



CIRANO
Centre interuniversitaire de recherche
en analyse des organisations

Série Scientifique
Scientific Series

N° 95s-23

**INNOVATIVE EFFORTS AS
DETERMINANTS OF EXPORT
PERFORMANCE: THE CASE OF
SPECIALIZED SUPPLIERS**

*Louis A. Lefebvre, Élisabeth Lefebvre,
Mario Bourgault*

Montréal
Avril 1995

CIRANO

Le CIRANO est une corporation privée à but non lucratif constituée en vertu de la Loi des compagnies du Québec. Le financement de son infrastructure et de ses activités de recherche provient des cotisations de ses organisations-membres, d'une subvention d'infrastructure du ministère de l'Industrie, du Commerce, de la Science et de la Technologie, de même que des subventions et mandats obtenus par ses équipes de recherche. La *Série Scientifique* est la réalisation d'une des missions que s'est données le CIRANO, soit de développer l'analyse scientifique des organisations et des comportements stratégiques.

CIRANO is a private non-profit organization incorporated under the Québec Companies Act. Its infrastructure and research activities are funded through fees paid by member organizations, an infrastructure grant from the Ministère de l'Industrie, du Commerce, de la Science et de la Technologie, and grants and research mandates obtained by its research teams. The Scientific Series fulfils one of the missions of CIRANO: to develop the scientific analysis of organizations and strategic behaviour.

Les organisations-partenaires / The Partner Organizations

- Ministère de l'Industrie, du Commerce, de la Science et de la Technologie.
- École des Hautes Études Commerciales.
- École Polytechnique.
- Université de Montréal.
- Université Laval.
- McGill University.
- Université du Québec à Montréal.
- Bell Québec.
- La Caisse de dépôt et de placement du Québec.
- Hydro-Québec.
- Banque Laurentienne du Canada.
- Fédération des caisses populaires de Montréal et de l'Ouest-du-Québec.
- Télé globe Canada.
- Société d'électrolyse et de chimie Alcan Ltée.
- Avenor

Ce document est publié dans l'intention de rendre accessible les résultats préliminaires de la recherche effectuée au CIRANO, afin de susciter des échanges et des suggestions. Les idées et les opinions émises sont sous l'unique responsabilité des auteurs, et ne représentent pas nécessairement les positions du CIRANO ou de ses partenaires.

This paper presents preliminary research carried out at CIRANO and aims to encourage discussion and comment. The observations and viewpoints expressed are the sole responsibility of the authors. They do not necessarily represent positions of CIRANO or its partners.

Innovative Efforts as Determinants of Export Performance: The Case of Specialized Suppliers

Louis A. Lefebvre[†] Élisabeth Lefebvre[†] Mario Bourgault[†]

Abstract / Résumé

This paper presents empirical evidence on the relationship between innovative efforts and performance on international markets for the specific case of small firms acting as “specialized suppliers”. In addition to tangible efforts such as R&D expenditures, intangible efforts are also considered. Results clearly identify specific innovative efforts as determinants of export performance. Moreover, the study results suggest a particular innovative profile for “global” specialized suppliers, especially as it relates to R&D collaborative agreements and information scanning sources used in the product development process.

Les résultats présentés dans cette étude portent sur le lien entre efforts innovateurs et performance sur les marchés internationaux, dans le cas particulier des petites firmes appelées « fournisseurs spécialisés ». Outre les efforts de nature tangible telles les dépenses en R-D, les efforts de nature intangible sont également considérés. Les résultats permettent d'identifier clairement un certain nombre d'efforts comme déterminants de la performance à l'exportation. L'analyse révèle par ailleurs un profil innovateur propre aux fournisseurs spécialisés « mondiaux », notamment en ce qui a trait aux accords de collaboration en R-D et les sources d'information utilisées dans le processus de développement de produits.

[†] École Polytechnique — CIRANO, 2020 University - 25th Floor, Montreal, Quebec, CANADA H3A 2A5.

1. Introduction

International markets can be very attractive for small and medium-sized firms as they represent significant opportunities for growth. Although incentives to export may vary, and in spite of unfavorable arguments such as limited resources, numerous studies have reported examples of SMEs active outside their national borders and capable of facing international competition (Bonaccorsi, 1992; Samuels *et al.*, 1992; Edmunds and Khoury, 1986). While showing dynamism and a willingness to engage in international activities, those firms cannot, however, escape today's technology-oriented competition. Such competition has been widely discussed over the last years and many aspects of it have been described: shortened product development cycle, customer-driven markets and knowledge-intensive products are some characteristics of the world economy (Clark and Wheelwright, 1993; Thurow, 1992; Stalk and Hout, 1990; Piore and Sabel, 1984). In this context, it appears essential that SMEs show the ability to engage in various innovative efforts in order to sustain their competitive edge.

