Innovation and firm internationalisation: evidence from Italy

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Abstract: The paper explores the relation between innovation investments and internationalisation choices of Italian firms. To this end, we rely on an integrated data set that combines the *Indagine sulle Imprese Manifatturiere* carried out by the *Unicredit Bank* with publicly available company accounts for the period 2004–2006 to estimate a multinomial Probit model. This methodology allows studying how innovation affects different modes of internalisation. Our results suggest that the various channels of international involvement are positively associated with both having carried out innovative and ICT investments. As expected, this finding can be traced to the positive impact of these variables on firm productivity, which permits more internationalised firms to exploit market opportunities compared to domestic firms.

Keywords: innovation; trade; international business.

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1 Introduction

The last several decades have documented a notable increase in firms' commitment to foreign markets, drawing researchers' attention to the characteristics of international versus domestic enterprises.

This paper is motivated by new insights in the light of the recent literature, initiated by Melitz (2003), which emphasises the role of heterogeneity within trading firms. This literature has extensively analysed firms export behaviour unveiling a number of new and interesting stylised facts. A combination of trade barriers (either fixed or variable costs of exporting) and heterogeneity in the underlying characteristics of firms explains why not all firms export. Despite an overlap in the vector of exports determinants across studies, the international evidence is mixed. We ask whether heterogeneity at firm level plays a role on internationalisation strategies.

Specifically, our main aim is to contribute to a better understanding of how and why participation in international markets differs across firms by focusing on the relationship between innovation activity, Information and Communication Technologies (ICT) adoption and international involvement at firm level. Since ICT investments generally create new opportunities for product differentiation and innovation across the whole economy, they are a key factor for competitive advantages in international markets as ICT diffusion can be expected to stimulate trade and Foreign Direct Investments (FDI). Furthermore, as ICT is a general-purpose technology it brings benefits to the overall organisation of the firm. The expansion of ICT is a well-known aspect of OECD countries and its dynamics affects structural change and overall economic internationalisation (European Commission, 2007). A global economy, increasingly digitally networked, implies major challenges for firms and policy-makers.

To investigate the relationship between the innovation activities (which refers to the conversion of knowledge into new products, services and processes, and ICT investments) and firms' internationalisation is crucial. Innovation is undertaken for the sake of distinguishing products from competitors (horizontally or qualitatively), thereby securing a firm's market position against its rivals. We may associate innovation of that kind with what we will refer to as *product innovation*. Furthermore, productivity gains are possible through *process innovation*.

Another stylised fact points out that international activity is increasingly carried by FDI, imports and outsourcing within global value chains besides pure exporting (Mayer and Ottaviano, 2007). Thus, our empirical analysis considers such evidence.

We take into account two approaches to modelling the determinants of internationalisation performance. The first one groups together productive resources of firms that determine firms' competitive advantage in international markets (labour, capital, firm size, and being a part of a group or in foreign ownership). The second one focuses on the quality of firms' products or services as a basis of competitive advantage that is connected to technology (development and implementation of new products and processes, ICT adoption).

The empirical analysis uses an integrated data set combining the Survey on the Manufacturing Firms collected every three years by the *Unicredit Bank* with company accounts provided by CERVED.[1] Survey data refer to the period 2004–2006 and are representative of the Italian manufacturing industry, while company accounts are available for the years 1998–2006. The database we use contains, alongside with standard balance sheet data, data on several firm characteristics (e.g. age, innovative activities, sector, etc.) as well as detailed information on firms' global engagement.

Taking into account the findings of previous research on international trade, our model will include a number of indicators of firms' productive resources and innovation activities augmented by the ICT use variables. We adopt a multinomial Probit model to assess whether innovative activity and investments in ICT positively affect firms' choice

to internationalise and how their impact changes as the foreign involvement increases (from export to FDI). In doing so, we control for other determinants of firms' internationalisation decision such as age, size, group membership, labour composition, leverage, geographical location, as well as industry-specific effects.

The paper is organised as follows. Section 2 reviews the theoretical literature. Section 3 illustrates the methodology, while Section 4 describes the data used in the empirical analysis. The results are then presented and discussed in Section 5, while Section 6 offers concluding remarks.

