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The Role of Agglomeration and Technology in Shaping Firm's Strategy and Organization

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THE ROLE OF AGGLOMERATION AND TECHNOLOGY IN SHAPING FIRM'S STRATEGY AND ORGANIZATION

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ABSTRACT

Over the last few years a growing number of contributions have shown that the presence of business groups, i.e. sets of firms legally distinct but belonging to the same owner(s), is widely present among medium sized and large firms. In this paper we consider the group as the appropriate unit to delimit the firm's boundary, i.e. as the organizational form adopted by firms when they grow in size. Starting from this premise, the main aim of this paper is to analyse the role of structural variables, such as spatial agglomeration and technology, in determining some aspects of firms' strategy, such as specialization and vertical integration. To conduct the analysis, we take advantage of a new and large data-set at firm and business group level that covers all the Italian manufacturing firms organized as joint-stock companies. The paper shows that spatial agglomeration and technology influence the growth pattern of business groups and their diversification and vertical integration strategy. Specifically, we show that the incidence of business groups in industrial districts is higher than in non-district areas and also that what matters is not simply belonging to an industrial district, but the 'size' of the local system and the strength of agglomeration forces. Indeed the belonging to a specialized cluster has a negative influence on diversification while it has a positive impact on vertical integration. Finally, we find that these results are not homogeneous across industrial districts, being strongly affected by the industry in which the district is specialized. The positive influence of agglomeration forces on vertical integration is particularly significant for mechanics districts but not for districts specialized in traditional industries. At the same time the negative influence of spatial agglomeration on diversification strategy is detected for traditional sectors showing that groups operating within these industries tend to growth around their core businesses.

KEYWORDS

Business groups, agglomeration, technology, vertical integration.

1. INTRODUCTION

Over the last few years a growing number of contributions have shown that the presence of business groups, i.e. sets of firms legally distinct but belonging to the same owner(s), is significant. This phenomenon is not specific to large firms and to the Italian economy, but is widespread among small and medium-sized firms (SME) and in other industrialised countries (Brioschi et al., 2002; Iacobucci, 2002; Loiseau, 2001; Rosa and Scott, 1999). This literature has shown that the group is the organizational form normally adopted by firms when growing in size; i.e. when entrepreneurs or managers expand their control over business activities.

From a theoretical point of view, the presence of business groups poses the question of whether the group or the single legal unit should be considered as the elementary unit in economic analysis: i.e., what is generally meant in microeconomic theory by 'firm'. Recent contributions have shown that this question cannot be answered in a completely general way (Iacobucci, 2004). However, in most cases, the business group can be assimilated to a multidivisional firm (M-form) where the central direction (the ultimate owner) is responsible for deciding the resources to be allocated to existing divisions (firms) and when they should be opened (set up or acquired) or closed (liquidated or sold).

In this paper we consider the group as the appropriate unit to delimit the firm's boundary, i.e. as the 'observed' organizational form adopted by firms when they grow in size. Indeed, the characteristics of the legal units belonging to a group can be used to analyse some aspects of the firm's growth strategies and organization, such as diversification, vertical integration, etc. Starting from this hypothesis, the main aim of this paper is to analyse the role of structural variables, such as spatial agglomeration and technology, in determining a specific feature of business groups' strategy such as diversification and vertical integration. Specifically, the analysis concerns, first, the presence and characteristics of business groups by industrial districts (our proxy for spatial agglomeration) and industries (our proxy for technology) and, secondly, the role played by these two structural variables in influencing diversification and vertical integration strategies.

Up to now little theoretical work has been done on the relationships between agglomeration forces and firms' heterogeneity (Duranton and Puga, 2003). This paper is a first attempt to make an empirical contribution to this literature, extending an earlier study (Cainelli *et al.*, 2006). Moreover we analyse the joint role of spatial agglomeration and technology in influencing diversification and vertical integration strategies of firms.

To conduct the analysis, we take advantage of a new and large data-set at firm and business group level, recently developed by ISTAT (the Italian National Statistical Institute). The data-set, referring to 2001, covers all manufacturing firms organized as joint-stock companies.

The paper is organized as follows. In section two we briefly discuss our hypothesis of taking the business group as the observed firms' organizational form; we then examine the relationships between agglomeration, technology and firm strategy and develop the hypotheses to be empirically tested. Section three describes the characteristics of the data-set and discusses the empirical evidence of the presence of business groups by industrial districts, industries and Pavitt sectors. The econometric analysis aimed at detecting the joint impact of agglomeration and technology on vertical integration strategy is presented. Finally, section four presents the main conclusions.

2. RELATED LITERATURE

2.1 Business groups as an organizational form

Given the definition of business groups as a set of legally distinct units controlled by the same owner, several classifications have been proposed, the most common one being pyramidal and joint groups. The first is similar to a multidivisional firm in which there is a firm at the top and several layers of controlled companies while joint groups occur when several firms share minority crossholdings (and often some members of the boards of directors), which allows them to coordinate their strategies. The latter organization is particularly

widespread among Japan's largest firms. However, because in this type of group it is not possible to identify a unitary control, they do not fit our definition of a business group. Thus, we focus here on pyramidal groups.