Amongst the rich literature published in recent decades on export performance, only a limited number of studies have addressed technological issues and, among those who did, very few have explored beyond R&D expenditures. Yet, recent research has highlighted the importance of considering a wide array of innovative efforts when measuring the innovative capacity of SMEs (Lefebvre *et al.*, 1993). Though tangible efforts such as R&D expenditures and technology acquisition are crucial in many cases, intangible efforts also need to be considered.

In this context, the research questions we chose to explore through the present study can be stated as follows:

- (i) To what extent are realized tangible and intangible innovative efforts in small firms related to their export performance measured in terms of both volume and destination of sales?
- (ii) Which tangible and intangible innovative efforts are the strongest determinants of export performance?
- (iii) Which specific tangible and intangible innovative efforts characterize small firms operating on global markets?

Some answers to these questions are provided following a detailed study conducted on a sample of small independent firms engaged in R&D activities which also correspond to the profile of firms described by Pavitt (1984) as "specialized

suppliers”. These firms were chosen for three main reasons. First, if innovative efforts are assumed to go beyond R&D investments, all firms, for the sake of comparison, should have a common denominator and should therefore be actively engaged in R&D activities. Second, when studying efforts related to technological innovation, firms should belong to the same “technological family” (Pavitt *et al.*, 1989:85) based on sectors of production and use of innovation. Third, specialized suppliers play a major role in industrialized economies, especially small ones where scale-intensive firms cannot rely on a large domestic market.

2. Theoretical background

2.1 Nature of exports

Internationalization has become a central theme for advocates of economic growth and broad international agreements such as the signed accord between the United States, Canada and Mexico (NAFTA) are providing firms with new opportunities to extend their market base. Beyond the volume of exports generated by countries, a closer look at the very nature of those exports can be most instructive with regard to their ability to keep up with international competition in the long run. In the case of many Asian countries (Japan, Korea, and the “Five Tigers”), exports have unquestionably been a key lever in the rapid rise of National Gross Domestic Product. This has been accomplished by exporting mainly manufactured goods instead of natural resources as is the case in many other export-intensive economies. For those countries, it appears that general increases in export value, especially manufactured goods, may be related to a gradually increasing use of technology, both in terms of machinery and creation of knowledge. The obvious success of Asian countries on international markets largely supports the basic assumption of this study which is that export performance and technological innovation may be closely related.

2.2 Exports and SMEs

In the context of increased market globalization, the well-established multinational enterprises (MNEs) account for the largest share of the world’s exports. In fact, the proportion of exports made by national MNEs or foreign affiliates in the U.S., U.K. and Japan in 1987 respectively represented 80%, 80% and 41% of all exports made by those countries (Dunning, 1993). Cross-border trade within firms (intra-firm trade) is also very important since approximately 42% of U.S. exports in 1989 were transactions between U.S. firms and their foreign affiliates or parents (Dunning, 1993).

Such numbers may seem to diminish the role played by SMEs on international markets. Even though their share of world trade does indeed remain much lower than that of larger firms, many SMEs are nevertheless very active abroad and, in fact, rely on the development of foreign markets to ensure corporate growth. This is particularly true of firms evolving in niche markets or firms originating from small countries where local markets are limited. In this respect, some recent studies conducted in Italy and the Netherlands have challenged the usual assumption that SMEs are less inclined to export than larger firms (Thurik, 1993; Bonaccorsi, 1992). Even a large market like the United States, in spite of the previously cited statistics, shows a high percentage of exporters among its small firms. A recent report issued by the U.S. Secretary of Trade and Commerce reveals that about 70% of all exporting enterprises were small firms with fewer than 100 employees (Prozak, 1993). Moreover, considering the strategic role played by SMEs in most economies¹, it appears essential to look at how they perform on international markets and how they can improve their performance in view of the nature of today's competition.

2.3 Determinants of export performance

Over the years, researchers have generated numerous studies on exports many of which focused on the determinants of performance. As highlighted by a few authors who have produced thorough literature reviews on the topic, generalizations are still very difficult to make and much depends on firms' business position as well as the environment in which they operate (Walters and Samiee, 1990; Aaby and Slater, 1989; Miesenbock, 1988). However, a closer look at the various efforts made to identify determinants of performance suggests a grouping of variables into four broad categories. Our objective is not to replicate such a literature review but rather to indicate the most common themes of research.

