Organizational Complexity of Multinational Groups and Productivity in the European Union

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Abstract

In this paper we explore one dimension of global value chains: the complexity of organization of international production within multinational business groups as represented by the worldwide control chains. Exploiting a unique dataset that matches affiliates with parent companies, we first propose a measure of entropy for the control chain borrowed by hierarchical graph theory, then linking it to the performance of affiliates measured by productivity. We restrict our focus on a sample of some 22,211 firms located in the New Member States of European Union and controlled by ultimate parent companies located in EU-15, confronting them with individually owned foreign businesses. We find that simple affiliation to a multinational business group implies a different firm performance, although the effect becomes non monotonous for relatively higher levels of complexity. Among the benefits of affiliation we find in particular that financial constraints are softer whatever the size of the multinational group

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1 Introduction

The alternative organizational modes of foreign production by multinational firms constitute an important variable in determining their relative performance. The choice to internalize some value-added activities, the degree of diversification, the size of investment and their location worldwide are all decisions that allow multinational firms to improve technical efficiency, increase profitability and more in general enhance competitiveness through a coordinated management of a hierarchy defined by property rights. The more important as a variable if we consider the surge in cross-border production chains as one distinctive feature of the actual wave of economic globalization, with trade in intermediate products (i. e. products that are purchased by industrial customers) accounting for more than half of total exports for example in European Union (see Fig. 1). The role of hierarchies, as developed by multinational firms in shaping global production chains, is confirmed by the evidence that intra-firm exports (i.e. the trade among firms or branches belonging to the same multinationals) is a growing phenomenon. Official aggregated data for US and Japan show that around one third of trade flows were due to bilateral shipments from subsidiaries to parent companies (Helpman et al., 2008). More recent data for Italy have shown that at least 48.8 percent of manufacturing exports and 53.2 percent of manufacturing imports of foreign subsidiaries located in the country is due to trade within their own group (ISTAT, 2008). It means that half of the trade generated from Foreign Direct Investment (FDI) in this country should be considered intra-group trade. Through a sectoral analysis of US and Japan data, the OECD (2002) also suggested that the increasing trend in both intra-industry and intra-firm trade is revealing of the establishment of vertical production chains, especially with less developed countries.

In this paper, we explore one dimension of the vertical production chains, that is the complexity of organization of international production within multinational business groups as represented by the complexity of the worldwide control chains, and link it to the performance of their own affiliates.

By multinational business group we mean every multinational firm composed by a headquarter that controls at least one affiliate located abroad, whereas by complexity of the control chain we propose an index which ranges from zero to infinity, namely from the case of a parent company operating only one subsidiary in a foreign country to subsidiaries embedded in long control chains ramified in different world regions. Matching balance sheet and ownership data of subsidiaries with balance sheet and ownership data of parent companies, we are first able to piece together control chains of multinational groups and then derive a continuous firm-specific measure that we refer to as Global Index of Complexity (GIC) for organizational hierarchies defined by property rights. Relating this index to firms' characteristics, we have three important results.

First, we find that the simple affiliation to a business group implies a different firm performance. In particular, we observe that subsidiaries owned by groups with a worldwide presence explained by a hierarchical complex structure are more productive than simpler groups, which

in turn are more productive than firms owned by foreign individual shareholders, although the effect becomes non monotonous for relatively higher levels of complexity. These results confirm the evidence provided by Khanna and Palepu (2000a; 2000b) for business groups (whether domestic or multinational) in emerging economies such as India and Chile, where they can alleviate market imperfections not only in financial markets (Chang and Choi, 1988) but also in product markets, labor markets and technology.

Second, different from the results of Nickell and Nicolitsas (1999) for UK, we find that financial pressure has a negative effect on productivity, but that this pressure is softened by the affiliation to a group whatever its size. Further considering the different organizational modes of the finance function by the group as a whole (Kuppuswany and Villalonga, 2010) and the recourse to the Stock Exchange by single affiliates, we lean towards the hypothesis that the better reputation provided by the affiliation to the group for credit loans is more effective than the possibility offered by the development of an internal capital market in explaining the softening of the financial constraint, especially for firms in transition economies that require enormous financial resources only partially provided by young credit markets that operate in a context of information asymmetries (Konings et al., 2003).

The third result concerns a comparison between the performance of affiliates involved in the production of intermediate products and the ones that adopt a traditional strategy of market-seeking. The levels of productivity are on average lower for the affiliates that sell their standardized intermediate products to industrial consumers, whereas in the case of differentiated goods and services purchased by final consumers the affiliate is able to apply a higher markup because of a lower elasticity of substitution. Moreover, when the intermediate production is controlled by a group with the development of an internal market for them, it is more likely that the internal price is chosen to be more favorable to the group than the market price, with the difference affecting the level of productivity. However, once looking at dynamics, i. e. the rates of growth of total factor productivities, the difference fades away and the benefits due to the affiliation to a business group prevail.

The geographical and time span of our analysis is the European Union in the period before and after the enlargement to Eastern Europe: the latter event can be used as a sort of natural experiment since, beside the global tendency towards falling trade costs and technological progress that enables multinational firms to fragment production internationally, enlargement has induced an acceleration towards the creation of international value chains starting from a virtually FDI-free environment, thus allowing for a good control of initial conditions. In particular, we restrict our analysis to subsidiaries located in the new members of the European Union but owned by old members before the accession, with some insights on the relative performance of German and Italian groups. These two countries, in fact, are the two main investors in the area in terms of number of subsidiaries but their groups adopt different corporate structures and their subsidiaries report different results in terms of performance with respect to the average of old members.

The paper is organised as follows: in Section 2 we present some stylized facts of the East-West European integration, showing how this latter is essentially driven by the internationalization of value-added activities. In Section 3, we describe the procedure adopted to build our sample of international groups, splitted between parent company and foreign subsidiaries. In Section 4 we define the boundary of the multinational groups and we introduce the Global Index of Complexity, discussing some stylized facts related to this measure. The relationship between group complexity, financial pressure and productivity is reported in Section 5, while Section 6 concludes.

2 Foreign production in New Members of EU and East-West integration.

Long before the European enlargement to ten new members of Central and Eastern Europe (CEE) in 2004 and two others in 2007, trade flows between Eastern and Western Europe had been increasing as the result of the gradual trade liberalization induced by the Europe Agreements in the 1990s. At the date of accession, thus, only the formal adoption by the New Member States (NMS) of the EU Common External Tariff remained to be implemented, with trade barriers having already been progressively abolished during the accession negotiations. However, as shown by Figure 1, the trend in the growth of trade within EU did not stop at the accession date, but kept on increasing as economic integration in the enlarged single market acquired new and deeper forms.

[Figure 1 about here]

The volume of monthly trade flows increased of a 119% rate in the decade from January 1999 to September 2008, the month after which we can observe a trade collapse as one of the effects of the financial crisis that let total exports shrink almost to the levels of 2004. Once decomposing the trade in intermediate products and final goods according to BEC-SNA categories[1], we note that most of the growth of the last decade is due to the category of intermediate products which are the ones that originate international production chains either as arm's-length relationships across different firm nationalities or as intra-firm trade for multinationals operating cross-border. This simple stylized fact for the European Union as a whole is further confirmed for the case of accession countries by Figure 2, where a measure of foreign production is provided by UNCTAD with aggregate flows of Foreign Direct Investment crowding to these countries from the rest of the world, both in million dollars and in percentage of the EU total. The steep path from the beginning of transition showed an acceleration in 2004, the year of accession for ten New

[1] BEC (Broad Economic Categories) is a classification of traded products that takes into account the final use of them. They are then aggregated according to SNA (System of National Accounts) categories that distinghish between intermediates at different stages of production (primary, parts and components, semifinished) and final goods (capital and consumption). http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=10&Lg=1

Members, reaching a considerable amount of 75,660 million dollars in 2007 and an average 9% if weighted against inward FDI destined to the Union as a whole. A figure that shows convergence towards the Western levels given the disparity in economic size from which they depart, since they account only for 7% of EU GDP but collect 21% of the population.

[Figure 2 about here]

Even though in 2008 the percentage of FDI aggregate stock in New Members reached only a 3.95% respect to world total stock, there is a strong degree of heterogeneity in FDI to GDP per capita stock indices, till a peak of more than 80% for small open economies such as Bulgaria, Hungary, Estonia and Malta which are well above an average of 55% for the entire region.

