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Deep Trade Agreements and Vertical FDI

The Devil Is in the Details

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Abstract

Recent data show that the institutional content of preferential trade agreements has evolved over time. Although pre-1990s preferential trade agreements mostly focused on tariff liberalization, recent agreements increasingly contain deep provisions in diverse areas, such as intellectual property rights, investment, and standards. At the same time, there has been a remarkable increase in the internationalization of production through foreign direct investment and outsourcing. This paper employs the Antràs and Helpman (2008) model of contractual frictions and global sourcing to study how deep trade agreements affect the international organization of production. The paper constructs new measures of the depth of preferential trade agreements and of vertical foreign direct investment to test the theory. Consistent with the model, the analysis finds evidence that the depth of trade agreements is correlated with vertical foreign direct investment, and that this is driven by the provisions that improve the contractibility of inputs provided by suppliers, such as regulatory provisions. Because this implication of the model is specific to the so-called "property rights" theory of the multinational firm, the findings provide empirical support to this approach vis-à-vis alternative theories of firm boundaries.

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Deep Trade Agreements and Vertical FDI: The Devil Is in the Details

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1. Introduction

How are trade agreements and the international organization of production related? The recent wave of Preferential Trade Agreements (PTAs) has brought this question to the forefront of trade research and the trade policy debate. The key insight of this literature is that the "depth" of trade agreements is associated with the international fragmentation of production.[1] This paper adds to this line of work by looking at how the content of trade agreements, that is the specific provisions embedded in PTAs, relates to the way in which goods are traded internationally (i.e. within-firms or arm's length). The underlying idea is that "deep" trade agreements affect - and are affected by - firms' make-or-buy decisions, that is whether producers outsource to trading partners' suppliers or vertically integrate production processes with affiliates in foreign economies.

Trade agreements are usually thought of as reciprocal market access exchanges involving tariff cuts and the reduction of other border measures. But most modern day trade agreements contain provisions that cover a wide array of non-tariff measures, both at the border and behind-the-border. An incomplete list includes: technical barriers to trade (TBT) and sanitary and phytosanitary (SPS) measures, rules on investment and intellectual property rights (IPR) protection, provisions on anti-corruption, competition policy, labor standards, etc. While some of these areas are regulated at the World Trade Organization (WTO), recent PTAs tend to go beyond multilateral rules (see, WTO (2011) for detailed evidence). The literature refers to these new trade agreements as "deep" to distinguish them from traditional PTAs that focus only on market access commitments -sometimes referred to as "shallow".

Similarly, while most non-experts tend to think of international trade as involving the exchange of final goods produced with (mostly) local inputs, trade has radically changed in the past thirty years in response to a growing international fragmentation of production processes. This phenomenon has been widely

[1] See Lawrence (1996) and Baldwin (2011) for a discussion of the relationship between PTAs and the international fragmentation of production and Antràs and Staiger (2012) for a first formal model that combines offshoring and the design of trade agreements. A survey of the academic literature and of the policy debate is in WTO (2011).

documented in a number of studies using different methodological approaches.[2] A variety of technological factors, most notably the revolution in information and communication technology (ITC), lie beneath this transformation. But institutions, and in particular trade institutions, are also recognized as a determinant and a consequence of the evolving international trade structure. Orefice and Rocha (2014) show that signing deeper agreements increases trade in parts and components between PTA members and that, on the other hand, higher levels of trade in parts and components increase the likelihood of signing deeper agreements.

In this paper, we dig further into the relationship between deep trade agreements and the process of internationalization of production. The specific question that we address is how deep agreements relate to the way goods are traded internationally (i.e. inside or outside the boundaries of the firm). When firms choose their global sourcing strategy, a key decision is the extent of control they want to exert over their foreign production processes. Certain firms in certain sectors choose to own foreign assets through vertical Foreign Direct Investment (FDI) as a means to enhance such control.[3] Others offshore production, but instead rely on independent foreign suppliers, a sourcing strategy commonly known as foreign outsourcing. Importantly, these control decisions are associated to different modes of international trade: FDI gives rise to within-firm trade, while foreign outsourcing results in arm's length trade.

As is well understood from the trade and industrial organization literature, the incomplete nature of international contracts affects firms' vertical integration decisions (i.e. FDI versus foreign outsourcing).[4] In the so called "property rights" approach adopted in Antràs (2003) and in much of the international trade literature, ownership is a means to reduce the hold-up problem created by contractual incompleteness. Underlying this notion, there is the idea that contractual frictions are pervasive in international transactions because of differences in legal systems, poor institutional quality in certain countries involved in one end

[2] Different measures are provided by Feenstra and Hanson (1996), Hummels, Ishii, and Yi (2001), Johnson and Noguera (2012). Koopman et al. (2014) provide a unifying framework to measure the international fragmentation of production.

[3] The theoretical literature has long distinguished market seeking (i.e. horizontal) FDI and efficiency seeking (i.e. vertical) FDI (Markusen 1984, Helpman 1984). For brevity, unless otherwise specified, whenever we refer to FDI in the rest of the paper, we imply vertical FDI. As is well known, in practice this distinction is not the only relevant one and we will come back to this point in the next section.

[4] There are a number of excellent surveys that discuss different angles of this literature, including Helpman (2006), Antràs (2012), and Antràs and Yeaple (2013).

of the transaction and limited enforcement ability. Deep trade agreements reduce contractual uncertainty, because in addition to smoothing differences in contractual institutions (either by setting common rules or by allowing mutual recognition of heterogeneous practices among PTA members), they provide a commitment device for countries with weaker institutions and a mechanism to enforce rules through dispute settlement. By doing so, deep agreements interact with the make-or-buy decisions of firms and, hence, with the way goods are traded internationally.

To guide our empirical analysis of the impact of PTAs on vertical FDI, we employ the model by Antràs and Helpman (2008) (henceforth, AH). AH's framework introduces different degrees of contractual frictions across countries in a model of the international organization of production. This setting allows us to study the impact of improvements in the quality of contracting institutions, such as the ones brought about by a deep PTA, on firms' location and control decisions. The main insight of the theory is that deep provisions in PTAs may increase or decrease vertical FDI, depending on whether they improve the contractibility of inputs provided by the headquarters (headquarter services) or by the suppliers (components). Provisions that improve the contractibility of headquarter services are, for example, protection of intellectual property rights or investment provisions; provisions that improve the contractibility of components are, for example, standards and other regulatory requirements that promote harmonization or mutual recognition. As we put it in the title: when it comes to the effects of deep agreements on vertical FDI, the devil is in the details (i.e. the content) of the agreement. The reason for this finding is entrenched in the logic of the property rights approach to the boundary of multinational firms. Because ownership is a means to reduce hold-up problems created by contractual incompleteness, it matters if the PTA provisions improve the relative contractibility of different inputs.

We test this theory using a new data set on the content of PTA provisions and using firm-level information to construct a sectoral measure of vertical FDI. We proxy the depth of an agreement with different indexes and we find that deeper agreements are associated with higher values of vertical FDI. However, once we look at the composition of PTAs, depth per-se is no longer positively correlated with vertical FDI, whereas the type of provisions included in an agreement matters. In fact, while provisions that improve the

contractibility of inputs provided by suppliers have a positive relationship with vertical FDI, provisions that improve the contractibility of headquarter services are almost always uncorrelated with FDI.

Our work fits in the broader research effort aiming at understanding the relationship between international trade and institutions (see, Nunn and Trefler (2013) and WTO (2013) for recent surveys). Our findings complement a number of recent works in this area. In particular, Bernard, Jensen, Redding, and Schott (2010) and Nunn and Trefler (2013) have empirically investigated how contractual frictions affect intra-firm trade. The difference between these studies and our analysis are twofold: first we employ firm-level information to measure vertical FDI, rather than focusing on intra-firm trade. This allows us to expand the analysis to countries other than the United States, for which intra-firm trade data are not always publicly available. Second, we focus on changes in contractibility determined by deep agreements rather than by domestic institutions or by other technological determinants of contractibility. Recent empirical work has also looked at the relationship between international agreements -PTAs and bilateral investment treaties (BITs)- and FDI (among others, Blanchard and Matschke , 2012; Baltagi, Egger, and Pfaffermayr , 2008; Egger and Merlo , 2012).[5] Overall, these studies show that trade and investment agreements affect and are affected by FDI/offshoring. Aside from the use of a new measure for vertical FDI, our work adds to these findings by focusing on the depth/content of trade agreements, which allows disentangling an important channel through which trade institutions affect the ways goods are traded internationally.

The rest of the paper is organized as follows. Section 2 presents the theory of how PTA provisions are related to the international organization of production. Section 3 describes the methodology used to assess the depth and composition of trade agreements and to measure vertical FDI. The empirical analysis and the key findings of the paper are presented in Section 4. Concluding remarks follow.

[5] Blanchard (2007) and Blanchard (2010) present formal models of FDI and trade agreements. Differently from our work, these models study the implications of international investment for trade/tariff negotiations.

2. Theory: Deep PTAs and the international organization of production

In this section, we briefly present the theory that we use to guide our empirical analysis. Since the model is a simplified version of the well-known model by AH, we only review its most important features and stress the key difference introduced in this paper and the relevant testable implications.

Antràs and Helpman (2004) present a framework to analyze the determinants of firms' global sourcing strategies and describe an equilibrium where firms with different productivity levels choose different ownership structures (outsourcing or vertical integration) and different supplier location (domestic or foreign). AH build on this framework to explicitly model contracting institutions and to allow for partial contractibility of the inputs needed in the production process. The essential idea is that certain characteristics of inputs (or activities needed to supply these inputs) can be written in ex ante contracts and verified by a court of law, while others are not contractible. They show that the contractibility of inputs (i.e. the share of contractible input characteristics/activities) plays an important role in the ownership and location decisions of firms. As domestic institutions such as a country's quality of the legal system are a determinant of inputs contractibility, AH find that the global sourcing strategies of firms depend on the domestic institutions of the countries where they operate. We extend the model of AH and allow for the contractibility of inputs to be a function of domestic institutions and the rules embedded in deep trade agreements. This simple extension permits to precisely identify the channels through which different provisions in trade agreements affect the international organization of production.