2.4 Past research on determinants of export performance

In the first group are included those variables related to firms' characteristics — *what the firms are* — such as size as measured by the number of employees, the volume of sales, or the expenditure in human resources (see for example, Wagner, 1995) and experience on international markets, also referred to as the degree of internationalization.

Besides those factual characteristics, other variables drawn from organizational theory such as variables measuring managers' or decision-makers' characteristics were

¹ Not only do SMEs play a very important role in the above-mentioned countries but they also play a fundamental role in strong economies like that of Germany or Japan (OECD, 1993).

studied. Again, several authors have analysed factual variables such as level of education, first nationality, knowledge of a foreign language while others have studied subjective variables such as managers' attitude toward foreign markets, their perception of risk or their values (Bijmolt and Zwart, 1994).

Another group of variables that have been scrutinized are those related to the competencies of firms — *what firms do or are able to do* — and focused on the way they organize and use their resources. Among such variables are management capabilities (planning, controlling, etc.), information gathering activities and specific technology/products (Walter and Samiee, 1990; Aaby and Slater, 1989).

Finally, it is possible to consider an additional group of variables related to firms' environment — *what firms are influenced by* — and include characteristics of the industry, markets in which they operate and firms' environment such as stimulating measures of different levels of governments. In addition, some authors (mainly from the field of marketing) also consider variables which one could regard as moderating factors. This last group usually includes strategy-related variables such as elements of a firm's marketing mix (product, price or promotion). This inclusion of strategic factors is justified in a perspective where coalignment (or fit) between strategy and factors in the first groups should have a positive effect on export performance (Cavusgil and Zou, 1994; Lee and Yang, 1990).

2.5 Technological innovation as an understudied dimension

The above groups of variables identified in regard to export performance highlight the fact that technological issues have generally been left out of the picture in spite of the considerable number of studies carried out. The few attempts made to understand the role of technology restricted the analysis to variables such as R&D expenses, number of owned patents or proprietary technologies (Ito and Pucik, 1993; Miesenbock, 1988; McGuinness and Little, 1981). Clearly, this limited view does not sufficiently reflect SMEs' reality nor does it account for the major progress recently accomplished towards better understanding the role and the nature of technology in firms. In this context, the focus of the present study is therefore clearly directed towards considering a wide variety of technological efforts and assessing their relationship with SMEs' export performance.

Most economists, management scientists and engineers studying technological change would now agree that the notion of R&D does not grasp the whole complexity of innovation within firms and particularly SMEs. Sources of innovation are diversified and so are the resources and mechanisms put in place to assimilate the information required (Napolitano, 1991). Therefore, it appears essential to consider not only the

amount of money spent on R&D or specialized human resources - the tangible efforts - but also some intangible indicators such as the technological strategy pursued by the firm through its research activities (product development, improvement of existing products, etc.), the nature of the partnerships for collaborative R&D, as well as the sources of information for conducting R&D and commercialization activities.

3. Method

3.1 Sample

The sample used for this study consisted of firms located in the province of Quebec, Canada, and registered in government files as being firms conducting formal R&D activities. A total of 692 firms, which corresponds to the entire population, was considered for the survey. A self-administered questionnaire was mailed to the CEO of each firm after having been extensively pre-tested with 15 persons (10 of whom were CEOs). Considering the strategic nature of all innovation-oriented activities, CEOs are considered to be the best respondents for this kind of survey as they have a major influence on resource allocation and on strategic orientation, especially in the context of small firms.

A total of 236 questionnaires were returned which constitutes a response rate of 34.8%². It should be noted that the sample representation does not differ from that observed in the population of firms operating in Quebec with respect to size and sector of economic activity (goodness of fit test $\chi^2=4.67$, $p=0.197$ and $\chi^2=0.005$, $p=0.968$ respectively).

Three restrictions are imposed on the responding firms in order to reflect the focus of the present study. First, firms retained have fewer than 200 employees. This upper limit corresponds to one of the standard definitions of small firms (Stanworth *et al.*, 1982). Second, they are independent, therefore excluding any multinational affiliates. This second restriction allows us to exclude firms operating as affiliates of multinational consortiums which may be exporting as a result of advantages provided by the head office or preferential trade agreements between affiliates. In both cases, the smaller firms have access to a pool of resources which is not available to independent firms. As a result, multinational affiliates are not considered in this study. Third, in order to control for and “take into account the enormous variety between firms in sources of technological opportunities and in the rate and direction of their

² The response rate of 34.8 is the ratio of 236 over 687 firms instead of 692. In the case of 14 firms, the address had changed or the firm had ceased its activities.