Given these trends in FDI flows, it is interesting to restrict the focus of analysis by category of investment. In the same Figure 2 we have also the relative importance of cross-border M&A's, which are one possible form of entry in a host country with a foreign economic activity, i.e. brownfield investment through the acquisition of an incumbent firm in the local market that excludes the greenfield investments and reinvestment of earnings. Even if at the beginning of 2000s the percentage of M&A's value covered almost the entire amount of FDI crowding to the region, newly-found affiliates and reinvestment of earnings from previous activities represent the bulk of the flows for the rest of the period, especially in the recent years after the accession.

A combined reading of Figures 1 and 2 provides first evidence of an economic integration based on the creation of international production chains driven by the establishment of multinational firms in New Members of the European Union that are able to trade in intermediate products with the rest of Europe, either destined to the internal market (within the group) or to other industrial consumers for further stages of production before reaching the final consumers.

3 The boundary of the Multinational Business Group

Following a widely accepted definition (Dunning and Lundan, 2008), we define a multinational firm as an enterprise that controls value-added activities in more than one country and we consider a foreign investor as an individual, an enterprise or a government that operates in a country other than the country of residence with a lasting interest (OECD, 1996). There is a slight but important difference among the two previous definitions that arise concerns about the delimitation of a boundary for foreign production. If in the first case we would have a clear example of a hierarchy created for the coordinated management of firms (or branches) as an alternative to market horizontal relations, in the second case the "lasting interest" of the investor does not imply control of management decisions, even if a considerable influence on an economic activity is always to be taken into account, and also it does not require the presence in different countries. Essentially, in the first case we would have a clear-cut case of internalization of foreign activities in order to minimize transaction costs (Williamson, 1985; Gatignon and Anderson, 1988; Hennart, 2000), whereas a foreign direct investor can be distinguished by a portfolio investor for the duration of the interest, this latter a wider definition that includes also,

but not only, the case of internalized activities. From an empirical point of view, the concerns arisen are twofold: a) the first is a problem of threshold: which is the level of equity participation and/or voting rights that allows to define control within the hiearchy of a Multinational Firm? b) Second, how should we consider the case of firms owned by foreign individuals?

The first question has no straight answer, since control is defined in relation to the degree of other shareholders' participation[2] and can be rather considered firm-specific. For example, in the case of a public company, a minority share can allow control on the whole company either because the rest of equity is fractioned among unorganized shareholders or, as it is sometimes the case for financial funds, the majority is not interested in the management but considers the investment essentially as a portfolio activity. The commonly accepted FDI threshold of 10% can then be considered too low or too high once looking for control, according to firm-specific considerations. Here we follow the consolidated experience of the international accounting standards (IAS/IFRS) and proxy control above a threshold of 50.01% of direct or indirect participation. In theory, a trade-off emerges when dealing with subsidiaries belonging to more groups: completeness of the control chain (boundary of the group) would call for a double counting of them by different groups, while a complete partition of the subsidiaries among groups would call for their belonging to only one single group. A threshold of 50.01% would seem more appropriate for the case in hand, but it could exclude some affiliates leaving them outside the boundary of any group and introducing a potential selection bias. We will control in the next sections if results change in case we include double-counting of firms with a lower threshold of 25.01%, that however in our sample account only for about 1%.

As for the firms that are considered foreign because they are directly owned by residents in another country, we split these FDI in two different subcategories: the first one is considered a multinational group when at least another firm is owned by the same individual and is located in another country, the second one is simply considered as originating an individually(or family-)owned internationalized firm but not belonging to a group.

More briefly, we define a Multinational Business Group as a set of at least two companies located in different countries and linked by a common control as defined by property rights above 25.01%. Adopting this criterion, and employing the Amadeus database by Bureau van Dijk[3], we are able to identify more than 129,114 globally-active groups in the European Union, of which only 30,301 have two or more subsidiaries abroad, the majority being represented by one foreign subsidiary owned by a parent company located in one of the EU members.

Within this wider set of companies we restrict our analysis to the European groups that, having their ultimate owner in one of the EU-15 countries, locate their affiliate(s) in at least one of the New Member States[4]. The period considered for the sample is 1998-2006, an interesting

[2] Or eventually by monopsonistic relationships between suppliers and industrial customers, where the bargaining power of a unique customer is such to define control.

[3] Amadeus by Bureau van Dijk collects more than 8 million European companies in ... countries.

[4] Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia on 1st May 2004; Bulgaria and Romania on 1st January 2007.

period for the progress of economic integration within European Union, when accession of New Members was first prepared and then implemented, but also when the euro was adopted as a single currency. Both events concur in fostering the creation of intra-European production networks.

The recent availability of ownership data lets us trace the whole control chain of each company, allowing us to match every subsidiary with the ultimate owner, up the chain, which ultimately controls the whole group to which the single subsidiary belongs.

Matching ownership data of ultimate owners with their subsidiaries, we have obtained a sample where, together with balance sheet data of every subsidiary, we have merged either the balance sheet data of the ultimate parent company in EU15 or some other ownership data of the foreign owner in case of individual ultimate ownership.

The sample includes firms engaged in every economic activity classified in NACE rev 1.1 at 4-digit codes, i.e. it also cover services. Table 1 provides a description of the sample in terms of nationalities and numbers.

[Table 1 about here]

Among EU15, Germany and Italy are the countries that, as our sample data show, host together parent companies which owns the majority of subsidiaries located in New Members, 23.77% and 29.72% respectively. More than German ones, Italian subsidiaries in New Members are in general individual(or family)-owned (97.3% of the Italian sample), with only 67 parent companies that own an average of 2.61 subsidiaries each. Here Sweden, Denmark and Luxembourg are the only old members of EU that have more corporate-owned than individually-owned subsidiary. In the case of Luxembourg, however, the data show that most of ultimate parent companies are often legal entities located in the country because of tax exemptions, but with clear foreign (different from Luxembourg) nationality.

4 The Global Index of Complexity (GIC)

In order to derive a synthetic measure of organizational complexity of the multinational network, we borrow from graph theory. Graph theory has among its scopes to observe and measure mathematical similarity of objects with a multidimensional nature and represent them in a graph form. Figure 3 is an example of a theoretical graph with its nodes and edges, where the first are elements of a more complex system connected together by the second ones in different and alternative ways.

From the draw of anorganic molecules to the representation of a file system on a computer, complexity of natural and social systems can be measured by some form of entropy tailored to the specific objects of analysis. Here we adapt a measure for entropy of hierarchical graphs (Emmert-Streib and Dehmer, 2007) to the measurement of the complexity of control chains of business groups operating abroad.

A hierarchical graph is any flat graph to which at least one parent node is added to assign

functions to the other nodes (Palacz, 2003). In our measure, the nodes of the graph are the subsidiaries and the edges are represented by control participations. Hierarchical graphs are generalizations of tree graphs: if the latter ones provide for only one vertex from which several arms depart as in a tree but two different nodes are connected by only one edge, the hierarchical graphs allow for different ultimate vertices that can be directly or indirectly connected through several edges. Given the concept of hierachical graph as defined above, the adoption of it to represent a firm hierarchy as defined in transaction cost economics seems even obvious, whether it represents the organization chart of a single firm, its division in branches or the agglomeration of affiliates coordinated by a headquarter as in our case.

The algorithm we use to measure complexity of corporations requires a previous step in order to identify the boundary of the multinational group following the discussion of the previous paragraph and adopting the notion of control to determine the economic space that belongs to the firm. As international economic literature has often showed when analyzing spillover effects, influence on the management of a firm is possible with lower participation and in fact, it is not necessary to have complete control on a subsidiary to exert influence on management or to contribute positively with knowledge and experience. To the extent, following IAS/IFRS accounting standard, we have opted for a minimum threshold for direct or indirect control participation of 50.01%, since our objective is to trace the effects of hierarchical coordination. The consideration of cross-participations, i.e. the indirect participation of the headquarter through the stakes belonging to other affiliates within the group, allows to take into account the effective control exerted by the headquarter on the management of a single subsidiary.

Once we have identified the boundary of the Multinational Business Groups, we are able to draw the control chain of every corporation as in the example depicted in Figure 3, where the coloured objects represent nodes/subsidiaries belonging to the complex system of a single business group, whereas the other nodes can represent another business group interlinked with the first one. The draw clearly shows how mobile can be boundaries between groups: the exclusion of subsidiary 13 and the inclusion of subsidiary 9 in the first group, for example, is determined solely by the combination of control threshold and cross-participations.

There are however several dimensions that have to be considered for every group having at disposal the whole control chain : the number of nodes, in this case clearly linked to subsidiaries; the number of edges, in our case given by the control links; and the number of levels, represented by the vertical distance of subsidiaries from the ultimate owner.

