The Determinants of Export Performance: A Firm-Level Study of Italian Manufacturing

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I. Introduction

Empirical studies on the determinants of international trade have mainly been carried out across countries and industries. Only recently, and thanks to the greater availability of firm-level data, have a number of attempts been made to address the further issue of why some firms export more than others.

The idea that, in order to be successful in foreign markets, a firm should be large in size can be questioned on the basis of various arguments. In any case, from an empirical point of view, the size/exports relationship cannot be evaluated without controlling for other characteristics of firms besides their efforts to increase foreign sales (such as innovation expenditures). By considering a comprehensive set of explanatory variables, numerous empirical studies (reviewed in Section II) have found that the relationship between size and export performance is not always and necessarily positive.

This paper examines a variety of characteristics besides size and industry which are able to influence a firm's export behaviour: namely, the propensity to take on work subcontracted by other firms, affiliation with a business group, and geographical location. As far as innovation variables are concerned, together with the intensity of R&D, the paper considers other qualitative indicators of innovation, with particular regard to the role played by innovative machinery and the relative importance of product versus process R&D.

The results of Probit and Tobit estimates carried out on a sample of 3,659 Italian manufacturing firms are presented in Section III. They show that, after controlling for the set of the above-mentioned variables, only within the sub-sample of small firms is there a positive impact of size on export probability and intensity; for large firms, instead, the relationship is U-shaped. In addition, larger firms take advantage of being affiliated with business groups (especially if they operate internationally), while the intensity of subcontracting depresses the export performance of small and medium-sized enterprises (SMEs). With regard to innovation variables, it emerges that small firms achieving better export performance rely primarily on product rather than process innovations. The intensity of R&D and the importance attributed to the introduction of innovative machinery are more effective for medium-sized and large firms, respectively.

II. Export Performance, Firms' Characteristics and Innovative Activities

1. Firms' Size and Intensity of Exports

It is generally believed that firms should be large in size in order to compete in the global market. If, in fact, firms must operate in different national markets by implementing a wide set of complex strategies (exports, foreign direct investments, joint ventures, and international agreements), the contention that 'big is necessary' is difficult to confute. However, if the analysis is confined to export activity alone, the relevance of firm size can be questioned on several grounds.

From a theoretical point of view, predictions about the size/exports relationship can be based on the analysis of export behaviour of a firm which enjoys (at least in the short run) some domestic market power while it is a price-taker in the foreign market; this implies to assume a certain degree of segmentation between the two markets (because of transport costs, tariffs, standards or consumers' tastes).

The short-run price and output choices of this firm can be described as those of a discriminating monopolist. In Figure 1, D_d and D_w denote domestic and foreign demand, respectively, the latter being infinitely elastic with respect to the world price p_w. If the firm produces in the domestic market only (the quantity q_{d0} at price p_{d0}) its profits amount to the area $p_{d0}abc$. If it decides to produce in both markets, the total output is q_t; that sold in the home market (at price p_{d1}) is q_{d1}, while the output sold abroad (at price p_w) is $q_t - q_{d1}$. Thus, the

Figure 1: *Export Behaviour of a Price-Taking Firm in Foreign Markets*
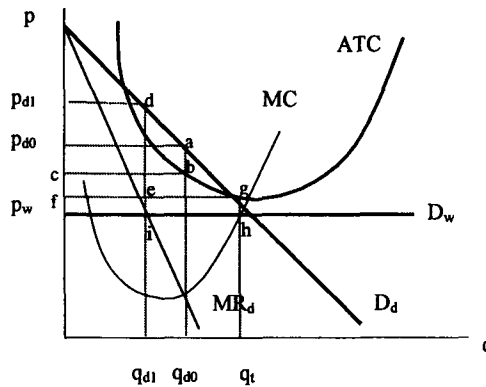
export intensity of the firm (i.e. the share of exports in total sales) is $p_w(q_t - q_{d1})/[p_{d1}q_{d1} + p_w(q_t - q_{d1})]$.

Note that a profit-maximizing firm will export only if the net profits achieved by producing for both the domestic and the foreign market (i.e. the difference between the profits $p_{d1}\,def$ and the losses *eghi*) are higher than the profits obtained by producing exclusively for the home market. This means that the losses arising in foreign markets (by selling at a price lower than the average total cost) are more than offset by the increase in domestic profits due to the overall cost reduction (Basevi 1970).

In order to analyze the relationship between size and export intensity, consider two firms, indexed with 0 and 1, both of which have market power at home but not abroad. Let us assume that firm 0 is characterized by a domestic demand schedule which is lower than that of firm 1 (with a lower intercept and the same slope), and that the two firms have identical marginal costs and face the same world price. This case is described in Figure 2.