development” (Pavitt, 1990: 19), it was decided to concentrate on one technological family identified by Pavitt whose original typology has already been extensively tested empirically although with some variants (Pavitt *et al.*, 1989; Archibugi *et al.*, 1991). All firms retained belong to a category labeled “specialized suppliers”. These firms derive their technological advantages from their ability to improve the performance of specialized inputs and they are characterized by the fact that they thrive on product innovation. A detailed description of such firms is provided in Pavitt (1984). A rigorous and systematic procedure for identifying firms in our sample that fit the profile of specialized suppliers was followed:

- (i) Firms were retained on the basis of their principal sector of activity (4 digit-SIC codes);
- (ii) All firms retained were examined individually in order to ensure that they corresponded to the profile of specialized suppliers with respect to firm size and technological profile. Four persons³ participated in this second step and firms were selected on the basis of a consensus.

With three simultaneous restrictions, the final sample on which all statistical analyses are performed is 101 firms.

3.2 Research variables

Research variables along with their operational measures and theoretical justification are presented in table 1.

³ Including the first two authors of this article as well as Marie Lavoie, invited professor at the École Polytechnique and Ph.D. graduate from SPRU, and Carl St-Pierre, research professional.

TABLE 1
Research Variables and their Operational Measures

Research variables	Operational measures	Theoretical justification
Export performance:		
Volume	Ratio of export sales to total sales	Most common measure as reported by Cavusgil and Zou (1994), Aaby and Slater (1989)
Destination	North America vs other countries	As suggested by Porter (1991)
Tangible innovative efforts:		
R&D intensity	Investments in R&D as a percentage of annual sales (factual)	A classical measure of innovation efforts
Technocratization	Percentage of scientific/technical employees (factual)	Collins <i>et al.</i> (1988)
Intangible innovative efforts:		
R&D strategy:	Extent to which R&D activities are directed towards basic research (perceived) Extent to which R&D activities are directed towards applied research (perceived) Extent to which R&D activities are directed towards product development (perceived) Extent to which R&D activities are directed towards process improvement (perceived) Extent to which R&D activities are directed towards improvement of existing products (perceived) Extent to which R&D activities are directed towards improvement of existing scientific/technological assets (perceived)	Link and Tassey (1987) Lefebvre <i>et al.</i> (1993)
Collaborative R&D	Importance of R&D activities conducted with customers (perceived) Importance of R&D activities conducted with competitors (perceived) Importance of R&D activities conducted with subcontractors (perceived) Importance of R&D activities conducted with colleges (perceived) Importance of R&D activities conducted with universities (perceived) Importance of R&D activities conducted with governmental agencies (perceived)	Acs and Audretsch (1992) Kleinknecht and Reinen (1991) Roessner and Bean (1993)
Sources of information	Importance of sources of information for the product development activities (perceived) Thirteen distinct sources of information: trade shows, suppliers, clients, competitors, consultants, industrial partners, government agencies, colleges, universities, R&D group, marketing group, production group, finance group. Importance of sources of information for commercialization activities (perceived) Thirteen distinct sources of information: trade shows, suppliers, clients, competitors, consultants, industrial partners, government agencies, colleges, universities, R&D group, marketing group, production group, finance group.	Hauschildt (1992) Bierly and Chakrabarti (1994)

¹ All perceptual measures measured on 7-point Likert scales where 1 = not important and 7 = very important.

The dependent variable: export performance

Numerous measures of export performance are found in the literature (Cavusgil and Zou, 1994). The relative volume of exports, captured by the ratio of export sales to the firm's total sales is certainly one of the most frequently used and is retained here. Yet it is felt that a further distinction should be made to take into account the final destination of exports. In fact, Porter (1991) suggested in his analysis of Canada's competitiveness that exports realized in other countries than the United States, which is by far Canada's most important trading partner, are a better indicator of the performance of Canadian firms. Further, it is assumed that, for small independent firms, final destination may constitute an important indicator of performance since it provides an indication of both the reach of the firm's products and of the capacity of the firm to expand beyond its immediate geographical market. The dependent variable is therefore export performance, assessed here by a dual measure of relative volume and destination of exports.

Independent variables: tangible and intangible innovative efforts

The first group of independent variables is concerned with tangible innovative efforts and the measures employed are strictly factual. Traditional variables such as investments in R&D over annual sales and percentage of scientific/technical employees are included. These two variables provide an indication of the level of monetary investments in technological innovation made by small firms.