Following Antràs and Helpman (2004) and Antràs and Helpman (2008) , we assume that there are two countries: the North, which is a high-cost country and has good contracting institutions, and the South, which is low-cost but has weaker contracting intuitions relative to the North. Final good producers are located in the North. We focus on a firm that produces a brand of a differentiated product and for notational simplicity we drop the indexes. Demand is generated by CES preferences. Production is Cobb-Douglas using two inputs headquarter services (intangible inputs produced in-house by the final good producer) and components, which can be sourced in the North or in the South. Specifically, final good production is given by:

$$q(\theta) = \theta \left(\frac{h}{\eta}\right)^{\eta} \left(\frac{m}{1-\eta}\right)^{1-\eta},$$

where θ captures the firm's productivity; $\eta \in (0,1)$ is a measure of the headquarter intensity of technology; and m and h are components and headquarter services respectively. The inputs in the latter variable include, for instance, patents or trademarks derived from research and development activities in the North or skill and investment intensive branding and financial activities. Both inputs are brand specific, in the sense that they are customized to fit the needs of this brand and cannot be usefully employed for other brands.

Each input is produced with a continuum of activities in the interval $[0,1]$ according to the following technology:

$$\omega = \exp\left[\int_0^1 log\omega(i)di\right],$$

where $\omega = h, m.$

Following AH, we assume that only activities in the interval $[0, \mu_\omega]$ are contractible, where $0 \leq \mu_\omega \leq 1$. As discussed above, by this we mean that only a fraction of the characteristics of these activities can be specified in enforceable ex ante contracts, while the remaining fraction is non-contractible. As usual in the literature, this assumption can also be interpreted as all activities/characteristics being only partially contractible.[6] For simplicity, we assume full contractibility in the North and focus on incomplete contracting in the South only.[7]

Differences in contractibility across production processes and across countries reflect technological and institutional variation. In particular, we assume that the institutional environment is not only determined by the characteristics of domestic institutions (as in AH), but also by a number of disciplines that a country commits to in the context of a PTA. To clarify this point, let λ be an index of the quality of domestic institutions and define $\gamma = (\gamma_1, .., \gamma_N)$, as the set of deep provisions that can be introduced in a trade agreement. Then we can write

$$\mu_h = h(\lambda, \gamma_1, .., \gamma_T) \text{ and } \mu_m = m(\lambda, \gamma_{T+1}, .., \gamma_N),$$

[6] See Acemoglu, Antràs, and Helpman (2007).
[7] As further discussed below, this assumption allows to abstract from the control decision in domestic sourcing.

with $h'(\cdot), m'(\cdot) > 0$,

where, without loss of generality, we have ordered the first T provisions as the ones that affect the contractibility of headquarter services, such as protection of intellectual property rights or investment provisions. The remaining provisions include those PTA rules that affect the contractibility of components, such as standards and other regulatory requirements that promote harmonization or mutual recognition. [8]

A final good producer decides whether to source components (m) in the North or in the South and whether to vertically integrate or not. Sourcing components from the South gives raise to within-firm trade under vertical integration or arm's length trade in the case of foreign outsourcing. As we have assumed that there are no contractual imperfections in the North, the choice between vertical integration and outsourcing in the domestic market is immaterial and we, therefore, abstract from it in what follows. Different organizational choices are associated to different fixed costs. Following the literature, these costs are assumed to satisfy: $f_V > f_O > f_D$, where f_V is the fixed cost of FDI, f_O is the fixed cost of foreign outsourcing and f_D is the fixed cost of domestic sourcing.

In what follows, we provide an informal discussion of the location/control decision of the final good producer and of the organizational forms that emerge in an industry equilibrium (the full characterization of the equilibrium is in AH).

When a final good producer in the North chooses to source components abroad, it is exposed to weaker contractual institutions in the South. The resulting uncertainty leads to under-investment in the supply of those h and m activities that are non-contractible (a *two-sided hold-up problem*).[9] For these activities, the price of the exchange between the final good producer in the North and the supplier of components in the South is decided ex post (i.e. after the initial investments were made) through bargaining. This bargaining

[8] The marginal impact of domestic and PTA provisions can vary substantially and we are agnostic on the different effects. However, the point that we want to make is that certain PTA provisions will only affect the contractibility of headquarters, while others only impact on the contractibility of components. Naturally, there will be provisions in a trade agreement, such as anti-corruption rules, that (if effective) may well be equivalent to an improvement in the domestic legal system (λ).

[9] Note that foreign sourcing reduces the contractibility of headquarter services even though they are supplied in the North, because all parts of a contract governing an international transaction are harder to enforce.

process determines the distribution of the surplus from the international production relationship. Importantly, how the surplus is divided between the two parties depends on the organizational form of production. Specifically, when the final good producer in the North owns the input supplier (i.e. under FDI), it obtains the larger share of surplus compared to arm's length trade. Conversely, foreign outsourcing increases the share of surplus for the component supplier in the South. Because the expectation of a larger surplus creates stronger incentives to supply inputs, ownership alleviates one side of the two-sided hold-up problem. In this environment, the choice of the organizational form by the final good producer depends on the relative importance that non-contractible headquarter services and components have in the production of the final good. Intuitively, if the supplier's non-contractible activities are relatively more crucial in production, then it is efficient for the final good producer to incentivize the supplier through arm's length contracts. Vertical integration, on the other hand, is the optimal organization structure when non-contractible headquarter services are relatively more important in production.

As firms within a sector vary by productivity (θ) and because different location/control choices imply different fixed costs, the AH model can generate multiple organizational forms within an industry. Specifically, AH show that in sectors with sufficiently high headquarter intensity, final good producers obtain components through domestic sourcing, foreign outsourcing and FDI (Proposition 9(i)). There is a simple intuition for this result. Consider first the location choice. Foreign sourcing has higher fixed costs than domestic sourcing. Therefore, it is optimal for the final good producer to source components in the South only when its productivity is sufficiently high so that the efficiency gains more than compensate the fixed costs. Consider next the control decision. The choice between FDI and foreign outsourcing presents a trade-off between fixed costs and efficient production. On the one hand, vertical integration is associated to higher fixed costs. On the other hand, vertical integration increases the surplus for the final good producer and, therefore, the incentives to invest in non-contractible headquarter activities that are relatively more important in high headquarter intensive sectors. For more productive producers, it is more efficient to pay the fixed cost of vertical integration and reduce the under-investment problem in headquarter intensive activities.

Figure 1 illustrates this result in AH. The figure shows the profits of the final good producers under domestic sourcing (D), foreign outsourcing (O) and FDI (V):

$$\pi_i = Z_i \vartheta - f_i \quad \text{with} \quad i = D, O, V,$$

where ϑ is a linear function of the firm's productivity θ and Z_i is a derived parameter that depends on the firm's location/control choice as discussed above. As the figure shows, firms with low productivity source domestically, those with intermediate levels of productivity choose foreign outsourcing, and firms with even higher productivity vertically integrate in the South.

Starting from this industry equilibrium, we investigate how the location/control choice of final good producers is affected by the content of a trade agreement between the North and the South. We do this in two steps.

First, we focus on PTA provisions that improve the contractibility of components (μ_m) such as standards and other regulatory requirements that promote harmonization or mutual recognition. AH show that the share of firms doing FDI on the total number of active firms (σ_V in AH) is increasing in μ_m (Proposition 9(ii)). The reason is that with better contracting of components, final good producers in the North are less dependent on the power of incentives they can offer to the suppliers of components in the South, thus making vertical integration more attractive. Figure 2 provides a graphical intuition of this effect. The dashed lines represent profits under a PTA that improves the contractibility of components (or, equivalently, that improves disproportionally the contractibility of components relative to headquarter services). Profitability of domestic sourcing (Z_D) is not affected by the trade agreement, profitability under vertical integration (Z_V) increases more than profitability under foreign outsourcing (Z_O), leading to an increase in FDI. Note that while the total share of firms engaging in vertical integration increases, an improvement in the contractibility of components may have an ambiguous impact on the share of global sourcing through FDI versus outsourcing (i.e. on the fraction of imports that are intra-firm). Intuitively, the latter is confounded

by the positive impact that improved institutions in the South via a PTA has on the total number of firms in the North offshoring to the South (the sum of FDI and foreign outsourcing).[10]

Next, we consider the impact on FDI/outsourcing of the provisions in a PTA that improve the contractibility of headquarter services (μ_h) such as protection of intellectual property rights or investment provisions. AH show that the share of firms that engage in FDI over the total number of active firms is decreasing in μ_h (Proposition 9(ii)). With better contracting of headquarter activities, under-investment in these services becomes relatively less important, so that a larger share of final good producers value more the incentives that they can provide to component suppliers in the South through outsourcing. The graphical intuition for this case is provided in Figure 3. As before, the dashed lines represent profits under a trade agreement, which in this case only contains provisions that affect (or affect disproportionally) the contractibility of headquarter services. The profitability of firms under vertical integration (Z_V) increases less than the profitability under foreign outsourcing (Z_O), leading to a decrease in FDI. As the profitability of firms engaging in domestic sourcing is not affected by the PTA, the figure shows that better contracting institutions for headquarter services in the South increase the number of firms in the North that offshore. This implies that the share of global sourcing through FDI versus outsourcing is unambiguously lower.

Summing up, the AH model has two clear predictions on the relationship between deep trade agreements and firms' global sourcing strategies:

i. PTA provisions improving the contractibility of components (μ_m) are associated with an increase in profitability under vertical integration relative to outsourcing, leading to an increase in the share of firms engaging in FDI;

ii. PTA provisions improving the contractibility of headquarter services (μ_h) are associated with an increase in profitability under outsourcing relative to vertical integration, leading to a decrease in the share of firms engaging in FDI.

[10] This ambiguity has limited the ability of empirical studies to test the predictions of the AH model using trade data (see, Nunn and Trefler, 2012).

In simple words, more than the depth of the agreement, it is its content that determines the choice between vertical integration or foreign outsourcing and that therefore will impact on the structure of trade (intra-firm versus arm's length). As others in the literature have recognized (e.g. Baldwin, 2011, WTO, 2011, Orefice and Rocha, 2013), the depth of a trade agreement is associated to more offshoring. But its relationship with FDI can, in general, be either positive or negative.