The simplest version of a Global Index of Complexity (GIC) we propose is able to summarize the information content given by those dimensions in a unique numerical variable that can be fitted both to groups spreading their economic activity worldwide and to simple groups constituted by one parent company owning one subsidiary abroad. Given the scope of our analysis, we assume that domestic subsidiaries are all collapsed at level 0, with no distance from the parent company[5]. The Index thus assigns a discrete probability distribution $P : L \rightarrow [0, 1]$

[5] An alternative method can include all domestic subsidiaries in a level one, without regard of the actual

to every level l, where probability is $p_l = \frac{n_l}{N}$ with n_l number of nodes on level l and N total number of nodes:

$$GIC = \sum_{l=1}^{L} p_l \log\left(1/p_l\right) = \sum_{l=1}^{L} \frac{n_l}{N} \log\left(\frac{N}{n_l}\right) \tag{1}$$

As such, the index ranges from zero, when a parent company operates all subsidiaries in a foreign country[6] at the same level l, to infinity. The higher the index, the more ramified are the control chains that have to be covered before reaching the final objective of the coordinated management decision. The logarithmic weight with base 2 assigned to the probability term of every level increases the measure of complexity (marginal complexity) when more subsidiaries (n_l) are included such that:

$$\frac{\partial GIC}{\partial p_l} < 0, \qquad \text{with } n_l \in \mathbb{N} \text{ and } n_l > 1 \tag{2}$$

but with $\frac{\partial GIC}{\partial^2 p_l} > 0$, hence a decreasing marginal complexity in n_l number of subsidiaries for level l. This latter characteristic of the measure we adopt for complexity is consistent with the idea that, after an initial fixed cost substained by the parent company to implement a governance for the whole system, a marginal increase in the complex structure of the system would cost less and less to the parent company thanks to economies of scale.

The GIC is also increasing in the number of levels given that a new level would add another term to the sum, but this formulation of the Index does not discriminate among subsidiaries belonging to different levels, that is $\frac{\partial GIC}{\partial p_m} = \frac{\partial GIC}{\partial p_n}$ for $m \neq n$ two different levels when $m < n$. The complexity that another subsidiary adds to the general complexity is not differentiated for the level it belongs. To do it, we can give a penalty additional weight to the probability distribution of levels more distant from the parent company. We could thus rewrite another version of Index:

$$GIC^* = \sum_{l}^{L} l \frac{n_l}{N} \log\left(\frac{N}{n_l}\right) \tag{3}$$

where as before $l \in \mathbb{N}$ is the level/distance from the ultimate parent company that is now taken into account in the incremental complexity, since $\frac{\partial GIC}{\partial p_m} > \frac{\partial GIC}{\partial p_n}$ for $m < n$.

Here the rate at which marginal complexity decrease with the acquisition of subsidiaries depends on the combination of number of subsidiaries already at that level and the number of levels itself.

The choice between the simple Global Index and its augmented version should depend on

level given by control links, and then beginning with foreign subsidiaries from level 2. The additive property of the Index allows then a decomposition between domestic and global complexity, once a complete partition of subsidiaries on levels is made.

[6] The Index is not monotonically increasing in the number of subsidiaries since we are interested more in the combination of subsidiaries and property passages that leaves room for complexity in the coordination procedure. The more the contemporary combination of nodes and levels you have to go through to implement a managerial decision, the more the difficulty to drive a bargain among conflictual stakeholders. See for example for a reference on minority shareholders

considerations about the control that ultimate parent company have on more distant subsidiaries.

Another way to stress the distance (or complexity) could be the explicit introduction of the edge entropy in the measure, for example if we considered cross participations as a further dimension in the Index, or also if we wanted to count how many intra-firm trade connections are present within the group and their thickness. In the first case, as we have mentioned above, an affiliate can be finally owned through direct participation (held by the headquarter) and indirect cross participations (held by any other affiliates in the control chain) and the control participation should take into account both. But a proliferation of edges, i. e. the direct or indirect property links among members of the group, could be another factor determining complexity in the coordination of the Multinational Business Group that makes enforcement of management difficult the more distant the affiliate is considered in terms of property rights. We would have a joint probability distribution $p_{ij} = p_i^e * p_j^n$, such that $p_i^e = \frac{e_l}{E}$ and $p_j^n = \frac{n_l}{N}$, with e_l number of edges at level l and E total number of edges in the graph and the simple multiplication of the two events' probabilities to indicate that they are mutually independent. The Index in this latter case would be:

$$GIC^{**} = \sum_{i}^{L} \sum_{J}^{L} p_{ij} \log \left(1/p_{ij}\right) \tag{4}$$

$$\frac{\partial GIC}{\partial p_{ij}} < 0, \qquad \text{with } n_l, e_l \in \mathbb{N} \text{ and } n_l > 1,\ e_l > 1 \tag{5}$$

with a decreasing marginal complexity in both nodes and edges, provided that we have at least one subsidiary and one control link on each level.

However, given the scope of our analysis, the combined consideration of a threshold and cross-participations at a preliminary step for the boundary suffices to single out controlled affiliates and their performance in relation to the size of the group, whereas this latter version of the Index would be useful to measure hierarchies that flow into some form of alliances (i. e. hybrid form of organization between hierarchies and markets) with some participations well below a control threshold but a certain degree of influence in management decisions. Of course in this latter case we would have no perfect partition of subsidiaries among final headquarters, but very ramified graphs where connections (edges) gradually fade out.

Interesting to mention, we think that this index would be also useful in the case of intra-firm trade, where one would have a measure of the integration of activities within the group based on the number of exchanges of intermediate products among affiliates. A hint on the degree of vertical integration of the group in the production process.

Applying our Index to the sample of subsidiaries and global ultimate owner described in Section 1, with a threshold for control participation at 50.01 percent, we have a GIC for parent companies located in EU15 and we can attribute this variable to 3819 subsidiaries located in the New Member States. As Table 1 shows, 18,392 firms have an individual ultimate owner and do

not have an Index of Complexity, i.e. they fall into the category of foreign individually owned firms as discussed in Section 3. An in-depth analysis we have conducted on the ownership data has demonstrated that 92.9% of sample subsidiaries that are ultimatelly owned by individuals are also immediately owned by individuals, i.e. there is no control chain to consider for them. For the 7.1% remaining we cannot retrieve ownership data for ultimate owners.

A first useful exercise able to show investment strategies for corporate groups investing in New Members of EU is the decomposition of the GIC according to world regions. What we do is a separate calculation of the Index within a world region, isolating it from rest of the world[7]. Results are shown in Figure 4. Two interesting remarks emerge from this exercise. The first one is that sample groups are well rooted in developed countries, as from average GICs indicate: other "EU15" countries (different from country of origin), "North America", "Oceania"(essentially Australia and New Zealand) and "Rest of Europe" (countries not members of the EU) display thicker distributions. Instead, EU groups have a simpler corporate structure in less developed countries: "Latin America", "Far East and South-East Asia "(including China and India), "Middle East and Africa". Complexity in New Members sat between that registered for developed countries and that portrayed for less developed countries. The second remark is that, more than the geographical distance, data suggest a relationship between the development of a hierarchy with a complex production network of subsidiaries and the quality of institutions of the host countries that should be further investigated. Beyond our sample, a first investigation on European business groups investing abroad has shown that the one-parent-one-subsidiary strategy is the most preferred in emerging countries. In particular, out of the 129,114 globally-active groups monitored within the EU, there are only 1,213 groups that have invested in China or India and 960 of them have invested in both China or India and the NMS.

[Figure 4 about here]

In Figure 5 we present another interesting exercise, showing the kernel density (log) estimation for the complexity distribution of EU15 sampled groups, first confronted with German ones alone and then with Italian ones. The most simple complexity is given by a one-parent-one subsidiary control chain: looking at the thick left tails of the distributions we see that many groups operating in New Member States adopt this ownership structure, while this is relatively less the case for Italian and German groups, where however, as we have seen in the previous section, the bulk of firms are owned by individuals with no control chain (not reported in this figure). The other peak of the EU15 and German distributions is in the middle, with a not so high global complexity, with German groups that pull the average EU15 curve up. Italian groups are instead either relatively small or relatively large, with a striking absence in the center of the distribution of middle-complex groups.

[Figure 5 about here]

[7] This exercise obviously excludes one-parent-one-subsidiary structures given that, if present, they had the unique subsidiary in New Member States due to the initial selection of the sample

The first important preliminary result we find, once differentiating between subsidiaries controlled by a group and firms controlled by foreign individuals (see Section 3 above), is that the simple affiliation to a corporate group, whatever his complexity, is related not only to higher productivity, but also to higher firm size and profitability.