With the same marginal cost schedule, denoted by MC_a, both firms produce the same quantity q_a in order to maximise profits. However, the export sales of firm 0 are substantial $(p_w(q_a - q_{d0}))$, while firm 1 does not export at all because the world price is precisely at the level in which MC_a cuts its domestic marginal revenues (MR_{d1}). Since, in terms of total sales, firm 0 is smaller than firm 1 $(p_{d0}q_{d0} + p_w(q_a - q_{d0}) < p_{d1}q_a)$, an inverse relationship between total sales and export intensity arises. This occurs because firms with large domestic outputs have little or no incentives to export because they can achieve the lowest level of aver-

Figure 2: *Domestic Sales, Production Costs and Export Performance*

age costs by largely or entirely serving the home market alone. By contrast, firms with a low domestic demand are compelled to export in order to reduce costs and raise profits.[1]

However, the foregoing conclusion[2] derives from the strong assumption that firms of different sizes (in terms of both total and domestic sales) face identical costs. To relax this assumption, let us suppose that firm 1 (the larger one) has a marginal cost schedule MC_b lower than that of firm 0 (which remains MC_a): this can come about, for instance, because the former is able to invest more resources to increase its capital-labour ratio or to work with a more technology-advanced capital stock. In this case, firm 1 will have an incentive to export – that is, to add some foreign sales $(p_w(q_b - q_a))$ to its previous domestic sales $(p_{d1}q_a)$ – and, depending on the distance between the two marginal cost schedules, its export intensity $- p_w(q_b - q_a)/[p_{d1}q_a + p_w(q_b - q_a)]$ – may be lower, equal or even greater than that of firm 0. As a consequence,

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[1] The inclusion of fixed costs incurred to enter foreign markets does not change the implications of the model, because it can be shown that the absolute increase of profits due to exports is inversely related to domestic sales, which implies that, with a given fixed cost, small firms will continue to export while some of the larger firms will find it convenient to produce for the domestic market only.

[2] In a long-run setting and according to a number of studies (see, e.g., Basevi 1970; White 1974), Glejser et al. (1980: 508) argue that "if exporting is essentially designed to achieve economies of scale, a negative correlation is likely to occur between domestic sales and the *ratio* of exports to domestic turnover". The same 'cost-reduction' argument holds in the short-run model described in Figure 2, and it can also be applied to justify an inverse relationship between total sales and the ratio of exports to total sales.

if large firms are more efficient than their smaller counterparts, the relationship between firm size and export intensity is ambiguous rather than inverse.

Wagner (1995: 33) adduces various reasons why size should have a positive impact on export performance: "... economies of scale in production, a more fully utilization of (specialized) executives, the opportunity to raise financing at lower cost, benefits from bulk purchasing, own marketing department plus own sales force, and a high capacity for taking risks...". However, in the light of the previous discussion, the 'economies of scale' argument can also be used to justify an inverse or non-significant relationship.

Moreover, Wagner himself finds that, in the case of German firms, the positive relationship between size and export intensity holds only up to a point. Similarly, several other studies[3] have found that the same relationship is not constantly increasing but assumes an inverted U-shape. This means that the impact of size on export performance is positive only for a first (and generally small)[4] range of the size variable (total sales or employees) and there is an upper threshold after which the relationship becomes negative or non-significant.

Besides the arguments already introduced, others can be adduced to justify the presence of an ambiguous relationship between size and export performance.

Lefebvre and Lefebvre (2001) contend that size may be relevant during the first stages of internationalization but not thereafter. Moreover, what matters is not the absolute but the relative size of a firm: some smaller firms may well be important players in their own niche markets, whereas other SMEs find that they are unable to compete with their larger rivals occupying dominant market positions. Calof (1993: 67) argues that although there is a positive association between firm size and internationalization, the size variable cannot be considered a barrier to exporting. "Certainly, large firms with more resources are better able to seek out internationalization opportunities, and they appear to do so with greater frequency than small and medium-sized firms. However, ... small and medium-sized firms are capable of entering the same markets as are large firms. Size only limits the number of markets served". Both lines of argument suggest that the costs and benefits due

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[3] See Bonaccorsi (1992), Kumar and Siddharthan (1994), Lefebvre et al. (1998), Wakelin (1998), and Sterlacchini (1999).

[4] On the basis of a study concerned with Italian firms, Bonaccorsi (1992: 609) concludes that "a minimum size for export involvement probably does exist, but it is not a very large size".

to exports may differ substantially across firms, depending not only on their size but also on their competitive strategy.

Bonaccorsi (1992), in particular, points out that the relationship between size and exports cannot be generalized because it is closely dependent on firms' export strategies. The limited internal resources available to small firms prevent them from achieving a stable presence in a large number of foreign markets. As a consequence, they usually implement weak (or narrow) export strategies – that is, strategies requiring a low level of sunk costs – so that they can easily exit from stagnant foreign markets and enter others with better economic prospects. In addition, small firms find that exporting is the easiest way to grow and, often, their internationalization is a 'collective' process. The last argument refers to the role played by agglomeration economies – exploitable by small firms located in industrial districts – and it will be resumed in the next section.

2. Other Firms' Characteristics and Export Performance

In a firm-level analysis of export performance, besides size, a further important control variable is the industry to which firms belong, simply because some industry-specific features affect opportunities to export.

An aspect already mentioned is the relevance of the economies of scale that determine, within industries, the number of extant firms and their size distribution (i.e. the level of concentration), and hence their propensity to export. Glejser et al. (1980: 508) pointed out that "A high domestic concentration could negatively affect the share of exports in total sales. First, it allows dominant firms to reap the possible economies of scale on the home market .... Second, insofar as concentration means monopoly power, dominant firms can exploit the negatively sloped domestic demand, and can avoid the possibility of exporting, as this would involve increasing the demand elasticity and becoming price-takers ...".