Before we move on to the empirical analysis, there are two considerations that concern the specific structure of the model used in this paper. Both considerations have important implications for the empirical strategy that follows. The first relates to an endogeneity problem. In the model, PTA provisions are introduced as exogenous shocks to the institutional environment. However, as a growing literature shows, international trade itself can have an impact on institutional choices, including the decision to sign a trade agreement and the depth and content of such agreement.[11] Specifically, negotiations of deep PTA provisions result from a two-level game, where governments interact strategically with special interests in the domestic arena and with other governments in the international arena, much like the tariff negotiations analyzed in Grossman and Helpman (1995). In this set up, countries that have stronger FDI relationships may have a greater incentive to introduce in a trade agreement language that facilitates vertical integration. The correlations in Predictions i) and ii) are still valid, but we need to recognize that the direction of causality may run in both ways, from the content of a trade agreement to the composition of trade and vice versa. We will come back to this point in Section 4.

The second consideration is that Predictions i) and ii) are specific to the "property rights" theory of the firm (Grossman and Hart , 1986) underlying the AH model. Importantly, prediction i) stands in contrast to the "transactions cost" approach to the boundary of the firm (Williamson, 1975, 1985), which underpins several studies on the international organization of production (e.g. Grossman and Helpman , 2005, and Costinot, Oldenski, and Rauch , 2011). As discussed above, in the property rights approach what matters in the make-or-buy decisions of firms is the relative contractibility of different inputs. This is the deep reason why

[11] For recent surveys, see Nunn and Trefler (2013) and WTO (2013), chapter C.6.

improvements in the contractibility of components increase FDI: creating incentives for the suppliers of headquarter services through vertical integration becomes a relatively more important problem when PTA disciplines improve the contractibility of components. To the contrary, in the transactions cost approach, vertical integration is an efficient response to any type of contracting difficulties. Therefore, PTA provisions that improve the contractibility of headquarter services and/or components are predicted to always lower FDI and increase outsourcing. The empirical analysis that follows, therefore, provides an indirect test of the two theories.

3. Data description and methodology

We begin our empirical analysis by describing the data on the depth of trade agreements and on vertical FDI.

3.1. Depth and composition of PTAs

Preferential Trade Agreements are usually thought of as bilateral or multilateral agreements that aim at the reduction in tariffs. Recently, the economic literature started to examine in more detail the composition of trade agreements, allowing us to distinguish between shallow and deep agreements. Shallow agreements are those agreements that guarantee reciprocal decreases in tariffs. Following Horn, Mavroidis, and Sapir (2010) and WTO (2011), we define deep agreements as those agreements covering multiple provisions that go beyond tariff liberalization.[12]

The WTO constructed a data set on the content of preferential trade agreements by mapping a total of 52 disciplines across 100 PTAs signed between 1958 and 2011. The agreements included in the data set cover more than 90 percent of world trade.[13] Due to availability of FDI data, we focus our analysis on three countries, Germany, Japan, and the United States. These countries are the main origin of most foreign investments in the world and represent the hubs of production networks.[14] We therefore work with a sub-sample

[12] Horn et al., (2010) identify up to 52 provisions in US and EU agreements.
[13] The database has been assembled by the Economic Research division of WTO for the World Trade Report 2011, available at http://www.wto.org/english/res_e/publications_e/wtr11_dataset_e.htm
[14] In addition, as reported in Lanz and Miroudot (2011), Germany, Japan and the US are among the most represented countries in ORBIS in terms of the number of parent companies and sales of vertical foreign affiliates.

of 57 agreements: 35 signed by the European Union, 11 by Japan, and 11 by the United States. Table A1 in the appendix lists all the mapped agreements that we use in our analysis.

In order to conduct quantitative analysis, it is necessary to have a measure of the depth of an agreement. We follow the approach used by Orefice and Rocha (2014) and we quantify the depth of an agreement in three different ways. First, we count the number of legally enforceable provisions covered in a PTA.[15] The higher the number of provisions in an agreement, the deeper is the agreement. The other two measures of depth are constructed using principal component analysis (PCA).[16] PCA allows us to construct two indexes that contain the provisions with the highest degree of commonality across the spectrum of deep agreements. The *Top5* index includes TRIPS, IPR, countervailing measures, state trading enterprises, and movement of capital provisions, whereas the *Top10* index includes also public procurement, competition policy, anti-dumping, investment, and state aid.

In order to analyze the relationship between the content of PTAs and FDI, we distinguish between two types of provisions, namely h- and m- provisions, according to whether these provisions are likely to affect headquarter services or the production of parts and components. We think of headquarter activities to be, for example, related to research and development, brand management, innovation, and financial decisions. Therefore, we consider GATS, TRIPS, IPR, investment, and movement of capital as h-provisions. On the other hand, the production of parts and components are likely to be affected by standards and custom regulations. Thus we classify SPS, TBT, consumer protection, customs, and export taxes provisions as m–provisions.

Table 1 below shows the frequencies of each h- and m-provisions in the 57 agreements taken into consideration. The table shows that there is some variation in the type of provisions covered in the

[15] As in Horn et al. (2010) l legal enforceability is based on the language used in the agreements. Commitments expressed with a clear, specific and imperative legal language, can more successfully be invoked by a complainant in a dispute settlement proceeding, and therefore are more likely to be legally enforceable. In contrast, not clearly formulated legal language might be related with policy areas that are covered but that might not be legally enforceable.

[16] Principal Component Analysis is a procedure that orthogonally transforms a number of possibly correlated variables into a number of uncorrelated variables called principal components. This transformation is defined in a way such that the first principal component accounts for the highest level of variability in the data.

agreements. For example, only 22 agreements have TBT measures, whereas almost all of them have a provision regarding customs. Figure 4 plots the share of agreements that include h- and m-provisions by country. All the agreements signed by the EU contain customs provisions but only 11 percent of them cover consumer protection. On the other hand, all agreements signed by the United States and Japan deal with consumer protection. Provisions regarding GATS and customs are included in all Japanese agreements, whereas all U.S. agreements include TRIPS. While the least frequent provision in the agreements signed by Japan is export taxes (45 percent of agreements), in U.S. agreements they are investment, movement of capital, and TBT (around 80 percent of the agreements). Finally, the less frequent provisions in EU agreements are TBT and SPS, covering less than one-third of the mapped agreements.

3.2. Identification and Measurement of Vertical FDI

The model outlined in Section 2 ultimately gives predictions on the share of firms engaging in vertical FDI relative to outsourcing. Since we do not have information about the total number of firms and on the extent of outsourcing in an economy, we test the first part of the predictions regarding the profitability of vertical integration by focusing on a measure of positive flows of vertical FDI.

In order to quantify vertical FDI flows we apply the methodology proposed by Alfaro and Charlton (2009), used also by Lanz and Miroudot (2011) , using firm level data obtained from the ORBIS dataset. The Bureau van Dijk collects information about location, ownership, detailed sector level, and operational data (e.g. revenues) for more than 100 million firms in Europe, Americas, and Asia-Pacific region.

We restrict our analysis to subsidiaries in any country of the world owned by parent firms located in Germany, Japan, or the United States, respectively, for the years 2003, 2007, and 2011.[17]

Alfaro and Charlton (2009) methodology allows to identify three types of foreign direct investment, namely vertical, horizontal and complex.[18] Simply put, horizontal FDI is an activity of a foreign-owned subsidiary

[17] We select firms such that only industrial parent firms are included in our dataset. This is done in order to exclude individuals, government, or financial institutions owners.

[18] See appendix A for a definition of ownership and additional details about our measure of vertical FDI.

producing in the same NAICS 6-digits sector of the parent firm. Vertical FDI instead arises when the production of the subsidiary is an input for the production done by the parent firm. In Alfaro and Charlton's words, vertical FDI are defined "as the activity of the foreign-owned subsidiaries in industries upstream from the parent industry (according to the US input-output matrix)". If the activity of the subsidiary satisfies both these criteria, then the FDI is defined as complex. The remaining case in which the subsidiary produces in a different sector of the parent which is not an input is classified as non-identified investment.[19]

More formally, the definition of FDI is based on the intersection of the sets of primary sectors of the parent firm and its subsidiary. Let S be the set of 6-digits NAICS codes of the subsidiary and P be the set of 6-digits NAICS code of the parent. An element x of S is an input of an element z of P ($x \to z$) if the total requirements coefficient of the US Input-Output (IO) table is bigger than 0.03.[20] Given these definitions, we can formally identify the 4 types of connections between the parent and the subsidiary:

i. Horizontal FDI: if S and P share any element (i.e. if $S \cap P \neq \emptyset$);

ii. Vertical FDI: if any element of S is an input of any element of P (i.e. if $\exists\, x, z\ s.t.\ x \to z$ where $x \in S$ and $z \in P$);

iii. Complex FDI: if S and P share any element and any element of S is an input of any element of P (i.e. if $S \cap P \neq \emptyset$ and $\exists\, x, z\ s.t.\ x \to z$ where $x \in S$ and $z \in P$);

iv. Non-identified: if none of the above is satisfied.

For each subsidiary and parent we know the unique core industry at 4-digit NAICS 2007 level and a set of 6-digits NAICS primary codes.[21] To identify the link between two firms, we use the sets of primary codes of a subsidiary and its parent. If the two sets intersect and all the sectors of the subsidiary are not inputs of any sector of the parent, then these firms are linked by a horizontal relationship. Instead, if the subsidiary

[19] Non-identified links can also be thought as conglomerates. Indeed, Herger and McCorriston (2013) define relationships between firms that neither share the same industry nor are they linked through the supply chain as conglomerate cross border acquisitions.

[20] The threshold has been chosen following Alfaro and Charlton (2009).

[21] The cardinality of the set of primary codes is not fixed ex-ante. Some firms report only one primary 6-digits code, some subsidiaries provide up to 36 primary codes.

operates in at least a sector that is an input for any sector of the parent, then the firms are in a vertical relationship. If, moreover, the two sets intersect then the FDI is complex.