The second group of independent variables is central to this research and focuses on intangible innovative efforts. Previous research has highlighted the fact that innovation originates from various sources and not only from formal R&D operations (Napolitano, 1991; Cohen and Levin, 1989). Further, it has been shown that, in order to benefit fully from investments in R&D, a firm must develop some complementary capabilities (Lefebvre *et al.*, 1993). This research builds on these assumptions and goes a step further by expanding the types of intangible innovative efforts to include R&D strategy, collaborative R&D activities, and sources of information for product development and commercialization activities.

The first subgroup of intangible innovative efforts captures the specific R&D strategy pursued by firms. In an effort to clarify the nature of those activities, Link and Tassej (1987) proposed to consider five broad strategies, namely basic research, applied research, product development, process development and improvement of existing products. We have included a sixth item, the improvement of existing scientific/technological assets, in view of recent literature in the economics of technological change which strongly emphasizes the cumulateness and firm-specificity of technology. The second subgroup of intangible innovative efforts relates to the widespread trend towards the creation of alliances and other forms of

cooperation between firms, governmental agencies and universities. Sharing resources, knowledge and risks in order to better compete has become a common theme over the years and, in this respect, needs to be considered as one of the firms' efforts in the pursuit of technological improvement. The choice of partners varies substantially which explains why six categories of partnerships are included, namely with customers, competitors, subcontractors, colleges, universities and government agencies. These six categories reflect the usual forms of collaborative R&D, i.e. business to business (Kleinknecht and Reijnen, 1991), university to business (Acs and Audretsch, 1992) and governmental agency to business (Roessner and Bean, 1993). Finally, the third subgroup of variables relating to intangible innovative efforts has to do with the information sources firms draw on in support of their product development and commercialization activities.

4. Results and discussion

Results will be presented in three consecutive steps. First, we will draw a brief profile of the firms in our sample. The intensity levels of innovative efforts as potential determinants of export performance will then be examined. Finally, we will focus on the specific types of innovative efforts which are associated significantly with export performance.

4.1 Profile of specialized suppliers

The firms acting as specialized suppliers in the sample are all independent SMEs which, on average employ 127 full-time workers and have an annual sales volume in the order of \$ 15 million. These firms without exception are all engaged in formal R&D activities. They are, indeed, R&D-intensive with a mean investment in R&D activities of \$ 1.5 million representing, on average, more than 10% of their annual sales. They are also very dynamic in terms of export performance: more than 90% export their products beyond their own immediate domestic markets and 70% are active on U.S. and/or other foreign markets. In terms of sales volume, 16% is exported to North American markets outside Quebec, and 10% elsewhere in the world. This dichotomy on export destination is maintained for the subsequent analysis.

The dynamism displayed by these R&D-intensive firms in terms of export performance, although high, is not overly surprising since, according to recent official statistics, R&D-intensive firms achieve more exports (Baldwin *et al.*, 1994). This clearly suggests that there is some positive association between technological innovation and export performance. We therefore propose to examine more closely

the relationships between different innovative efforts and export performance in R&D-intensive specialized suppliers.

4.2 Export performance and the level of intensity of aggregate innovative efforts

Table 2 summarizes the results of the regression analyses conducted with two different dependent variables capturing both the volume and destination of sales. The first dependent variable is the percentage of sales realized on North American markets and the second represents the percentage of sales on other foreign markets.

TABLE 2
Summary of multiple regression analysis:
Intensity of innovative efforts and export performance

Independent variables	Dependent variables ¹	
	Percentage of sales realized on North American markets	Percentage of sales realized on other foreign markets
Level of technological investments (with industrial sectors as dummy variables)	5.56% * (15.89% *)	7.01 ** (10.17%)
Level of information scanning for commercialization and R&D activities (with industrial sectors as dummy variables)	4.87% (11.20%)	5.67% (11.23%)
Level of diversity of R&D strategies (with industrial sectors as dummy variables)	1.31% (12.37%)	5.27% ** (8.91%)
Level of collaborative R&D (with industrial sectors as dummy variables)	0.27% (17.22% *)	3.22% * (7.22%)
Level of all technological efforts (with industrial sectors as dummy variables)	20.84% (22.41%)	24.40% (29.16%)

¹ Adjusted R²

- * p < 0.10
- ** p < 0.05
- *** p < 0.01
- **** p < 0.001

For each independent variable, a total score is calculated for any given firm on all dimensions of that variable. For example, the collaborative R&D variable has 6 different dimensions (table 1) and thus a firm could score as high as 42 since the scales have 7 modalities. This is what we termed the measure of intensity and the same procedure was applied to all independent variables. The basic assumption is that, the greater the intensity of all innovative efforts, the better these firms perform on North American and other foreign markets. In general, our results provide weak support for this assumption with the exception of the level of technological investments for both dependent variables. The sector of economic activity has a definitive impact on export performance: increases in the explained variances are observed for all the regression models where industrial sectors are entered as dummy variables⁴. When trying to explain export performance on other foreign markets, the level of diversity of R&D strategies and the level of collaborative R&D provide some significant, although rather weak explanation. Finally, the cumulative intensity of all innovative efforts is not significant. Could it be that the nature of the innovative efforts rather than their intensity provides a better explanation of export performance?