2   Literature review

A wide range of empirical studies has analysed the factors that determine the exporting behaviour of manufacturing firms in many countries and regions. The burgeoning micro-econometric literature on international trade has allowed a detailed investigation of the choices of export market participation. Mostly, researchers have investigated the differences between exporters and non-exporters with regard to readily identifiable firm characteristics and it is widely recognised that firms that are more productive self-select into export markets. Firm-specific attributes and sector wide characteristics have been used to model export propensity. Among these, productivity, firm size, firm age, product and export market diversification have been focused upon (for a survey of the literature, see, e.g., Bernard and Jensen, 2004; Bernard and Jensen, 1999; Bernard et al., 2007; Eaton et al., 2004; Eaton et al., 2008; Wagner, 2008; Mayer and Ottaviano, 2007; Federici and Parisi, 2014; Greenaway and Kneller, 2007). Successful export performance is due to certain firms having enough productivity to overcome the costs of exporting (see, e.g., Bernard et al., 2007; Melitz, 2003; Melitz and Ottaviano, 2008; Das et al., 2007). The empirical literature has also examined the implications of many other factors on firms' export decision such as firms' financial health (Greenaway and Kneller, 2007), labour training (Ottaviano and Martincus, 2011), Research and Development (R&D) intensity (Wagner, 2001), and credit constraints (Minetti and Zhu, 2011). Furthermore, several studies analysed the influence of prior experience in exporting to the internationalisation strategies of firms (e.g. Roberts and Tybout, 1997; Ottaviano and Martincus, 2011).

However, exporting is only one of several ways in which firms may be active in international markets. The expansion of firms across national borders has stimulated new theoretical developments and a wide stream of empirical literature to examine factors affecting decisions related to more general internationalisation process (for a comprehensive review, see Greenaway and Kneller, 2007; Wagner, 2008). In addition to exporting activities, FDI became another important issue of discussion on globalisation. Helpman et al. (2004) extend Melitz's study to incorporate FDI into trade and firm heterogeneity model. Representing firm heterogeneity by productivity difference, their model predicts that the least productive firms serve only domestic market. Relatively more productive firms' exports and the most productive firms engage in FDI.

The firm participation in foreign markets provides, of course, a wide set of forms of internationalisation, such as commercial penetration, technical agreements, outsourcing, and FDI. For example, firms try to exploit synergies in exporting, engaging in commercial penetration and making agreements with foreign firms. On the other hand, FDI may coexist to some extent also with exports and trade and technical agreements.

The relevance of complex internationalisation strategies and the set of different options available to the firms has been stressed by Antras and Helpman (2004), Grossman et al. (2006), Ottaviano and Turrini (2007), and Bougheas and Görg (2008).

The literature has stressed the role of technological innovation in improving exports and FDI (Castellani and Zanfei, 2007). Basile et al. (2003) find that innovative activities have positive effects on other internationalisation modes as well (commercial penetration and trade-technical agreement). Our study will add to this area of research by empirically investigating the role of ICT and innovation investments in internationalisation choices of firms. Over the last decades, an ever-increasing number of firms, particularly those in the manufacturing sector, are engaging in international activity (OECD, 2008).

3 Methodology

To analyse the effects of innovation and ICT investments along with other control variables, on internalisation propensity, we adopt a multinomial Probit model. The binary choice (yes/no) corresponds to each internationalisation category depending on a function of covariates specified through different equations and allowing the simultaneity of internationalisation choices.

In a k-choice multinomial Probit model the profitability of the kth choice depends on a deterministic component reflecting the firms' characteristics (represented by a vector x_i^k) and an unobservable component (e_i^k).

A firm i will choose the strategy (k) that maximises profits, so that the probability of choosing alternative k is:

$$\Pr(s = k) = \Pr\left(P_k^i > P_q^i\right), k \neq q, k = 1, 2, \ldots, K \tag{1}$$

A multinomial Probit provides several advantages over other discrete choice models used in the literature. Differently from ordered choice models, the multinomial model prevents from formulating an a priori ranking on the patterns of firm' internationalisation process. Because a firm could simultaneously pursue more than one mode of internationalisation, that is, it could adopt combination of modes, the main advantage of this model is in avoiding the need to formulate an a priori assumption on the internationalisation choices.

Furthermore, contrarily to the multinomial logit model, it does not assume the implausible independence from alternative hypothesis that implies that adding another alternative or changing the features of a third alternative does not affect the relative odds between other alternatives.

4 Data description

As anticipated in the introduction, this paper uses an integrated data set combining micro-data from the 10th Survey on the Manufacturing Firms (2004–2006) administered by the *Unicredit Bank* and company accounts. The survey is based on a questionnaire sent to a sample of firms of the manufacturing sector every three year. The sample covers 5018 corporations, and is stratified by size class, geographical area, and industry to be representative of the population of Italian manufacturing firms with more than ten employees (amounting to 39,868 enterprises). Company accounts data are collected by CERVED and are available for the period 1998–2006.