Table 2 summarizes the number of subsidiaries in each FDI category. Around 13 percent of the subsidiary firms in our data are linked to their parents through a vertical link. A slightly bigger share of subsidiaries, almost 14 percent, is involved in horizontal FDI. The majority of firms, 72 percent, are classified in a non-identified relationship. Comparing our numbers to the reference literature, Lanz and Miroudot (2011) find that in OECD countries 12.8 percent of total foreign direct investments links are horizontal, 12.9 percent vertical, 14.8 percent complex and 59.5 percent are not identified; in Alfaro and Charlton (2009) the shares are 23 percent, 25 percent, 11 percent, and 41 percent respectively. A possible explanation of the high share of non-identified links can be the presence of conglomerates. Conglomerates are formed by firms that are neither horizontally related through sharing the same industry nor are they vertically connected through the supply-chain. As Herger and McCorriston (2013) suggest a possible reason behind the formation of conglomerates lies in financial frictions or corporate governance problems such as principal-agent issues between shareholders and management. In fact, they document an increase of conglomerate cross-border acquisitions due to financial diversification needs.

Figure 5 confirms one of the main points made by Alfaro and Charlton (2009). At a more aggregate level, it is striking to notice that most of subsidiaries and parents that are in a vertical relationship operate in the same core industry. The figure focuses only on parents and subsidiaries both operating in manufacturing sectors for visual clarity; however a similar pattern can be detected even if we include all sectors. This is to illustrate that if we look at an aggregate level we would be detecting a lot less vertical FDI and probably misreport those foreign investments as horizontal FDI.

How do we measure the value of vertical foreign direct investment? Ideally, we would like to have information on intra-firm trade. Unfortunately, these data are not available. We, therefore, quantify foreign direct investment from country i (United States, Japan, or Germany) in sector k, at time t as the aggregate value of the revenues of all subsidiaries producing inputs for sector k in country (destination) j (FDI_{ijkt}). For example, vertical FDI of the automobile sector in the United States are the sum of revenues of all the

U.S.-owned subsidiaries that produce car inputs, such as plastic, seat-belts, glass, and so on, in a foreign country. [22]

It is important to note here the difference with the measure of FDI in Alfaro and Charlton (2009). In fact, as a measure of FDI, they use the value of sales aggregated at the sector of the subsidiaries. While their approach measures the value of FDI done in an industry, our way of aggregating firms' revenues allows us to evaluate the amount of FDI done by an industry. Following the previous example, they look at the total value of sales of all the firms in the plastic, seat-belts, or glass sector. On the contrary, since we are interested in the reasons why firms in a particular sector do more FDI, we aggregate revenues at the sector of the lead firm. In other words, instead of looking at the total amount of FDI done by firms in the car industry and wine sector in the production of glass, we focus on the amount of FDI done by firms in the cars (or wine) industry in all sectors that produce the inputs needed to produce cars (or wine).

4. Empirical findings

In this section we empirically investigate the relationship between deep agreements and internationalization of production. First, we analyze whether deeper agreements have a positive impact on vertical FDI. Then, we go a step further and evaluate whether particular provisions included in a trade agreement are related to firms decisions on whether to vertically integrate or not. In particular, we test whether m- type provisions are positively related to increases in vertical FDI.

4.1. PTA Depth and Vertical FDI

We first look at whether and how deeper agreements attract more FDI. In order to do this, we estimate the following equation:

$$FDI_{ijkt} = \beta_1 DEPTH_{ijt} + \beta_2 INSTITUTIONS_{jt} + \beta_3 \log(Tariff)_{ijkt} +$$

$$+\beta_4 \mathrm{BIT}_{ijt} + \gamma_1 X_{jt} + \gamma_2 X_{ij} + \delta_{ikt} + \varepsilon_{ijkt} \qquad (1)$$

[22] Despite the fact that there is no availability of intra-firm trade data in the ORBIS database, total revenues of vertically integrated subsidiaries are a good proxy for it. In fact, the correlation between our data on vertical FDI and related party trade from the Bureau of Economic Analysis is 0.69.

where k is the parent's sector, t is time, i and j are country indexes (i for the "origin" country and j for the "destination" country). As we already mentioned above, our dependent variable, FDI_{ijkt}, is the log of the value of the revenues of all subsidiaries in a particular sector k. In the regressions that follow we consider only positive values of FDI, focusing therefore only on the intensive margin of vertical FDI as a measure of the profitability of vertical integration.

$DEPTH_{ijt}$ is a variable that captures the depth of the agreements. More precisely, it can either be a dummy equal to one if there is a PTA, the number of provisions included in the PTA, or the log of one of the two indexes constructed using the principal component analysis previously described. $INSTITUTIONS_{jt}$ are captured by the variable Rule of Law from the Worldwide Governance Indicator database. $Tariff_{ijkt}$ represents the level of tariffs imposed by the origin country i (Germany, Japan and the US) on product k. This variable helps us to separate the impact of our PTA variable that goes beyond pure tariff liberalization. BIT_{ijt} is a dichotomous variable capturing the existence of a bilateral investment treaty between i and j at time t. X_{jt} is a vector of controls for characteristics of the destination country that vary over time. It includes GDP, GDP per capita and destination country remoteness.[23] X_{ij} are country-pair variables such as geographical distance, contiguity, common language, colonial relationship.

A series of fixed effects are included in the regression in order to control for potential omitted variables bias. Specifically, δ_{ikt} are sector-country-time fixed effects. The inclusion of country-pair FE bears potential collinearity issues with our variables of interest since both depth and the content of PTAs do not vary much over time.[24] We control for country-pair characteristics by always including the set of variables X_{ij} described above.

[23] Remoteness is constructed following Head (2003) and Freund and Rocha (2010): $\text{Remote}_{jt} = \frac{1}{\sum_{s \neq j}^{S} \text{GDP}_{st}/\text{Dist}_{js}}$ where S is the set of all countries in the world.

[24] In fact, our variables of interest changes from 0 to a positive number and then remains constant for the period after the signing of the agreement for all the country pairs with an agreement.

It is important to notice that the industry considered in these fixed effects is at the 4-digits NAICS, a more aggregate level with respect to the 6-digits level of disaggregation of FDI.[25] This is done in order to be able to include a variable that captures the level of headquarter intensity of the sector, defined as η in equation 1. In particular, we measure η as the ratio between total capital expenditures and total wage at the industry level using data from the Annual Survey of Manufactures in 2007 provided by the U.S. Census Bureau and we introduce a dummy equal to one if η is above the average in the regressions.[26]

Country-sector-year fixed effects are used to control for time variant country specific factors such as domestic policies that might affect the location and control decisions of parent firms. Together with the variables capturing the remoteness of the destination country, these fixed effects control for the multilateral trade resistance.[27] Finally, in all regressions standard errors are clustered at the 6-digits sector level.

Table 3 reports the estimated OLS coefficients on the impact of deep integration on FDI using different combinations of year-, country-sector and country-sector-year fixed effects.[28] The results in column 2 show that having a trade agreement is associated with higher levels of FDI. Signing a trade agreement corresponds to an increase in FDI of 54 percent. The depth of an agreement is positively associated with foreign direct investment. Columns 3 to 8 report the coefficients for different measures of depth, namely the number of provisions, $Top5$ and $Top10$ indexes. In particular, column 4 shows that including one additional provision in the agreement is associated with an increase in FDI of 1.82 percent. The coefficients of depth when measured by the $Top5$ index (columns 5 and 6) are very similar to the coefficients of the $Top10$ index (columns 7 and 8): an increase of one percent in $Top5$ ($Top10$) is associated with an increase of vertical FDI by 0.48 (0.44) percent.

[25] The results are actually robust to the inclusion of fixed effects at the 6-digits.
[26] The same data from the ASM have been used in Nunn and Trefler (2012) where they examine the importance of the relative contractibility of headquarter services and supplier inputs.
[27] An alternative way to control for general equilibrium effects in a similar context is presented in Egger et al (2011). Their estimation strategy deals also with endogeneity of trade agreements and the presence of numerous zeros in the bilateral trade data matrix.
[28] The results presented in the paper focus only on the positive flows of FDI. When using the pseudo-Poisson maximum likelihood (PPML) methodology proposed by Santos-Silva and Tenreyro (2006) to take into account zero flows, the coefficient of PTA becomes non-significant while the number of provision is still positive and significant.

The other coefficients reported in the table are consistent with the theory: capital intensive sectors are more likely to be vertically integrated and better domestic institutions, using rule of law as a proxy, are positively correlated with FDI.

The correlation between BITs and FDI is worth further comments. Bilateral investment treaties are usually thought to be an important channel through which countries can attract foreign direct investment. However, the empirical literature on the topic is inconclusive. In particular, a recent paper by Baker (2012) shows that BITs had a positive impact on FDI until the mid-1990s.[29] In line with this result, the coefficient of the BIT dummy in our regressions is not significant.

Results not reported in the table show that the coefficients of GDP, common language, and the dummy for China are positive and significant. On the other hand, contiguity is negatively correlated with vertical FDI. The coefficients of all the other variables, namely distance, GDP per capita, colonial relationship, and remoteness are not statistically different from zero.

So far we have said nothing about the direction of causality. The control decisions of firms are expected to respond to the depth of PTAs, but firms may lobby for deeper integration. Moreover, countries tend to sign similar agreements in order to avoid trade diversion. We deal with this potential endogeneity issue by using an instrumental variable approach. More precisely, we instrument PTA depth between country i and country j with the weighted average depth of all the agreements signed by i and j with third countries. This type of instrumental variable approach has already been used in the literature (see, for instance, Orefice and Rocha, 2014).