In the following Table 2 we calculate the performance premia of affiliates owned by corporate vs. individuals or families: in the first column we adopt a simple OLS, while in the second column we include industry fixed effects in order to correct for possible correlation of firm-level measures with industry characteristics. Firm-level productivity is given by estimates of TFP according to the Levinsohn and Petrin (2003) methodology[8] (see Appendix for details) and by labor productivity proxied by value added per worker and turnover per worker. Firm size is proxied by both number of employees and turnover, whereas profitability is represented by the profit/loss before taxation from the balance sheet.

[Table 2 about here]

On average, for subsidiaries located in the New Member States owned by EU15 residents, the affiliation to a group means a 90.7% difference in terms of TFP, with labor productivity even higher. Group-owned subsidiaries are on average fourfold bigger in terms of turnover, but also more than twice bigger in terms of employees and three times more profitable. As for profits, prudence is required because the favorable taxation in the countries of enlargement could have given incentive to the phenomenon of transfer prices which can cause displacement of profits within the group, a phenomenon that can not take place in our control subsample of individual-owned subsidiaries.

The higher performance of foreign affiliates with respect to firms owned by foreign individuals could be attributed to higher managerial pressure and/or to specific and standardized production and management processes experimented in other affiliates of the group. Especially the latter could be a qualification of what we generally refer to spillovers. Even if economic literature has showed that foreign-owned firms are more productive than domestic ones due to knowledge spillovers, the codification of them within a business group should allow a faster and better circulation whereas family-owned businesses, in which knowledge tends to be less codified, are less able to let spillovers circulate worldwide. As we will see in the next section, the international boundary of the group has its importance in the circulation of experiences. Size premia are even larger than productivity premia and this difference could be explained by the greater availability of resources that subsidiaries of corporate groups typically enjoy with respect to constraints that individually owned subsidiaries have to face.

A second important result is that the nationality of the parent companies seems to matter. Confronting German and Italian subsidiaries on productivity, firm size and profitability, we observe that German-owned firms perform better than Italian ones on average. That is what we

[8] The identification of a sectoral production function and a firm-specific residual for TFP has required the consideration of all the firms (including domestic ones) in every New Member country and every sector included in the original dataset for a total of about 2 million firms with data on capital, labor and intermediates provided by the Amadeus database by Bureau van Djik.

report in Table 3, with the same methodology as before, but with the premium now calculated in terms of German vs. Italian ownership, for both types of ownership (corporate vs. individual or family-owned). Of course here the difference is to be attributed to organizational talents that owners and management of different nationality bring with themselves from home country.

[Table 3 about here]

German-owned firms are more productive, 22.3 percent if individually-owned and 29.2 if group-owned when we take TFP levels. Once controlling for industry fixed characteristics, also labor productivity is higher for German subsidiaries, with a ratio higher in case of individually owned firms that are 32.2 percent more productive than Italian ones This latter result could be in part explained by the fact that we know from our sample that German subsidiaries are usually more capital intensive with an average ratio between capital and labor of 238,000 euro for Germany and 183,000 euro for Italy. With a more capital intensive production process, ceteris paribus, a firm will register higher marginal labor productivity and lower marginal labor productivity. In fact, for German-owned firms we register a capital productivity, calculated as value added on fixed assets, which is 21.1 percent lower than Italian-owned firms. Size and profitability show premia for subsidiaries with a German ultimate owner which are almost twice as large in case they are corporate-owned.

5 On the determinants of productivity of foreign subsidiaries

Once having determined a ranking of productivity, and a correlation between type of corporate control and firm performance, it is worth further exploring this relationship in order to understand whether corporate ownership *per se*, or rather the characteristics associated to corporate control, namely the complexity of the group and financial pressures, matter for productivity.

We have already treated in Section 4 our proposal for the measurement of groups' extension of hierachical organization, the GIC in its first augmented version that takes into account a penalty for farther levels of distance from the headquarter. From the point of view of transaction cost economics the GIC can be also considered as the size of the group, i.e. the extent to which the Multinational Business Group has internalized value-added activities. A measure to be confronted with the size of the affiliate itself at the beginning of the period ($size_{it-1}$) and the size of the ultimate parent company at the beginning of the period (S_{it-1}), in order to have a complete overview of the effects of internalization processes on productivity. For the financial constraint instead, we prefer to adopt the measure suggested by Nickell and Nicolitsas (1999), through a firm- and time-specific ratio:

$$FP_{it} = \frac{interest\_payments_{it}}{profit\_before\_tax_{it} + depreciation_{it} + interest\_payments_{it}} \tag{6}$$

which is based on the cost of the credit rather than on the level of indebtness and/or leverage as done in other studies (Desai et al, 2008), since we argue that levels here could be the

object of a specific financial strategy whereas the real cost paid for this strategy is the price that conveys information on the position of the firm on financial markets. Unfortunately we don't have data to measure the extent and the development by multinationals of an internal capital market since our firm-specific $interest\_payments_{it}$ can comprehend both interests paid to external resources and financial expenses for intra-group loans. We try however to verify if the recourse to the Stock Exchange (a dummy $quoted_i$ that equals 1 if the affiliate is quoted) has an effect on the financial constraint and, following Kuppuswamy and Villalonga (2010), if the specialization of the group in financial activities (a dummy $financial\_group_i$ that equals 1 if the headquarter is specialized in financial activities[9] and/or the majority of subsidiaries is involved in financial activities) is the cause of a softening of the financial constraints. A binary variable $group\_control_i$ separates the dataset between firms that are controlled by a group and individually owned firms, whereas another binary variable $intermediates_i$ disentangle between core activities involving the production of intermediate products (whether destined intra-group or to other industrial customers) and production of final goods and services[10].

We first estimate the following specification for Total Factor Productivity levels of all the firms included in the dataset:

$$\begin{aligned}\ln(TFP_{it}) &= \alpha_0 + \alpha_1 * \ln(size_{it-1}) + \alpha_2 * (FP_{it-1})^{\gamma} + \alpha_{3*} * group\_control_i + \\ &+\alpha_4 * group\_control_i * (FP_{it-1}) + \alpha_5 * quoted_i + \\ &+\alpha_6 * quoted_i * (FP_{it-1}) + \alpha_7 * financial\_group_i + \\ &+\alpha_8 * financial\_group_i * \alpha_9 * (FP_{it-1}) + intermediates_i + \\ &+\alpha_{10} * intermediates_i * group\_control_i + \mu_h + \eta_j + \theta_t + u_i + \epsilon_{it} \qquad (7)\end{aligned}$$

The results are reported in the first column of Table 4, where we adopt a Hausman-Taylor (1981) strategy with fixed effects for industry (η_j), host country (μ_h), time (θ_t) and the endogeneity through time of size ($size_{it-1}$) is controlled instrumenting with firm fixed effects (u_i).

The preference of a Hausman-Taylor (1981) estimation model on both a Fixed Effects model and a Random Effects model emerges as a result of a pre-estimation test proposed by Baltagi et al. (2003). The use of such a model specification allows us to introduce in our estimating equation fixed individual characteristics, such as the corporate ownership, controlling however for the correlation between some of these characteristics and the unobserved individual-level random effects. Following the pre-estimation strategy proposed by Baltagi et al. (2003), we performed a dual Hausman test, the first one confronting Fixed Effects model and Random Effects model, as we have just done before, and a second one comparing Fixed Effects and

[9] A financial activity here excludes the mere holding activity and administration of the group subsidiaries (NACE rev. 2, code 7010)

[10] RPI classification of economic activities based on NACE rev. 1 4-digit codes.

Hausman Taylor with a coherent choice of regressors suspected to be endogenous after the first test. If the result of the first test failed to prove consistency of Random Effects over Fixed Effects, the result of the second test has instead provided a direction for the consistency of the Hausman Taylor estimation strategy. As a further control on the correctness of the Hausman Taylor choice, we also have performed a modified (robust) version[11] of the Hausman test as proposed by Woolridge (2002), to avoid the shortcoming of the classical version that assumes Random Effects model as efficient, with α_i and ϵ_{it} independent and identically distributed.

[Table 4 about here]

The coefficient of firm size here is negative and significant meaning that larger firms show lower levels of productivity. But, considering the size itself as a control, we confirm that group-affiliated subsidiaries are 78% more productive, a result consistent with the preliminary evidence reported in Table 2. Ceteris paribus, financial pressure has a negative effect on productivity levels, contrary to what Nickell and Nicolitsas (1999) found for UK but consistent with a transition economies context where restructuring of firms' activities is crucial to reach competitiveness and it involves the employment of remarkable stocks of financial resources (Konings et al. 2003).

