-\phi)^{1-\beta}}\right)^{\frac{-\alpha}{1-\alpha}}}$$

it simplifies to expression (15) in the main text. Hence, propositions 1 and 2 hold.

Derivation of the model with intra-firm wage bargaining

We now present the full characterization of the model with individual wage negotiations. The solution to the Stole and Zwiebel (1996a,b) multi-person bargaining game implies the following surplus-splitting rule determining wages:

$$(1-\lambda)\frac{\partial[(1-\phi O(i))R^i(k,l)-w(l)l]}{\partial l} = \lambda[w(l)-\omega]$$

in the left-hand side are marginal revenues net of the increase in marginal costs of keeping one worker (and as in the main body, $O(i)=1$ for outsourcing). The right-hand side is the payoff to the worker net of its outside option. Solving the above differential equation gives

$$w^i = \frac{(1-\beta)\alpha}{(1-\beta)\alpha(1-\lambda)+\lambda}\frac{(1-\phi O(i))R^i(k,l)}{l} + \lambda\omega$$

Under vertical integration the firm solves

$$max_{k^v,l^v}\Pi^v = \frac{\lambda}{(1-\beta)\alpha(1-\lambda)+\lambda}R(k,l) - \lambda\omega l - rk$$

The solution is

$$k^v = \frac{\alpha\beta A}{r\varphi}\left(\frac{\omega^{1-\beta}r^\beta\varphi}{\alpha\lambda^\beta}\right)^{\frac{-\alpha}{1-\alpha}}\lambda \qquad l^v = \frac{\alpha(1-\beta)A}{\omega\varphi}\left(\frac{\omega^{1-\beta}r^\beta\varphi}{\alpha\lambda^\beta}\right)^{\frac{-\alpha}{1-\alpha}}$$

with $\varphi = [(1-\beta)\alpha(1-\lambda)+\lambda] < 1$. In the text we call $\widetilde{\lambda} = \frac{\lambda}{\varphi}$. Equilibrium profits:

$$\Pi^v = \left(\frac{\omega^{1-\beta}r^\beta\varphi}{\alpha\lambda^\beta}\right)^{\frac{-\alpha}{1-\alpha}}(1-\alpha)\widetilde{\lambda}$$

Under outsourcing the firm and supplier solve respectively

$$k^o = argmax\{\phi R(k,l) - rk\}$$
$$l^o = argmax\{\tfrac{\lambda}{(1-\beta)\alpha(1-\lambda)+\lambda}(1-\phi)R(k,l) - \lambda\omega l\}$$

giving

$$k^o = \frac{\beta A\alpha\phi}{r}\left(\frac{r^\beta\omega^{1-\beta}\varphi^{1-\beta}}{\alpha\phi^\beta(1-\phi)^{1-\beta}}\right)^{\frac{-\alpha}{1-\alpha}} \qquad l^o = \frac{(1-\beta)A\alpha(1-\phi)}{\omega\varphi}\left(\frac{r^\beta\omega^{1-\beta}\varphi^{1-\beta}}{\alpha\phi^\beta(1-\phi)^{1-\beta}}\right)^{\frac{-\alpha}{1-\alpha}}$$

and profits

$$\Pi^o = [\phi(1-\beta\alpha) + \frac{\lambda}{\varphi}(1-\phi)(1-(1-\beta)\alpha)] \left(\frac{r^\beta \omega^{1-\beta} \varphi^{1-\beta}}{\alpha \phi^\beta (1-\phi)^{1-\beta}} \right)^{\frac{-\alpha}{1-\alpha}}$$

the ratio of profits is as given in the main body of the paper. Note that in both cases the solution features labor hoarding which does not however affect our main results.

Proofs

Proof of Proposition 1 Let $\Phi(\lambda, \alpha, \beta, \phi) = \frac{\Pi^v}{\Pi^o}$ be the ratio of profits from both organizational modes in Section 2. $\Phi(\lambda, .)$ is a continuous and differentiable function of λ in the interval $(0, 1)$. Three additional properties of Φ suffice to prove Proposition 1:

1. $\Phi(1, \alpha, \beta, \phi) > 1$
2. $\frac{\partial \Phi(\lambda, .)}{\partial \lambda} > 0$
3. $\Phi(0, \alpha, \beta, \phi) = 0$

We first show 1. Note

$$\Phi(1, \alpha, \beta, \phi) = \frac{(1-\alpha)}{[1-\alpha[1+\phi(\beta-1)-\beta(1-\phi)]] \left(\phi^\beta (1-\phi)^{1-\beta} \right)^{\frac{\alpha}{1-\alpha}}}$$

and $\Phi(1, 0, \beta, \phi) = 1$. Thus, $\frac{\partial \Phi(1,\alpha,\beta,\phi)}{\partial \alpha} > 0 \ \forall \ \alpha \in (0,1), \ \forall \ \beta \in [0,1] \ , \ \forall \ \phi \in (0,1)$ is a sufficient condition for $\Phi(1, \alpha, \beta, \phi) > 1$. A necessary and sufficient condition for $\frac{\partial \Phi(1,\alpha,\beta,\phi)}{\partial \alpha} > 0$ is:

$$log \left(\frac{1}{\phi^\beta (1-\phi)^{1-\beta}} \right) > (1-\alpha) \frac{(\phi + \beta - 2\phi\beta)}{1-\alpha(1-\phi-\beta+2\phi\beta)}$$