4.3 Export performance and the nature of different types of innovative efforts

Table 3 summarizes the results of multiple regression analyses using the same two dependent variables presented in table 2 and the independent variables that capture the nature of the different types of innovative efforts. For example, in the case of collaborative R&D, all 6 dimensions are considered as individual variables in the regression equations. In order to arrive at the best regression models, the “forward stepwise” procedure⁵ is used.

Concentrating on the nature of the efforts appears to be much more interesting not only in terms of explanatory power but also in terms of the interpretive capacity it provides. First, the explained variances are much larger and are highly significant. Second, the nature of the different types of innovative efforts is a far better predictor of export performance on foreign markets.

⁴ The adjusted R^2 for these models are indicated in brackets in table 2.

⁵ This procedure is the most widely used automatic search method for multiple regression analysis.

TABLE 3
Summary of multiple regression analysis¹:
Type of innovative efforts and export performance

Independent variables	Dependent variables	
	Percentage of sales realized on North American markets	Percentage of sales realized on other foreign markets
Technological investments R&D intensity Technocratization Adjusted R ² Adjusted R ² with industrial sectors as dummy variables	- 0.22 *** R ² = 5.04% ** (R ² = 6.30% **)	0.26 *** R ² = 6.66% ** (R ² = 6.66% **)
Sources of information for the development of products Universities Finance Production Adjusted R ² Adjusted R ² with industrial sectors as dummy variables	0.27 *** R ² = 7.46% ** (R ² = 7.46% **)	0.38 **** - 0.39 **** 0.27 *** R ² = 21.25% **** (R ² = 21.25% ****)
R&D strategies Fundamental research Applied research Improvement of existing scientific/technological assets Adjusted R ² Adjusted R ² with industrial sectors as dummy variables	0.41 **** - 0.21 ** R ² = 19.83% **** (R ² = 25.65% ****)	0.33 *** R ² = 10.66% *** (R ² = 10.66% ****)
Collaborative R&D R&D activities conducted with competitors R&D activities conducted with universities Adjusted R ² Adjusted R ² with industrial sectors as dummy variables	0.24 ** R ² = 5.95% ** (R ² = 12.29% ****)	0.27 *** 0.38 **** R ² = 21.83% **** (R ² = 21.83% ****)
All types of innovative efforts Adjusted R ² Adjusted R ² with industrial sectors as dummy variables	R ² = 22.86% **** (R ² = 25.76% **)	R ² = 35.00% **** (R ² = 35.00% ****)

¹ Standardized β and adjusted R²

* p < 0.10
** p < 0.05
*** p < 0.01
**** p < 0.001

In examining the standardized betas, some interesting observations can be made with respect to determinants of export performance on global markets. Technocratization which represents a major significant dimension of technological investments and which also denotes a higher level of technological sophistication is strongly associated with exports on global markets. As far as the importance of the different information sources is concerned, a great deal of weight is attached to the information provided by universities indicating that some form of links exist either through formal scientific activities and training programs or through informal exchanges between individuals or groups. In either case, it does seem to have a positive effect on a firm's export generating capacity. These firms also appear to attach a great deal of importance to the information provided by their production group. This would indicate that when evaluating their competitive stand and export capacity CEOs attach greater weight to the technical and manufacturing information as opposed to strict financial data. This is a somewhat interesting finding in that it denotes a strong preoccupation with technology management issues and therefore a corporate culture which is technically oriented and which recognizes the importance of strong manufacturing competencies. The R&D strategy with respect to applied research is another significant contributing factor of export performing firms. These R&D activities are mostly conducted with universities and, to a lesser degree, with competitors. Collaborative R&D with universities supports and qualifies the previous finding with respect to privileged information sources. Furthermore, it appears that collaborative agreements with competitors may be an important condition in providing either the necessary level of complementary know-how or the required critical mass to operate on far-away markets. These results suggest quite convincingly that synergy between complementary partners may be a winning strategy for small firms wishing to operate on foreign markets. Furthermore, they provide additional evidence of the important role universities play with regard to some form of R&D spillover. This result holds for both dependent variables, which makes it even more compelling.

