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 (PTAs) has evolved over time. While pre-1990s PTAs 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, we have witnessed to a remarkable increase in the internationalization of production through foreign direct investment (FDI) 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. We then construct new measures of the depth of PTAs and of vertical FDI to test the theory. Consistently with the model, we find evidence that the depth of trade agreements is correlated with vertical FDI 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, our findings provide empirical support to this approach vis-à-vis alternative theories of firm boundaries.

1 Introduction

How are trade agreements and the international organization of production related? The

sions 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 componens are, for example, standards and

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.

2 Theory: Deep PTAꜱ 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 contract-

but also by a number of disciplines that a country commits to in the context of a PTA. To clarify this point, let   be an index of the quality of domestic institutions and define $= (\ _1; :::; \ _N)$, as the set of deep provisions that can be introduced in a trade agreement. Then we can write

$$_h = h(\ ;\ _1; :::; \ _N) \text{ and } \ _m = m(\ ;\ _1; :::; \ _N)$$

with $h^{\theta}(:); m^{\theta}(:) > 0,$

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-si e hol -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 bargain-

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[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 ( ).

[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.

ing 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
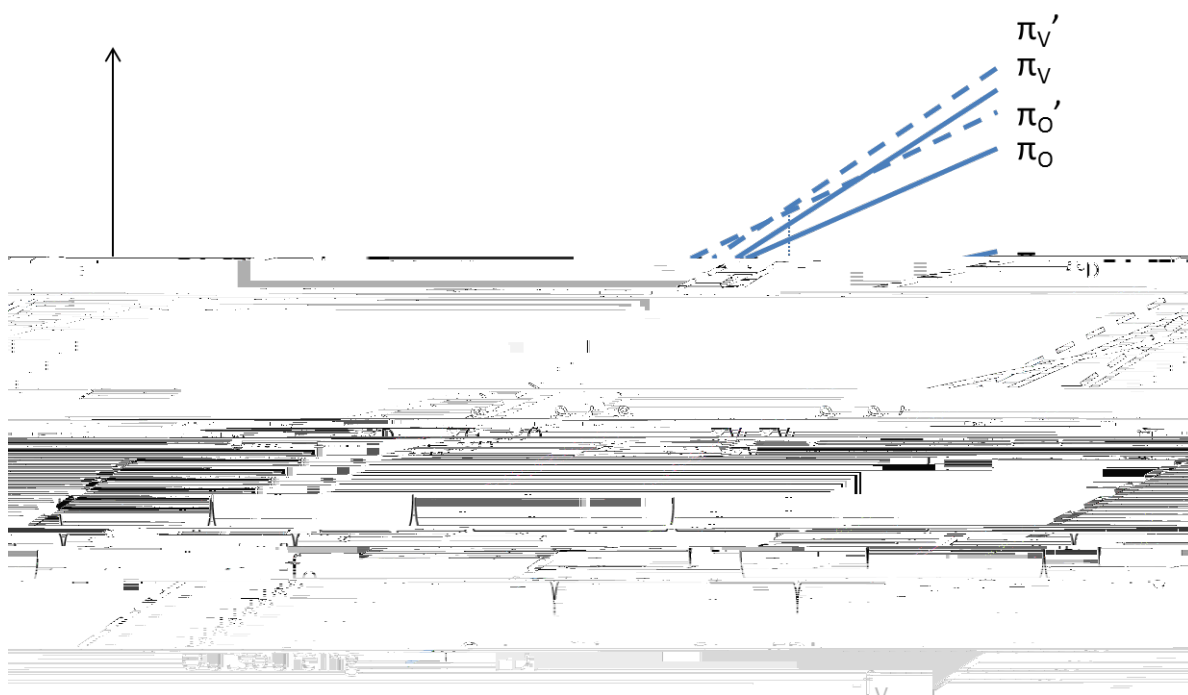
Figure 3: Effects of PTA provisions improving contractibility of components ($''_h$)

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

1. PTA provisions improving the contractibility of components ($_m$) 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;

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

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 (2014)), 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 1 and 2 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 1 and 2 are specific to the "property rights" theory of the firm Grossman and Hart (1986) underlying the AH model. Importantly, prediction 1 stands in contrast to the "transactions cost" approach on the boundary of the firm (Williamson (1975) and Williamson (1985)), which underpins several studies on the international organization of production (e.g. Grossman and Helpman (2005), and Costinot et al. (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 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.

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

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[11]For recent surveys, see Nunn and Trefler (2014) and WTO (2013), chapter C.2.