A Wald test for linear and non-linear hypothesis performed after the Hausman and Taylor (1981) estimation has helped us to provide the specification with the inclusion of a quadratic term ($\gamma = 1, 2$, respectively). Increasing levels of financial pressure have a proportionally increasing effect on TFP levels, i.e. the exposure to a harder and harder credit constraint makes restructuring more and more difficult. A result that makes sense and that opens up problems of informative asymmetries in financial markets, where the cost of the credit substained by restructuring firms is not related to the potential of the firm itself, but to the collateral it is able to provide. In fact, we have tried to include the total debt load in the specification (debt on assets), once controlling for financial pressure, but we have found it to be not significant on the levels of productivity. On the contrary, the positive and significant coefficient of the interaction term between financial pressure and group control shows that firms that are affiliated to a group have a softer financial constraint, with financial pressure having a proportionally lower effect on productivity with respect to individually owned firms. Unfortunately we cannot directly infere from these results if the relief is due to the creation of an internal capital market within the group or to a better reputation that an affiliate can provide as collateral when recurring to external financial resources. We verify however that the quotation on the Stock Exchange is neither among the determinants for the softening of the constraint nor a feature that suggests higher levels of productivity. Adopting instead the strategy of Kuppuswamy and Villalonga

[11] The robust version of the Hausman test proposed by Woolridge is based on the null hypothesis that after a first partial demeaning of the specification following Random Effects strategy, a further demeaning for individual time fixed effects is not significant. From the following specification:
$y_{it} - \widehat{\theta}\overline{y_i} = (1 - \widehat{\theta})\alpha_i + \beta(X_{it} - \widehat{\theta}\overline{X}_i) + \gamma(X_{it} - \overline{X}_i) + v_{it}$

where $\widehat{\theta}$ is the estimated version of $\theta = 1 - \sqrt{\frac{\sigma_e^2}{T_i\sigma_\alpha^2 + \sigma_e^2}}$, γ is not significantly different from zero.

(2010), a striking result emerges for groups that have affiliates and/or headquarters involved in a professional financial activity (different from simple holdings). Here we have that they are on average 18% less productive than the ones that are owned by other groups, the latter presumably more interested in the integration of their subsidiaries in international value chains rather than in exploiting dividends as for any other financial investment. It is in fact clear from the data that most of the financial groups we can identify are essentially financial funds and there is also no evidence of a different credit constraint for affiliates belonging to them. A different reasoning applies to the noteworthy result for affiliates involved in the production of intermediates that are on average 18% less productive and even less in the case of group affiliation. The lower level of productivity can be due to the relative standardization of intermediate products destined to industrial consumers with respect to the provision of differentiated final goods and services purchased by final consumers. In the first case a greater elasticity of substitution determines a lower markup, hence a lower price that in the case of an affiliate selling within its own group it is also an internal price more favorable than a market one. The interaction term between group-control and intermediates production confirm this latter expectation.

Restricting our analysis only to group-owned affiliates we estimate the following specification for which results are reported in the second column of Table 4:

$$\begin{aligned}\ln(TFP_{it}) &= \alpha_0 + \alpha_1 * \ln(size_{it-1}) + \alpha_2 * \ln(S_{it}) + \alpha_3 * \ln(FP_{it-1})^{\gamma} + \alpha_4 * \ln(GIC_i) + \\ &+\alpha_5 * \ln(GIC_i) * (FP_{it-1}) + \alpha_6 * quoted_i + \alpha_7 * quoted_i * FP_{it-1} + \\ &+\alpha_8 * fin\_group_i + \alpha_9 * fin\_group_i * FP_{it-1} + \alpha_{10} * intermediates_i + \\ &+\mu_h + \eta_j + \theta_t + u_i + \epsilon_{it} \qquad (8)\end{aligned}$$

In this case we substitute the binary variable that showed affiliation with our group size measure, the GIC_i in the second augmented version of Section 4[12] and we also control for the size of the ultimate parent (S_{it-1}). Results show that affiliation to a more complex hierarchy is associated to higher productivity levels. In line with what transaction cost economics argues, the benefits of a bigger hierarchy could range from an enhanced exporting activity due to intra-group trade, to superior managerial practices, access to standardized and codified technologies, better market information with respect to 'lonely knights' or better access to finance, thanks for example to a better reputation and to the support of a network of relations collected by the group. The relation with productivity is however not monotone, with subsidiaries owned by medium-sized groups benefiting more from the affiliation to a global network than subsidiaries belonging to very complex groups. The results actually allow for the computation of a complexity threshold at 2.41 (the exponential of 0.88), below which benefits are definitely positive. From

[12]It is the GIC plus one to calculate the logarithms and avoid the dropping of zero-complexity groups from regression estimates, that is the groups composed of one headquarter and one affiliate.

Figure 5, where we showed the kdensity log distribution of complexity of EU15 business groups operating in New Member States, we can see that the threshold is set more or less in the middle with respect to the existing groups, that we however remember are only the groups investing in New Members for which we calculate worldwide complexity. In particular, we see that 59.5% of group-owned subsidiaries belong to networks below this threshold. If we separately consider German and Italian groups operating in the new member States we can moreover notice that the median and mode of our GIC index for Germany are set below the threshold, whereas the Italian distribution is relatively flat within the same range. From the subsidiary sample, about 54 percent of Italian subsidiaries belong to networks that show a complexity above the threshold, whereas the figure for Germany is only 23 percent. Hence, right where the complexity benefits more, Italian groups are relatively less present than German and EU15 ones. The latter is a structural weakness for the Italian organizational presence in the countries of enlargement which is hindering their exploitation of profit opportunities. Surprisingly, the coefficient for the interaction term between financial pressure and group complexity is not significantly different from zero. Comparing this result with the interaction term in the previous specification and recalling that our specification now includes only those firms that are corporate-owned, we conclude that, once the corporate control is assured, the size of the network is not important in assessing the financial constraints the subsidiaries face. More than the wider internal capital market that a business group can develop, the better reputation of a firm that is controlled by a business group seems to be the crucial factor in determining the cost of the credit.

Besides the analysis of TFP levels done in the previous specifications, we perform a similar exercise for TFP growth rates to control if firm performance through time is influenced more by management coordination than by a cherry-picking selection bias with wider groups able to acquire affiliates with better perspectives given their information advantage. Again here, we first consider the whole dataset with group-owned and individually owned firms given the specification:

$$\begin{aligned}\Delta \ln(TFP_{it}) &= \alpha_0 + \alpha_1 * \ln(size_{it-1}) + \alpha_2 * (FP_{it-1})^{\gamma} + \alpha_{3*} * group\_control_i + \\ &+\alpha_4 * group\_control_i * (FP_{it-1}) + \alpha_5 * intermediates_i + \\ &+\alpha_6 * intermediates_i * group\_control_i + \mu_h + \eta_j + \theta_t + u_i + \epsilon_{it} \qquad (9)\end{aligned}$$

and then we restrict the dataset to group-owned firms for which we have the measurement of complexity:

$$\begin{aligned}\Delta \ln(TFP_{it}) &= \alpha_0 + \alpha_1 * \ln(size_{it-1}) + \alpha_2 * \ln(S_{it}) + \alpha_{3*} * \ln(FP_{it-1})^{\gamma} + \\ &+ \alpha_4 * \ln(GIC_i) + \alpha_5 * \ln(GIC_i) * (FP_{it-1}) + \alpha_6 * intermediates_i + \\ &+ \mu_h + \eta_j + \theta_t + u_i + \epsilon_{it} \end{aligned} \tag{10}$$

and results are contained respectively in columns 1 and 2 of Table 5.

[Table 5 about here]

The results on the whole dataset show that on average firms affiliated to a group grow 8.64% more after controlling for the negative effect of firm size. An important result, this latter, that confirms the idea that corporate ownership assures the accession to benefits over time. The financial pressure, calculated as in the previous specifications, has a negative effect on the growth rate of productivity but is partly loosened for group affiliates, as a confirmation of one of the benefits of corporate control. The second column of Table 5 excludes once again firms belonging to individuals and concentrates only on group affiliates. Here we find a 5.9 percent positive effect of group complexity on the productivity growth rate, once controlling for firm size and ultimate parent size. The Wald test here excludes a non-linear specification for $\ln(GIC_i^*)$ and point estimates confirm a less stringent financial constraint on productivity growth for group-owned subsidiaries, but the interaction term between complexity and financial pressure rejects again the group complexity as one of the determinants for the softening of the constraint . Differently from the case of levels, we observe no difference in growth rates for subsidiaries involved in the production of intermediates. This is actually a confirmation of the fact that the productivity gap in levels is attributable to the relative standardization of production and a lower elasticity of substitution with respect to final goods and services. Some characteristics, these latter, that however do not prevent firms to enhance competitiveness and performance within their own sector exploiting the benefits of the affiliation to a group.

