

The Propensity to Export and R&D: Does size matter?

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Tyler Chamberlain and
Jérôme Doutriaux
University of Ottawa
and
Jean-Sibert LaPolice, Industry Canada



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Introduction



- This paper explores the relationship between R&D and exporting, connected to the size of firms
 - R&D is a major input into technological innovation
 - Exporting is the essence of international business
 - By conducting R&D firms can establish a competitive advantage that can then be the basis of exporting
- The data used in this study is for small and medium-sized firms which tend not to spend as much on R&D and also tend not to be as involved in international as markets

R&D and Firm Size



- The 'Schumpeterian Hypothesis' is that large firms in concentrated markets will tend to dominate in R&D activities. (US National Science Foundation 1961; Link, 1981; Pavitt, Robson and Townsend, 1987)
- It is important to remember, however, that small firms are often responsible for the most important 'radical innovations'. (Tushman and Anderson, 1986; Christensen, 1997)
- An 'S' shaped relationship has been observed between R&D and firm size. (Soete, 1979)
- Will the same tendencies be observed among SME's?

R&D and Exporting



- A number of studies from industrialized nations and developing countries have observed a significant relationship between R&D activities and exporting. (Kumar and Siddharthan, 1994; Wagner, 1995; Wakelin, 1998; Bernard and Jensen, 1999; Roper and Love, 2002; Doutriaux, 1993)
- Will this relationship hold in all sectors?

Hypotheses (1)



- H1: There will be a positive relationship between R&D and firm size for all industries studied, except those with a primarily local line of business and/or those in which there exist an oligopolistic market structure.
 - This relationship is not expected to hold for:
Accommodation/Food Services, Transportation/
Warehousing and Finance/Insurance/Real Estate.

Hypotheses (2)



- H2: There will be a positive relationship between R&D expenditure and exporting, among all sizes of firms and all sectors of activity.

Hypotheses (3)



- H3: Access to finance (stock market, government grants and credit from suppliers) is positively correlated with the R&D and export orientations of firms in all sectors.

Table 1



Table 1
Distribution of firms by R&D intensity, by sector

Sector	Sample		Population estimates				
	Number of firms	Mean R&D intensity	Total number of firms	R&D intensity			
				No R&D	1-10%	11-20%	Over 20%
Total	8427	3.32	1357347	71%	20%	5%	4%
Primary	1264	2.34	163902	76%	20%	3%	2%
Construction	814	1.87	173635	76%	21%	1%	2%
Manufacturing	993	4.83	64041	59%	26%	10%	5%
Wholesale & Retail	1376	2.41	192370	72%	19%	6%	3%
Finance, Insurance, Real Estate	244	2.06	82348	70%	25%	4%	1%
Professional Services	1535	5.41	233231	63%	21%	7%	9%
Accommodation & Food Services	636	2.19	71196	80%	15%	4%	1%
Other Services	1077	3.88	304274	72%	17%	7%	5%
Transportation & Warehousing	488	2.14	72350	77%	17%	4%	3%
Percentages may not sum up to 100 because of rounding							

Table 2



Table 2
Distribution of firms by size (FTE equivalent) by sector (Number and percentage of firms)
Firms with no missing values on Export and R&D

Sector	Sample		Population estimates			
	Number of firms	Mean number of employees	Total number of firms	Number of employees (FTE)		
				None	1 to 5	Over 5
Total	8125	9.26	1342719	51%	33%	15%
Primary	1227	8.26	163365	62%	29%	8%
Construction	797	6.58	172717	49%	37%	14%
Manufacturing	928	13.89	61252	36%	34%	30%
Wholesale & Retail	1330	9.91	190679	42%	35%	23%
Finance, Insurance, Real Estate	241	3.84	81435	68%	19%	13%
Professional Services	1501	6.56	231628	68%	25%	7%
Accommodation & Food Services	586	17.60	67244	18%	41%	41%
Other Services	1045	7.99	302675	43%	42%	16%
Transportation & Warehousing	470	8.18	71724	62%	29%	9%
Percentages may not sum up to 100 because of rounding						