Most of the literature on business groups is devoted to justifying why pyramidal groups exist and comparing the behaviour and performance of firms belonging to business groups with those of independent firms. This literature has mainly focused on financial aspects (Almeida and Wolfenzon, 2005). The pyramidal group is regarded as a financial mechanism to minimize the amount of capital needed by the ultimate owner to control business activities; i.e. as a mechanism to separate control rights, concentrated in the hand of the vertex, from cash flow rights, dispersed among the minority shareholders of the companies belonging to the group.

There is an important strand of literature focussed on organizational issues in pyramidal groups (Goto, 1982; Kester, 1982). Following the transaction cost perspective, this literature considers the group as an intermediate organization between the internal hierarchy and the market. The main aim of these authors is to explain why the relationships between companies belonging to business groups can be more efficient than those observed in integrated firms or in market transactions between independent firms. Within this approach, business groups are assimilated to a multidivisional firm where the controlling owner's role is to allocate resources to existing firms and to decide whether they should be started up or closed down (Chandler, 1982).

While the financial perspective is more appropriate in the case of the largest groups, the organizational perspective appears to be more useful for explaining the existence and the characteristics of small and medium sized groups. Moreover, a recent interpretation considers the business group as an organizational form specifically adapted to the new conditions of markets and technology (Gerlach, 1997). Until the middle of the seventies of the last century, efficiency in mass production was the main aim of firms. Macroeconomic stability and the regular pace of technological change were the characteristic features of that time, often labelled as the 'golden age' of industrialized economies (Glyn *et al.*, 1990). These conditions changed dramatically during the seventies towards a market environment characterized by macroeconomic instability, rapid and unpredictable technological innovations, growing differentiation of consumer tastes. These changes are at the basis of the regained importance of small firms and of the increasing role played by innovation rather than static efficiency in the performance of firms and economic systems. They have also posed considerable pressure on large firms to enhance their ability to perceive market changes and to adapt their strategy and business models (Drucker, 1985; Kanter, 1983). Within the new market conditions it is not only efficiency which matters but also the dynamic capabilities of organizations (Teece *et al.*, 1997). The major tendencies in organization design have been towards the reduction of hierarchical levels (delaying), the enhancement of operative autonomy of organizational units and a stronger emphasis on responsibility and results for people within the organization (empowerment, pay for performance, etc.). In this context the group has emerged as an organizational form specifically suitable to cope with the new market conditions. Indeed, the legal autonomy accorded to the units which constitute the group, allows managers to implement the desired mix of control and autonomy for specific business activities. Moreover, it also allow to better control the risks associated with the entering into new business activities.

These are the reasons why we consider the group as being the appropriate unit to delimit the firm's boundary; i.e. why we take business groups as the 'observed' organizational form adopted by firms when they grow in size. Thus, business groups are specifically relevant to study the influence of structural variables in the growth strategies of firms: specifically in shaping diversification and vertical integration decisions.

2.2 Spatial agglomeration and business groups

Only recently have the relationships between spatial agglomeration and firm's strategy and organization attracted the attention of the economics literature. For example, Rosenthal and Strange (2003) examine how corporate organizations affect the benefits that arise from clustering within a given industry. Moreover, as Duranton and Puga (2003) argue, up to now little theoretical work has been done on the relationships between agglomerations forces and firms' heterogeneity. This paper is a first attempt to make an empirical contribution to this literature, extending an earlier study (Cainelli *et al.*, 2006).

We characterize agglomeration as the belonging of groups to industrial districts. In these production structures, which are particularly widespread within the Italian economy, agglomeration forces such as labour market pooling, local knowledge spillovers, face to face contacts, etc. play an important role in enhancing

firms' innovative activity and economic performance (Cainelli and Zoboli, 2004). Despite the importance of business groups and industrial districts in the Italian economy, until recently only a few studies had analysed the relationships between these two phenomena (Bianchi and Gualtieri, 1990; Brioschi et al., 2002; Brusco et al., 1996; Dei Ottati, 1996). From the point of view of our analysis, these contributions present two main drawbacks. From an empirical point of view, they refer to specific industrial districts, making it difficult to assess to what extent their results can be generalized; from a theoretical point of view, they do not analyse the relationship between the nature of agglomeration forces and the presence and features of business groups.

Some more recent studies have tried to systematically analyse the relationship between industrial districts and business groups, taking account the characteristics of the latter (Brioschi et al., 2002; Brioschi et al., 2004), but they do not develop a general framework for the possible relationship between a firms' organization and strategy and their belonging to an industrial district. To construct hypotheses about the empirical relationships between these phenomena we need further remarks.