6 Conclusions

We have investigated the performance of subsidiaries in the New Member States of the European Union that are owned by residents of the 15 original members. Within a context of firm heterogeneity, we have found that affiliates to business groups are more productive, bigger and more profitable than firms that are owned by foreign individuals. National premia have been found to be relevant in the case of German and Italian subsidiaries with respect to the average of the other investing countries in the sample, with German-owned affiliates more productive, bigger and more profitable than Italian ones. A new degree of heterogeneity has been tested through the adoption of a measure that we call Global Index of Complexity (GIC), which is

able to summarize the complexity of a global value chain of a business group. After some stylized facts that depict sampled groups as more complex in developed countries with a pattern of complexity that could be differentiated by country of destination, we have found that Total Factor Productivity (TFP) of subsidiaries is strongly related to the worldwide complexity of the group to which they are affiliated. This result could be referred to the chance that the single subsidiary has to access to a variety of experiences that spill over within the group, or equivalently, to the stock of managerial procedures that is accumulated by increases in size and is redistributed from core to periphery as Penrose (1959) predicted. The wider the group, the more the subsidiary can benefit from affiliation, even if it is involved in the production of intermediates that can suffer from an internal price transfer effect when compared with independent firms, as we find in the case of productivity levels. Once looking at dynamics, i.e. at productivity growth rates, difference in performance for these latter firms fades away and the benefits from affiliation prevail, confirming a premium for corporate control. Results, however, show that the relation between productivity and global complexity is not monotone but decreasing, with small- and medium-sized groups that have a more clear-cut influence on productivity. Among the benefits of affiliation we test a loosening of the financial constraint that, after controlling for the organization of the finance function, we attribute to the intangible collateral that group reputation is able to provide, better than the development of an internal capital market. In emerging markets and transition economies the financial pressure that subsidiaries face should mainly be due to information asymmetries of credit institutions and the scarcity of financial resources makes the restructuring more difficult with a negative effect on productivity levels and growth rates. In this case a better reputation and additional resources are available to the single subsidiary through the participation to an international network.

Annex: Levinsohn and Petrin (2003) productivity estimates

Let y_t denote (the log of) a firm's output in a Cobb-Douglas production function of the form

$$y_t = \beta_0 + \beta_l l_t + \beta_k k_t + \beta_m m_t + \omega_t + \eta_t \tag{A1.1}$$

where l_t and m_t denote the (freely available) labour and intermediate inputs in logs, respectively, and k_t is the logarithm of the state variable capital. The error term has two components: η_t, which is uncorrelated with input choices, and ω_t, a productivity shock unobserved by the econometrician, but observed by the firm. Since the firm adapts its input choice as soon as it observes ω_t, inputs turn out to be correlated with the error term of the regression, and thus OLS estimates of production functions yield inconsistent results.

To correct for this problem, Levinsohn and Petrin (2003b), from now on LP, assume the demand for intermediate inputs m_t (e.g. material costs) to depend on the firm's capital k_t and productivity ω_t, and show that the same demand is monotonically increasing in ω_t. Thus, it is possible for them to write ω_t as $\omega_t = \omega_t(k_t, m_t)$, expressing the unobserved productivity shock ω_t as a function of two observables, k_t and m_t.

To allow for identification of ω_t, LP follow Olley and Pakes (1996) and assume ω_t to follow a Markov process of the form $\omega_t = E[\omega_t|\omega_{t-1}] + \xi_t$, where ξ_t is a change in productivity uncorrelated with k_t. Through these assumptions it is then possible to rewrite Equation (A1.1) as

$$y_t = \beta_l l_t + \phi_t(k_t, m_t) + \eta_t \tag{A1.3}$$

where $\phi_t(k_t, m_t) = \beta_0 + \beta_k k_t + \beta_m m_t + \omega_t(k_t, m_t)$. By substituting a third-order polynomial approximation in k_t and m_t in place of $\phi_t(k_t, m_t)$, LP show that it is possible to consistently estimate the parameter $\widehat{\beta}_l$ and $\widehat{\phi}_t$ in Equation A1.3. For any candidate value β_k^* and β_m^* one can then compute a prediction for ω_t for all periods t, since $\widehat{\omega}_t = \widehat{\phi}_t - \beta_k^* k_t - \beta_m^* m_t$ and hence, using these predicted values, estimate $\widehat{E[\omega_t|\omega_{t-1}]}$. It then follows that the residual generated by β_k^* and β_m^* with respect to y_t can be written as

$$\widehat{\eta_t + \xi_t} = y_t - \widehat{\beta}_l l_t - \beta_k^* k_t - \beta_m^* m_t - \widehat{E[\omega_t|\omega_{t-1}]} \tag{A1.4}$$

Equation (A1.4) can then be used to identify β_k^* and β_m^* using the following two instruments: if the capital stock k_t is determined by the previous period's investment decisions, it then does not respond to shocks to productivity at time t, and hence $E[\eta_t + \xi_t|k_t] = 0$; also, if the last period's level of intermediate inputs m_t is uncorrelated with the error period at time t (which is plausible, e.g. proxying intermediate inputs with material costs), then $E[\eta_t + \xi_t|m_{t-1}] = 0$.

Through these two moment conditions, it is then possible to write a consistent and unbiased estimator for β_k^* and β_m^* simply by solving

$$\min_{(\beta_k^*, \beta_m^*)} \sum_h [\sum_t (\widehat{\eta_t + \xi_t}) Z_{ht}]^2 \tag{A1.5}$$

with $Z_t \equiv (k_t, m_{t-1})$ and h indexing the elements of Z_t.

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Figure 1: Trade and global value chains in European Union (1999-2009).
Source: own elaboration on Eurostat/ComExt

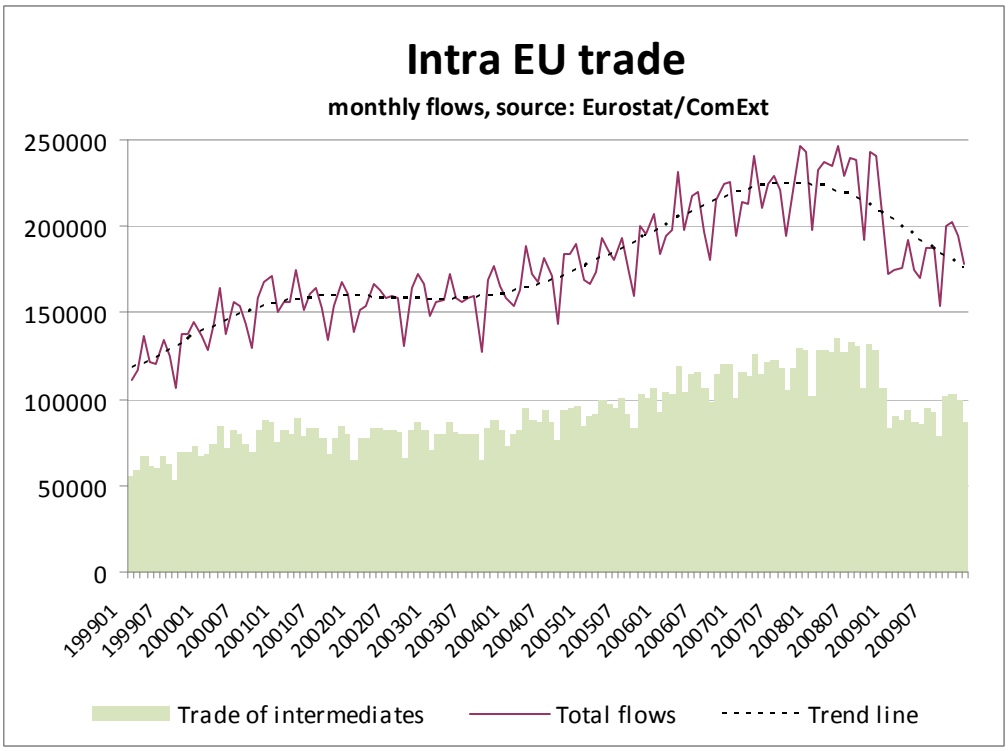

Figure 2: Foreign Production in EU New Members (1993-2006).
Source: own elaboration on UNCTAD –Foreign Direct Investment Database