Another factor concerns the patterns of technological change: these, according to the taxonomy introduced by Pavitt (1984),[5] are strongly

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[5] Pavitt identifies four sectoral patterns of technological change. In 'supplier-dominated' industries (such as those producing traditional consumer goods) most innovations are produced by suppliers of equipment and materials rather than by autonomous innovative activities internal to firms. In-house engineering and R&D capabilities are instead stronger in 'specialized suppliers' (which thrive on product innovations) and 'scale- intensive' industries (which instead focus on process innovations in order to exploit latent economies of scale). Finally, the highest commitment to R&D is recorded in 'science-based' industries.

industry-specific. To the extent that innovative activities affect a firm's export performance (see the next section), account must be taken of the presence of these sectoral patterns of technological change.

Moreover, if the different areas of a country are strongly specialized in particular industrial activities, the impact of the industry variable on the export propensity of firms is reinforced by agglomeration economies. The latter can give important competitive advantages to small firms, as well as to industries and countries, like Italy, characterized by the strong presence of industrial districts.[6]

According to Becchetti and Rossi (2000), external economies in the provision of export services and exchanges of information about foreign markets may improve the export performance of small firms located in 'Marshallian districts' (see also Bagella et al. 1998). In this way, small firms – lacking specific internal resources which are needed to implement effective export strategies – are able to benefit from a reduction in the costs required to enter foreign markets (see the last part of the previous section). Obviously, the positive effect of geographical agglomeration on export performance will be higher if local firms compete in segmented foreign markets or when there are strong complementarities among them (both in production and commercial activities). In their empirical work, Becchetti and Rossi find that, in Italy, the location of SMEs in industrial districts increases both their probability of exporting and their export intensity.

Especially (although not exclusively) in industrial districts, many SMEs are specialized in particular phases of the production process and work as subcontractors for other larger and more mature firms. The latter can be termed 'independent firms' (or contractors), and they produce their goods for final users; while a subcontractor is a firm to which other enterprises of the same industry outsource one or more production phases. This distinction is important for the analysis of export performance – and particularly that of SMEs –, since it is reasonable to assume that contractors are able to realize a larger amount of direct export sales than subcontractors can. In fact, for a small sample of Italian SMEs, Sterlacchini (1999) has found that the percentage of sales due to subcontracting significantly depresses both the probability of export-

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[6] In Italy, each region (or even province) is specialized in a few industries, and the structure of industrial (local) systems is based on the agglomeration, in particular areas, of a large number of small manufacturing firms embedded in networks characterized by increasing specialization (of single productive units) and division of labour (among units). The situation is therefore that of the industrial districts thoroughly analyzed by Brusco (1982) and Pyke et al. (1990).

ing and the export shares of firms. Results consistent with this finding have been obtained by a study of a large sample of Canadian SMEs (Lefebvre and Lefebvre 2001).[7]

Significant external economies for firms may derive from belonging to industrial districts and networks; but they can also be achieved through formal integration with other firms. The affiliation of a firm with an industrial or business group enhances its financial and commercial capabilities, and this should increase its opportunities for internationalization and its propensity to export, especially when the business group operates internationally.

3. Innovative Activities and Exports

The relationship between technological innovation and international trade has mainly been investigated at a macro-economic level, and in this connection a large body of theoretical and empirical literature has stressed that innovations provide countries and industries with comparative advantages stronger and more durable than those based on unit labour costs.[8] A similar conclusion should also emerge from micro-economic studies, simply because technological knowledge is embodied in firms, and because the firm is the subject that decides to invest in innovative activities with a view to improving its performance.

Empirical studies carried out at the firm level have generally found a positive and significant relationship between innovation and export performance. However, this relationship is not close and not always significant when innovation is measured solely in terms of the intensity of R&D expenditures or employees,[9] because this indicator neglects other types of innovative effort of particular importance to firms of small size or belonging to non-R&D-intensive industries (Sterlacchini 1999).

A firm-level study carried out in Canada by Lefebvre et al. (1998) has shown that a firm's R&D intensity does not affect its export performance. By contrast, other technology variables (such as the percentage of employees with technical and scientific backgrounds and the presence of joint R&D projects with external partners) exert a positive and

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[7] Apart from technological capabilities (examined in the next section), Lefebvre and Lefebvre (2001) consider other variables that may affect a firm's export performance. They focus in particular on commercial capabilities such as the extent of product diversification, the presence of trademarks or proprietary products, access to distribution channels and the types of intermediaries employed by SMEs in foreign markets.

[8] See, e.g., Fagerberg (1988), Dosi et al. (1990) and Wakelin (1997).

[9] See Hirsch and Bijaoui (1985), Ito and Pucik (1993) and Kumar and Siddharthan (1994).

significant impact. Similar findings have been obtained by Becchetti and Rossi (2000) for Italian firms. These authors find that R&D intensity increases neither the probability of being an exporter nor the share of exports on sales; instead, other innovation variables (such as the importance attributed by firms to innovations) have a positive and significant effect.