The right-hand side of this inequality is decreasing in α. Setting $\alpha = 0$ and rearranging the condition can be expressed as $f(\beta, \phi) > 0 \ \forall \ \beta \in [0,1] \ , \ \forall \ \phi \in (0,1)$ with

$$f(\beta, \phi) = \beta \left[log \left(\frac{1-\phi}{\phi} \right) - 1 + 2\phi \right] - log(1-\phi) - \phi$$

Note that for $\phi > 1/2$, $\partial f(\beta, \phi)/\partial \beta < 0$ thus $f(1, \phi) = -log(\phi) - 1 + \phi > 0$ is sufficient for $f(\beta, \phi) > 0$. For $\phi < 1/2$, $\partial f(\beta, \phi)/\partial \beta > 0$ thus $f(0, \phi) = -log(1-\phi) - \phi > 0$ is sufficient for $f(\beta, \phi) > 0$. And $f(\beta, 1/2) > 0 \ \forall \ \beta > 0$. Hence $\frac{\partial \Phi(1,\alpha,\beta,\phi)}{\partial \alpha} > 0$ and $\Phi(1, \alpha, \beta, \phi) > 1 \ \forall \ \alpha \in (0,1), \ \forall \ \beta \in [0,1] \ , \ \forall \ \phi \in (0,1)$.

2. is proven by partial differentiation of Φ w.r.t λ

$$\frac{\partial \Phi(\lambda, .)}{\partial \lambda} = \frac{\lambda^{\frac{1-(1-\beta)\alpha}{1-\alpha}} (1-(1-\beta)\alpha) \left[\phi(1-\beta\alpha)\lambda^{-1} + (1-\phi)\beta\alpha \right]}{[\phi(1-\beta\alpha) + \lambda(1-\phi)(1-(1-\beta)\alpha)]^2 \left(\phi^\beta (1-\phi)^{1-\beta} \right)^{2\frac{\alpha}{1-\alpha}}} > 0$$

given that $\Phi(0, .) < 1$, $\Phi(1, .) > 1$ and $\frac{\partial \Phi(\lambda,.)}{\partial \lambda} > 0$ then by continuity it follows that, as stated in Proposition 1, there is a unique $\lambda^*(\beta, \alpha, \phi) \ \epsilon \ (0,1)$ such that $\Phi(\lambda^*, .) = 1$, with $\Phi(\lambda, .) < 1$ for $\lambda < \lambda^*$ and $\Phi(\lambda, .) > 1$ for $\lambda > \lambda^*$. QED.

Proof of Proposition 2 By the implicit function theorem

$$\frac{\partial \lambda^*(\beta,.)}{\partial \beta} = -\frac{\frac{\partial \Phi}{\partial \beta}}{\frac{\partial \Phi}{\partial \lambda}}$$

In the proof of Proposition 1 we show that $\frac{\partial \Phi}{\partial \lambda} > 0$ for all $\lambda \in (0,1)$. We now derive the conditions for $-\frac{\partial \Phi}{\partial \beta} > 0$. Partial differentiation of Φ gives

$$-\frac{\partial \Phi(\beta,.)}{\partial \beta} = \Omega \left[-\frac{(1-\alpha)(\phi - \lambda(1-\phi))}{[\phi(1-\beta\alpha) + \lambda(1-\phi)[1-\alpha(1-\beta)]]} - log\left(\frac{\lambda(1-\phi)}{\phi}\right)\right]$$

with $\Omega = \frac{\alpha\lambda \frac{1-(1-\beta)\alpha}{1-\alpha}\left(\phi^{\beta}(1-\phi)^{1-\beta}\right)^{\frac{-\alpha}{1-\alpha}}}{\phi(1-\beta\alpha)+\lambda(1-\phi)[1-\alpha(1-\beta)]} > 0 \; \forall \; \lambda \in (0,1)$. The term in brackets determines the sign of $-\frac{\partial \Phi}{\partial \beta}$. Define

$$Z(\lambda,\beta,\alpha,\phi) = -\frac{(1-\alpha)(\phi - \lambda(1-\phi))}{[\phi(1-\beta\alpha) + \lambda(1-\phi)[1-\alpha(1-\beta)]]} - log\left(\frac{\lambda(1-\phi)}{\phi}\right)$$

$Z(\lambda,.)$ is a continuous and differentiable function of λ, $\forall \; \lambda \in (0,+\infty)$, and satisfies the following properties:

1. $lim_{\lambda \to 0} Z(\lambda,\beta,\alpha,\phi) = +\infty$
2. $\frac{\partial Z(\lambda,\beta,\alpha,\phi)}{\partial \lambda} < 0$ for $\lambda \in (0,+\infty)$
3. $Z(\lambda,\beta,\alpha,\phi) \mid_{\lambda = \frac{\phi}{1-\phi}} = 0$

To prove 2., it can be shown that $\frac{\partial Z(\lambda,.)}{\partial \lambda} < 0$ if the following condition is satisfied

$$\frac{(1-\alpha)[(2-\alpha)](1-\phi)\phi\lambda}{[\phi(1-\beta\alpha) + \lambda(1-\phi)[1-\alpha(1-\beta)]]^2} - 1 < 0 \tag{21}$$

The left-hand side of the inequality is a concave function of λ with maximum at $\lambda = \frac{\phi(1-\beta\alpha)}{(1-\phi)[1-\alpha(1-\beta)]}$. Replacing in (21) gives $\frac{(1-\alpha)(2-\alpha)}{4(1-\beta\alpha)[1-\alpha(1-\beta)]} - 1$ which is negative $\forall \; \alpha \in (0,1)$, $\forall \; \beta \in [0,1]$.