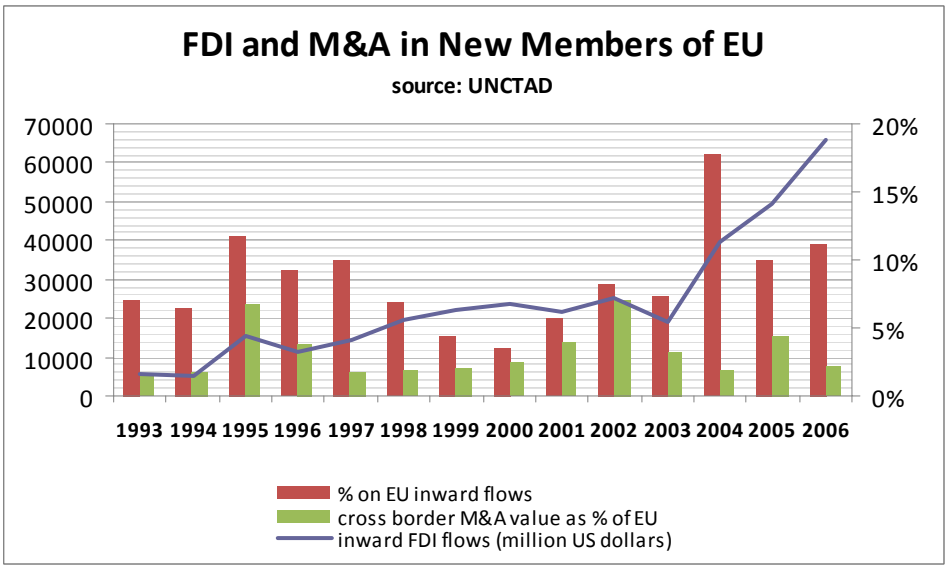

Table 1: Matching Ultimate Owners and affiliates: a dataset

Parent country	Number of firms involved				Indicators		
	Ultimate parent companies (A)	Group-owned subsidiaries (B)	Individually or family-owned subs (C)	Foreign-controlled firms in EU15 (B + C)	*AVERAGE NUMBER OF SUBS BY GROUP (B/A)*	*PERCENTAGE OF GROUPS ON THE TOTAL EU15*	*PERCENTAGE OF SUBSIDIARIES ON THE TOTAL EU15*
Austria	28	144	1,198	1,342	*5.14*	*1.71*	*6.04*
Belgium	97	239	472	711	*2.46*	*5.92*	*3.20*
Denmark	205	302	119	421	*1.47*	*12.52*	*1.90*
Finland	66	210	221	431	*3.18*	*4.03*	*1.94*
France	143	538	1,173	1,711	*3.76*	*8.73*	*7.70*
Germany	**141**	**541**	**4,739**	**5,280**	**3.84**	**8.61**	**23.77**
Greece	24	48	1,755	1,803	*2.00*	*1.47*	*8.12*
Ireland	6	36	43	79	*6.00*	*0.37*	*0.36*
Italy	**67**	**175**	**6426**	**6,601**	**2.61**	**4.09**	**29.72**
Luxembourg	6	129	20	149	*21.50*	*0.37*	*0.67*
Netherlands	98	303	614	917	*3.09*	*5.98*	*4.13*
Portugal	3	13	54	67	*4.33*	*0.18*	*0.30*
Spain	85	134	342	476	*1.58*	*5.19*	*2.14*
Sweden	520	740	328	1,068	*1.42*	*31.75*	*4.81*
United Kingdom	149	267	888	1,155	*1.79*	*9.10*	*5.20*
Total	**1,638**	**3,819**	**18,392**	**22,211**	***2.33***	***100***	***100***

Figure 3: A Multinational Groups as a Hierarchical Graph

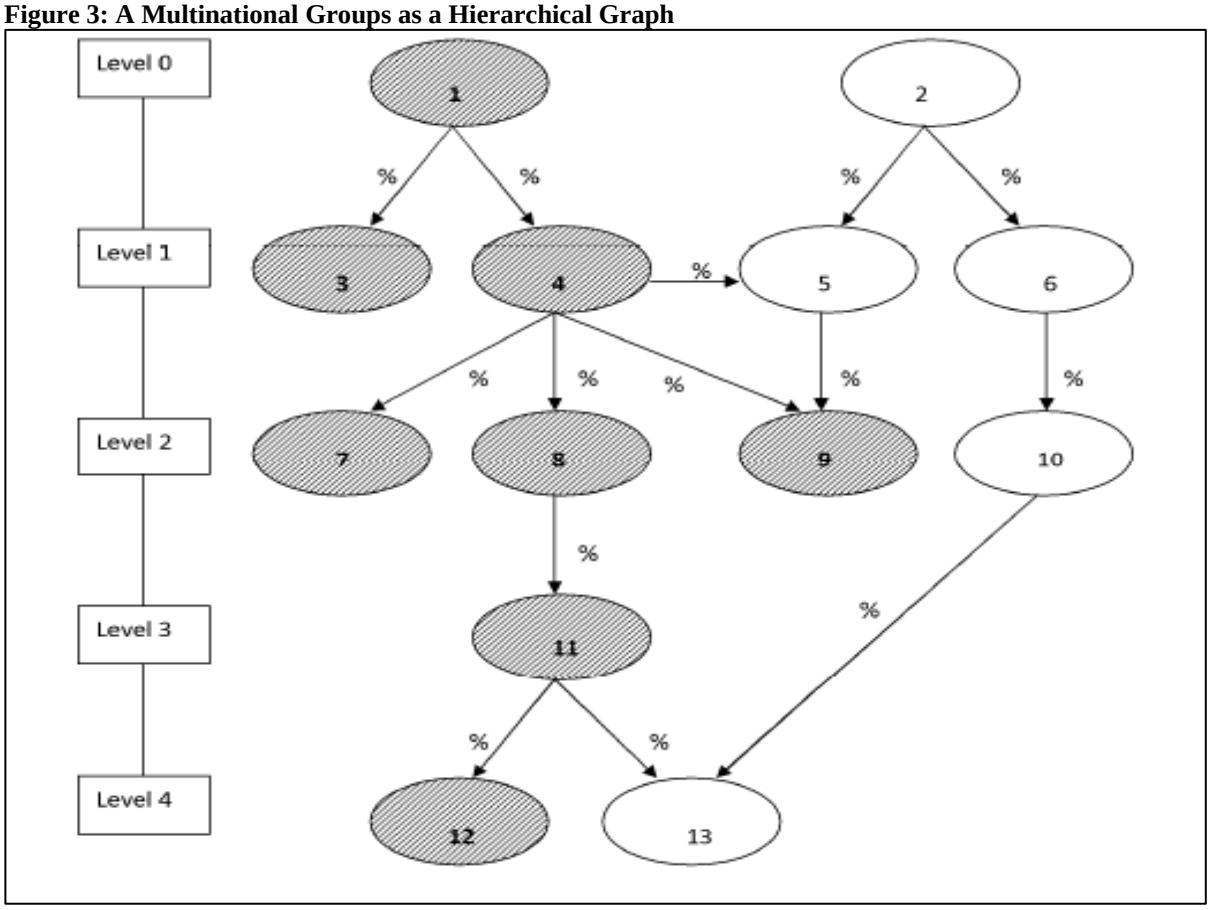

Figure 4: Multinational Complexity in key geographical areas of business groups investing in New Members