Collected data include information on the firm's features (size, employment structure, legal status, participation in groups), and the firm's activity (investments, internationalisation, finance, innovation activity). Some of these variables are available for each year covered by the survey; some refer to the time of interview; others refer to the three-year period covered by the survey.

Table 1 displays a breakdown of the companies present in the data set by Pavitt's taxonomy (Pavitt, 1984) and size (number of employees).

The distribution among sectors shows the predominance of businesses operating in traditional manufacturing sectors (49.3%) and special sectors (27%). The portion of high technology firms is relatively low – less than 5%. Furthermore, the majority of firms can be qualified as small–medium-sized enterprises, employing up to 50 workers, in line with the well-known features of the Italian manufacturing sector. The survey provides us with information about whether or not a firm exported in the year of each survey wave, and about foreign sales if the firm exported. On average over 60% of the firms in the sample exported.

Table 1   Number of companies present in the data set by Pavitt sector, firm size, exporting status (year 2006)

	Number	*%*
Sector		
Traditional sectors	2476	49.3
Scale sectors	958	19.1
Special sectors	1353	27.0
High-tech sectors	231	4.6
Size (number of employees)		
11–20	1727	34.4
21–50	1515	30.2
51–250	1395	27.8
251–500	213	4.2
More than 500	168	3.3
Status		
Non-exporting	1939	38.6
Exporting	3079	61.4
Total	5018	100.0

Source: Survey on manufacturing firms (*Unicredit*)

Table 2 illustrates the export intensity, measured by the share of turnover from export over aggregate turnover, by quantiles of total turnover.

Turnover from exports represent about 41% of total turnover and, as intuitive, export intensity increases as one moves to higher turnover quantiles.

To complete the description of the data set, in Table 3 we report the mean values and the standard deviation of the main continuous variables used in the empirical analysis discussed in Section 4. Such values are reported for four groups of firms: domestic firms (39%), exporting firms (43%),[2] firms exporting and making trade agreements with

foreign enterprises (12%), firms exporting and carrying out FDI or delocalising part of their activity (6%), as well as for the whole sample. This classification will be discussed in Section 5.

Table 2 Export intensity by quantiles of total turnover (year 2006)

Quantiles	Mean
1	35.3
2	36.8
3	41.2
4	43.2
5	46.2
Total	41.3

Source: Authors' calculations

Table 3 Summary statistics (mean values, standard deviation in italics) of: log capital, skilled workers, firm age, log size (number of employees), debt ratio by status of firms (year 2006)

	Domestic	Exporters	Exporters/trade agreements	Exporters/FDI/delocalisation	All firms
Log capital	13.4	13.8	14.3	14.5	13.7
	1.6	*1.5*	*1.5*	*1.7*	*1.6*
Skilled labour*	30.2	32.2	30.9	34.5	31.3
	36.8	*36.7*	*35.9*	*37.9*	*36.7*
Age	23.4	28.4	28.7	27.4	26.3
	21.1	*24.8*	*23.7*	*22.3*	*23.2*
Log size	3.1	3.4	3.7	3.8	3.3
	0.8	*0.9*	*0.9*	*1.1*	*0.9*
Debt-equity ratio*	25.9	25.0	25.9	20.7	23.9
	3.6	*2.4*	*1.4*	*0.2*	*2.8*
Number of firms	1939	2142	615	322	5018
% of total	38.64	42.69	12.26	6.42	100.00

Note: *percentages.
Source: Authors' calculations

Exporting firms outnumbers domestic firms. As it appears obvious, compared to domestic firms more internationalised enterprises tend to be more capitalised, employing a higher share of skilled workers, having a higher age, and showing a greater size. This is consistent with empirical evidence, which demonstrates that firms that are more open tend to be more productive.

Table 4 illustrates that the share of enterprises carrying out innovative investments (in the form of both process and product innovation) is higher (62%) than non-innovative firms (37%), whereas there is no difference between firms reporting or non-reporting ICT expenses (in the form of software, hardware, telecommunication purchases).

Table 4   Innovation and ICT investments (year 2006)

	Number	*%*
Innovation		
No	1881	37.5
Yes	3137	62.5
ICT		
Yes	2508	49.9
No	2510	50.1
Total	5018	100.0

Source: Survey on the Manufacturing Firms (*Unicredit*)

5   Results

The database provides information on whether a firm has developed new product innovation or process innovation over the previous six months or not. The corresponding questions we rely on are as follows:

In year t we have introduced (a) new product innovations, and (b) new process innovations. We use the answers to these questions to construct a dummy variable that takes two values, 1 if new product and process innovations were undertaken in year *t* and 0 otherwise.

In the same way, we generate a dummy variable for ICT (*investments in hardware, software, network, and telecommunications*).