Information sharing about production technology and market needs, transmission of ideas, and speed of the imitative process are some of the characteristic features of industrial districts and, more generally, of spatial agglomeration of production activities. They help firms to increase efficiency and to foster product innovation and growth. Moreover, knowledge spillovers and information sharing enhanced by spatial proximity allow firms to seize business opportunities along the production chain or in related sectors (Cainelli and Leoncini, 1999). At the same time economic geography models have shown that specialization can have a negative impact on diversification of production activity (Duranton and Puga, 2001). For these reasons the growth processes of district firms normally take the form either of product differentiation within the same sector, or vertical integration. Both forms concern activities along the district production chain. Moreover, the familiarity of firms within the same district favours acquisitions among them (Brioschi *et al.*, 2002). As a result, it is likely that the setting up of new firms or the acquisition of established ones will involve firms belonging to the same sector of specialization and located within the same district.

From the previous discussion it emerges that spatial agglomeration forces play a role in shaping firms' growth strategies. Specifically, we can expect that groups belonging to industrial districts are less diversified than groups operating outside industrial districts.

2.3 Technology and business groups

The second aspect investigated in this paper concerns the influence of technology on firms' strategies. Specifically, we focus on diversification and vertical integration choices.

The issue of firm diversification has attracted the attention of economists (especially evolutionary economists) and of management scholars. The two most important issues in this large literature are: a) the causes explaining diversification; b) the relationship between diversification and firm performance. Closely associated to these issues is that of the direction of diversification. The resource-based view (RBV) of the firm (dating back to the work of Penrose) stresses the importance of related diversification. Sustainable competitive advantage is based on the availability of specific, not easily imitable, resources (Wernerfelt, 1984). As a result, firms should expand their activities in activities where they can make a valuable use of these resources (Martin and Sayrak, 2003). According to this perspective, we should observe a positive relationship between related diversification and performance and a negative relationship between conglomerate diversification and performance. Finance researchers make less stringent hypotheses about the direction of diversification and generally favour the hypothesis of a negative relationship between diversification and firm performance. The 'agency' view sees diversification as the result of managers perceiving their objectives to the expense of shareholders. A review of this abundant literature is beyond the scope of this paper. Indeed, our interest is focussed to the relationships between technology and the direction and degree of diversification of firms.

The economic approach that has paid more attention to the relations between the characteristics of industries and the patterns of growth and diversification of firms is the evolutionary approach. This approach stresses the importance of learning processes in shaping the growth patterns of firms. This has two implications: a) the growth has a cumulative and path-dependent nature (Cantweel and Anderson 1996); b) it is influenced by the characteristics of the industry in which the firm initially develops its activity. An interesting feature of this approach is that it relies on the concept of technological regime (Breschi et al., 2000). Moreover, this concept is not easily usable in our case given the absence of recognized associations

between technological regimes and the standard classification of industries. As a proxy in this regard we use the Pavitt (1984) classification of innovation regimes.

Using these two approaches, Teece et al. (1994) proposed the concept of 'corporate coherence'. Within their perspective firms do not diversify their activities in a random way, searching for the most attractive markets, but follow a coherent pattern of expansion. In other words, coherence means that the businesses controlled by a firm are related to one another by technological and market characteristics. This approach combines elements of RBV and evolutionary theories by considering not only internal factors, like enterprise learning and competence, but also external factors. These latter relate to the market environment such as technological opportunities, strength of competition, complementarity of assets. The features of industries that influence the pattern of growth and diversification of firms are basically two: technological opportunities and selection. The former refer to the capability of firms to efficiently use in related areas the knowledge accumulated in the original activity.

As business groups are the result of a growth process by diversification from the original activity, we expect their presence to be influenced by the industry they belong to. Specifically: a) groups should be more widespread in science based industries where the knowledge base is more easily transferable in other sectors; the degree and the span of diversification is higher in groups belonging to science based sectors than in groups operating in other sectors (especially dominated supplier sectors).

Vertical integration can be considered as a specific form of diversification. Nevertheless its nature and justification are fundamentally different that that of diversification. There are two main theories explaining the degree of vertical integration of firms: transaction cost economics (TCE) and property rights theory (PRT). According to TCE (Williamson, 1985) vertical integration occurs as a result of the need to prevent *ex-post* hold-up problems resulting from transaction specific investments. The advantages of vertical integration in reducing or avoiding the costs of market transactions must be compared with the cost of producing within the firm (cost of integration). The latter depends on the ability to monitor employees and convey information within the organization.

In contrast to the TCE approach, which emphasises *ex-post* transaction problems, PRT focuses on distortions in *ex-ante* investment. The residual rights of control, guaranteed by the ownership of assets, are particularly valuable in situations of *ex ante* incomplete contracting and *ex post* opportunist behaviour. Some of the assumptions and conclusions of the two theories are very similar. Nevertheless it has been shown that this is not always the case (Whinston, 2001). PRT predictions are more difficult to empirically test than TCE theory. This is probably the reason why much of the empirical literature on vertical integration is based on TCE, relying on single industry case studies. Only a few studies have used a cross industry approach to explore the intensity and the determinants of vertical integration (Acemoglu et al., 2004; Fan and Lang, 2000).