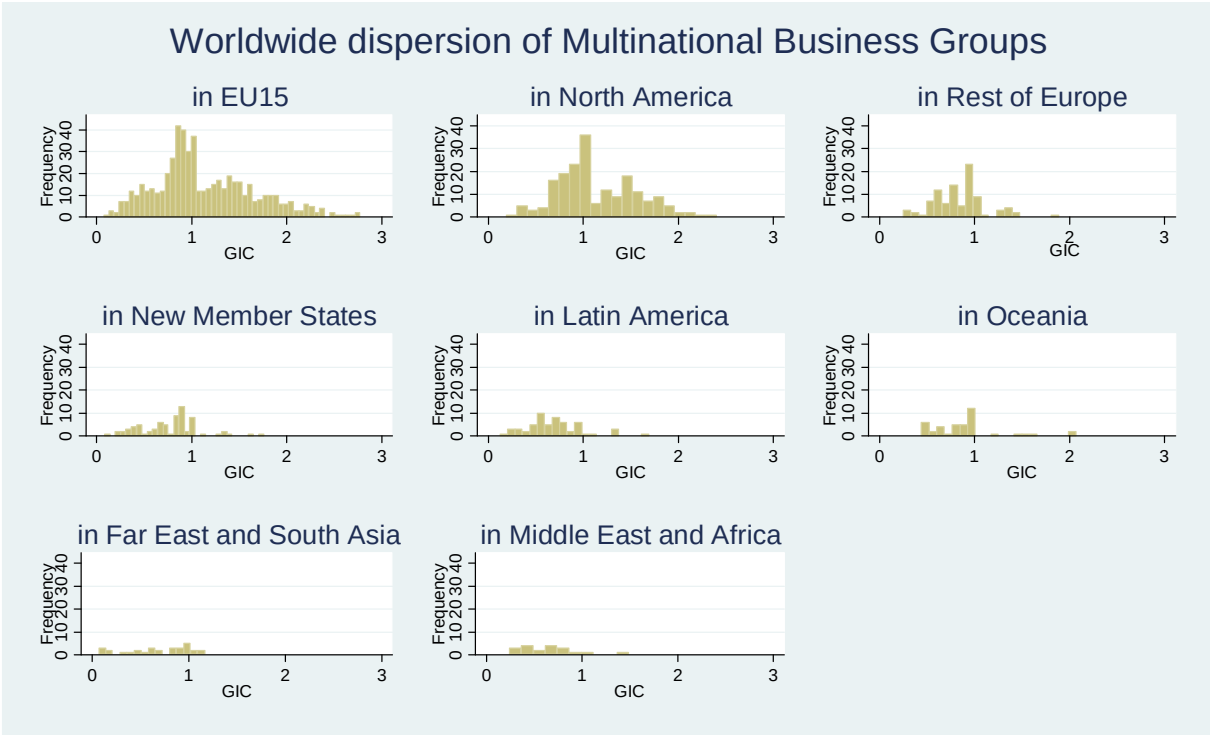

Figure 5: Multinational Complexity of German, Italian and other EU 15 groups investing in New Members

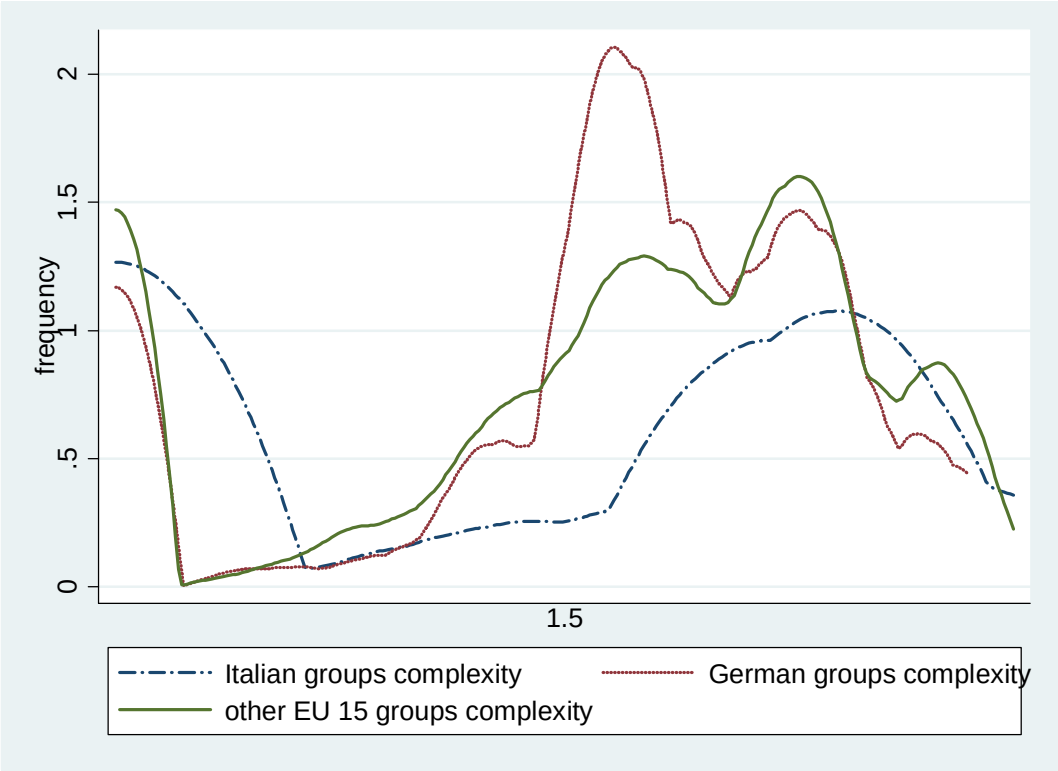

Table 2: Control premia for affiliates in New Members

	OLS	*OLS fixed effects*
Log TFP	***1.014****	***0.907****
	(0.011)	***(0.011)***
Log Value Added per Worker	***1.364****	***1.071****
	(0.018)	***(0.018)***
Log Turnover per Worker	***1.939****	***1.691****
	(0.015)	***(0.015)***
Log Employment	***2.269****	***2.183****
	(0.014)	***(0.014)***
Log Turnover	***4.401****	***4.071****
	(0.021)	***(0.021)***
Log Profit	***3.515****	***3.117****
	(0.024)	***(0.025)***

Table 3: National premia for German vs Italian affiliates

	Individually or family-owned		*Controlled by a group*	
	OLS	***OLS fixed effects***	***OLS***	***OLS fixed effects***
Log TFP	***0.202******	***0.223******	***0.330******	***0.292******
	(0.014)	***(0.014)***	***(0.052)***	***(0.055)***
Log Value Added per Worker	***0.434******	***0.322******	***-0.171****	***0.227****
	(0.029)	***(0.029)***	***(0.095)***	***(0.089)***
Log Turnover per Worker	***0.402******	***0.304******	***0.524******	***0.442******
	(0.020)	***(0.020)***	***(0.065)***	***(0.065)***
Log Employment	***0.351******	***0.371******	***0.668******	***0.455******
	(0.018)	***(0.018)***	***(0.080)***	***(0.093)***
Log Turnover	***0.727******	***0.515******	***1.291******	***0.973******
	(0.028)	***(0.017)***	***(0.094)***	***(0.093)***
Log Profit	***0.404******	***0.516******	***1.186******	***1.040******
	(0.033)	***(0.033)***	***(0.116)***	***(0.114)***

Table 4: Productivity levels, group size and financial pressure

Dependent variable : ln(Total Factor Productivity)	Hausman-Taylor (1)	Hausman-Taylor (2)
$ln(size_{t-1})$	-.0956***	-.0736***
	(.0061)	(.0118)
$ln(parent\_size_{t-1})$		.0028
		(.0030)
financial $pressure_{t-1}$	-.1287***	-.0736***
	(.0043)	(.0118)
squared financial $pressure_{t-1}$	-.0075***	-.0051***
	(.0004)	(.0008)
group control	.7779***	
	(.0380)	
financial $pressure_{t-1}$*group control	.0184***	
	(.0042)	
ln(GIC)		2.2280**
		(.7070)
squared_ln(GIC)		-1.2668**
		(.4693)
financial $pressure_{t-1}$*GIC		-.0078
		(.0103)
quoted	-.0312	-.3593
	(.2600)	(.4023)
financial $pressure_{t-1}$*quoted	-.0602	-.0261
	(.0388)	(.0527)
financial group	-.1840**	-.1748**
	(.0859)	(.0900)
financial $pressure_{t-1}$*financial group	.0013	-.0048
	(.0133)	(.0130)
intermediates production	-.1769***	-.3285***
	(.0402)	(.0782)
intermediates*group_control	-.1769**	
	(.0690)	
Constant	5.2578***	5.5030***
	(.0588)	(.3674)
IV firm fixed effects	Yes	Yes
Sector fixed effects	Yes	Yes
Host country fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Observations	20,609	3283
Wald	3742.37 (26)	493.33 (27)

Table 5: Productivity growth, group size and financial pressure

Dependent variable : growth rate of TFP	Hausman-Taylor (3)	Hausman-Taylor (4)
$ln(size_{t-1})$	-.0963***	-.0432**
	(.0079)	(.0157)
$ln(ultimate\_parent\_size_{t-1})$		-.0034
		(.0021)
$financial\ pressure_{t-1}$	-.0560***	-.0339***
	(.0053)	(.0021)
$squared\ financial\ pressure_{t-1}$	-.0034***	-.0022**
	(.0005)	(.0008)
group control	.0864***	
	(.0252)	
$financial\ pressure_{t-1}$*group control	.0144**	
	(.0049)	
ln(GIC)		.0589***
		(.0191)
$financial\ pressure_{t-1}$*GIC		.0050
		(.0066)
intermediates production	.0780**	-.0005
	(.0229)	(.0247)
intermediates*group_control	-.0215	
	(.0370)	
Constant	.2454***	.2252**
	(.0515)	(.0828)
IV firm fixed effects	Yes	Yes
Sector fixed effects	Yes	Yes
Host country fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Observations	15,438	3,902
Wald	493.33	105.53