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 et al. (2010) and WTO (2011), we define deep agreements as those agreements covering multiple provisions that go beyond tariff liberalization.[12]

The WTO constructed a dataset 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 dataset cover more than 90% of world trade.[13] Due to availability of FDI data, we focus our analysis on three countries, Germany, Japan, and SA. We therefore work with a sub-sample of 57 agreements: 35 signed by the European nion, 11 by Japan, and 11 by the SA. Table A.1 in the appendix lists all the mapped agreements included 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.[14] 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).[15] 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*

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 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 E contain customs provisions but only 11% of them cover consumer protection. On the other hand, all agreements signed by the S and Japan deal with consumer protection. Provisions regarding GATS and customs are included in all Japanese agreements, whereas all S agreements include TRIPS. Whilst the least frequent provision in the agreements signed by Japan is export taxes (45% of agreements), in S agreements they are investment, movement of capital, and TBT (around 80% of the agreements). Finally, the less frequent provisions in E agreements are TBT and SPS, covering less than 1 third of the mapped agreements.

Table 1: Frequencies of h and m provisions in PTAs

h 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

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.

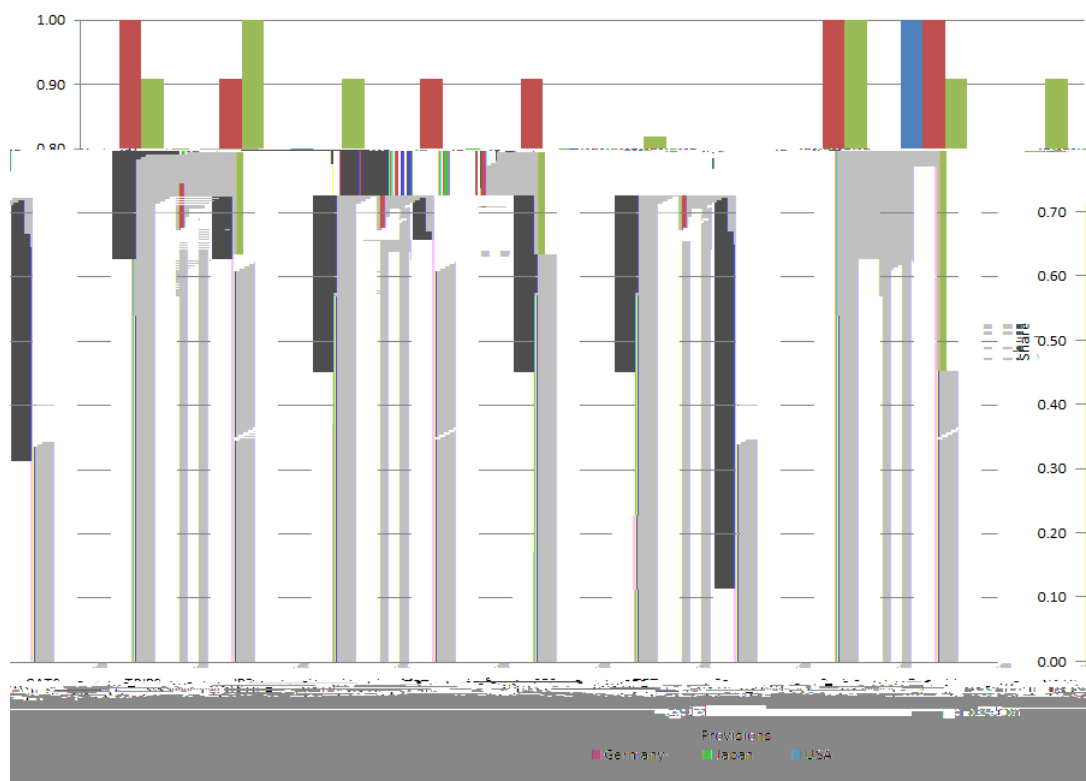We restrict our analysis to subsidiaries in any country of the world owned by parent firms

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

located in Germany, Japan, or SA respectively, for the years 2003, 2007, and 2011.[16]

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 S-Input-Output (IO) table is bigger than 0.03.[19] 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.[20] 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 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 per cent of the subsidiary firms in our data are linked to their parents through a vertical link. A slightly bigger share of subsidiaries, almost 14 per cent, is involved in horizontal FDI. The majority of firms, 72 per cent, 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% of total foreign direct investments links are horizontal, 12.9% vertical, 14.8% complex and 59.5% are not identified; in Alfaro and Charlton (2009) the shares are 23%, 25%, 11%, and 41% 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 below confirms one of the main points made by Alfaro and Charlton (2009). At