Table 3



Table 3
Relationship between R&D intensity (3 levels) and Size (Full Time Equivalent, 3 levels) - Chi-square analysis

Sector	Sample statistics			Weighted population statistics
	N	Chi-Square	Sign.	N
Primary	1227	5.87	.218	163364
Construction	797	17.30	.002	172717
Manufacturing	928	19.66	.000	61252
Wholesale & Retail	1330	7.85	.097	190680
Finance, Insurance, Real Estate	241	n.a. *	n.a. *	81434
Professional Services	1501	42.05	.000	231628
Accommodation & Food Services	586	7.19	.126	67245
Other Services	1045	11.21	.024	302677
Transportation & Warehousing	470	20.06	.000	71726

* sample too small to conclude (some cells with less than 5 expected observations)

Table 4



Table 4
R&D and Exporting, Chi-square tests

Sector		Sample			Weighted Population	
		No R&D	Some R&D	2-sided sig.	No R&D	Some R&D
Primary	Non Exporting	819	302	.000	115611	33870
	Exporting	75	68		8218	6203
Construction	Non Exporting	641	160	.000	131415	40020
	Exporting	4	9		227	1974
Manufacturing	Non Exporting	370	248	.000	28431	15234
	Exporting	134	241		9139	11238
Wholesale & Retail	Non Exporting	878	277	.000	127228	40967
	Exporting	125	96		13658	13658
Finance, Insurance, Real Estate	Non Exporting	187	51	n.a.*	56004	24543
	Exporting	5	1		134	134
Professional Services	Non Exporting	746	458	.000	134254	70711
	Exporting	127	204		16187	16187
Accommodation & Food Services	Non Exporting	476	157	n.a.*	57087	14080
	Exporting	2	1		10	10
Other Services	Non Exporting	645	303	.000	215196	76847
	Exporting	47	82		9376	9376
Transportation & Warehousing	Non Exporting	333	86	.163	51549	13506
	Exporting	51	20		3261	3261

* sample too small to conclude (some cells with less than 5 expected observations)

Table 5



Table 5
R&D and Exporting, by Size (number of employees, FTE) - Chi-square analysis, 2-sided levels of significance

Sector	Sample, FTE class Chi-square analysis			Sample size by number of employees (FTE)			
	0	1 to 5	Over 5	Firms	Number of employees		
					0	1 to 5	Over 5
All sectors (N=8427)	.000	.000	.000	8125	2616	3100	2409
Primary	.059	.166	.000	1227	436	503	288
Construction	n.a.*	n.a.*	n.a.*	797	228	362	207
Manufacturing	.056	.133	.000	928	214	343	371
Wholesale & Retail	.004	.001	.000	1330	328	523	479
Finance, Insurance, Real Estate	n.a.*	n.a.*	n.a.*	241	137	66	38
Professional Services	.000	.025	.000	1501	721	444	336
Accommodation & Food Services	n.a.*	n.a.*	n.a.*	586	52	221	313
Other Services	.001	.000	.000	1045	334	438	273
Transportation & Warehousing	n.a.*	n.a.*	n.a.*	470	166	200	104

Table 6



Table 6
Non Exporters vs. Exporters - Logistic Regression Analysis, All sectors

Variables in the equation	B	S.E.	df	Sig.	Exp(B)
R&D expenditures (C8025)	0.457	0.035	1	0.000	1.58
Number of employees (FTE)	0.011	0.001	1	0.000	1.01
Majority owner >10 years experience (EXP10)	0.210	0.074	1	0.005	1.23
Gov Grants (C3014) **	0.188	0.125	1	0.133	1.21
Equity Financing (C3004) **	0.298	0.166	1	0.072	1.35
External financing requested (C3000)	0.041	0.076	1	0.588	1.04
Credit from suppliers requested (C3002)	0.037	0.115	1	0.747	1.04
Grant, subsidy requested (C1103)	0.228	0.088	1	0.009	1.26
Sectors *			8	0.000	
Primary	-0.408	0.162	1	0.012	0.67
Construction	-2.342	0.310	1	0.000	0.10
Manufacturing	1.042	0.149	1	0.000	2.84
Wholesale & Retail	0.087	0.152	1	0.567	1.09
Finance, Insurance, Real Estate	-1.840	0.436	1	0.000	0.16
Professional Services	0.325	0.149	1	0.029	1.38
Accommodation & Food Services	-3.938	0.624	1	0.000	0.02
Other Services	-0.337	0.165	1	0.041	0.71
Constant	-2.767	0.155	1	0.000	0.06