Using a database of more than 3,000 Canadian SMEs, Lefebvre and Lefebvre (2001) enlarge the set of indicators conventionally applied to measure firms' technological capabilities by also considering the level of automation, the degree of modernization of equipment and machinery, and the presence of unique know-how. They find that all these technology variables, together with the intensity of R&D and skilled labour, exert a positive influence on the export performance of Canadian SMEs. Similar results have been obtained by a study carried out in Italy and based on a sample of SMEs belonging to 'specialized suppliers' and 'supplier-dominated' industries (Sterlacchini 1999): the intensity of innovative activities other than R&D (expenditures on design and trial production and the technological level of capital stock) has a positive and significant impact on firms' probability of exporting and on their export shares.

III. An Empirical Analysis for Italian Manufacturing Firms

The role of the various determinants of export performance described in the previous section has been examined by the present author in an empirical study of 4,005 Italian manufacturing firms. Used for this purpose was the database compiled by Mediocredito Centrale[10] (a financial institution specialized in the provision of medium- and long-term loans to Italian firms). Data were collected by questionnaires mailed to a stratified random sample of firms with fewer than 500 employees[11] (the overwhelming majority of Italian firms) and to the population of firms of larger size. The share of exports in total sales by these firms refers to 1991, whereas most of the indicators that can be used as ex-

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[10] The original database consisted of 4,100 firms. Ninety firms were eliminated because most of the 1991 data on them were missing. In addition, five very large firms (with total sales amounting to more than 1,970 million ecu) and five very small firms (with total sales less than 0.13 million ecu) were excluded from the analysis. The same database has been used by Becchetti and Rossi (2000) in their empirical study cited in the previous section.

[11] The sample was constructed according to their distribution in terms of size, industry and location.

planatory variables of export performance are available for the period 1989–1991.

1. Descriptive Analysis

In the overall sample of 4,005 firms, the share of exporters in 1991 amounts to 64.8 per cent, but there are significant differences among firms of different size. By using total sales in 1991, and according to the criteria adopted by the European Commission in the early 1990s, the sample can be broken down into three size groups: small firms (with total sales of less than 5 million ecu), medium-sized firms (with between 5 and 20 million ecu of total sales) and large firms (with total sales of more than 20 million ecu).[12]

Table 1: *Descriptive Statistics by Firm Size*

Size classes (total sales)	Number of firms	Percentage of exporting firms	Mean of the firms' export shares (std.dev.)	Share of exports in sales	Percentage of sub-contractors[a]
All firms					
Small (with less than 5 million ecu)	1,278	46.2	13.6 (24.0)	16.7	21.1
Medium (from 5 to 20 million ecu)	1,284	74.1	25.5 (27.9)	26.7	6.2
Large (with more than 20 million ecu)	1,443	72.9	25.0 (27.0)	23.9	1.8
Total	4,005	64.8	21.5 (27.0)	24.0	9.4
Only firms that are not subcontractors[a]					
Small	1,008	53.1	16.0 (25.4)	18.8	
Medium	1,205	76.1	26.4 (28.0)	27.5	
Large	1,417	73.0	25.0 (27.0)	23.8	
Total	3,657	68.5	23.0 (27.3)	24.0	

[a] A subcontractor is a firm with a share of sales due to subcontracting equal to or greater than 50 per cent.

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[12] See Commission des Communautés Européennes (1993). Total sales in Italian liras have been converted into ecu by using the average rate of change in 1991. The descriptive statistics by firm size do not significantly change when firms are distinguished according to the number of employees (fewer than 50 for small firms, fewer than and more than 250 for medium and large firms, respectively). Total sales – as a measure of size – are chosen in order to make the descriptive statistics consistent with the regression analysis (cf. Section III.2).

Table 1 shows that in the sub-sample of small firms the percentage of exporters lies far below the overall average, while the highest probability of exporting is recorded by medium-sized firms. However, when we look at the share of exports in total sales, we find that medium-sized firms are still the most export-oriented, but the relative performance of small firms improves.

As expected, the percentage of small firms classifiable as subcontractors (with a share of sales due to subcontracting equal to or greater than 50 per cent) is the highest in the sample. When subcontractors are excluded from the analysis (see the lower part of Table 1), the percentage of exporters among small firms increases from 46 to 53 per cent and, also in terms of the other two indicators of export performance, the difference with respect to larger firms decreases. Thus, the analysis of the export performance of small firms cannot neglect their nature as subcontractors.

The Mediocredito database provides a three-digit classification of Italian manufacturing industries; moreover, each industry is assigned to one of the four technological groups identified by Pavitt (see Section II.2). For each group, Table 2 reports the distribution of the firms in the sample and the different measures of export propensity. In the Appendix, Table A.1 provides detailed statistics for the industries composing each group.

There are major differences in terms of export probability among these industries. In fact, the highest percentages of exporting firms are recorded by 'specialized suppliers' followed by 'supplier-dominated' industries. The same industries also prevail in terms of the mean of the firms' export shares, whereas 'scale-intensive' industries remarkably improve their performance when the industry share of exports in total sales is used. This suggests that there are some large firms (in terms of

Table 2: *Descriptive Statistics by Technological Group*

Groups of industries	Number of firms	Percentage of exporting firms	Mean of the firms' export shares (std. dev.)	Share of exports in sales
Science-based	158	59.5	13.6 (21.3)	16.2
Scale-intensive	1,191	58.0	17.7 (23.9)	24.7
Specialized suppliers	913	75.4	30.0 (29.4)	36.7
Supplier-dominated	1,743	64.3	20.3 (27.1)	19.4
Total manufacturing	4,005	64.8	21.5 (27.0)	24.0

total sales) in this group which are much more export-oriented than the others belonging to the same industry.[13]

These findings are consistent with the Italian (sectoral) specialization in international trade: in effect, the greatest (revealed) comparative advantages are recorded by industries producing traditional consumer goods and machinery, while the export performance of 'science-based' industries is weaker (Amendola et al. 1992).