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

[20]

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

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.
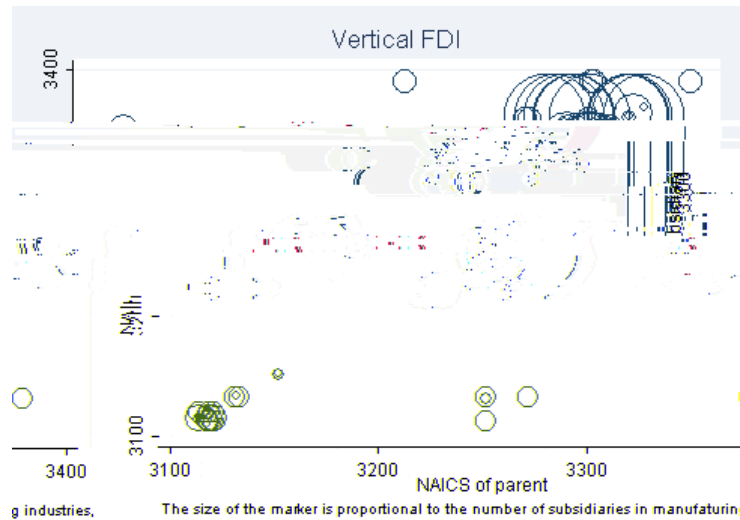
Figure 5: Vertical FDI

How do we measure the value of vertical foreign direct investment? Ideally, we would like to have information on intra-firm trade. nfortunately, these data are not available. We, therefore, quantify foreign direct investment from country i (S, Japan, or Germany) in sector k, at time t as the aggregate value of the revenues of subsidiaries operating in sector k and country (destination) j (FDI_{ijkt}). For example, vertical FDI of the automobile sector in the S is the sum of revenues of all the S-owned subsidiaries that produce car inputs, such as plastic, seat-belts, glass, and so on, in a foreign country.[21]

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[21]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 0.89.

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:

$$
\begin{aligned}
FDI_{ijkt} = {}_1 DEPTH_{ijt} + {}_2 INSTITUTIONS_{jt} + {}_3 \log(Tariff)_{ijkt} + \\
+ {}_4 BIT_{ijt} + {}_1 X_{jt} + {}_2 X_{ij} + {}_k + {}_{it} + {}_{ijkt}
\end{aligned}
\tag{1}
$$

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. We also control for the level of tariffs imposed by the origin country i (Germany, Japan and the S) on imports of 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.[22] X_{ij} are country-pair variables such as geographical distance, contiguity, common language, colonial relationship.

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A series of fixed effects are included in the regression in order to control for potential omitted variables bias. Specifically, $_k$ and $_{it}$ are sector and country-time fixed effect respectively. It is important to notice that the industry fixed effects $_k$ are at the 4-digits NAICS, a more aggregate level with respect to the 6-digits level of disaggregation of FDI. This is done in order to be able to include a variable that captures the level of headquarter intensity of the sector, defined as in equation 1. In particular, we measure 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 .S. Census Bureau and we introduce a dummy equal to one if is above the average in the regressions.[23]

Country-time 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.[24] 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 and FDI.[25] The results in column 1 show that having a trade agreement is associated with higher levels of FDI. Signing a trade agreement corresponds to an increase in FDI of 77 percent. Also the depth of an agreement is positively associated with foreign direct investment. Columns 2 to 4 report the coefficients for different measures of depth, namely the number of provisions, *Top5*, and *Top10* indexes. In particular, column 2 shows that including one additional provision in the agreement is associated with an increase in FDI of 1.85%. Since the indexes *Top5* and *Top10* are in logs, an increase of one per cent in the index is associated with an increase of 0.57 and 0.51 per cent respectively.

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.[26] In

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Table 3: Vertical FDI and Deep Integration

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 potential 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 any other country excluding the agreement between i and j. 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 agreement S-Peru we use the average depth of the agreements signed by Peru with all other countries excluding the S and the agreements signed by the S with all other countries excluding Peru. Each agreement of Peru (SA) is weighted with an index of similarity between Peru (SA) and its partners. More formally, if we define as the set S of all countries excluding country i and j, 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

depth with j to avoid trade diversion effects.[28] [29]

Table 4 reports the results of the 2-SLS regressions.[30] 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.