Turning to determinants of export performance on North American markets, the negative correlation coefficient for R&D intensity should be interpreted with caution. Firms in this group already carry out a significant amount of R&D; the results only point to the fact that, beyond a certain point, more R&D efforts are not associated with better export performance. As for the negative coefficient for improvement of existing scientific-technological assets and the strong positive coefficient for fundamental research, these imply that a firm must be able to go beyond its current activities and continuously explore new product opportunities. These efforts, of course, require highly skilled employees and strong links with potential sources of information on new technological developments.

As we enter industrial sectors as dummy variables in the regression models, we now fail to find strong support for a sectorial effect on export performance: there is no increase in the explained variance for global markets and only slight increases for North American markets. This is revealing and provides additional support to the previous findings since they apply irrespective of a firm's sector of activity.

5. Conclusion

Trying to understand the relationship between export performance and tangible and intangible efforts in a group of R&D firms identified as specialized suppliers reveals interesting results. First, there is obviously an important and significant association between export performance and specific types of innovative efforts, especially for those firms operating on global markets. The nature of the specific innovative efforts is a much stronger predictor of export performance on global markets than the aggregated measure (or level of intensity) usually referred to and is not subject to sectorial influences as in the case when the intensity of innovative efforts is considered.

In terms of tangible efforts in the form of technological investments, there is a clear indication that the percentage of scientific employees within a firm contributes significantly to export performance on global markets. This finding indicates the rich potential for SMEs to establish a strong and diversified base of highly-educated employees to meet the very demanding requirements of the world markets, in terms of initiating projects, launching new products and ensuring quality and efficiency in production, commercialization and distribution. As for the level of R&D investments, no evidence was found for their contribution to the firms' dynamism on North American markets.

R&D strategies directed at basic and applied research are also positively correlated whereas efforts aimed at merely improving existing scientific and technological assets are obviously not sufficient and, in fact, are negatively associated with export performance.

Also very important is the strong tie between universities and the exporting firms in conducting collaborative R&D as well as in information transfer activities related to product development. In fact, firms operating on global markets seem to have developed a distinctive capability to collaborate to a significant extent not only with universities but also with competitors. This finding is at odds with what is usually considered to be the individualistic practice of small more traditional independent firms. As specialized suppliers, these firms are already convinced of the rich potential

of R&D activities but those who succeed on global markets seem to be more inclined to stay at the leading edge of progress and knowledge. In this regard, collaboration appears to be one of the favored ways to achieve this goal.

To conclude, it is becoming obvious that operating on global markets does involve significant efforts on the part of firms and that these efforts require a departure from the usual practices found in the smaller firms. This is evident at least in the case of specialized suppliers. In view of the critical importance that international markets will have for most firms in the years to come, further research should investigate the validity of these findings for other types of firms.

References

- Aaby, N. and Slater, S.F., 1989, "Management Influences on Export Performance: A Review of the Empirical Literature 1978-1988", *International Marketing Review* **6**(4), 6-26.
- Acs, Z.J. and D.B. Audretsh, 1992, "Innovation and Firm Size: The New Learning" in Dodgson, M. and R. Rothwell (eds.), *Small Firms and Innovation: the External Influence*, Geneva: Inderscience Enterprises Limited.
- Archibugi, D., S. Cesaratto and G. Sirilli, 1991, "Sources of Innovative Activities and Industrial Organization in Italy", *Research Policy* **20**, 299-313.
- Baldwin, J., W. Chandler, C. Le and T. Papalladis, 1994, *Strategies for Success*, Cat. No. 61-53E, Statistics Canada, Ottawa.
- Bierly, P. and A. Chakrabarti, 1994, "The Relationship Between a Firm's Knowledge Base and Technology Cycle Time", *Proceedings of the R&D Management Conference*, Manchester Business School, May.
- Bijmolt, T.H.A. and P.S. Zwart, 1994, "The Impact of Internal Factors on the Export Success of Dutch Small and Medium-Sized Firms", *Journal of Small Business Management* (April), 69-83.
- Bonaccorsi, A., 1992, "On the Relationship Between Firm Size and Export Intensity", *Journal of International Business Studies* **23**(4), 605-635.
- Cavusgil, S.T. and S. Zou, 1994, "Marketing Strategy-Performance Relationship: An Investigation of the Empirical Link in Export Market Venures", *Journal of Marketing* **58**, 1-21.
- Clark, K.B. and S.C. Wheelwright, 1993, *Managing New Product and Process Development*, New York: Free Press.
- Cohen, W.M. and R.C. Levin, 1989, "Empirical Studies of Innovation and Market Structure" in Schmalensee, R. and R.D. Willig (eds.) *Handbook of Industrial Organization*, vol. II, Elsevier Science Publishers B.V.
- Collins, P.D., J. Hage and F.M. Hull, 1988, "Organizational and Technological Prediction of Change in Automaticity", *Academy of Management Journal* **31**(3), 512-543.
- Cooper, R.G. and E.J. Kleinschmidt, 1985, "The Impact of Export Strategy on Export Sales Performance", *The Journal of International Business Studies* (Spring), 37-55.
- Dunning, J.H., 1993, *Multinational Enterprises and the Global Economy*, Workingham, U.K.: Addison-Wesley Publishing.
- Edmunds, S.E. and S.J. Houry, 1986, "Exports: A Necessary Ingredient in the Growth of Small Business Firms", *Journal of Small Business Management* (October), 54-65.