The approach followed by Acemoglu *et al.* (2004) is particularly interesting in our case as they aimed to assess the role of technology in the vertical integration choice. Following the property rights approach, their model predicts that: i) backward integration (i.e. the control of input suppliers) is positively related to the technological intensity of the acquirer and negatively related to the technological intensity of the supplier; ii) forward integration (i.e. the control of output acquirer) is positively related to the technological intensity of the acquirer and negatively related to the technological intensity of the supplier.

Using TCE theory we should obtain the opposite results as the technology intensity of the supplier is positively related to the degree of transaction specificity, thus increasing the probability of backward integration. Moreover, TCE also suggests a role for spatial agglomeration in vertical integration. Indeed spatial proximity and face to face contact, together with social and cultural homogeneity of industrial districts, should attenuate opportunistic behaviours thus reducing transaction costs (Dei Ottati, 1994). This means that, other things being equal, we can expect that groups in industrial districts will show a lower degree of vertical integration as they can more easily rely on market exchanges with supplier firms.

However, this negative effect of agglomeration on vertical integration could be counterbalanced by the action of local knowledge spillovers and information sharing, which facilitate the acquisition of resources and competences along the district production chain (Brioschi *et al.*, 2002).

3. DATA AND RESULTS

3.1 The data set

For our empirical analysis we use two different versions – a firm level and a business group level – of a new and original data-set on business groups recently developed by ISTAT. The data refer to the year 2001. Merging the information about joint stock companies drawn from the Italian industrial census and the first version of the firm level data set, we are able to assess the presence of firms belonging to business groups by industry and industrial districts. The latter are identified according to the Sforzi-ISTAT procedure (ISTAT, 1997). This procedure considers the local labour systems (LLS) as the unit of analysis and identifies 199 industrial districts within the 784 LLS into which the Italian territory is divided.

The business group version of the data-set was used to study the strategic choices of business groups. To compare district and non-district groups we isolated the manufacturing groups defined according to the following two criteria: i) group composed of at least two production companies (we excluded financial and property companies or non-active companies) one of which is a manufacturing firm; ii) largest company in the group is a manufacturing firm. The industry a group belongs to is determined by the sector of its largest company. A manufacturing group is classified as belonging to a particular industrial district when its largest company is located in it, and it operates in the same sector of the district.

Given these criteria we identified 8,661 manufacturing groups, of which 4,125 belong to an industrial district. It is worthwhile noting that according to other statistical sources the number of manufacturing business groups is higher than that identified using the ISTAT data-set. Referring to the same year, Unioncamere (2004, p. 96) estimates about 16,000 groups as belonging to the manufacturing sector. Both data-sets are built taking into consideration joint stock companies and adopting the same definition of control: i.e. the ownership of at least 50% of the shares. The discrepancy is due to the way in which the ‘raw’ data have been elaborated. For our analysis we exclude what we call ‘pseudo-groups’ – i.e. groups with one production company and one or more financial companies - and groups composed of mostly foreign companies and only one Italian company because the ISTAT data-set lacks information (employees, activity, etc.) about foreign companies. We also only consider business groups with at least two ‘active’ companies (excluding financial companies). The analyses carried out in the following sections consider only the production companies (i.e. domestic, non-financial firms) belonging to manufacturing business groups. Of the 34,358 firms belonging to manufacturing groups, 28,579 are production companies. Of these companies, 8,661 are the largest company by which we characterize the industry of the group (Table 1).

Table 1 – Companies belonging to manufacturing groups by type.

	Largest company	Other companies	Total	%
Production	8661	19918	28579	83.2
Financial		4182	4182	12.2
Foreign		1597	1597	4.6
Total	8661	25697	34358	100

The distribution of manufacturing groups by class of employees and number of companies is shown in Table 2.

Table 2 – Manufacturing groups by number of employees and number of companies

Class of employees	Class of production companies						Total
	2	3	4-5	6-9	10-49	50-	
2-19	1,801	265	41	4			2,111
20-49	1,840	402	128	20	7		2,397
50-99	1,014	374	175	39	11		1,613
100-249	715	353	245	89	29		1,431
250-499	182	118	133	92	35	3	563
500-999	79	41	64	69	42	4	299
1000-	32	32	43	44	79	17	247
Total	5,663	1,585	829	357	203	24	8,661

3.2 The presence of business groups by industrial districts, industries and Pavitt's sectors

As a first step in the analysis of the role of agglomeration and technology in shaping firm strategy and organization we show some descriptive statistics about the presence of business groups within Italian industrial districts and by sector of activity. The empirical evidence shows that business groups are more widespread within industrial districts than outside them, thus confirming the findings of previous contributions on this issue (Brioschi *et al.*, 2002). In particular, columns 1 and 2 of Table 3 suggest that, passing from non-district to district LLSs, the share of firms belonging to business groups tends to increase. In the first case, the share of total firms is equal to 21.3%, whereas in the second it increases to 23.8%. This finding appears to be reinforced when we take into account only those firms specialized in the district sector. In fact, in this case the share of firms belonging to a business group is higher than in the two previous cases.