Given 1. and 2. then $\lambda = \frac{\phi}{1-\phi}$ is the unique root of Z in the interval $(0,+\infty)$. Therefore $Z(\lambda,\beta,\alpha,\phi) > 0$ for $\lambda \in \left(0, \frac{\phi}{1-\phi}\right)$, $\alpha \in (0,1)$, $\beta \in [0,1]$, $\phi \in (0,1)$. Hence $\frac{\partial}{\partial \beta}\lambda^*(\beta,\lambda,\alpha,\phi) > 0$ for $\lambda \in \left(0, \frac{\phi}{1-\phi}\right)$, $\alpha \in (0,1)$, $\beta \in [0,1]$, $\phi \in (0,1)$.

Note that $\phi \geq 1/2$ implies $\lambda^* \geq 1$. Hence, as Corollary 1 states, $\phi \geq 1/2$ is a sufficient condition for $-\frac{\partial \Phi(\beta,.)}{\partial \beta} > 0$ for $\lambda \in (0,1)$ $\beta \in [0,1]$, $\phi \in (0,1)$ $\alpha \in (0,1)$. QED.

Proof of Proposition 3. Label $\Gamma(\lambda,\alpha,\beta,\phi) = \frac{\Pi^v}{\Pi^o}$ the ratio of equilibrium profits in the individual bargaining case. Note that $\Gamma(1,\alpha,\beta,\phi) = \Phi(1,\alpha,\beta,\phi)$, i.e. the expression for the ratio of profits is identical to the case of collective bargaining when the firm has all the bargaining power. In the proof of Proposition 1 it is shown that $\Phi(1,\alpha,\beta,\phi) > 1$, thus $\Gamma(1,\alpha,\beta,\phi) > 1$. Similarly, $\Gamma(0,\alpha,\beta,\phi) = 0 < 1$. We therefore need to show that $\frac{\partial \Gamma(\lambda,.)}{\partial \lambda} > 0 \; \forall \; \lambda \in (0,1)$ $\beta \in [0,1]$, $\alpha \in (0,1)$, $\phi \in (0,1)$.

Partially differentiating Γ w.r.t λ

$$\frac{\partial \Gamma(\lambda,.)}{\partial \lambda} = \frac{\frac{\widetilde{\lambda}^{\frac{1-(1-\beta)\alpha}{1-\alpha}}(1-(1-\beta)\alpha)((1-\beta)\alpha)}{[(1-\beta)\alpha+\lambda[1-(1-\beta)\alpha]]^2}\left[\phi(1-\beta\alpha)\widetilde{\lambda}^{-1}+(1-\phi)\beta\alpha\right]}{\left[\phi(1-\beta\alpha)+\lambda(1-\phi)(1-(1-\beta)\alpha)\right]^2\left(\phi^{\beta}(1-\phi)^{1-\beta}\right)^{2\frac{\alpha}{1-\alpha}}} > 0$$

QED.

Inverse timing

The ratio defining organizational choices is:

$$\frac{\Pi^V}{\Pi^O} = \frac{\lambda^{\frac{1-\alpha(1-\beta)}{1-\alpha}}(1-\alpha)}{\left[\phi(1-\alpha)+\lambda(1-\phi)(1-\alpha(1-\beta))\right]\phi^{\frac{\beta\alpha}{1-\alpha}}}$$

The proof of existence of a unique cutoff $\lambda^*(\beta,\phi,\alpha)$ is analogous to that of Proposition 1. A sufficient condition for $\frac{\partial\lambda^*}{\partial\beta}(\beta,\phi,\alpha) > 0$ in this case is $\lambda < \phi$.

Data Appendix

Labor Market Indexes

The main measures of labor market institutions are drawn from Botero et al. (2004). The *collective bargaining index* is the "collective protection subindex". It is constructed as the average of eight dummy variables that equal one: (1) if employer lockouts are illegal, (2) if workers have the right to industrial action, (3) if wildcat, political and sympathy/solidarity/secondary strikes are legal, (4) if there is no mandatory waiting period or notification requirement before strikes can occur, (5) if striking is legal even if there is a collective agreement in force, (6) if laws do not mandate conciliation procedures before a strike, (7) if third party arbitration during a labor dispute is mandated by law and (8) if it is illegal to fire or replace striking workers. The *labor union power index* used in column (5) of Table 7 is the "union power subindex". It is constructed as the average of seven binary variables that equal one: (1) if employees have the right to unionize, (2) if employees have the right to collective bargaining, (3) if employers have the legal duty to bargain with a union, (4) if collective contracts are extended to third parties by law, (5) if the law allows closed shops, (6) if workers, or unions, or both have a right to appoint members to the board of directors, and (7) if workers' councils are mandated by law.

