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Abstract

The paper investigates the relationship between firms' international cooperation strategies and export decision. It proposes an extension of the recent class of models of firm heterogeneity and trade according to which prospective exporters must engage in a cooperation agreement with a foreign partner in order to favour their market access and distribution activities overseas. The paper analyses the empirical relevance of this model by means of a new survey dataset providing information on the internationalization activities of 814 Norwegian firms in the service sectors for the period 2004-2006. The econometric results point out that international cooperation, both on existing and on innovative products, is indeed an important factor to foster the firms' decision to enter the export market.

JEL codes: F10; F15; L24; O33

Keywords: Export; firm heterogeneity; international cooperations; innovation; survey data

1. Introduction

A recent strand of literature in international economics investigates the reason why firms differ in terms of their propensity to enter foreign markets and their ability to do so. Melitz (2003) and Helpman, Melitz and Yeaple (2004) represent two of the seminal papers in this new modelling literature on firm heterogeneity and international trade. In short, this class of models points out that, in order to commercialize their products overseas, enterprises must pay a sunk (export) costs: since firms are characterized by different productivity levels, only high productivity enterprises will be able to make this investment and become international, whereas most other firms will only produce for the domestic market.[1]

At the same time as these new theoretical ideas were being proposed, a large number of applied contributions have analysed the empirical relevance of this class of models by making use of firm-level data for a number of different countries. The micro-econometric literature on firm heterogeneity and international trade has found substantial support for the key ideas proposed by the Melitz-like models, and shown the great differences that characterize exporting firms *vis-a-vis* domestic enterprises.

Specifically, this applied literature has to a large extent focused on two main sets of factors explaining firms' export propensity. The first is enterprises' productivity, which has been shown to be much larger for exporters than for domestic firms by a great number of contributions (Wagner, 2007; Mayer and Ottaviano, 2007; Bernard et al., 2007; Greenaway and Kneller, 2007; Moxnes, 2010). The second set of explanatory factors refers to firms' innovative activities. The R&D intensity of firms and their innovative output (e.g. patents, commercialization of new products) have been found to

[1] Further elaborations of this seminal idea have later been proposed by, among others, Bernard et al. (2003 and 2007), Costantini and Melitz (2007) and Melitz and Ottaviano (2008). See also the related model developed by Ekholm and Midelfart (2005). A survey of these theoretical models has recently been presented by Castellacci (2011).

be closely related to the enterprises' performance in international markets (Aw et al., 2007; Barrios et al., 2003; Roper and Lover, 2002; Lachenmaier and Wöbmann, 2006; Cassiman and Golovko, 2007; Damijan et al., 2008).

Despite the great progress achieved by this recent strand of firm heterogeneity literature, one aspect that has not yet received proper attention is the strategy that is pursued by each firm in order to enter the export market. In other words, once a firm realizes to have a high enough productivity to pay the sunk export costs, how precisely does it organize in order to prepare for its export activities? What strategy does it adopt, and what obstacles or barriers to internationalization does it encounter while preparing to become an exporter?

Our paper intends to shed new light on these questions by focusing on the relationship between firms' international cooperation strategies and export decision. The paper argues that international cooperation agreements represent an important strategy that prospective exporters follow in order to favour their market access and distribution activities overseas. Specifically, we propose an extension of the recent class of models of firm heterogeneity and trade according to which prospective exporters must engage in a cooperation agreement with a foreign partner.

The paper then analyses the empirical relevance of this model by means of a new survey dataset providing information on the internationalization activities of 814 Norwegian firms in the service sectors for the period 2004-2006. The econometric results point out that international cooperation, both on existing and on innovative products, is indeed an important factor to foster the firms' decision to enter the export market.[2]

[2] These insights are in line with the empirical results of a few papers that have recently investigated the role of vertical linkages and firms' network activities on enterprises' export performance (Beise-Zee and Rammer, 2006; Clausen and Pohjola, 2009; Alvarez et al., 2009; Laursen, 2009).

The contribution proposed by the paper to the firm heterogeneity literature is twofold. First, the study sheds new lights on the export decision process and the related firm internationalization strategy, rather than simply assuming that these only depend on a combination of firm's productivity and sunk export costs. Secondly, the paper provides new firm-level evidence on the process of internationalization in the service sectors, which have frequently been neglected in the previous literature due to the lack of reliable data. The paper is organized as follows: section 2 presents the theoretical model, section 3 the survey data and indicators, sections 4 and 5 the results of the empirical analysis, and section 6 concludes and outlines the main results of the work.