For example, to instrument the depth of the United States–Peru agreement, we use the average depth of the agreements signed by Peru with all other countries excluding the United States and the agreements signed by the United States with all other countries excluding Peru. Each agreement of Peru (the Unite States) is weighted with an index of similarity between Peru (the United States) and its partners. More formally, if

[29] See also the discussion about the literature on BITs and FDI in Baker (2012).

we define as S the set of third countries with whom i and j have signed an agreement, the instrument is constructed as follows:

$$Depth_{ijt}^{IV} = \frac{\sum_{s \in S} w_{ist} Depth_{ist} + \sum_{s \in S} w_{jst} Depth_{jst}}{N_{it} + N_{jt}}$$

where N_{it} is the number of mapped agreements of country i in year t excluding the agreement with j, N_{jt} is the number of mapped agreements signed by country j in year t excluding the agreement with i, and w_{ijt} and w_{ist} and w_{sjt} are weights that take into account the GDP similarity between country i and s and between country j and s in time t.[30]

The rationale of this instrument comes from the domino effect theory of PTAs first introduced by Baldwin and Jaimovich (2010). If a pair of countries signs an agreement to increase FDI flows, then a third country would like to sign a similar agreement to avoid investment diversion. We expect that the higher the level of integration between a country j and its partners, the higher the probability that country i will sign a PTA of similar depth with j to avoid trade diversion effects. [31] The first stage results for the IV specification are in line with our expectations (see Annex Table A3). The F-statistic of the regression indicates that none of the instruments are weak. Given that our model is perfectly identified we cannot perform an exogeneity test for our instruments, however, potential direct effects of agreements with third parties on FDI flows are reduced by the system of weights that we use in the construction of the instrument.[32] The second stage results are reported in Table 4.The coefficients of all our measures of depth remain positive and significant suggesting that deeper integration is an important factor driving the make-or-buy decision of firms.

The main message of this section is that deeper agreements matter for the decision of firms to vertically integrate in a foreign country. Taking this into account, does vertical FDI depend on the type of provisions

[30] More precisely: $w_{pst} = \log(1 - (^{GDP_{pt}}/_{GDP_{pt} + GDP_{st}})^2 - (^{GDP_{st}}/_{GDP_{pt} + GDP_{st}})^2)$ for $p \in \{i, j\}$.

[31] A similar argument has been provided by Chen and Joshi (2010). In a three-country theoretical model the authors highlight the importance of third-country effects in the formation of new PTAs. They examine how the incentives of a county pair to enter into a PTA with each other vary depending on whether the two countries already have existing PTAs with the third country.

[32] For example, for the agreement between the US and Peru, lower weights are given to agreements between Peru and countries similar to the US and to agreements between the US and countries similar to Peru. In other words, the instrument for North-South agreements gives lower weight to similar North-South agreements.

included in deep agreements? In other words, is the content of PTAs related with firms decisions on whether to do vertical FDI or to foreign outsource? We examine this central issue in the next subsection.

4.2. Content of PTAs and Vertical FDI

The type of provisions included in a PTA is related to the firm's choice between vertical integration or foreign outsourcing: i) PTA provisions improving the contractibility of components (μ_m) are associated with an increase in the profitability of FDI relative to outsourcing, and ii) PTA provisions improving the contractibility of headquarter services (μ_h) are associated with an increase in the profitability of outsourcing relative to vertical integration. While we expect to find a positive relationship between μ_m and FDI as a proxy of vertical integration, the relationship between FDI and μ_h is less clear-cut.

We classify provisions into two different categories. The first set of provisions, also called h-provisions, contains those disciplines that improve the contractibility of headquarter services (i.e. the ones that improve μ_h). As discussed in Section 3.1, this set includes GATS, TRIPS, IPR, investment, and movement of capital. The second set of provisions, also called m-provisions, comprises PTA provisions that potentially address the contractibility of components (i.e. the ones that improve μ_m). In this group we include measures that relate to SPS, TBT, consumer protection, customs, and export taxes.

Once we have distinguished the two types of provisions, we construct a number of indexes, μ_h and μ_m, that capture to which extent an agreement includes disciplines aiming at the improvement of the contractibility of headquarter services or intermediate inputs respectively. We construct these indexes in two alternative ways.

First, we create a dummy μ_ω that is equal to one if there is at least one provision of the ω-type in the PTA, where $\omega = h, m$. Second, we use a discrete variable constructed as follows:

$$Discrete\ \mu_\omega = \begin{cases} 2 & if\ all\ provisions\ of\ \omega - type\ in\ PTA \\ 1 & if\ at\ least\ one\ provision\ of\ \omega - type \\ 0 & otherwise \end{cases}$$

Table 5 reports the estimated OLS coefficients of the following regression:

$$FDI_{ijkt} = \beta_1 \mu_{h,ijt} + \beta_2 \mu_{m,ijt} + \beta_3 DEPTH_{ijt} + \beta_4 INSTITUTIONS_{jt} +$$

$$+\beta_5 \log(Tariff)_{ijkt} + \beta_6 \mathrm{BIT}_{ijt} + \gamma_1 X_{jt} + \gamma_2 X_{ij} + \delta_{ikt} \qquad (2)$$

Columns from 1 to 3 show the results when we capture $\mu_{h,ijt}$ and $\mu_{m,ijt}$ with dummy variables. The last three columns report the OLS coefficients when $\mu_{h,ijt}$ and $\mu_{m,ijt}$ are discrete. In all regressions we include the total number of provisions covered in a PTA ($DEPTH_{ijt}$) in order to detect whether depth per-se is still correlated with vertical FDI once we consider the composition of the agreements. The rest of variables and fixed effects included in the regressions are identical to the ones described in the previous subsection. We control, in fact, for tariffs imposed by i on the imports of k, rule of law, GDP, GDP per capita, contiguity, distance, colonial relationship, common language, a dummy for China, remoteness, and BITs. In order to deal with potential omitted variables, we also include country-industry-year fixed effects. The only difference with respect to the regressions in section 4.1 is the disaggregation of the industry fixed effects. In fact, we now use 6-digits NAICS industry fixed effects. As a consequence of this, we cannot include anymore the variable that captures the capital intensity of an industry.[33]

Accordingly to what is predicted by the theory, the results in table 5 show that, once we look more in detail at the composition of agreements and we consider separately different sets of provisions, h- and m-provisions are related to vertical integration in different ways. The variables that capture the presence of provisions that improve the contractibility of inputs always have a positive and significant coefficient. The results in column 6 suggest that only provisions that improve the contractibility of components are positively related to vertical FDI. Including at least one provision in the agreement or moving from an agreement with some provision to one with all m-provisions increases FDI by 82 percent. As to headquarter provisions, instead, the correlation is absent in most of the specifications. There is a negative and statistically significant coefficient only in column 3, where we include both the dummies μ_h and μ_m.

[33] As robustness checks, we also run the regressions with industry and country-year fixed effects. Moreover we also aggregated the industries in the fixed effects at the 4-digits level and we added capital intensity. Results are in line with the ones reported in the table and capital intensive sectors are more likely to engage in FDI.

Regarding the unreported coefficients, only GDP, common language, and colonial relationship present a positive correlation with FDI; on the other hand, contiguity is, in some cases, negatively correlated with vertical FDI. Finally, as before, BITs seem not to be correlated with foreign direct investments.

In theory, if our measures of μ_h and μ_m really capture contractibility of headquarter services and components, the effect of the μ's should be stronger on industries with high contractual input intensity. In order to check this implication, we run regressions with the interaction between depth and contractual input intensity as measured by the variable constructed by Nunn (2007).[34] The interaction between the μ's and contractual input intensity allows us to introduce a finer set of fixed effects that help controlling for a wider set of possible omitted variables. The results in table 6 includes country-pair-year and country-industry-year fixed effects.[35] The coefficients of the interaction between contractual input intensity and the dummies μ_h and μ_m are significant and with the expected signs. However, when we use the discrete μ_h and μ_m the coefficients are not significant. This is most likely due to the reduction in the number of observations following the merging of our dataset with the information provided by Nunn (2007).

As a robustness check we also estimate equation 2 with the addition of the average level of tariffs imposed by the origin country i (Germany, Japan and the US) on the set of imported inputs needed to produce product k.[36] The results show that provisions that improve the contractibility of components are associated with more vertical FDI (see column 6 table A2). Due to data availability, the estimated sample is reduced by almost 50 percent after taking into account average input tariffs.[37] We have therefore decided to exclude such variable from our preferred specification in the remaining of the paper.

So far, we simply looked at the correlation between the μ's and vertical FDI. In order to explore whether m-provisions included in deep PTAs improve FDI we re-run our regressions using an instrumental variable

[34] The same exercise has been done for the depth of PTAs but the coefficients are not significant.

[35] If we include only country-industry-time fixed effects, the coefficients of the μ's alone are as expected and the coefficients of the interactions are similar to the ones in table 6.

[36] Input tariffs have been averaged over all inputs needed to produce product k using the share of sales of all the firms producing each input in our sample as weight.

[37] In the construction of the average tariffs of inputs a lot of information is lost while matching tariff data at the HS level with the sector at the NAICS level of the subsidiaries in our dataset.

approach. We construct our instruments for μ_h and μ_m provisions using a similar logic to the one of the instrument for the depth of PTAs. More precisely our instrument for μ_m (μ_h) is the weighted average μ_m (μ_h) of all the agreements signed by i and j with any other country excluding the agreement between i and j. As before, the weight of each agreement w_{ijt} is a weight that takes into account the GDP similarity between country i and j in time t. The first stage results for the IV specification confirm the correlation of provisions of a certain type (μ_m or μ_h) between similar agreements (see Annex Table A4).[38] One again, the F-statistic of the regression confirms the relevance of our instruments. The second stage results, are reported in Table 7. The coefficients of μ_m remain positive and significant in each specification. The coefficient of μ_h, has the expected sign in both preferred specifications in columns 3 and 6 but it is significant only when we use the dummy variable.[39]

Our results confirm the predictions of the "property rights" model: the composition of PTAs and different sets of provisions included in an agreement are related to FDI in different ways. Moreover, it is important to notice that once we go into the details of the composition of PTAs, deeper integration per-se is not anymore correlated with the organizational decisions of firms. This was expected since the theory predicts that deeper agreements are related to more offshoring but it does not provide any clear prediction about the relationship with vertical FDI.

5. Conclusion

We use the AH model to guide our analysis on the relationship between deep trade agreements and the international organization of production. Then we test the theory by combining a new data set on the depth

[38] The negative coefficient of μ_h^{IV} for μ_h is likely due to the penalization that the weights give to the North-South agreement. In fact, μ_h provisions such as IPR and investment disciplines are less likely to be in North-North and South-South agreements, thus the correlation between μ_h and its instrument is negative.