The *firing costs index* is the "cost of firing workers subindex". It measures the cost of firing 20 percent of the firm's workers (10 percent are fired for redundancy and 10 percent without cause). The cost of firing a worker is calculated as the sum of the notice period, severance pay, and any mandatory penalties established by law or mandatory collective agreements for a worker with three years of tenure with the firm. If dismissal is illegal, the cost of firing is set equal to the annual wage. The new wage bill incorporates the normal wage of the remaining workers and the cost of firing workers. The cost of firing workers is computed as the ratio of the new wage bill to the old one. To ensure consistency across countries the index considers and "standardized" employer with the following characteristics: (i) it is a manufacturing company wholly owned by nationals; (ii) its legal domicile and its main place of business is the country's most populous city; (iii) it has 250 workers; and (iv) it abides by every law and regulation, but does not grant workers more prerogatives than are legally mandated. Whenever both a standard duration or payment and a possible extended period of time or payment is provided by law, the standard one is chosen.

In Table 5 we use as a control an index of the incidence of minimum wages for the year 1999 provided

in the World Economic Forum's *Global Competitiveness Report*. In Table 7 we use union coverage in 1980 and 1999 from Nickell (2006) for 18 OECD countries.[47] The variable was constructed using information from Ochel (2001) and the OECD's *Employment Outlook* 2004.

Country-level controls

The "rule of law" variable is taken from Kaufmann, Kraay and Mastruzzi (2003). It weights a number of variables capturing the perceptions of individuals about contract enforcement. It covers the years 1997 and 1998. The log of capital stock per worker in 1999 is taken from the Penn World Tables and as the measure of skill endowment is the percentage of the population aged over 25 with at least secondary education in 1999 drawn from Barro and Lee (2000).

Trade and FDI openness are respectively the Trade Freedom and Investment Freedom indexes produced by Heritage Foundation for 2000. Trade freedom is based on the trade-weighted average rate (main source the World Bank WDR) and on non-tariff barriers. Investment freedom measures equal treatment for foreign and domestic investors. The regulation of entry index is the number of steps required by law to start a business, taken from Djankov et al. (2002). Protection of intellectual property rights in 2000, is drawn from Ginarte and Park (1997). The measure of financial development ("private credit") is the amount of credit from banks and other financial institutions to the private sector as a share of GDP in 1999 drawn from Beck at al (2000). The top tax rate for corporations is provided by World Tax Database (University of Michigan). A caveat is that the information refers to taxes on domestic companies, and different rates might apply on foreign owned firms. We use it due to the lack of wide cross-country information on corporate taxes to foreign firms. Legal origins were obtained from La Porta et al. (1997).

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[47] Australia,Canada, Belgium, Denmark, Finland, Germany, Japan, Ireland, Italy, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States. The database also contains (other than France) Austria, for which there is no data for the selected variable.

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Table 5: Collective bargaining and intra-firm trade

Dependent variable:	Share of intra-firm imports						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Collective bargaining	-0.050***	-0.059***	-0.084***	-0.066***	-0.061***	-0.055***	-0.122***
	(0.010)	(0.011)	(0.014)	(0.019)	(0.017)	(0.010)	(0.019)
Capital endowment		0.015***	0.024***	0.032**	0.014	0.012*	0.049***
		(0.005)	(0.006)	(0.014)	(0.012)	(0.007)	(0.008)
FDI openness		0.002***	0.002***	0.001**	0.000	0.000	
		(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	
Trade openness		-0.001***	-0.001***	-0.002*	-0.000	-0.000	
		(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	
Skill endowment			-0.017***	-0.014**	-0.007	-0.007*	-0.011**
			(0.005)	(0.006)	(0.006)	(0.004)	(0.006)
Rule of law			0.020	-0.170***	-0.132***	-0.092***	-0.125***
			(0.026)	(0.040)	(0.040)	(0.020)	(0.036)
IPR protection				0.000	0.000***	0.000***	
				(0.000)	(0.000)	(0.000)	
Entry costs				-0.055***	-0.048***	-0.037***	
				(0.007)	(0.007)	(0.004)	
Private credit				0.013*	0.007	0.002	-0.017**
				(0.007)	(0.007)	(0.003)	(0.008)
Corporate tax rate				0.003***	0.003***	0.002***	
				(0.001)	(0.001)	(0.000)	
Minimun wage incidence					-0.006***	-0.006***	
					(0.002)	(0.001)	
Civil law dummy							-0.041***
							(0.007)
Imported product fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country random effects	No	No	No	No	No	Yes	No
Observations	112488	110592	109838	93770	93134	93134	94038
R^2	0.635	0.639	0.642	0.650	0.654		0.649