Besides the size and industry distribution of firms, there are several reasons for taking account of their geographical location as well. First, agglomeration economies or industrial districts (which, according to Section II.1, should enhance the export performance of SMEs) are not homogeneously distributed across regions in Italy. In fact, small-firm agglomerations (or 'Marshallian districts') are particularly numerous in the northern and some of the central regions, while they are rarer in the southern ones (Pyke et al. 1990). Second, the Italian industries characterized by a greater export propensity are concentrated more in the north-eastern and central regions. Finally, a large share of Italian exports go to northern Europe (and particularly to Germany), so that the firms located in northern Italy benefit more from geographical proximity to export markets (Conti and Menghinello 1996).

Although with a high level of aggregation, the role of geographical location was taken into account by breaking down the sample of Italian firms into four macro-areas: north-west, north-east, central and south. Table 3 shows that north-eastern firms are characterized by a

Table 3: *Descriptive Statistics by Geographical Area*

Geographical areas	Number of firms	Percentage of exporting firms	Mean of the firms' export shares (std. dev.)	Share of exports in sales
North-west	1,778	69.0	21.2 (25.4)	21.7
North-east	1,304	69.4	25.2 (28.1)	30.2
Central	564	57.3	20.7 (29.4)	21.5
South	359	38.7	10.8 (22.7)	24.8
Total	4,005	64.8	21.5 (27.0)	24.0

[13] Table A.1 in the Appendix shows that – whatever indicator is used – the industries with the highest export propensity are Industrial and agricultural machinery, Other manufacturing industries (classified as 'specialized suppliers'), Leather and leather products and Clothing and footwear ('supplier-dominated'). Only the Rubber products industry (included in the 'scale-intensive' group) records a comparable export performance.

probability of exporting similar to that of the firms located in the north-west, but they exceed the latter in terms of export shares.

The firms located in central regions have a lower probability of exporting, but they improve their position when the other two indicators of export intensity are used. Finally, the worst performance is recorded by southern firms, especially in terms of exporters and mean of firms' export shares. However, for this area, the share of exports in total sales is higher than that recorded by central and north-western regions, suggesting that some large southern firms, as opposed to their smaller counterparts, are characterized by a very high export intensity.

2. Regression Analysis

The descriptive analysis has already shown that there are interesting linkages between export propensity and some characteristics of Italian firms. To identify the most significant relationships, Probit and Tobit estimates were carried out; the dependent variables were the *probability of exporting* and the *share of exports in total sales in 1991*, respectively.

With respect to the intensity of exports, censored Tobit estimates were preferred to OLS (in line with the majority of firm-level studies described in Section II). In effect, as happened with my sample, when there are many firms that do not export at all and a few firms that derive all their sales from exports, OLS estimates are downward biased.

The independent variables were the following:

- *three dummy variables for small, medium-sized and large firms*, which were computed by using total sales in 1990 and according to the thresholds suggested by the European Commission; these binary variables were inserted in the regressions also as interaction dummies (i.e. multiplied by all the other explanatory variables) in order to test whether the independent variables' coefficients were significantly different among the three size classes;
- firm size was measured by *total sales in 1990* (millions of ecu) and, to test the presence of a non-linear impact on the dependent variables, the square of total sales was used as well. With respect to the possible problem of endogeneity of total sales and other explanatory variables,[14] it should be noted that the model employed here is not the empirical counterpart to a theoretical, micro-found-

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[14] It is assumed in the regression analyses that the causality runs from size to export performance. To be rigorous, the direction of causality should be tested using panel data. Unfortunately, the export variable is available only for 1991 in our database, and there is no information about the year when a firm first became an exporter. Bernard and Wag-

ed model; therefore, its coefficients only estimate the parameters of the conditional mean of the share of exports in total sales of firm i (x_i) on the whole set of independent variables (Z_i). In formulae, $x_i = \mathrm{E}\,[x_i \mid Z_i] + \varepsilon_i$, where $\mathrm{E}\,[\varepsilon_i \mid Z_i] = 0$ by construction. Leaving the issue of unobservability of $x_i < 0$ aside (since the Tobit formulation takes care of that), it is clear that the estimated model does not aim at quantifying 'deep' behavioural parameters but only to summarize the evidence in a statistically meaningful way. The choice of including in the conditioning set some variables (total sales and, as we shall see below, R&D intensity) lagged by one year,[15] stems from the idea that it is more meaningful to condition on past (and thus given) data;

- the propensity to work as a subcontractor was measured by the *percentage of sales due to subcontracting in 1991*;
- affiliation of a firm with an industrial or business group was taken into account by using two dummy variables: *national group* (if the firm belonged to an Italian group) and *international group* (when the group operated internationally);[16]
- to control for geographical location, three dummy variables were inserted in the regressions: *north-east*, *central* and *south*;
- industry fixed effects were controlled by including 26 dummies (see Table A.1 in the Appendix).