Table 4: Vertical FDI and Deep Integration

	(1)	(2)	(3)	(4)
	FDI (log of revenues in 1000$)			
PTA	1.229***			
	(0.318)			
N. of Provisions		0.0558***		
		(0.0102)		
log(Top 5)			2.351***	
			(0.465)	
log(Top 10)				1.538***
				(0.296)
Rule of Law	0.382***	0.370***	0.389***	0.389***
	(0.123)	(0.126)	(0.125)	(0.125)
Tariff (log)	0.106	-0.133	0.0266	0.0389
	(0.210)	(0.233)	(0.220)	(0.220)
BIT	0.161	0.223	0.157	0.147
	(0.136)	(0.145)	(0.140)	(0.139)
Dummy=1 if >avg	0.773***	0.754***	0.752***	0.759***
	(0.277)	(0.284)	(0.282)	(0.281)
Observations	4,816	4,692	4,692	4,692
R-squared	0.240	0.232	0.229	0.233
Industry-4dig FE	Yes	Yes	Yes	Yes

firms to vertically integrate in a foreign country. Taking this into account, does vertical FDI depend on the type of provisions 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 PTA Content 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 ($_m$) are associated with an increase in the profitability of FDI relative to outsourcing, and ii) PTA provisions improving the contractibility of headquarter services ($_h$) are associated with an increase in the profitability of outsourcing relative to vertical integration. While we expect to find a positive relationship between $_m$ and FDI as a proxy of vertical integration, the relationship between FDI and $_h$ 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 increase $_h$). 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 increase $_m$). 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, $_h$ and $_m$, 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 $_l$ that is equal to one if there is at least one provision of the l-type in the PTA, where $l = h, m$. Second, we use a discrete variable constructed as follows:

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

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

$$FDI_{ijkt} = {}_1\,{}_{h;ijt} + {}_2\,{}_{m;ijt} + {}_3 DEPTH_{ijt} + {}_4 INSTITUTIONS_{jt} +$$
$$+ {}_3 \log(Tariff)_{ijkt} + {}_4 BIT_{ijt} + {}_1 X_{jt} + {}_2 X_{ij} + \qquad (2)$$
$$+ {}_k + {}_{it} + {}_{ijkt}$$

Columns 1 to 3 show the results when we capture ${}_{h;ijt}$ and ${}_{m;ijt}$ with dummy variables. The last three columns report the OLS coefficients when ${}_{h;ijt}$ and ${}_{m;ijt}$ 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 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 coutry-year and industry 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.[31]

Accordingly to what is predicted by the theory, the results in table 5 show that, once we look more in detail 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.[32] 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 77 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 ${}_h$ and ${}_m$

Table 5: Vertical FDI and the content of PTAs

	FDI (log of revenues in 1000$)					
	(1)	(2)	(3)	(4)	(5)	(6)
Dummy h = 1 if at least one h provision	0.399		-0.943*			
	(0.424)		(0.515)			
Dummy m = 1 if at least one m provision		0.751**	1.479***			
		(0.374)	(0.457)			
Discrete h				0.108		-0.0254
				(0.244)		(0.233)
Discrete m					0.581**	0.570***
					(0.230)	(0.213)
N. of Provisions	0.00859	-0.00215	0.00783	0.0128	0.00182	0.00303
	(0.0150)	(0.0115)	(0.0148)	(0.0177)	(0.00832)	(0.0184)
Rule of Law	0.235**	0.255**	0.283**	0.230**	0.272**	0.272**
	(0.107)	(0.109)	(0.108)	(0.108)	(0.109)	(0.109)
Tariff (log)	-0.131	-0.0700	-0.0743	-0.154	-0.112	-0.118
	(0.224)	(0.227)	(0.231)	(0.231)	(0.218)	(0.237)
BIT	-0.109	-0.0991	-0.0819	-0.108	-0.0589	-0.0578
	(0.118)	(0.117)	(0.115)	(0.118)	(0.124)	(0.123)
Observations	8,888	8,888	8,888	8,888	8,888	8,888
R-squared	0.333	0.334	0.334	0.333	0.334	0.334
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Country-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 are clustered at the 8 digits NAICS level.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

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.

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.

So far, we simply looked at the correlation between 's and vertical FDI. The model does not have clear predictions on the direction of causality. Table 6 reports the results of 2-SLS regressions using an instrument constructed similarly to the instrument for the depth of agreements.[33] More precisely our instrument for the content of PTAs is the weighted average 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 coefficients of $_m$ remain positive and significant in each specification. The coefficient of $_h$, instead is not significant and it has the expected sign only when we use the discrete variable.

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

Consistently 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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[33]The results of the first stage regressions are in the annex Table A.3.