Notes: The regressions are OLS estimations of (17). The dependent variable is the share of intra-firm imports of HS4-product p from exporting country c by firm i. Fixed effects by firm and imported product and a constant are included in all specifications. "Collective bargaining" measures the power and protection of workers during industrial conflicts. Both are obtained from Botero et al. (2004)-details are provided in the data appendix. "Capital endowment" is the log of the stock capital per worker from the Penn World Tables. "FDI openness" and "Trade openness" are from the Heritage Foundation. "Rule of law" is an index weighting variables capturing the perceptions of individuals about the enforcement of contracts from Kaufmann, Kraay and Mastruzzi (2003) in 1997 and 1998. "Skill endowment" is the percentage of the population over age 25 with at least secondary education from Barro and Lee (2000). "Entry costs" is the natural logarithm of the number of steps required by law to start a business from Djankov et al. (2002). "Private credit" is the ratio of credit to the private sector to GDP from Beck et al. (2000). "Corporate tax" is the top tax rate to corporations from World Tax database (U. of Michigan). "Minimum wage incidence" measures the perceptions the incidence of minimum wages in labor costs from the Fraiser Foundation. "Civil law dummy" equals one is the country's legal origin is French, German, socialist or scandinavian. All variables are for 1999 except indicated. Columns (1) to (3) report estimates for 64 countries, and columns (4) to (7) for 54 countries. In column (6) we use a two-way error component model with product and firm fixed effects and random country effects. First, product and firm means are removed, then we GLS with country random effects is run on the transformed data. Heteroskedasticity-robust standard errors clustered by country-product pairs are reported in parentheses. ***,**, and * indicate significance at the 1, 5 and 10 percent levels respectively.

Table 6: Identifying vertical production chains

Dependent variable:	Share of intra-firm imports	
	(1)	(2)
	All firms	French MNEs
Collective Bargaining	-0.051**	-0.064***
	(0.021)	(0.022)
Rule of law	-0.256***	-0.242***
	(0.047)	(0.062)
Capital endowment	0.035**	0.022
	(0.016)	(0.017)
Skill endowment	-0.017**	-0.034***
	(0.008)	(0.010)
FDI openness	0.001**	0.003***
	(0.001)	(0.001)
Trade openness	-0.003***	-0.001
	(0.001)	(0.001)
IPR protection	0.000*	0.000
	(0.000)	(0.000)
Entry costs	-0.071***	-0.028***
	(0.008)	(0.010)
Private credit	0.030***	-0.015
	(0.008)	(0.010)
Corporate tax rate	0.002*	-0.002
	(0.001)	(0.002)
Imported product fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
Observations	57942	22471
R^2	0.607	0.608

Notes: The regressions are OLS estimations of (17) on the "intermediate goods subsample" as described in the text, where importers not reporting manufacturing as main activity and imports in the same category as the main product of the importing unit are dropped (50 countries are included). Column (2) further restricts the sample to importing firms with headquarters in France "French MNEs"(48 countries). The dependent variable is the share of intra-firm imports of HS4-product p from exporting country c by firm i. Fixed effects by firm and imported product and a constant are included in all specifications. "Collective Bargaining" measures the power and protection of workers during industrial conflicts, obtained from Botero et al. (2004)- details are provided in the data appendix. Definitions of other country variables are provided in the notes to Table 5 and in the data appendix. Heteroskedasticity-robust standard errors clustered by country-product pairs are reported in parentheses. ***,**, and * indicate significance at the 1, 5 and 10 percent levels respectively.

Table 7: Robustness checks

Dependent variable:	Share of intra-firm imports					
	(1)	(2)	(3)	(4)	(5)	(6)
	OECD subsample	Switchers subsample	Alternative measures for CB			
					IV	
Collective bargaining	-0.094***	-0.103***				
	(0.016)	(0.021)				
Labor union power			-0.050***			
			(0.009)			
Union coverage 1999				-0.074***		
				(0.011)		
Union coverage 1999 (IV)					-0.121***	
					(0.012)	
ILO convention C98						-0.060***
						(0.007)
Controls: Rule of law, capital endowment, skill endowment, FDI openness, trade openness.						
Instrument					Union coverage 1980	
Imported product fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	101548	68740	109838	97016	97016	108359
R^2	0.656	0.545	0.642	0.665	0.665	0.644

Notes: The regressions are OLS estimations of (17), excepting for column (5). The dependent variable is the share of intra-firm imports of HS4-product p from exporting country c by firm i. Fixed effects by firm and imported product and a constant are included in all specifications. "Collective Bargaining" measures the power and protection of workers during industrial conflicts (Botero et al., 2004- details are provided in the data appendix). Column (2) reports the regresion for the sub-sample of firms that report imports using both sourcing modes. "Labor union power" measures the statutory protection and power of unions(Botero et al., 2004- details are provided in the data appendix)."Union coverage" is the number of workers covered by collective agreements in 1999 and 1980 normalized on employment from Nickell (2006). "ILO convention" is a dummy equal to one if the country has ratified the ILO convention on the freedom of association and collective bargaining (C98). All regressions include as controls: rule of law, capital endowment, skill endowment, FDI openness and trade openness. Definitions are provided in the notes to Table 5 and in the data appendix. Column (1) includes 25 OECD members, column (2) 57 countries, columns (3) 64 countries, columns (4) and (5) 18 OECD members, and column (6) 85 countries. Heteroskedasticity-robust standard errors clustered by country-product pairs are reported in parentheses. In column (2) we restrict the estimating sample to firms that report positive imports under both sourcing modes across countries and products. In column (4) union coverage in 1999 is instrumented with the same variable in 1980. *** indicates significance at the 1 percent level.