[39] The coefficient of tariffs becomes positive in some specifications of table 7. The variable measures the level of tariffs imposed by the country of origin of FDI on the imports of the sectors that make investments abroad (i.e. not on the imports of the "intermediate" goods from subsidiaries abroad). The positive coefficient may simply capture the political economy of protectionism, as larger FDI tend to be correlated with the size of the sector in the domestic economy.

and content of PTAs and a measure of vertical FDI derived from detailed sector-level information for more than one million firms worldwide.

Consistent with the theory, we establish two main findings. First, deep trade agreements are associated to an increase in FDI. Second, PTA provisions that improve the contractibility of components relative to headquarter services are associated to more FDI. However, once we look at the content of PTAs, deep integration is not associated to more vertical FDI anymore. In other words, it is the content more than the depth of PTAs that affects the way goods are traded internationally -i.e. within-firms or at arm's length. As this result is consistent with the "property rights" approach to the boundaries of multinational firms, but not with the "transaction cost" theory, it provides evidence in support of the first approach.

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Tables and Figures

Table 1: Frequency of h- and m-provisions in PTAs

HQ-provisions	**N. of Agreements**	**M-provisions**	**N. of Agreements**
GATS	32	SPS	22
TRIPS	43	TBT	24
IPR	39	Consumer protection	26
Investment	31	Customs	56
Movement of capital	41	Export taxes	42

Table 2: Distribution of Vertical, Horizontal, and Complex FDI

Type	Number of Subsidiaries	Share
Vertical	25230	13.11
Horizontal	26904	13.98
Complex	776	0.40
Non-identified	139603	72.52

Table 3: Vertical FDI and Deep Integration

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	FDI (log of revenues in 1000$)							
PTA	0.573**	0.542***						
	(0.227)	(0.197)						
N. of Provisions			0.0185***	0.0182***				
			(0.00662)	(0.00608)				
log(Top 5)					0.572*	0.479*		
					(0.304)	(0.280)		
log(Top 10)							0.508**	0.443**
							(0.225)	(0.205)
Dummy=1 if η>avg	0.779***	0.762***	0.775***	0.761***	0.777***	0.765***	0.777***	0.764***
	(0.280)	(0.232)	(0.281)	(0.233)	(0.280)	(0.232)	(0.280)	(0.233)
Rule of Law	0.319**	0.305**	0.295**	0.285**	0.292**	0.278**	0.300**	0.286**
	(0.124)	(0.128)	(0.121)	(0.126)	(0.122)	(0.127)	(0.123)	(0.127)
Tariff imposed by i in k (log)	0.0420	0.0561	-0.0588	-0.109	-0.0110	-0.0368	-0.00303	-0.0221
	(0.235)	(0.186)	(0.236)	(0.175)	(0.231)	(0.176)	(0.231)	(0.176)
BIT	0.0622	0.0365	0.0331	0.00601	-0.00897	-0.0376	0.00571	-0.0225
	(0.143)	(0.152)	(0.138)	(0.153)	(0.139)	(0.153)	(0.141)	(0.155)
Observations	4,816	4,816	4,777	4,777	4,777	4,777	4,777	4,777
R-squared	0.244	0.349	0.240	0.345	0.239	0.344	0.239	0.344
Industry-4dig FE	Yes	No	Yes	No	Yes	No	Yes	No
Country-Year FE	Yes	No	Yes	No	Yes	No	Yes	No
Country-Ind4dig-year FE	No	Yes	No	Yes	No	Yes	No	Yes

*** p<0.01, ** p<0.05, * p<0.1

Country-industry-year fixed effects are referred to the country of the parent firm. All regressions control for distance, contiguity, colony relationship, common language, a dummy for China, GDP, GDP per capita and remoteness of the country of the subsidiary. Robust standard errors in parentheses clustered at the 6-digits NAICS.

Table 4: Vertical FDI and Deep Integration: 2-SLS results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	FDI (log of revenues in 1000$)							
PTA	1.229***	1.096***						
	(0.318)	(0.258)						
N. of Provisions			0.0558***	0.0490***				
			(0.0102)	(0.00925)				
log(Top 5)					2.351***	2.004***		
					(0.465)	(0.421)		
log(Top 10)							1.538***	1.316***
							(0.296)	(0.269)
Dummy=1 if η>avg	0.773***	0.752***	0.754***	0.741***	0.752***	0.740***	0.759***	0.745***
	(0.277)	(0.225)	(0.284)	(0.228)	(0.282)	(0.228)	(0.281)	(0.227)
Rule of Law	0.382***	0.370***	0.370***	0.359***	0.389***	0.369***	0.389***	0.369***
	(0.123)	(0.122)	(0.126)	(0.125)	(0.125)	(0.124)	(0.125)	(0.124)
Tariff imposed by i in k (log)	0.106	0.175	-0.133	-0.171	0.0266	0.0514	0.0389	0.0739
	(0.210)	(0.169)	(0.233)	(0.155)	(0.220)	(0.164)	(0.220)	(0.166)
BIT	0.161	0.129	0.223	0.162	0.157	0.112	0.147	0.106
	(0.136)	(0.147)	(0.145)	(0.153)	(0.140)	(0.153)	(0.139)	(0.152)
Observations	4,816	4,816	4,692	4,692	4,692	4,692	4,692	4,692
R-squared	0.240	0.346	0.232	0.339	0.229	0.337	0.233	0.340
Industry-4dig FE	Yes	No	Yes	No	Yes	No	Yes	No
Country-Year FE	Yes	No	Yes	No	Yes	No	Yes	No
Country-Ind4dig-year FE	No	Yes	No	Yes	No	Yes	No	Yes

*** p<0.01, ** p<0.05, * p<0.1

Country-industry-year fixed effects are referred to the country of the parent firm. All regressions control for distance, contiguity, colony relationship, common language, a dummy for China, GDP, GDP per capita and remoteness of the country of the subsidiary. Robust standard errors in parentheses clustered at the 6-digits NAICS.

Table 5: Vertical FDI and the content of PTAs

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	FDI (log of revenues in 1000$)					
Dummy μ_h	0.336		-1.516***			
	(0.379)		(0.481)			
Dummy μ_m		0.961***	2.145***			
		(0.340)	(0.449)			
Discrete μ_h				0.0614		-0.0528
				(0.204)		(0.202)
Discrete μ_m					0.584**	0.598***
					(0.226)	(0.226)
N. of Provisions	0.0106	-0.00686	0.00856	0.0178	0.00271	0.00579
	(0.0131)	(0.0102)	(0.0131)	(0.0149)	(0.00823)	(0.0157)
Rule of Law	0.273**	0.296**	0.306***	0.269**	0.310***	0.310***
	(0.113)	(0.115)	(0.115)	(0.112)	(0.116)	(0.116)
Tariff imposed by i in k (log)	0.0106	0.201	0.203	-0.0381	0.0753	0.0590
	(0.144)	(0.162)	(0.163)	(0.142)	(0.152)	(0.161)
BIT	-0.0946	-0.0769	-0.0494	-0.0935	-0.0440	-0.0423
	(0.129)	(0.130)	(0.129)	(0.129)	(0.133)	(0.133)
Observations	6,888	6,888	6,888	6,888	6,888	6,888
R-squared	0.471	0.473	0.474	0.471	0.472	0.472
Country-Ind6dig-year FE	Yes	Yes	Yes	Yes	Yes	Yes

*** p<0.01, ** p<0.05, * p<0.1

Country-industry-year fixed effects are referred to the country of the parent firm. All regressions control for distance, contiguity, colony relationship, common language, a dummy for China, GDP, GDP per capita and remoteness of the country of the subsidiary. Robust standard errors in parentheses clustered at the 6-digits NAICS.

Table 6: Interaction with contractual input intensity

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	FDI (log of revenues in 1000$)					
Dummy μ_h * Nunn	-0.180		-4.281***			
	(0.627)		(1.120)			
Dummy μ_m * Nunn		-0.0758	4.168***			
		(0.645)	(1.174)			
Discrete μ_h * Nunn				-0.0799		0.453
				(0.324)		(0)
Discrete μ_m * Nunn					-0.258	-1.025
					(0.582)	(0)
Tariff imposed by i in k (log)	0.402	0.399	0.380	0.401	0.403	0.399
	(0.319)	(0.319)	(0.319)	(0.319)	(0.319)	(0)
Observations	3,313	3,313	3,313	3,313	3,313	3,313
R-squared	0.526	0.526	0.527	0.526	0.526	0.526
Country pair-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-6dig-year FE	Yes	Yes	Yes	Yes	Yes	Yes

Country-industry-year fixed effects are referred to the country of the parent firm. All regressions control for the number of provisions, the average depth of PTAs signed by j, rule of law, distance, contiguity, colony relationship, common language, a dummy for China, GDP, GDP per capita and remoteness of the country of the subsidiary. Robust standard errors in parentheses clustered at the 6-digits NAICS.
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Vertical FDI and content of PTAs, 2-SLS results

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	FDI (log of revenues in 1000$)					
Dummy μ_h	2.463***		-3.771**			
	(0.533)		(1.763)			
Dummy μ_m		2.995***	6.437***			
		(0.523)	(1.696)			
Discrete μ_h				-2.273***		-0.243
				(0.584)		(0.390)
Discrete μ_m					2.430***	2.671***
					(0.441)	(0.418)
N. of Provisions	-0.0498**	-0.0704***	-0.0561**	0.234***	-0.0480***	-0.0389
	(0.0210)	(0.0200)	(0.0224)	(0.0518)	(0.0171)	(0.0262)
Rule of Law	0.355***	0.378***	0.398***	0.333***	0.487***	0.500***
	(0.105)	(0.106)	(0.106)	(0.111)	(0.114)	(0.110)
Tariff imposed by i in k (log)	0.489**	0.826***	0.986***	-1.076***	0.532***	0.494**
	(0.195)	(0.245)	(0.267)	(0.297)	(0.204)	(0.225)
BIT	-0.0479	-0.0408	-0.00864	0.143	0.161	0.186
	(0.121)	(0.120)	(0.120)	(0.134)	(0.133)	(0.133)
Observations	6,764	6,764	6,764	6,764	6,764	6,764
R-squared	0.464	0.466	0.461	0.428	0.461	0.458
Country-Ind6dig-year FE	Yes	Yes	Yes	Yes	Yes	Yes

*** p<0.01, ** p<0.05, * p<0.1

Country-industry-year fixed effects are referred to the country of the parent firm. All regressions control for distance, contiguity, colony relationship, common language, a dummy for China, GDP, GDP per capita and remoteness of the country of the subsidiary. Robust standard errors in parentheses clustered at the 6-digits NAICS.