Table 6: Vertical FDI and content of PTAs: 2-SLS results

| | FDI (log of revenues in 1000$) | | | | | |
	(1)	(2)	(3)	(4)	(5)	(ℛ)
Dummy h = 1 if at least one h provision	2.131***		-2.388			
	(0.491)		(1.ℛ0ℛ)			
Dummy m = 1 if at least one m provision		2.452***	4.551***			
		(0.431)	(1.415)			
Discrete h				-2.184***		-0.342
				(0.ℛℛ1)		(0.411)
Discrete m					2.10ℛ***	2.493***
					(0.371)	(0.378)
N. of Provisions	-0.0357*	-0.0487***	-0.03ℛ7*	0.228***	-0.0351**	-0.0244
	(0.0202)	(0.0174)	(0.0204)	(0.0573)	(0.0152)	(0.0248)
Rule of Law	0.323***	0.348***	0.3ℛ3***	0.281**	0.441***	0.4ℛ2***
	(0.107)	(0.107)	(0.10ℛ)	(0.113)	(0.114)	(0.109)
Tariff (log)	0.04ℛ5	0.17ℛ	0.212	-0.7ℛ8**	0.047ℛ	0.0195
	(0.19ℛ)	(0.208)	(0.215)	(0.347)	(0.212)	(0.230)
BIT	-0.0ℛ23	-0.0721	-0.0572	0.198	0.124	0.1ℛ4
	(0.111)	(0.110)	(0.110)	(0.13ℛ)	(0.12ℛ)	(0.127)
Observations	ℛ,7ℛ4	ℛ,7ℛ4	ℛ,7ℛ4	ℛ,7ℛ4	ℛ,7ℛ4	ℛ,7ℛ4
R-squared	0.32ℛ	0.328	0.325	0.279	0.323	0.319
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Country-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 are clustered at the ℛ digits NAICS level.

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

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A   Appendix - Measurement of FDI

For our sample of countries and yer, 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 6 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%, the ultimate owner of firm 4 is firm 1, while, considering a path of minimum ownership of 50.01% the ultimate owner of firm 4 is firm 3.[34]
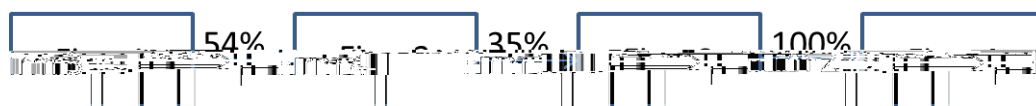

Figure 6: ORBIS definition of ownership

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).

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

Appendix - Additional tables

Table A.1: Complete list of agreements

Germany (EU)			US		
Agreement	Entry into force		Agreement	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-Faeroe 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 A.2: Vertical FDI and Deep Integration: First stage

	PTA	N. of Provisions	log(Top 5)	log(Top 10)
	(1)	(2)	(3)	(4)
PTA^{IV}	0.017***			
	(0.0005)			
N. of Provisions^{IV}		6.877***		
		(0.348)		
Top 5^{IV}			3.551	
			(0.221)	
Top 10^{IV}				3.242
				(0.189)
F-stat (p-value)	0.000	0.000	0.000	0.000
Observations	4,816	4,777	4,777	4,777

Robust standard errors in parentheses are clustered at the 8 digits NAICS level.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A.3: Vertical FDI and content of PTAs: First stage

	Dummy $_h$	Dummy $_m$	Dummy $_h$	Discrete $_h$	Discrete $_h$	Discrete $_h$
	(1)	(2)	(3)	(4)	(5)	(6)
Dummy $_h$^{IV}	4.584***		-19.995***			
	(1.755)		(4.537)			
Dummy $_m$^{IV}		5.110***	21.482***			
		(1.184)	(3.359)			
Discrete $_h$^{IV}				-20.101***		-19.224***
				(1.918)		(1.958)
Discrete $_m$^{IV}					3.208**	13.990***
					(1.133)	(2.211)
F-stat (p-value)	0.000	0.000	0.000	0.000	0.000	0.000
			Dummy $_m$			Discrete $_m$
Dummy $_h$^{IV}			-8.997**			
			(3.950)			
Dummy $_m$^{IV}			12.080***			
			(2.517)			
Discrete $_h$^{IV}						-2.451**
						(1.084)
Discrete $_m$^{IV}						3.087**
						(1.115)
F-stat (p-value)			0.000			0.000
Observations	8,784	8,784	8,784	8,784	8,784	8,784

Robust standard errors in parentheses are clustered at the 8 digits NAICS level.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$