Table 7



Table 7 Rotated Component Matrix (a)				
	Factor			
	Factor 1	Factor 2	Factor 3	Factor 4
C3014rec	0.118238	0.034745	0.989587	0.055229
C3004rec	0.097764	0.045651	0.055008	0.992397
C3000rec	0.865039	-0.02469	0.130033	0.088752
C3002rec	0.142694	0.976526	0.034582	0.045756
C1103rec	0.811201	0.253467	0.031644	0.047011
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.				
A	Rotation converged in 5 iterations.			

- Where
 - Factor 1: Requested external financing or government grants and subsidies.
 - Factor 2: Requested credit from suppliers
 - Factor 3: Received Government grants
 - Factor 4: Received equity financing

Table 8



Table 8
Non Exporters vs. Exporters, Logistic Regression Analysis
with factors to summarize financial variables
All sectors

Variables in the equation	B	S.E.	df	Sig.	Exp(B)
R&D expenditures (C8025)	0.456	0.035	1	0.0000	1.577
Number of employees (FTE)	0.011	0.001	1	0.0000	1.011
Majority owner >10 years experience (EXP10)	0.213	0.074	1	0.0042	1.238
Factor 1	0.095	0.029	1	0.0012	1.099
Factor 2	0.032	0.025	1	0.2099	1.032
Factor 3	0.046	0.024	1	0.0595	1.047
Factor 4	0.051	0.022	1	0.0244	1.052

Table 8 (continued)



Table 8 (cont.)
Non Exporters vs. Exporters, Logistic Regression Analysis
with factors to summarize financial variables
All sectors

Variables in the equation	B	S.E.	df	Sig.	Exp(B)
Sectors *			8	0.0000	
Primary	-0.402	0.162	1	0.0132	0.669
Construction	-2.332	0.310	1	0.0000	0.097
Manufacturing	1.053	0.149	1	0.0000	2.866
Wholesale & Retail	0.095	0.152	1	0.5307	1.100
Finance, Insurance, Real Estate	-1.836	0.436	1	0.0000	0.159
Professional Services	0.333	0.149	1	0.0255	1.395
Accommodation & Food Services	-3.927	0.622	1	0.0000	0.020
Other Services	-0.332	0.165	1	0.0439	0.718
Constant	-2.717	0.152	1	0.0000	0.066
Sample size	8427				
% correctly classified	85.5%				
Cox & Snell R Square	.125				
Nagelkerke R Square	.216				
* Reference sector: Transportation & Warehousing					

Key Findings



- Strong relationship between R&D and exporting, except in Transportation & Warehousing and cannot conclude for Finance, Insurance & Real Estate or Accommodations & Food Services.
- Correlation between R&D and exporting, independent of firm size, except for Primary and Manufacturing sectors and cannot conclude for Construction, Finance, Insurance & Real Estate and Accommodations & Food Services.

Key Findings (2)



- The sector of operation, experience of the majority owner, R&D intensity of the firm and the effort to look for equity financing or to request external grants and subsidies contribute significantly to explaining if a firm is an exporter or non-exporter.
- From the logistic regression in Table 9, it appears that Factor1 contributes significantly to explaining the difference between exporters and non-exporters. Factor 4 is also significant but only at the 0.02% level, whereas factors 2 and 3 are non significant at the 0.05% level of significance.