One section of the questionnaire is devoted to internationalisation choices, the basis for our analysis. The main forms of internationalisation considered are:

(a) Export

(b) Commercial penetration

(c) Trade or technical agreements with foreign firms

(d) FDI

(e) Total or partial production off shoring

(f)   Outsourcing of services from abroad.

We consider four internationalisation strategies and therefore four groups of firms: the pure domestic status, exporters, firms exporting and making trade agreements with foreign firms, and firms exporting and carrying out FDI or delocalising abroad part of their activity. Taking the domestic case as the base outcome, we estimate the unobserved propensity for the remaining three strategies.

Results are reported in Table 5, where the regressors' coefficients for any given choice can be interpreted as differences with respect to the base outcome. The table reports the estimated coefficients, the robust standard errors, and the *p-values*.

Table 5 Multinomial Probit estimates (base outcome pure domestic firms) (year 2006)

Variables	Exporters	Exporters/trade agreements	Exporters/FDI/delocalisation
Innovation	0.107	0.489***	0.327***
	(0.066)	(0.088)	(0.108)
ICT	0.0314	0.329***	0.301***
	(0.064)	(0.082)	(0.102)
Log capital	0.033	0.083***	0.085**
	(0.024)	(0.032)	(0.043)
Skilled labour	0.002**	0.001	0.004***
	(0.000)	(0.001)	(0.001)
Sector	0.485***	0.609***	0.407***
	(0.069)	(0.086)	(0.103)
Consortium	0.094	0.384*	0.014
	(0.181)	(0.211)	(0.267)
Geographical area	−0.319***	−0.229**	−0.138
	(0.073)	(0.093)	(0.111)
Log age	0.147***	0.061	−0.006
	(0.045)	(0.056)	(0.061)
Log size	0.245***	0.358***	0.336***
	(0.043)	(0.051)	(0.068)
Imports	0.655***	0.930***	0.909***
	(0.097)	(0.108)	(0.125)
Debt-equity ratio	−0.000	−0.004	−0.012**
	(0.000)	(0.005)	(0.006)

Note: Robust standard errors in parentheses.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Source: Authors' estimates

The coefficient for Innovation is positive and statistically significant for exporters. This means that undertaking innovative investments increases the probability of exporting, along with making trading agreements or delocalising/carrying out FDI.

However, the adoption and use of ICT affect the decision of exporting when firms engage in more internationalisation complex strategies (i.e. when firms also make trade agreements, delocalise or carry out FDI). Indeed, as the figures in Table 5 show, ICT is statistically significant only for the second and the third group.

We now turn to the other variables.

More capitalised firms have greater propensity to undertake internationalisation strategies. However, a larger capital stock seems not to increase the probability of pure exporting that is most likely driven by other firm features rather than its financial structure.

A higher share of skilled workers brings benefits in terms of efficiency, innovation and competitive advantages. Labour quality increases the probability of exporting and the other channels of foreign market participation.

Belonging to a consortium, as expected, is only relevant for the exporting/making trade agreements choice. This evidence suggests that firm's decisions of internationalisation

are affected by information spillover on foreign markets from belonging to a consortium. In addition, this result may be explained also by lower costs of setting up distribution, services, and advertising, so exploiting network externalities.

The geographical area has an impact on the first two modelled strategies but it is not relevant for the FDI/delocalisation choice, whereas Age is only statistically significant for the exporting decision, in the sense that 'older' firms have higher propensity to export. It seems that, as pointed out by some authors, positive effects of age, if present, may be offset by the argument that 'older' firms are less incline to face increasing risks associated with global environment conditions.

The results for the remaining variables are in line with the existing empirical literature. Indeed, belonging to a technical sector, having a greater size (measured as the logarithm of the number of employees), as well as importing services/material goods all have a relevant role in determining all the three-modelled strategies. In particular, one might argue that importing entails fixed costs so only the more productive firms look for higher quality output and/or more complex inputs.

In the analysis we also control for firm financial conditions, i.e. the leverage ratio (measured as the firm's ratio of total liabilities to total assets). Theoretical predictions suggest that a higher debt ratio has a negative noticeable impact on investments as it increases the firm's systemic risks. In our estimation, the debt ratio is only statistically significant for the exporting/FDI/delocalisation decision. This briefly explains that the negative weight of financial frictions is relevant for a greater internationalisation involvement.

Table 6 reports the marginal effects of the multinomial Probit. For simplicity's sake, in the discussion we omit the variables that are not statistically significant.

The marginal effects measure the (marginal) change in the predicted probability of belonging to the indicated group given a marginal change of each associated regressor, all else being equal, that is irrespective of the choice of the remaining modes. Marginal effects are computed around the mean values of all the regressors.