Figure 1: Organization choice in sectors with sufficiently high headquarter intensity

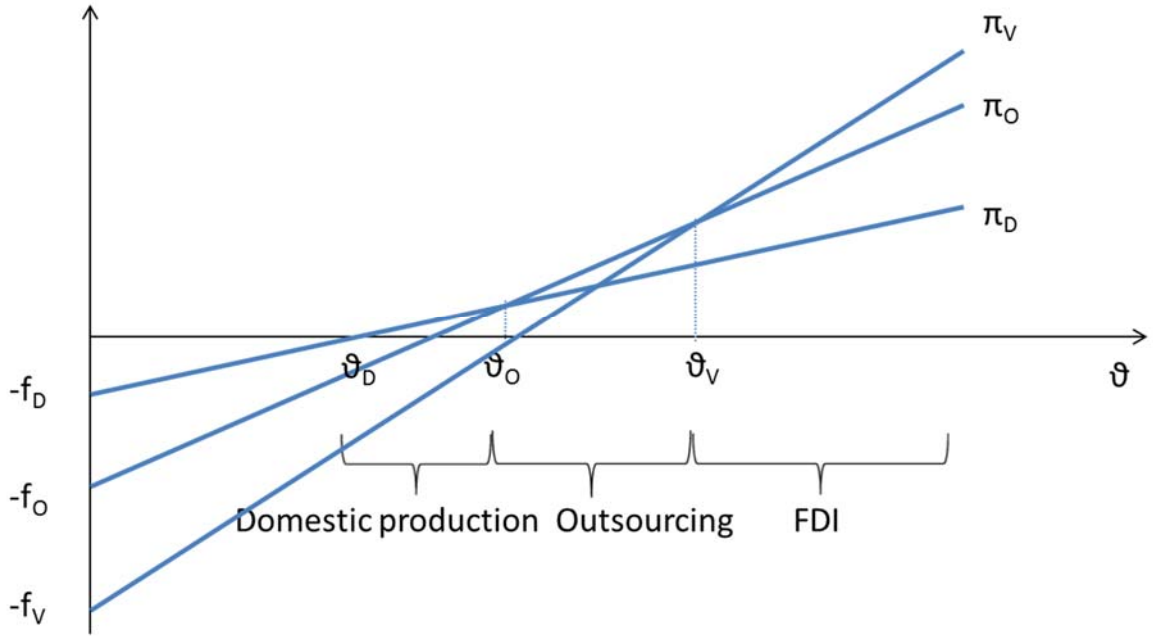


Figure 2: Effects of PTA provisions improving contractibility of components ($\uparrow \mu_m$)

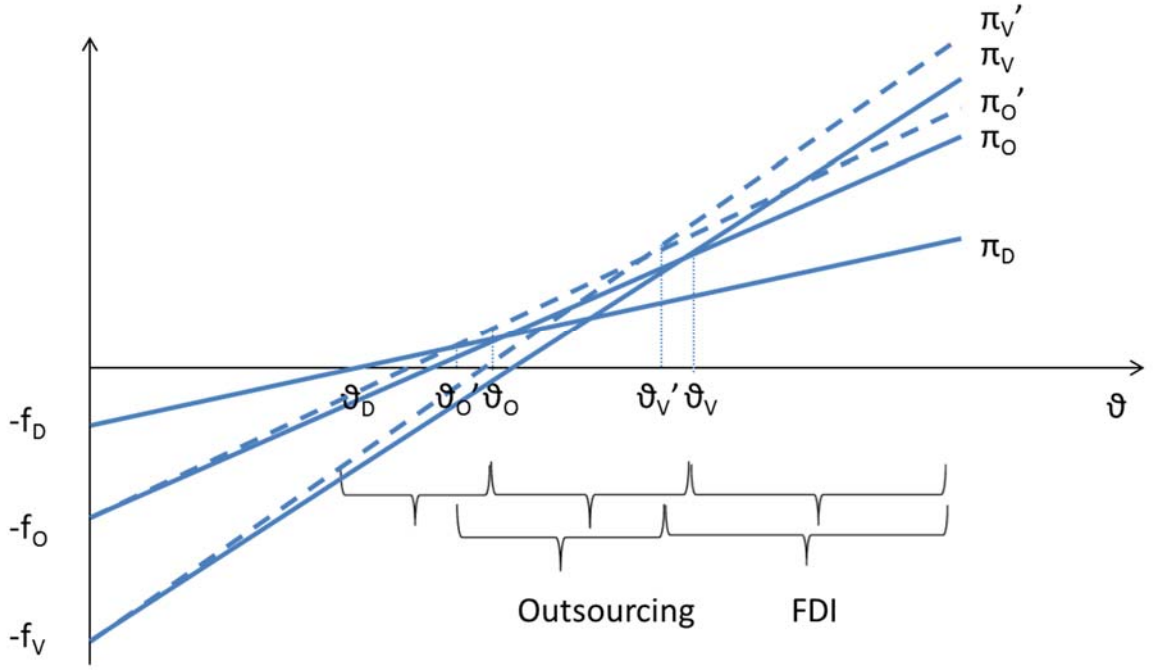


Figure 3: Effects of PTA provisions improving contractibility of components (↑ μ_h)