Moreover, the following indicators of innovative activities were considered:

- the *percentage of R&D employees*[17] *in 1990*; although the intensity of R&D employees is, over time, more persistent than total sales, the rationale for introducing this lag is the same as for the size variable;
- three qualitative and discrete variables (ranging from 0 to 3) identifying the importance attributed by firms to *process R&D*, *product R&D*, and the *introduction of innovative machinery* (either for replac-

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ner (1997) and Bernard and Jensen (1999) have carried out this test using data on firms' size, wages and productivity before and after the decision to enter foreign markets; they found that 'good firms' become exporters while exporting does not greatly improve firms' performance.

[15] When a two-year lag was imposed on the size and R&D intensity variables, the results of the Probit and Tobit regressions did not change significantly.

[16] The definition of *national group* excludes Italian-based multinationals while that of *international group* includes also Italian firms controlled by foreign companies.

[17] The questionnaire included a specific question on the number of R&D employees. R&D expenditures, instead, had to be extracted from balance sheet data and were less reliable because many firms did not report them.

ing old machinery or expanding productive capacity); the latter variable, in particular, can be used as a proxy for the investment in advanced process technologies;

• a dummy variable which is equal to one if the firm received *R&D public subsidies in 1989–1991* and zero otherwise.

Note that, apart from size and R&D intensity, the explanatory variables were not lagged with respect to the dependent ones because most of them identified firms' characteristics that do not change in the short run. Moreover, the set of innovation indicators that can be derived from the Mediocredito database is far from satisfactory because, in order to consider innovative activities different from in-house R&D efforts (namely, process innovations embodied in machinery), it was necessary to rely on qualitative variables.

Table 4 presents the regression results. Since there were many firms (especially those of small size) that did not report data for total sales and R&D employees in 1990, the number of observations decreases from 4,005 to 3,659.

In a first stage, the estimates were carried out by including the size interaction dummies for all the explanatory variables (with the exception of industry dummies): that is, without imposing any restrictions on the parameters. Subsequently, in the light of the results, the restriction was imposed for some independent variables that the coefficients should be equal among the groups of small, medium-sized and large firms. This procedure continued until, on the basis of a likelihood ratio (LR) test, the hypothesis that the restricted specification was to be preferred to the unrestricted one was rejected by the data.[18] Table 4 shows the findings of the restricted specifications which passed the LR test. For the sake of brevity, the coefficients of industry dummies are not reported.[19]

Starting with the impact of firm size, for both export probability and intensity, the estimated equations present a negative and significant intercept for small firms. However, inspection of the coefficients of

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[18] The test is computed as $LR = 2\,[\ln L(\text{unrestricted}) - \ln L(\text{restricted})]$ where $\ln L$ stands for log-likelihood. The restricted specification is rejected when LR is lower than the critical value (at a 0.05 level of confidence) of the χ^2 distribution with degrees of freedom equal to the number of restrictions.

[19] The findings for the industry dummies are consistent with the picture that emerges from the descriptive analysis (see Table A.1 in the Appendix). In both estimates a negative and significant coefficient arises for Office & computing machinery, for instance, while Rubber and plastic products, Textiles, Industrial and agricultural machinery, Leather products, Clothing & footwear and Wood & furniture get positive coefficients.

Table 4: *Probit and Tobit Regressions*
(number of observations = 3,659)[a]

Independent variables	Dependent variables	
	Probability of exporting in 1991	Share of exports in total sales 1991
Constant		
Dummy small	−0.63 (−3.51)*	−24.51 (−4.91)*
Dummy medium	0.11 (0.31)	−1.96 (−0.24)
Dummy large	−0.16 (−1.01)	−0.53 (−0.14)
Total sales 1990		
ID (Interaction Dummy) small	0.34 (3.67)*	11.45 (4.56)*
ID medium	0.04 (0.83)	1.04 (1.11)
ID large	−0.001 (−3.31)*	−0.02 (−2.73)*
(Total sales 1990)^2		
ID small	−0.03 (−2.17)*	−0.98 (−3.20)*
ID medium	−0.001 (−0.54)	−0.02 (−0.64)
ID large	0.000001 (2.73)*	0.00001 (2.41)*
Percentage of sales due to subcontracting 1991		
ID small	−0.01 (−9.06)*	−0.34 (−9.45)*
ID medium	−0.009 (−5.20)*	−0.18 (−4.11)*
ID large	0.001 (0.35)	0.003 (0.03)
National group (dummy var.)		
ID small	−0.11 (−0.61)	−4.92 (−1.06)
ID medium	0.02 (0.22)	−2.48 (−1.03)
ID large	0.80 (7.80)*	13.43 (6.33)*
International group (dummy var.)		
ID small	−0.11 (−0.38)	5.22 (0.73)
ID medium	0.16 (0.89)	5.43 (1.45)
ID large	0.99 (7.74)*	15.57 (6.15)*
North-east (dummy var.)	0.03 (0.42)	
ID small		1.45 (0.57)
ID medium		5.44 (2.58)*
ID large		6.48 (3.15)*
Central (dummy var.)		
ID small	−0.47 (−3.94)*	−8.20 (−2.43)*
ID medium	−0.23 (−1.81)	2.18 (0.73)
ID large	−0.11 (−0.82)	−0.43 (−0.14)
South (dummy var.)	−0.66 (−7.49)*	−13.98 (−6.00)*