Table 8: Firing costs and intra-firm trade

Dependent variable:	Share of intra-firm imports				
	(1)	(2)	(3)	(4)	(5)
	Full sample	Full sample	OECD sample	Intermediate good sample	Intermediate and French MNEs
Firing costs	-0.077***	-0.041**	-0.043*	-0.076***	-0.060**
	(0.012)	(0.020)	(0.024)	(0.023)	(0.029)
Rule of law	0.133***	-0.073	-0.231***	-0.115**	-0.116*
	(0.019)	(0.045)	(0.066)	(0.050)	(0.063)
Capital endowment	-0.009	0.014	0.023	0.016	0.001
	(0.006)	(0.013)	(0.018)	(0.015)	(0.015)
Skill endowment	-0.012***	-0.010	-0.016*	-0.016**	-0.031***
	(0.004)	(0.006)	(0.010)	(0.007)	(0.010)
FDI openness	0.002***	0.001**	0.002**	0.002***	0.003***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Trade openness	-0.001***	-0.001*	0.003*	-0.003***	-0.001
	(0.000)	(0.001)	(0.002)	(0.001)	(0.001)
IPR protection		0.000	-0.000***	0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)
Entry costs		-0.058***	-0.080***	-0.065***	-0.025***
		(0.008)	(0.011)	(0.009)	(0.009)
Private credit		0.002	0.011	0.008	-0.030**
		(0.009)	(0.011)	(0.010)	(0.013)
Corporate tax rate		0.002***	0.001	0.001	-0.002
		(0.001)	(0.001)	(0.001)	(0.002)
Imported product fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	109838	93770	88839	57943	22472
R^2	0.642	0.650	0.661	0.607	0.608

Notes: The regressions are OLS estimations of (17). The dependent variable is the share of intra-firm imports of HS4-product p from exporting country c by firm i. Fixed effects by firm and imported product and a constant are included in all specifications. "Firing costs" measures the costs of firing 20% of the workforce for a standardized firm. "Capital endowment" is the log of the stock capital per worker from the Penn World Tables. "FDI openness" and "Trade openness" are from the Heritage Foundation. "Rule of law" is an index weighting variables capturing the perceptions of individuals about the enforcement of contracts from Kaufmann, Kraay and Mastruzzi (2003) in 1997 and 1998. "Skill endowment" is the percentage of the population over age 25 with at least secondary education from Barro and Lee (2000). "Entry costs" is the natural logarithm of the number of steps required by law to start a business from Djankov et al. (2002). "Private credit" is the ratio of credit to the private sector to GDP from Beck et al. (2000). "Corporate tax" is the top tax rate to corporations from World Tax database (U. of Michigan). All variables are for 1999 except indicated. The number of countries included is: column (1) 64, column (2) 54, column (3) 25 OECD members, column (4) 50 and column (5) 48. See Table 6 for the definition of the int. goods sample. ***,**, and * indicate significance at the 1, 5 and 10 percent levels respectively.

Table 9: Collective bargaining, capital intensity and intra-firm trade

Dependent variable:	Share of intra-firm imports			
	(1)	(2)	(3)	(4)
CB × k intensity(s)	-0.108**	-0.212***	-0.229***	-0.224***
	(0.043)	(0.056)	(0.056)	(0.067)
Kc × k intensity(s)	0.048***	0.014	0.025	0.081***
	(0.012)	(0.013)	(0.023)	(0.027)
Hc × skill intensity(s)		0.010***	0.010***	0.012***
		(0.004)	(0.004)	(0.004)
CB × median size(s)		-0.015	-0.014	-0.013
		(0.014)	(0.014)	(0.014)
CB × RnD intensity(s)		1.374***	1.427***	1.442***
		(0.387)	(0.387)	(0.388)
CB × skill intensity(s)		0.050***	0.045***	0.045***
		(0.015)	(0.015)	(0.015)
CB × Rauch(s)		0.020	0.017	0.016
		(0.028)	(0.028)	(0.030)
FDI × k intensity(s)			-0.009***	-0.011***
			(0.002)	(0.002)
Trade × k intensity(s)			0.005***	0.005***
			(0.002)	(0.002)
Rule of law × Rauch (s)				-0.002
				(0.041)
Rule of law × k intensity(s)				-0.450***
				(0.119)
Entry × k intensity(s)				-0.085***
				(0.026)
Imported product fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Observations	80240	77806	77630	77627
R^2	0.573	0.575	0.575	0.575

Notes: The regressions are OLS estimates of (18). The dependent variable is the share of intra-firm imports of HS4-product p from exporting country c by firm i. Fixed effects by firm, imported product and country and a constant are included in all specifications. "CB" stands for the collective bargaining index that measures the power and protection of workers during industrial conflicts. This variable is obtained from Botero et al. (2004)- details are provided in the data appendix. "k int(s)" is capital intensity at the 4-digit CPA level calculated as the median of the natural logarithm of the ratio of the capital stock to total employment for all firms in the corresponding industry with available information. "skill int(s)" is the 4-digit CPA industry median of the log of the ratio of wages to total employment at the firm level. "size" is the 4-digit CPA industry median of the log employment at the firm level. "Rauch index" is Rauch's (1999) classification of commodities aggregated at the 4-digit CPA level (for the year 1990). Definitions of other country variables are provided in the notes to Table 5 and in the data appendix. All variables are for 1999 except indicated. Heteroskedasticity-robust standard errors are reported in parentheses. The number of countries included is: column (1) 62, column (2) 56, column (3) 55 and column (4) 54.***,**, and * indicate significance at the 1, 5 and 10 percent levels respectively.