2. The model

Our theoretical framework proposes an extension of the recent class of models of firm heterogeneity and trade (e.g. Melitz, 2003; Helpman, Melitz and Yeaple, 2004) by pointing out the important role played by firms' international cooperation strategies in fostering the enterprises' export activities. The overall set up presented in this section follows closely Melitz (2003) heterogeneity model. In each sector, firms are assumed to have different productivity levels: those enterprises that are below a given productivity threshold are not able to pay the sunk export costs and will therefore only produce for the domestic market; by contrast, above this productivity threshold, firms will be able to pay the sunk export costs and hence commercialize their products overseas.

Based on this framework, our extension of this type of heterogeneity models is to point out that those firms that are above the productivity threshold must engage in some type of cooperation agreement with foreign partners in order to gain market access and build up a distribution network abroad, which are necessary for the commercialization of their

products in international markets. Firms may either enter cooperation agreements with foreign partners to favour the commercialization of *existing* products, or also engage in collaborations to promote and sell their *new* (innovative) products in the foreign market. The cooperation strategy adopted by the firm will then affect its export propensity.[3]

In order to formalize this idea, we initially start from the same set up as the Melitz model. The cost function of each firm (measured in units of labour L) is specified as:

$$L = f + Q/\varphi \quad (1)$$

where f is a fixed production cost, φ is the labour productivity of the enterprise, and Q/φ is its variable cost. In each market, firms face a demand curve where the elasticity of substitution between two goods, σ, is assumed constant. Hence, the firm sets a profit maximizing markup $\sigma/(\sigma-1) = 1/\rho$, and a pricing rule $P(\varphi) = 1/(\rho\varphi)$.[4] The profit of the firm is thus:

$$\pi(\varphi) = R(\varphi) - L(\varphi) = R(\varphi)/\sigma - f \quad (2)$$

where $R(\varphi)/\sigma$ denotes the variable profits component. The key point of Melitz formalization is that firms have different productivity levels, which are determined by the (exogenous) probability distribution $g(\varphi)$. The firm's profits described in equation 2

[3] While the idea presented here is general and may be relevant for many different industries of the economy, we believe it is an even more plausible hypothesis within the context of the service sectors, on which we focus in our empirical analysis. One relevant characteristic that has previously been pointed out in the literature on services is in fact the importance of user-producer interactions for service provision and commercialisation (so-called *customisation*, see Castellacci, 2008 and 2010). In terms of firms' international activities, this may imply that, in order to develop a good knowledge of the foreign market and a close relationship to the users' needs, service firms may find it necessary to undertake cooperation agreements with foreign enterprises in order to export their services overseas.

[4] As in Melitz (2003, p.1699), we here assume for simplicity that the wage rate at the numerator of the pricing rule expression equals 1.

are thus a function of its productivity, since an enterprise with greater productivity φ can charge a lower price and sell more output. Once a firm discovers its productivity, it decides whether to produce only for the domestic market or whether it is also able to pay the necessary sunk costs and thus sell its products abroad.[5]

At this point, we depart from Melitz model and propose our extension of it. The idea we introduce is the following. High productivity firms decide to enter the export market, but in order to do so they must do two things. First, they must pay a sunk export cost, f_x. As previously observed in the literature, this is necessary in order to manage and overcome crucial barriers to international trade, such as regulatory obstacles, IPR management costs, skills and human capital requirements, etc. Secondly, prospective exporters must find an international cooperation partner in order to enhance their market access and distribution channels in the foreign market. Without a cooperation partner, high-productivity firms will not be able to start their export activity because they lack the information and distribution networks that are necessary to initiate their commercialization activities overseas.

We further assume that each firm can adopt two different cooperation strategies:

1. Either, it will try to sell its *existing* services in foreign markets by collaborating with an international partner. The main cooperation motive here is obviously market access and distribution. We call this strategy C (cooperation with a foreign partner).

2. Alternatively, the firm may decide not only to sell its existing services in foreign markets, but also to sell its *new* (innovative) services by collaborating with a foreign *innovative* partner. The driving cooperation motive here is not simply market access and

[5] Differently from Melitz, our model does not describe the case in which a firm does not even enter the domestic market because its low productivity does not make it possible to pay the fixed production costs. This is a convenient simplification that does not alter the model's substance and results. In other words, we neglect the firm's choice of whether or not enter the production process (analysed in Melitz, 2003, section 3), and instead focus on the firm's choice between domestic *versus* foreign markets (as in Melitz, 2003, sections 5 and 6).

distribution of existing products, but also the further development and foreign commercialization of new or improved product qualities. We call this strategy IC (cooperation with a foreign innovative partner).