Table 4: *Continued*

Independent variables	Dependent variables	
	Probability of exporting in 1991	Share of exports in total sales 1991
Share of R&D employees 1990		0.25 (2.19)*
ID small	0.003 (0.49)	
ID medium	0.04 (2.63)*	
ID large	0.02 (1.85)	
Process R&D (0=not significant; 3=very important)	0.04 (0.94)	−0.04 (−0.06)
Product R&D (0=not significant; 3=very important)	0.21 (5.64)*	3.72 (5.56)*
Introduction of innovative machinery (0=not significant; 3=very important)		
ID small	0.07 (1.23)	2.47 (1.68)
ID medium	0.17 (3.15)*	2.81 (2.54)*
ID large	0.29 (5.59)*	4.83 (4.65)*
R&D public subsidies (dummy var.)	0.75 (7.37)*	10.88 (6.23)*
Log-likelihood function	−1739.33	−12531.47
Percentage of cases correctly predicted	77.2	
Sigma		31.54 (65.86)*
Pseudo R^2**	0.285	0.289

[a] Industry dummies are not reported; t-statistics are in brackets. −* significant at the 0.05 level. − ** Computed as $1-(Lr/Lu)^{2/n}$ where Lr stands for the likelihood functions of the regressions in which all the coefficients but the constant are restricted to zero, Lu refers to the unrestricted regressions and n is the number of observations.

lagged total sales shows that the relationship is positive and of an inverted U-shape within the group of small firms, not significant for medium-sized firms, and negative, but U-shaped, for large firms.

The estimates yield the rough picture of the relationship between export intensity and total sales shown in Figure 3. For the whole range of sales the relationship resembles a cubic function. Only within the group of small firms (with less than 5 million ecu of total sales) does firms' size exert a positive impact on export shares, but there is a critical amount of sales (less than 5 million ecu) after which the relationship is slightly decreasing. As regards medium-sized firms, further increases in size do not affect the intensity of exports until the conventional (i.e. approximate) threshold of 20 million ecu is reached. There-

Figure 3: *Export Intensity and Total Sales: Estimated Relationship*
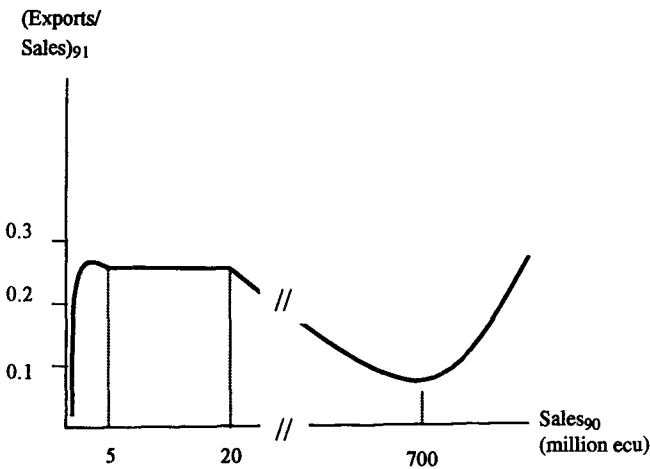
(Exports/
Sales)$_{91}$

after – that is, in the case of large firms – the share of exports diminishes, but there is again a critical level of sales (approaching 700 million ecu) at which the sign of the relationship changes; which means that very large firms may record an intensity of exports similar or even greater than that of SMEs.

A plausible explanation for these findings is as follows. Ceteris paribus, in order to become exporters and to have a substantial share of exports in their total sales, small firms must achieve a critical size. Below this minimum size, a firm probably does not possess sufficient managerial, financial and commercial capabilities to become an exporter. Above this size, the relationship between total sales and export performance is not significant but becomes U-shaped for large firms. A range of the size variable characterized by an inverse relationship may arise because large firms enjoy greater domestic market power and have less incentive to export (see Section II.1). However – i.e. notwithstanding their domestic market power – very large firms are likely to record a strong export propensity for at least two reasons. The first is that very large firms may enjoy market power abroad as well, and thus compete in an international oligopoly. If this is the case, they must be as active as possible in many national markets. A second reason (which is a complement of the former) is that, by serving almost exclusively or only the home market, very large firms are unable to minimize costs. In effect, as we shall see, large, more exported-orient-

ed firms attribute greater importance to the introduction of innovative machinery. As a consequence, they strive to work with a more technology-advanced capital stock and thereby constantly increase their efficiency. As a result, the level of output required to minimize costs may far exceed that allowed by the domestic market (see the discussion of Figure 2 in Section II.1).

Moving to the other explanatory variables, the percentage of sales due to subcontracting depresses both the probability of exporting and the export intensity of small and medium- sized firms. Since the large majority of Italian subcontractors are SMEs which work almost exclusively for larger contractors located in the same region or in Italy (Sterlacchini 1999), this result is not surprising.

Affiliation with a business group does not raise the export performance of SMEs, while the impact is positive and significant for the larger ones, and especially if they belong to an international group.

As far as geographical location is concerned, whatever the size of firms, location in southern Italy depresses export probability and intensity, and to a lesser extent the same happens to small firms located in central regions. By contrast, location in north-eastern regions enhances the export intensity of medium-sized and large firms.