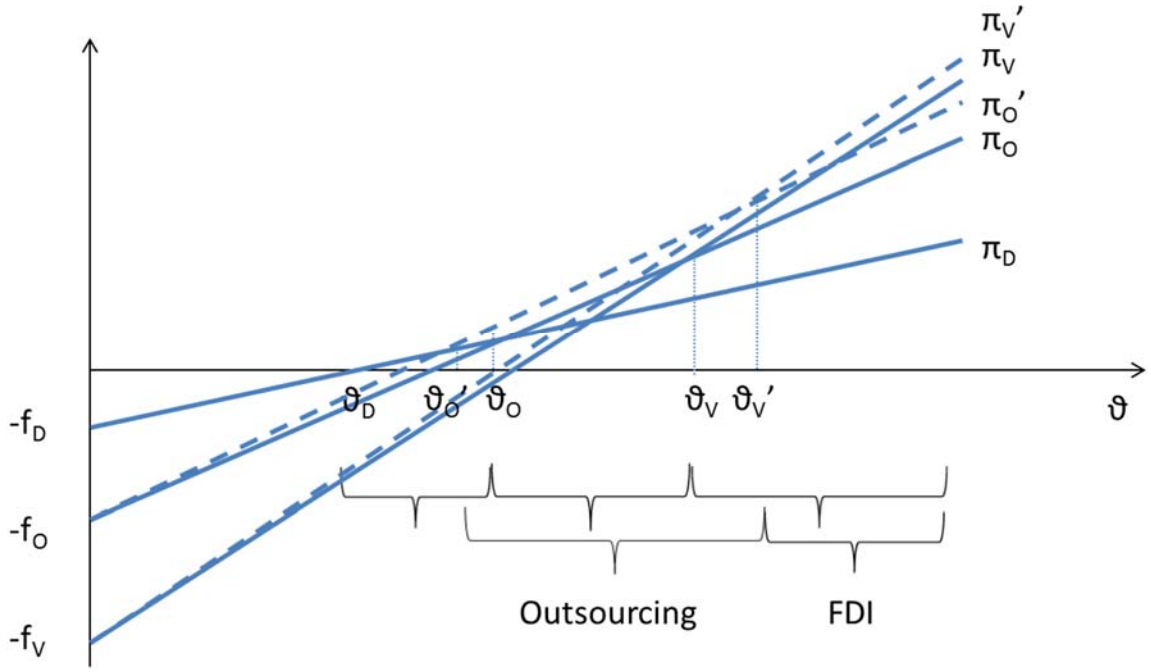


Figure 4: Frequency of *h*- and *m*-provisions in trade agreements by country

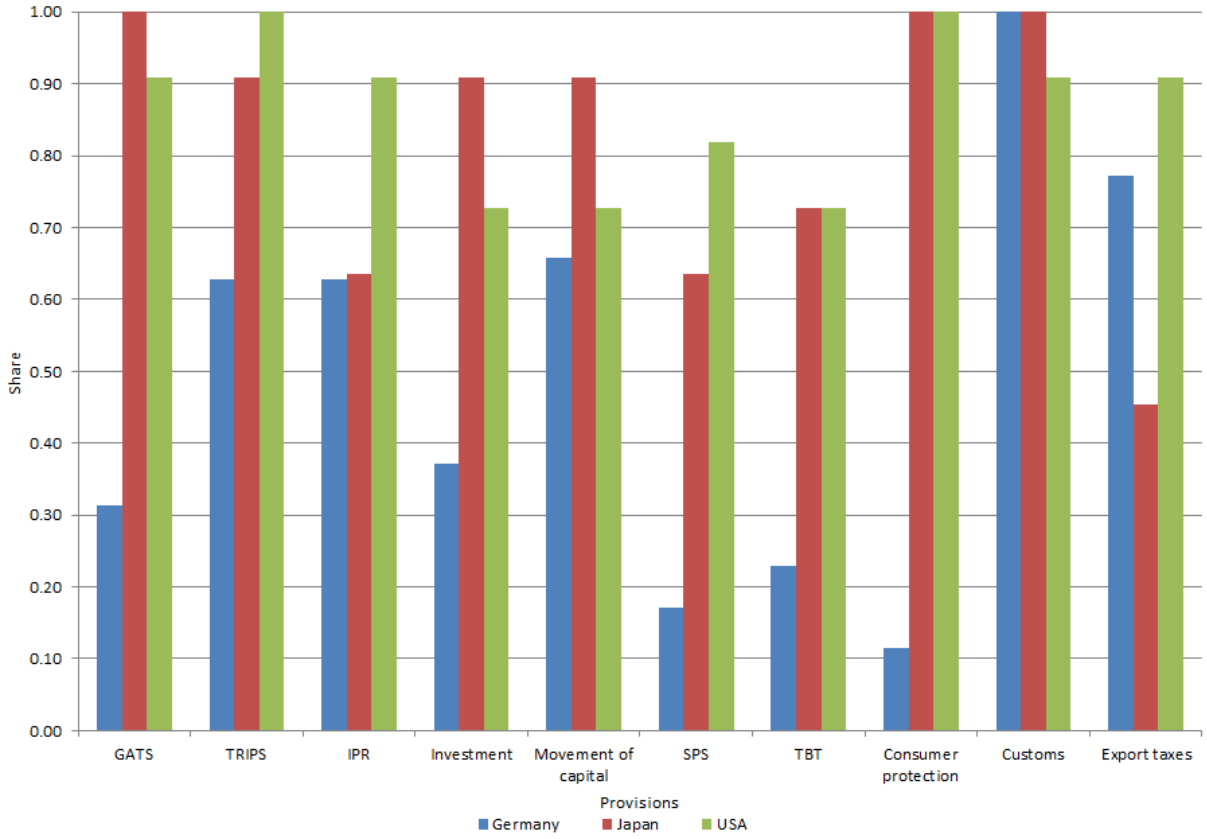
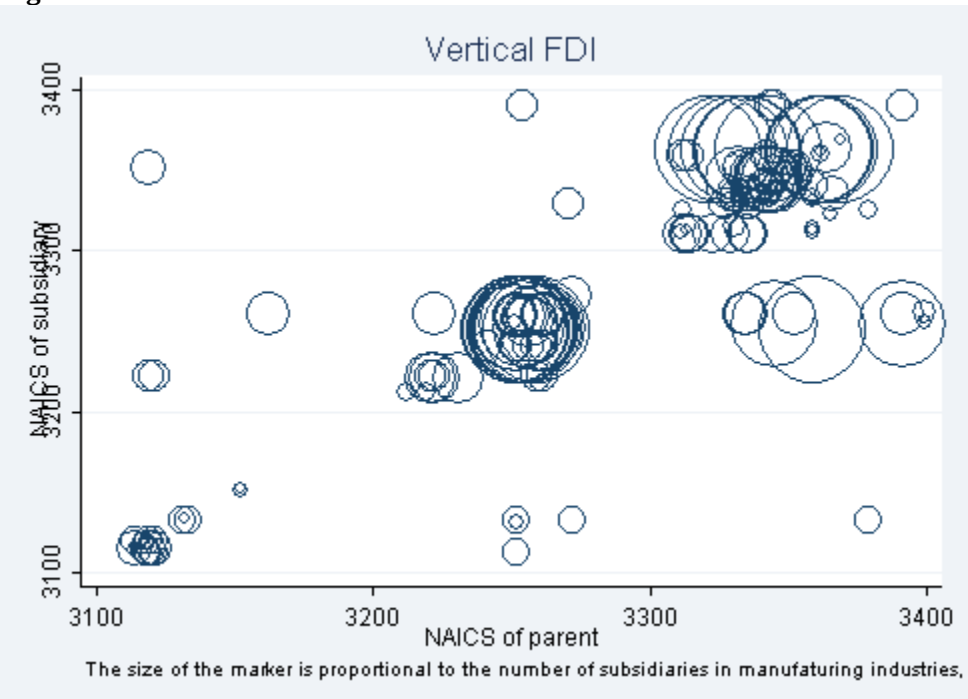


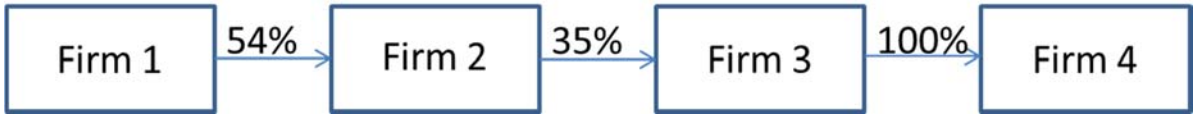
Figure 5: Vertical FDI



A. APPENDIX – Measurement of FDI

For our sample of countries and years, ORBIS records the revenues of 125,212 subsidiaries for which we can identify 42,984 ultimate owner parents. The definition of ownership provided in the ORBIS database "concerns the minimum percentage that must characterize the path from a subject company up to its ultimate owner". The example in Figure A1 illustrates this definition. The numbers between firms represent how much the firm at the bottom of the arrow owns of the firm at the arrowhead. Therefore, considering a path of minimum ownership of 25.01 percent, the ultimate owner of firm 4 is firm 1, while, considering a path of minimum ownership of 50.01 percent the ultimate owner of firm 4 is firm 3.[40]

Figure A1: ORBIS definition of ownership



It is important to note here the difference with the measure of FDI in Alfaro and Charlton (2009). In fact, as a measure of FDI, they use the value of sales aggregated at the sector of the subsidiaries. While their approach measures the value of FDI done in an industry, our way of aggregating firms' revenues allows us to evaluate the amount of FDI done by an industry. Following the previous example, they look at the total value of sales of all the firms in the plastic, seat-belts, or glass sector. On the contrary, since we are interested in the reasons why firms in a particular sector do more FDI, we aggregate revenues at the sector of the lead firm. In other words, instead of looking at the total amount of FDI done by firms in the car industry and wine sector in the production of glass, we focus on the amount of FDI done by firms in the cars (or wine) industry in all sectors that produce the inputs needed to produce cars (or wine).

[40] These thresholds are the only ones available in ORBIS. In our analysis we use the 25.01 percent threshold.

B. APPENDIX – Additional tables

Table A1

Germany (EU)		USA	
Agreement	**Year of entry into force**	**Agreement**	**Date of entry into force**
EC Treaty	1958	US-Israel	1985
EC-Overseas Territories	1971	NAFTA	1991
EU – Overseas Countries and Territories	1971	US-Jordan	2001
EC-Iceland	1973	US-Chile	2004
EC-Norway	1973	US-Singapore	2004
EC-Switzerland Liechtenstein	1973	US-Australia	2005
EC-Syria	1977	US-Bahrain	2006
EC Enlargement (12)	1986	US-Morocco	2006
EEA	1994	CAFTA-DR	2006
EC Enlargement (15)	1995	US-Oman	2009
EC-Turkey	1996	US-Peru	2009
EC-Faroe Islands	1997		
EC-Palestinian Authority	1997	Japan	
EC-Tunisia	1998	Japan-Singapore	2002
EC-Israel	2000	Japan-Mexico	2005
EC-Mexico	2000	Japan-Malaysia	2006
EC-Morocco	2000	Chile-Japan	2007
EC-South Africa	2000	Japan-Thailand	2007
EC-FYR Macedonia	2001	Japan-ASEAN	2008
EC-Croatia	2002	Japan-Indonesia	2008
EC-Jordan	2002	Japan-Philippines	2008
EU-San Marino	2002	Japan-Switzerland	2009
EC-Chile	2003	Japan-Viet Nam	2009
EC-Lebanon	2003	India-Japan	2011
EC Enlargement (25)	2004		
EC-Egypt	2004		
EC-Algeria	2005		
EC-Albania	2006		
EC Enlargement (27)	2007		
EC-Bosnia Herzegovina	2008		
EC-CARIFORUM	2008		
EC-Montenegro	2008		
EC-Cameroon	2009		
EC-Côte d'Ivoire	2009		
EU-Serbia	2010		

Table A2: Vertical FDI, Deep Integration and content of PTAs: robustness

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			FDI (log of revenues in 1000$)			
Dummy μ_h	-0.151		-0.953			
	(0.506)		(1.017)			
Dummy μ_m		0.0511	0.829			
		(0.409)	(0.845)			
Discrete μ_h				-0.139		-0.384
				(0.244)		(0.236)
Discrete μ_m					0.790***	0.992***
					(0.285)	(0.287)
N. of Provisions	0.0253	0.0185	0.0273	0.0296*	-0.00768	0.0113
	(0.0180)	(0.0128)	(0.0189)	(0.0176)	(0.0128)	(0.0195)
Rule of Law	0.181	0.184	0.193	0.178	0.236	0.236
	(0.171)	(0.173)	(0.173)	(0.171)	(0.178)	(0.178)
Avg tariff of inputs of k in i (log)	-0.735***	-0.730***	-0.729***	-0.737***	-0.729***	-0.744***
	(0.254)	(0.253)	(0.253)	(0.255)	(0.247)	(0.255)
BIT	-0.191	-0.192	-0.180	-0.190	-0.154	-0.138
	(0.213)	(0.213)	(0.208)	(0.213)	(0.214)	(0.215)
Observations	3,394	3,394	3,394	3,394	3,394	3,394
R-squared	0.498	0.497	0.498	0.498	0.499	0.500
Country-Ind6dig-year FE	Yes	Yes	Yes	Yes	Yes	Yes

*** p<0.01, ** p<0.05, * p<0.1

Country-industry-year fixed effects are referred to the country of the parent firm. All regressions control for distance, contiguity, colony relationship, common language, a dummy for China, GDP, GDP per capita, and remoteness of the country of the subsidiary. Robust standard errors in parentheses clustered at the 6-digits NAICS.

Table A3: Vertical FDI and Deep Integration: First stage

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	PTA		Count		Top5		Top10	
PTA^{IV}	0.017***	0.018***						
	(0.000)	(0.001)						
$Count^{IV}$			6.877***	6.874***				
			(0.347)	(0.372)				
$Top5^{IV}$					3.984***	3.572***		
					(0.221)	(0.238)		
$Top10^{IV}$							3.252***	3.268***
							(0.189)	(0.202)
F-stat (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	4,816	4,816	4,692	4,692	4,692	4,692	4,692	4,692

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A4: Vertical FDI and content of PTAs: First stage

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			μ_h			
Dummy μ_h^{IV}	4.459**		-24.842***			
	(1.975)		(5.177)			
Discrete μ_h^{IV}				-20.897***		-19.992***
				(2.194)		(2.261)
F-stat (p-value)	0.000		0.000	0.000		0.000
Dependent variable			μ_m			
Dummy μ_m^{IV}		5.883***	18.000***			
		(1.365)	(3.084)			
Discrete μ_m^{IV}					3.640***	3.485***
					(1.298)	(1.282)
F-stat (p-value)		0.000	0.000		0.000	0.000
Observations	4,692	4,692	4,692	4,692	4,692	4,692

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1