Table 3 - Firms belonging to a business group (2001), % of firms

	Firms		Employees	
	(c)/(a)	(c)/(b)	(c)/(a)	(c)/(b)
Non-district LLSs (585)	4.63	21.31	44.94	63.47
District LLS (199)	5.87	23.88	35.39	53.05
Industrial district (199)	5.86	24.11	35.67	53.28

(a) All firms

(b) Joint stock companies

(c) Firms belonging to a business group

The greater incidence of business groups within Italian industrial districts is further confirmed by Table 3, where the analysis takes into account industrial districts by sector of activity. From this evidence we find that, with the exception only of districts operating in 'other sectors', the presence of business groups is always greater in district rather than non-district areas.

For the purposes of this paper the higher presence of groups is more significant when measured in terms of firms than in terms of employees. This means that in industrial districts the group form is more widespread among smaller firms, while outside industrial districts the presence of the groups is more dependent on firm size. Indeed, industrial districts are characterized, by definition, by the presence of small and medium-sized firms, while in non-district areas large firms can be pre-eminent.

Table 4 - Firms belonging to a business group by sector of activity (2001), % of firms

	District firms		Non-district firms	
	(c)/(a)	(c)/(b)	(c)/(a)	(c)/(b)
Food (17)	5.67	20.61	2.69	17.75
Textile and clothing (68)	5.01	21.82	3.09	17.43
Leather and footwear (28)	4.06	15.92	2.83	14.73
Furniture (39)	4.91	25.33	2.39	18.66
Mechanics (33)	7.46	25.77	5.43	22.31
Other sectors (14)	7.23	20.99	9.27	26.27

(a) All firms

(b) Joint stock companies

(c) Firms belonging to a business group

We now examine the presence of business groups by industry and Pavitt sectors. This is a preliminary for the econometric analysis of the next section, where we use industries as proxies for technology. In Table 5 we report the incidence of firms belonging to business groups by industries and by class of employees.

The presence of business groups is particularly relevant in some industries such as (i) Chemicals and Allied Products, (ii) Petroleum Refining and Related Industries and (iii) Transportation Equipment. In other industries, such as (i) Lumber and Wood Products, (ii) Leather and footwear, and (iii) Miscellaneous Manufacturing Industries the presence of groups is low. This evidence suggests that in high and medium tech sectors business groups often represent a more efficient solution for firms' organizational problems.

Table 5 – Firms belonging to groups by industry and class of employees (% on total firms)

Industry	Class of employees				Total
	1-49	50-249	250-999	1000-	
Food, Beverages and Tobacco	15.1	47.9	71.9	93.8	18.3
Textile and clothing	13.7	38.7	73.0	90.0	16.8
Leather and footwear	10.9	30.6	71.0	100.0	13.1
Lumber and Wood Products (Ex. Furniture)	10.4	34.9	100.0		12.3
Paper, printing and publishing	18.6	49.7	80.6	83.3	20.9
Petroleum Refining and Related Industries	23.9	54.8	60.0	80.0	28.4
Chemicals and Allied Products	24.5	47.4	80.0	82.8	29.5
Rubber and Plastic Products	17.8	47.2	80.4	50.0	21.7
Stone, Clay, Glass and Concrete Products	16.3	44.9	80.0	91.7	19.7
Metal products	14.7	38.9	66.3	92.9	17.2
Industrial Machinery	19.0	45.5	76.1	82.4	22.6
Computer and electronics	17.2	45.9	70.6	82.9	20.4
Transportation Equipment	20.2	48.6	54.3	82.1	26.5
Miscellaneous Manufacturing Industries	13.2	34.2	66.7	100.0	15.2
Total	16.1	42.6	72.3	84.0	19.2

This is further confirmed by the analysis of the presence of business groups by Pavitt sectors (Tables 6). The presence of business groups is particularly relevant in the 'science-based' and 'scale-intensive' sectors and, to a minor extent, in 'specialized suppliers' industries. However, the presence of this organizational form in 'dominated supplier' sectors does not reach the values of the other Pavitt sectors.

Table 6 - Firms belonging to business groups by Pavitt sectors (2001) (% on total employees)

	Class of employees				Total
	1-49	50-249	250-999	1000-	
Dominated supplier	16.3	43.0	73.4	94.8	39.3
Scale intensive	21.5	49.7	75.6	87.2	53.3
Science based	27.7	53.6	70.4	94.9	68.7
Specialized suppliers	21.7	48.1	76.3	88.5	49.4
Total	24.0	58.6	93.1	107.1	60.1

3.3 Agglomeration, technology and diversification

In this section we analyse the influence of agglomeration and technology on the diversification patterns of business groups.

There are several ways of measuring the degree of diversification of firms, based on qualitative and quantitative information. Traditionally, diversification has been defined as the entry of a firm into a new sector. The boundaries between the sectors – also referred as industries (Jacquemin and Berry, 1979), segments (Denis *et al.*, 1997), lines of business (Montgomery, 1994) – are generally deduced from the classification system of activities adopted by statistical agencies. An aspect which is often neglected by the conventional analysis of diversification, both at a theoretical and at an empirical level, is the extension of firm's activities in different market segments within the same product category: i.e. differentiation. One of the reasons for this is that it is difficult to capture differentiation on the basis of the classification codes used by statistical agencies.