With regard to innovation variables, the intensity of R&D exerts a positive impact on the export shares of all firms, whereas, in terms of export probability, the positive effect is significant only for medium-sized firms. Independently of size, the importance attributed by firms to product R&D increases both export probability and intensity while the importance of process R&D is never significant. With respect to process innovation, medium-sized and (especially) large firms which give great importance to the introduction of innovative machinery record better export performances (see above). Finally, for all firms the achievement of R&D public subsidies is associated with a higher probability and intensity of exports.

IV. Concluding Remarks

This paper has emphasized that a variety of factors must be taken into account to provide a convincing explanation of why some firms are more export-oriented than others. However, the most important finding of the empirical analysis is that the determinants of export performance differ according to the size of firms.

First of all, only in the case of small firms is there a positive and significant impact of size (measured by total sales) on export perfor-

mances, and the relationship is inverted U-shaped. Total sales are instead not significant within the group of medium-sized firms, while a decreasing, though U-shaped, relationship emerges for large firms. As a consequence, it is possible to state that the upper limit above which the size of a firm does not increase its export propensity is not particularly high and, thus, it can be achieved even by small firms.

Secondly, firms with a substantial share of sales due to subcontracting record lower export performances, and this is especially the case of Italian SMEs working mainly for domestic contractors. Large firms, as opposed to SMEs, gain additional advantages from being affiliated with business groups, particularly with those operating on an international scale.

Finally, innovative activities increase export performances, but again their relative impact changes with the size of firms. Small firms which are successful in foreign markets rely almost exclusively on product innovations and this suggests that, to become exporters and sell a relevant share of output abroad, they must improve the quality of products rather than reduce costs and cut prices. Instead, for medium-sized and large firms the range of innovation indicators positively associated with export propensity is wider: the intensity of R&D positively affects the export probability of medium-sized firms while the priority assigned to the introduction of innovative machinery – i.e. the intensity of cost-reducing innovations – particularly enhances the export performances of large firms. The last result supports the idea that, in spite of their domestic market power, the larger and more efficient firms must add a significant amount of foreign sales to their domestic ones in order to minimize costs.

Appendix

Table A1: *Descriptive Statistics by Industry*[a]

	Number of firms	Percentage of exporting firms	Mean of the firms' export shares (std. dev.)	Share of exports in sales
Science-based industries				
Industrial and agricultural chemicals and pharmaceuticals	91	65.9	16.4 (24.2)	15.0
Office & computing machinery	23	30.4	6.7 (17.1)	19.2
Electrical measurement, electro-medical and telecommunications equipment	32	56.3	9.2 (13.8)	9.9
Aircraft	12	75.0	17.7 (18.4)	39.7
Scale-intensive industries				
Basic chemical products, soaps, detergents and perfumes	98	63.3	19.4 (25.5)	22.2
Basic metal industries	129	63.6	18.3 (21.4)	21.9
Building materials, glass and pottery	193	52.3	17.6 (23.7)	17.1
Man-made fibres	8	50.0	17.1 (22.8)	22.9
Electrical apparatus, Radio, TV and domestic appliances	302	68.2	24.8 (26.5)	28.1
Motor vehicles	67	76.1	25.1 (27.4)	44.8
Other means of transport	32	59.4	21.7 (25.1)	21.2
Paper, printing and publishing	322	41.9	6.9 (14.9)	15.0
Rubber products	39	79.5	31.5 (28.5)	26.2
Specialized suppliers industries				
Glues, paints and other chemical products	36	69.4	11.9 (13.4)	27.7
Industrial and agricultural machinery	535	80.2	35.3 (29.4)	42.3
Installation and repair of electrical and electronic equipment and apparatus	45	35.6	9.1 (19.5)	29.3
Precision instruments	53	71.7	28.9 (29.3)	27.3
Plastic products and tyres	172	75.0	20.8 (24.9)	28.1
Other manufacturing industries (musical instruments, toys, packaging, photographic labs., etc.)	72	70.8	35.0 (35.2)	29.3
Supplier-dominated industries				
Stones, asbestos and other non-metallic minerals	43	48.8	14.2 (26.1)	18.4
Metal products	539	63.8	19.6 (25.0)	23.7
Food	147	53.7	8.1 (15.7)	6.5
Other food products, beverages and tobacco	85	55.3	6.8 (13.8)	7.3
Textiles	354	64.1	21.6 (26.6)	27.9
Leather and leather products	56	87.5	37.7 (29.8)	42.4
Clothing and footwear	350	68.3	26.5 (31.2)	31.8
Wood and furniture	169	68.0	20.6 (29.9)	29.6

[a] Three-digit industries included in the same technological group as well as in the same two-digit industry have been merged. The distribution of industries reported in the table is thus a compromise between a three- and a two-digit level of classification.

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Abstract: The Determinants of Export Performance: A Firm-Level Study of Italian Manufacturing. – This paper analyzes some determinants of a firm's probability of exporting and export intensity and presents the findings of an empirical study carried out on a large sample of Italian firms. On the basis of Probit and Tobit estimates, it emerges that these determinants change according to the size of firms. In particular, only for small firms is the relationship between size and export performance positive. The export activity of small and medium-sized firms decreases with the share of sales due to subcontracting. Larger firms, instead, benefit more from being affiliated with business groups and performing innovative activities of a different nature. JEL no. F10, D21, O33.