While the meaning of marginal effects is quite straightforward for continuous variables they should be interpreted differently for dummy variables, as in the case of innovation investments, ICT, imports (a change from 0 to 1 for binary variables). In these cases, a marginal effect measures the effect of a change in the firm status (for example carrying out innovative investments) on the probability of one of the modelled strategies with respect to the base status (not carrying out innovative investments). Formally, for the kth binary variable, the marginal effect is the difference $\hat{P}\left(y_{m=1}\middle|x_{mk}=1\right)$ $-\hat{P}\left(y_{m=1}\middle|x_{mk}=0\right)$ calculated holding all the other covariates constant at the mean value.

Innovative investments and ICT purchases are only statistically significant for exporters making trade agreements, or firms that also undertake FDI or delocalise, whereas they are not significant for enterprises qualifying as pure exporters. In particular, a change in the innovation or ICT firm's investment behaviour increases the propensity to export/making trade agreements, respectively, by 0.06 and 0.04 percentage points. This means that the probability of exporting/making trade agreements is on average about 6 percentage points higher for innovative firms compared to non-innovative ones. A similar interpretation holds for firms that invest in ICT, i.e. the probability is 4 percentage points higher for ICT versus non-ICT investments. The effects of the same variables on the propensity to export and carrying out FDI or delocalising abroad part of their activity are lower as in both cases the probability increases by just 0.01 percentage points.

Table 6 Marginal effects (base outcome domestic firms) (year 2006)

Variables	Exporters	Exporters/trade agreements	Exporters/FDI/delocalisation
Innovation		0.061***	0.015**
		(0.012)	(0.007)
ICT		0.043***	0.017**
		(0.011)	(0.007)
Log capital		0.009**	
		(0.004)	
Skilled labour	0.000**		0.013**
	(0.000)		(0.002)
Sector	0.091***	0.050***	
	(0.018)	(0.011)	
Consortium		0.050**	
		(0.027)	
Geographical area	−0.077***		
	(0.020)		
Log age	0.041***		
	(0.012)		
Log size	0.038***	0.031***	0.012***
	(0.011)	(0.006)	(0.005)
Imports	0.103***	0.079***	0.034***
	(0.025)	(0.013)	(0.008)
Debt-equity ratio			−0.010**
			(0.000)

Note: Robust standard errors in parentheses.

   *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Source: Authors' estimates

We leave to the reader the analysis of the marginal effects of the other variables. Here, we just note that having imported services has a sizeable marginal impact on both the probability of exporting (0.103) and on the status export/making trade agreements (0.079). Belonging to a high-tech sector also has a relevant marginal impact on pure exporting (0.091). In line with the estimation, belonging to the South has a negative marginal impact on the probability to export (–0.077) and has no statistically significant effects on the other modelled choices. The share of skilled workers is significantly and positively associated with all internationalisation modes except trade agreements. Lastly, as expected, an increase in the debt-equity ratio affects only the choice of exporting/carrying out FDI/delocalise, though the impact is very small.

6   Conclusions

In this paper, we have explored the relation between innovation and ICT investments and firms' internationalisation.

Building on previous research, we have found that the pattern of international involvement and their link with firm characteristics depend heavily on the set of internationalisation modes considered as outcome variables. Taking into account more internationalisation channels in addition to exporting *per se* allow an in-depth description of the firms' behaviour when expanding abroad.

Besides differences between industrial sector and geographical location across the country, our empirical evidence shows that skill composition, innovative activities, ICT investments, financial constraints all play a role in differentiating the patterns of internationalisation. In particular, innovative activity is strongly associated with internationalisation strategies.

In order to evaluate a larger array of internationalisation modes in a multivariate framework we employ a multinomial Probit model. This econometric methodology allows to avoid any *a priori* assumptions, such as the substitutive or cumulative ones, on internationalisation patterns.

One policy implication of our results is the need to boost the ICT investments. In our opinion, the role of fiscal incentives to stimulate firm innovative investments could be of great importance as a tool to foster firms' performance as well as their participation in foreign markets.

Much work remains to be completed in order to increase our understanding of the impact of innovation on firms' internationalisation choices. Analysis of the role of favourable tax regimes, the use of disaggregated measures of the ICT, and a multi-country approach will characterise our future research agenda.

Acknowledgements

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Notes

1 CERVED is a consortium of private equity funds that evaluates businesses reliability and their financial structure.

2 Obviously, the group of exporting firms considered in Table 3 does not correspond with the one of Table 1 as the latter one includes also companies considered in the other two groups.