To characterize the diversification strategies of business groups we have constructed a dummy variable which takes the following values: 0 (differentiation) when all the companies in the group belong to the same 5-digit code; 1 (related diversification) when companies in the group have different 5-digit codes but all being within the same 2-digit code; 2 (unrelated diversification) when companies in the group have different 2-digit codes. Table 7 shows the distribution of groups according to the values of the diversification dummy.

Table 7 – Manufacturing groups by type of diversification and number of production companies

Dummy	Class of production companies						Total
	2	3	4-5	6-9	10-49	50-	
0	1,519	156	33	9			1,717
1	830	168	71	13	6		1,088
2	3,314	1,261	725	335	197	24	5,856
Total	5,663	1,585	829	357	203	24	8,661

The econometric analysis is carried out using as the dependent variable the dummy previously defined. It is clear that this dependent variable is unordered since the numerical values associated with diversification strategy are arbitrary in the sense that $0 < 1 < 2$ does not imply that outcome 1 is less than outcome 2, and so on. We assume that there are basically two explanatory variables that might explain these business groups' diversification strategies: i.e., technology, captured by Pavitt's dummies, and spatial agglomeration, captured by the belonging of the group to an industrial district and by an urbanization economy measure such as the natural log of population density in 1996 at the LLS level. In the case of industrial districts, we use the dummy (*Dis*) for all the Italian industrial districts and dummies for specific districts, such as food districts (*Dis_food*), textiles and clothing districts (*Dis_tex*), leather and footwear districts (*Dis_lea*) furniture districts (*Dis_furn*), mechanics districts (*Dis_mec*) and districts operating in other industries (*Dis_oth*). Finally, in order to eliminate (at least partially) business groups' unobservable fixed effects we introduce in our econometric specifications group size variables, captured by the natural log of the number of firms belonging to a group and by the natural log of the number of groups' employees.

As micro-econometrics tells us, the best way to model these three groups' strategic choices is by multinomial logit. Following Greene (2003), in this model the estimated equations provide a set of

probabilities for the J choices for a decision maker – in our case, Italian business groups – with characteristics x_i . In particular, this econometric methodology assumes that the probabilities for these J choices can be modelled as follows:

$$\text{Prob}(Y_i = j) = \frac{e^{\beta_j x_i}}{\sum_{k=0}^2 e^{\beta_k x_i}}, \quad j = 0, 1, 2$$

where $Y_i = 0$ if the business group i is not diversified (differentiation), $Y_i = 1$ if it is related diversified, and finally if $Y_i = 2$ it is diversified. The results of this econometric investigation are reported in Table 8.

Table 8 - Diversification, agglomeration and technology: estimates

	Multinomial Logit ^(a)		Multinomial Logit ^(a)	
	Coefficient	<i>t values</i>	Coefficient	<i>t values</i>
1 – related diversification				
Specialized supplier	0.003	0.03	0.002	0.02
Science based	-0.253	-1.27	-0.253	-1.27
Scale intensive	Ref.	Ref.	Ref.	Ref.
Dominated supplier	0.024	0.27	0.021	0.23
Log (number of firms' group)	1.633**	8.47	1.632**	8.46
Log (number of group's employee)	0.009	0.032	0.009	0.30
Log (population density) in 1996	0.048	1.26	0.048	1.25
Dis	0.049	0.62	...	...
Dis_food	...	...	0.280	1.03
Dis_tex	...	...	0.293**	2.76
Dis_lea	...	...	-0.345*	-1.74
Dis_mech	...	...	-0.011	-0.10
Dis_oth	...	...	-0.144	-1.14
2 – unrelated diversification				
Specialized supplier	0.036	0.44	0.029	0.36
Science based	0.416**	3.19	0.416**	3.19
Scale intensive	Ref.	Ref.	Ref.	Ref.
Dominated supplier	-0.166**	-2.47	-0.133**	-1.97
Log (number of firms' group)	3.396**	20.80	3.402**	20.79
Log (number of group's employee)	-0.247**	-9.85	-0.249**	-9.91
Log (population density) in 1996	-0.009	-0.33	-0.010	-0.37
Dis	-0.121**	-2.08	...	...
Dis_food	...	...	0.205	1.00
Dis_tex	...	...	-0.183**	-2.16
Dis_lea	...	...	-0.566**	-4.03
Dis_mech	...	...	0.039	0.46
Dis_oth	...	...	-0.155*	-1.72
N. Obs.	8,653		8,653	
Pseudo R ²	0.072		0.075	

(a) The regression also includes a constant term

Legend: ** significant at 5%; * significant at 10%

Note: t values are in parentheses

Our findings confirm the relevance of technology and spatial agglomeration in explaining firms' diversification strategy, accordingly with the hypotheses previously discussed. Specifically, the positive and statistically significant coefficient on the science based dummy can be interpreted as evidence of the capability of groups belonging to these sectors to expand in other business exploiting the technological knowledge accumulated in the original activity. On the contrary the coefficient on the dominated supplier shows the opposite sign, indicating that groups belonging to these industries tend to expand around their original activities.