Table 10: Collective bargaining, capital intensity and intra-firm trade

Dependent variable:	Share of intra-firm imports			
	(1)	(2)	(3)	(4)
CB	-0.066***			-0.084***
	(0.011)			(0.014)
CB × high k intensity(s)		-0.112***	-0.131***	
		(0.017)	(0.023)	
CB × low k intensity(s)		-0.027*	-0.059***	
		(0.016)	(0.019)	
Rule of law			0.000	0.020
			(0.032)	(0.026)
Capital endowment			0.015**	0.024***
			(0.007)	(0.006)
Skill endowment			-0.014**	-0.017***
			(0.005)	(0.005)
FDI openness			0.002***	0.002***
			(0.000)	(0.000)
Trade openness			-0.001***	-0.001***
			(0.000)	(0.000)
Imported product fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Observations	81365	81365	79481	109836
R^2	0.560	0.560	0.566	0.642

Notes: The regressions are OLS estimations of of (19). "CB" stands for the collective bargaining index that measures the power and protection of workers during industrial conflicts. This variable is obtained from Botero et al. (2004)- details are provided in the data appendix. "high k int(s)" is a dummy equal to one if the firm operates in a 4-digit CPA industry with capital intensity above the median of all manufacturing industries (except for 15 NACE Rev1). "low k int(s)" is a dummy equal to one if the firm operates in a 4-digit CPA industry with capital intensity below the median. Capital intensity of an industry is calculated as the median of the natural logarithm of the ratio of the capital stock to total employment for all firms with available information. Definitions of other country variables are provided in the notes to Table 5 and in the data appendix. Heteroskedasticity-robust standard errors clustered by country-product pairs are reported in parentheses. The number of countries included is: columns (1)-(2) 75, column (3) 54 and column (4) 58. ***,**, and * indicate significance at the 1, 5 and 10 percent levels respectively.

Appendix tables

Table 11: Correlation between labor market indexes

	Collective bargaining	Labor Union power	Firing costs	ILO C98	Union Cov. 1980	Union Cov. 1999
Collective bargaining	1					
Labor union power	0.031	1				
Firing costs	0.218	0.140	1			
ILO convention C98	0.057	0.158	0.022	1		
Union coverage 1980	-0.003	0.215	0.578	0.650	1	
Union coverage 1999	-0.010	0.507	0.646	0.542	0.873	1

Notes: Correlations between collective bargaining, union power, firing costs and the ILO C98 dummy are for 78 countries and correlations between these indexes and union coverage in 1980 and 1999 are for 18 OECD countries (see data appendix for a list).

Table 12: Correlation between industry-level variables

	Capital intensity	Skill intensity	Size (median)
Capital intensity	1		
Skill intensity	0.442	1	
Size (median)	0.410	0.462	1

Table 13: Correlation between labor market indexes and controls at the country level

	Collective bargaining	Labor union power	Firing costs	Capital endow.	Trade open.	FDI open.	Rule of law	Skill endow.	IPR prot.	Entry costs	Private Credit	Corp. tax
Collective bargaining	1											
Labor union power	0.070	1										
Firing costs	0.254	0.164	1									
Capital endowment	0.006	0.035	-0.187	1								
Trade openness	0.127	0.045	-0.162	0.693	1							
FDI openness	-0.067	-0.015	-0.102	0.510	0.496	1						
Rule of law	-0.101	-0.070	-0.216	0.805	0.561	0.398	1					
Skill endowment	-0.116	0.218	-0.047	0.634	0.481	0.354	0.619	1				
IPR protection	-0.019	0.175	-0.193	0.811	0.597	0.472	0.729	0.532	1			
Entry costs	0.360	0.292	0.347	-0.505	-0.265	-0.274	-0.658	-0.443	-0.380	1		
Private credit	0.029	-0.165	-0.217	0.631	0.500	0.310	0.676	0.462	0.497	-0.335	1	
Corporate tax rate	-0.074	-0.071	-0.110	-0.183	-0.248	-0.218	-0.154	-0.202	-0.255	-0.007	-0.209	1

Notes: See the data appendix for variable definitions.

Table 14: Capital intensive industries (APE, 4-digit)

High			Low		
APE		median (log) k/l	APE		median (log) k/l
221C	Newspapers printing	5.40	182G	Underwear	4.67
232Z	Petroleum refining	5.44	182J	Other clothing products	4.68
265A	Cement manufacturing	5.45	171F	Woll dyeing	4.70
241A	Industrial gas manufacturing	5.46	174A	Curtains and draperies	4.73
221E	Periodical printing	5.46	192Z	Luggage and leather products	4.73
median capital intensity across industries: 5.08					

Notes: Source EAE. Industry capital intensity is calculated as the mean of the firm-level ratio of the capital stock to total employment (in logarithm).