- Hauschildt, J., 1992, "External Acquisition of Knowledge for Innovations -- A Research Agenda", *R&D Management* **22**(2), 105-110.
- Ito, K. and V. Pucik, 1993, "R&D Spending, Domestic Competition, and Export Performance of Japanese Manufacturing Firms", *Strategic Management Journal* **14**, 61-75.
- Jaffe, A.B., 1989, "Real Effects of Academic Research", *American Economic Review* **79**(5), 957-970.
- Kleinknecht, A. and J.O.N. Reijnen, 1991, "Why Do Firms Cooperate on R&D? An Empirical Study", *Research Policy* **21**, 347-360.
- Lefebvre, É., L.A. Lefebvre and J. Harvey, 1993, "Competing Internationally Through Multiple Innovative Efforts", *R&D Management* **23**(3), 227-237.
- Lee, C.S. and Y.S. Yang, 1990, "Impact of Export Market Expansion Strategy on Export Performance", *International Marketing Review* **7**(4), 40-52.
- Link, A.N. and G. Tassej, 1987, *Strategies for Technology-based Competition*, Lexington, Mass.: Lexington Books.
- McGuinness, N. and N. Little, 1981, "The Impact of R-D Spending on Foreign Sales of New Canadian Industrial Products", *Research Policy* **10**, 78-98.
- Miesenbock, K.J., 1988, "Small Businesses and Exporting: A Literature Review", *International Small Business Journal* **6**(2), 42-61.
- Napolitano, G., 1991, "Industrial Research and Sources of Innovation: A Cross-Industry Analysis of Italian Manufacturing Firms", *Research Policy* **20**, 171-178.
- OECD, 1993, *Small and Medium Sized Enterprises: Technology and Competitiveness*, Paris.
- Pavitt, K., 1984, "Sectorial Patterns of Technical Change: Towards a Taxonomy and a Theory", *Research Policy* **13**, 343-373.
- Pavitt K., M. Robson and J. Townsend, 1989, "Technological Accumulation, Diversification and Organisation in U.K. Companies, 1945-1983" *Management Science* **35**(1), 81-99.
- Pavitt, K., 1990, "The Strategic Management of Technology", *California Management Review* (Spring), 17-24.
- Piore, M.J. and C.F. Sabel, 1984, *The Second Industrial Divide: Possibilities for Prosperity*, New York: New York Basic Books.
- Porter, M.E. and the Monitor Company, 1991, *Canada at the Crossroads: The Reality of a New Competitive Environment*, Business Council of National Issues and Minister of Supply and Services.
- Prozak, S.L., 1993, "Small Businesses are Exporting", *Business America* **114**(24), 2-8.
- Roessner, J.B. and A.S. Bean, 1993, "Industry Interaction with Federal Labs Pays off", *Research and Technology Management* (September-October), 38-40.

- Samuels, J., S. Greenfield, and H. Mpuku, 1992, "Exporting and the Small Firm", *International Small Business Journal* **10**(2), 24-36.
- Stalk, G. and T. Hout, 1990, *Competing Against Time*, New York:Free Press.
- Stanworth *et al.*, 1982, *Perspectives on a Decade of Small Business Research*, London: Gower Publishing Company Ltd.
- Thurik, R., 1993, "Exports and Small Business in the Netherlands: Presence, Potential and Performance", *International Small Business Journal* **11**(3), 49-58.
- Thurow, L., 1992, *Head to Head, The Coming Economic Battle Among Japan, Europe and America*, New York: William Morrow and Company Inc.
- Wagner, J., 1995, "Exports, Firm Size and Firm Dynamics", *Small Business Economics* **7**, 29-39.
- Walters, P.G.P. and S. Samiee, 1990, "A Model for Assessing Performance in Small U.S. Exporting Firms", *Entrepreneurship, Theory and Practice* (Winter), 33-50.