Also the sign of the spatial agglomeration dummy is negative and statistically significant, thus confirming the hypothesis that firms belonging to specialized clusters tend to growth remaining within the original sector. Disaggregating this dummy by sectors of specialization allows us to analyze the joint action of technology and agglomeration on diversification. The negative impact of agglomeration is confirmed for districts specialized in traditional sectors (like textile, leather and other sectors) while for the other district the coefficients are positive but not statistically significant.

3.4 Agglomeration, technology and vertical integration

In this section we complete our analysis by investigating the joint role of agglomeration and technology in shaping firms' vertical integration strategy.

To assess whether a diversified activity in a group can be considered to be a backward or a forward integration we use the Italian input-output tables for 2000 to determine when a pair of activities can be considered as part of the same production chain. The table contains the value of intermediate exchanges between 58 branches of economic activity, 23 of which are manufacturing activities. Indicated by $j=1,2,\dots,58$ the branches of economic activity, for each manufacturing industry $i = 1,2,\dots, 23$ we calculate the index b_{ij} as the share of intermediate consumption of industry i supplied by the industry j , so that for each i $\sum_j b_{ij} = 1$.

Excluding intra-industry exchanges the combination of the 23 manufacturing industries and the 58 potential supplier industries results in 1,311 pairs of activities. The larger b_{ij} , the larger the share of input requirement controlled by the producer in industry i in case of integration with industry j ; i.e. b_{ij} is an index of the quantitative relevance of backward integration. Of the 1,311 potential backward relationships 284 are null while the others show a positive value. Of these latter, 287 show a value over 1% and 85 a value over 5%. We chose the 3% value as a reasonable cut-off value for discriminating significant backward vertical relationships among manufacturing industries.

In the case of forward integration, we use a similar procedure. Given $j=1,2,\dots,58$ the branches of potential acquirers, for each manufacturing industry $i = 1,2,\dots, 23$ we have calculated the index f_{ij} as the share of intermediate sales of industry i supplied to industry j , so that for each i $\sum_j f_{ij} = 1$. Of the 1311

potential pairs of activities, there are 945 with the index $f_{ij}>0$, 255 with $f_{ij}>0.01$ and 97 with $f_{ij}>0.03$. As in the case of backward integration we chose the 3% value as a reasonable cut-off for discriminating significant forward vertical integration between pairs of industries.

On the basis of this analysis we constructed a dummy variable for each group according to the presence within the group of the pair of industries with values of b_{ij} and v_{ij} exceeding the threshold level indicated above. The dummy has the following values: 0 = the group is not vertically integrated; 1 = the group is forward integrated; 2 = the group is backward integrated.

Table 9 shows the distribution of manufacturing groups according to the type of vertical integration and number of production companies. Given the small number of cases we excluded from our analysis groups that were both forward and backward integrated.

Table 9 – Manufacturing groups by type of vertical integration within the manufacturing sector

Class of production companies	Vertical integration			Forward and Backward integrated	Total
	Non vertically Integrated	Forward integrated	Backward integrated		
2	5,008	287	368		5,663
3	1,270	123	188	4	1,585
4-5	591	89	139	10	829
6-9	228	53	60	16	357
10-49	103	31	52	17	203
50-	4	6	2	12	24
Total	7,204	589	809	59	8,661

The econometric investigation has been carried out using the methodology previously illustrated. The results of this econometric investigation are reported in Table 10.

Table 10 - Vertical integration, agglomeration and technology: estimates

	Multinomial Logit ^(a)		Multinomial Logit ^(a)	
	Coefficient	<i>t values</i>	Coefficient	<i>t values</i>
1 – forward integration				
Specialized supplier	-0.890**	-6.18	-0.906**	-6.25
Science based	-0.752**	-3.63	-0.750**	-3.62
Scale intensive	Ref.	Ref.	Ref.	Ref.
Dominated supplier	-0.685**	-6.92	-0.646**	-6.45
Log (number of firms' group)	0.590**	6.78	0.597**	6.82
Log (number of group's employee)	0.278**	8.17	0.277**	8.12
Log (population density) in 1996	-0.072*	-1.71	-0.084**	1.98
Dis	0.219**	2.43	...	...
Dis_food	...	...	0.130	0.45
Dis_tex	...	...	0.057	0.43
Dis_lea	...	...	0.065	0.26
Dis_mech	...	...	0.501**	4.20
Dis_oth	...	...	0.068	0.48
2 – backward integration				
Specialized supplier	1.245**	13.11	1.244**	13.09
Science based	0.472**	3.07	0.472**	3.07
Scale intensive	Ref.	Ref.	Ref.	Ref.
Dominated supplier	-0.583**	-5.17	-0.562**	-4.97
Log (number of firms' group)	0.686**	8.82	0.691**	8.88
Log (number of group's employee)	0.268**	8.70	0.266**	8.66
Log (population density) in 1996	-0.038	-1.03	-0.047	-1.26
Dis	0.205**	2.55	...	...
Dis_food	...	...	-0.037	-0.14
Dis_tex	...	...	0.118	0.99
Dis_lea	...	...	-0.167	-0.67
Dis_mech	...	...	0.328**	3.07
Dis_oth	...	...	0.260**	2.08
N. Obs.	8594		8594	
Pseudo R ²	0.095		0.097	