Table 15: Alternative specifications of equation (17)

Dependent variable:	Share of intra-firm imports		Dummy=1 for intra-firm	
	Tobit	**Fractional logit**	**Linear probability**	**Conditional logit**
Collective bargaining	-1.076***	-0.212***	-0.060***	-0.141**
	(0.068)	(0.014)	(0.006)	(0.065)
Capital endowment	0.090***	0.287***	0.018***	0.022***
	(0.028)	(0.126)	(0.003)	(0.008)
FDI openness	-0.009***	-0.211***	0.001***	0.003
	(0.002)	(0.056)	(0.000)	(0.002)
Trade openness	0.015***	0.443	-0.001***	-0.002**
	(0.002)	(0.073)	(0.000)	(0.001)
Product fixed effects	No	No	Yes	Yes
Importer sector fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Observations	109487	109487	95469	48045
R-squared & Log-Likelihood			0.676	

Notes: Estimates of (17). In columns (1) and (2) the dependent variable is the share of intra-firm imports of product p from exporting country c by firm i. In columns (3) and (4) the dependent variable is a dummy that equals one when the share of intra-firm trade is 100% (observations with share of intra-firm imports strictly between zero and 100 are dropped). Columns (2) and (4) report marginal effects. Heteroskedasticity-robust standard errors are reported in parentheses. The number of countries included is: columns (1)-(3) 63 and column (4) 33. ***,**, and * indicate significance at the 1, 5 and 10 percent levels respectively.

Table 16: Heckman selection model

Dependent variable:	Share of intra-firm imports		Dummy=1 for entry	
	(1)	(2)	(3)	(4)
	Outcome	Selection	Outcome	Selection
Collective bargaining	-0.029**	-0.080**	-0.041***	-0.111***
	(0.014)	(0.038)	(0.015)	(0.040)
Capital endowment	0.003	0.532***	0.005	0.054**
	(0.008)	(0.017)	(0.008)	(0.024)
FDI openness	-0.000	-0.011***	0.000	-0.007***
	(0.000)	(0.001)	(0.000)	(0.001)
Trade openness	0.000	-0.013***	0.000	-0.014***
	(0.000)	(0.001)	(0.000)	(0.001)
Skill endowment	-0.007	-0.252***	-0.003	-0.267***
	(0.005)	(0.009)	(0.005)	(0.010)
Rule of law	-0.087***	-1.234***	-0.124***	-1.148***
	(0.033)	(0.087)	(0.034)	(0.085)
IPR protection	0.000**	0.003***	0.000*	0.004***
	(0.000)	(0.000)	(0.000)	(0.000)
Entry costs	-0.027***	-0.046***	-0.027***	0.250***
	(0.006)	(0.014)	(0.006)	(0.015)
Private credit	-0.017***	0.670***	-0.012**	0.354***
	(0.005)	(0.015)	(0.005)	(0.015)
Corporate tax	0.000	0.015***	0.000	0.004***
	(0.000)	(0.001)	(0.000)	(0.001)
Instruments				
Distance		-0.592***		-0.486***
		(0.007)		(0.006)
Common language		-1.006***		
		(0.020)		
GDP per capita				0.779***
				(0.040)
Observations	225558	225558	221381	221381
Mills ratio		-0.013***		-0.019***
		(0.005)		(0.006)

Notes: We use the Heckman selection model. In the outcome equation the dependent variable is the weighted share of intra-firm imports from exporting country c by firm i. Notice that transactions for each firm are aggregated across imported products. In the selection equation the dependent variable is a dummy equal to one when the firm reports positive imports from country c and zero otherwise. Distance and common language are used as instruments in column (2) and GDP per capita and distance in column (4). Heteroskedasticity-robust standard errors are reported in parentheses. The number of countries included is 54 in columns (1) and (2) and 53 in columns (3) and (4). ***,**, and * indicate significance at the 1, 5 and 10 percent levels respectively.

Table 17: A Falsification exercise using the share of intra-firm exports

Dependent variable:	Share of intra-firm exports		
	(1)	(2)	(3)
Collective bargaining	0.006	0.006	
	(0.013)	(0.017)	
Firing costs			0.033**
			(0.013)
Rule of law	-0.088***	-0.110***	-0.116***
	(0.030)	(0.036)	(0.030)
Skill endowment	-0.030***	-0.036***	-0.030***
	(0.004)	(0.005)	(0.004)
IPR protection	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)
Entry costs	-0.004	-0.008	-0.007
	(0.006)	(0.007)	(0.005)
Private credit	0.020***	0.028***	0.027***
	(0.006)	(0.008)	(0.007)
Corporate tax rate	0.001***	0.003***	0.001***
	(0.000)	(0.001)	(0.000)
Capital endowment	0.043***	0.041***	0.044***
	(0.006)	(0.007)	(0.005)
FDI openness	-0.003***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.000)
Trade openness	0.001	0.001*	0.001**
	(0.000)	(0.000)	(0.000)
Product fixed effects	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
Observations	115858	55809	115858
R^2	0.623	0.609	0.623

Notes: The dependent variable is the share of intra-firm exports of product p to country c by firm i. In column (2) the sample is restricted to multinationals with headquarters in France. Heteroskedasticity-robust standard errors are reported in parentheses. All columns include 54 countries. ***,**, and * indicate significance at the 1, 5 and 10 percent levels respectively.