(a) The regression also includes a constant term

Legend: ** significant at 5%; * significant at 10%

Note: t values are in parentheses

As far as technology is concerned, all Pavitt's dummies are always statistically significant but with different signs. In the case of forward integration they are all negative, while in the case of backward integration they are positive in the case of specialized supplier and science based sectors and negative in the case of the dominated supplier sectors. This result shows the difficulty for firms belonging to dominated supplier sectors to control backward production phases, thus confirming the role of innovative regimes in influencing backward vertical integration choices. In the case of forward integration it emerges that all the estimated Pavitt dummy variables are negative against the scale intensive sector, thus suggesting an important role of firm size in determining this choice. This finding is confirmed by the positive and significant coefficients of variables capturing group size.

With regard to spatial agglomeration, the district dummy is positive and statistically significant in the case of both forward and backward integration. This means that agglomeration, captured in our analysis by membership of firms in industrial districts, positively affects the vertical integration strategies adopted by Italian business groups. This suggests the prevalence of local knowledge spillovers and information sharing effects with respect to the lowering of transaction costs.

However, the analysis referring to specialized clusters shows that these agglomeration effects are industry-specific. Indeed, the dummy for mechanics districts is positive and statistically significant in all the

forms of vertical integration considered while, with the exception of other districts in the case of backward integration, the dummies for the other types of districts are never statistically significant.

In this sense district dummies seem to capture industry effects rather than agglomeration effects; the latter are better captured by the LLS population size which is a proxy for the intensity of urban agglomeration economies.

4. CONCLUSIONS

This paper set out to analyse the relationships between certain structural variables, such as spatial agglomeration and technology, and firms' strategy. Despite the relevance of this research line for understanding the behaviour of firms, up to now only a few contributions have attempted to provide theoretical explanations and empirical evidences on these topics.

Our work contributes to this literature in three ways.

First, we show that spatial agglomeration influences the growth patterns of business groups and affects their presence in industrial districts.

Second, we detect the joint influence of spatial agglomeration and technology on firms' diversification and vertical integration decisions. More specifically, we show that the incidence of business groups in industrial districts is higher than in non-district areas and also that what matters is not simply belonging to an industrial district, but the 'size' of the local system and the strength of agglomeration forces. The greater incidence of business groups within the Italian industrial districts can be explained on the basis of the lower costs to district firms for acquiring information on the characteristics of competitors and/or suppliers, thus fostering acquisitions (Brioschi et al., 2002; Brioschi et al., 2004). Indeed the belonging to a specialized cluster has a negative influence on diversification while it has a positive impact on vertical integration.

Finally, we find that these results are not homogeneous across industrial districts, being strongly affected by the industry in which the district is specialized. Specifically, the positive influence of agglomeration forces in determining vertical integration is particularly significant for mechanics districts but not for districts specialized in the so called 'traditional industries'. At the same time the negative influence of spatial agglomeration on diversification strategy is detected for traditional sectors showing that groups operating within these industries tend to grow around their core businesses.

This latter result emphasizes the role of technology in these processes. We analysed how technology and innovation regimes influence the presence and growth strategy of business groups. Empirical evidence shows that there is a high heterogeneity in the presence of business groups by industry and Pavitt sectors. Specifically, we found that business groups are more widespread in high and medium-tech industries than in traditional industries. Because the group is the outcome of a growth process, the learning mechanisms and knowledge base characterizing firms belonging to the former industries can facilitate their ability to enter into new business activities. The econometric result confirms the capability of groups belonging to science based sector to diversify in other industries.

Finally, the degree and direction (backward or forward) of vertical integration were analysed. The control of the different stages of the production chain is one of the main strategic choices made by firms and one that strongly affects their organizational structure. Our empirical evidence shows that vertical integration is conditioned by technology. Specifically the technology intensity of the supplying industry shows a positive role in influencing backward integration. This result is consistent with the TCE approach, as the technology intensity of suppliers can be considered a proxy for the 'specificity' of firm transactions, as opposed to the property rights approach adopted by Acemoglu *et al.* (2004). In the case of the technology intensity of the acquiring sector the positive role of this variable in determining backward integration is confirmed.

We also detected the joint role of spatial agglomeration and technology in affecting firm's vertical integration decisions. Contrary to common opinion that low transaction costs within industrial districts favour vertical disintegration, our findings show that this is not the case, especially with reference to mechanical districts. This suggests the important role of technology in influencing the internal organization of industrial districts.

Overall our findings can be considered as a first attempt to investigate the joint role of spatial agglomeration forces and technology in shaping firms' strategy and organization. We are aware that further refinements both at theoretical and empirical level are needed.

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