The cooperation strategy IC *contains* (and it is strictly superior to) the strategy C, in the sense that a firm choosing IC will enter a cooperation agreement that is composed of two parts: access/distribution of existing services (as in C), plus the commercialization of new services.[6]

The prospective exporters must therefore pay the following fixed (sunk) costs:

- f_x: sunk export costs: all firms aiming at export must pay this;
- f_C: for firms choosing strategy C;
- $f_C + f_{IC}$: for firms choosing strategy IC.

The sunk costs of international cooperation (f_C and f_{IC}) entail the costs for finding a partner, managing the contractual costs and mantaining the contact with the partner in the future. Here we reasonably assume that strategy IC is more costly than C, because undertaking and managing an innovation cooperation is expected to be more complex and demanding than an ordinary cooperation that only refers to the commercialization of existing products.

Prospective exporters expect the following benefits from their exporting activity:

- $R_C(\varphi)$: for firms choosing strategy C. This is the additional revenue that can be earned by means of a greater market access and distribution that is made possible by the international cooperation activity;

[6] The empirical analysis of our firm-level dataset will later show the validity of the idea we are formalizing here. To anticipate, our data indicate that (1) nearly all exporting firms are engaged in some type of international cooperation; (2) enterprises adopting the strategy IC also cooperate on existing services (i.e. the strategy IC is stricly superior to C; in fact we never observe a firm that cooperates only on *new* services).

- $R_C(\varphi) + R_{IC}(\varphi)$: for firms choosing strategy IC. This is the additional revenue that can be earned not only by means of a greater market access and distribution due to the international cooperation activity, but also thanks to the greater commercialization of new services.

Hence, the model points out the existence of three distinct groups of firms: domestic (D), exporters with international cooperation (C), and exporters with international innovation cooperation (IC). The profits expected by each of these groups are:

$$\pi_D(\varphi) = R(\varphi)/\sigma - f \quad (3)$$

$$\pi_C(\varphi) = [R(\varphi)/\sigma + R_C(\varphi)] - [f + f_x + f_C] \quad (4)$$

$$\pi_{IC}(\varphi) = [R(\varphi)/\sigma + R_C(\varphi) + R_{IC}(\varphi)] - [f + f_x + f_C + f_{IC}] \quad (5)$$

where $\pi_D(\varphi)$, $\pi_C(\varphi)$ and $\pi_{IC}(\varphi)$ indicate respectively the profits of domestic firms (D), exporters with international cooperation (C) and exporters with international innovation cooperation (IC).

It is reasonable to assume that $R_C(\varphi) > f_C$ and $R_{IC}(\varphi) > f_{IC}$: if a firm chooses strategy C (or IC), the incremental revenues $R_C(\varphi)$ (or $R_{IC}(\varphi)$) are greater than the additional costs f_C (or f_{IC}) that it has to pay to manage the cooperation agreement. This implies that: $\pi_D(\varphi) < \pi_C(\varphi) < \pi_{IC}(\varphi)$. Hence, the profits expected from adopting strategy C are higher than D, and those earned by undertaking strategy IC are greater than C.

Given this set up, the factors affecting the firm's choice of adopting a cooperation strategy instead of another are twofold. First, the strategy choice will depend on the additional profits that the firm may expect to earn. Specifically, as pointed out in

equations 3, 4 and 5, the additional profits that can be earned by entering a cooperation agreement with a foreign partner depend on: (1) the firm's productivity level: the higher the productivity, the more likely is that the firm will decide to enter the export market and hence adopt cooperation strategy C or IC instead of D; (2) the sunk costs that must be paid to enter the foreign market, including both f_x, f_C and f_{IC}.

Secondly, the choice of the cooperation strategy will also be affected by the enterprise's innovation status. Innovative firms have in fact a greater absorptive capacity than non-innovative enterprises, and they therefore have a greater awareness of the importance of cooperation activity, and a superior capability to interact with external actors in order to gain access to foreign markets and advanced external knowledge. Further, if the firm has recently developed new products, the novelty and complexity of the latter may initially make it more difficult to introduce them in the foreign market, and hence make it necessary to enter a cooperation agreement in order to favour this commercialisation process. In summary:

$$\Pr\{C\} = s[R_C(\varphi); f_x; f_C; INNO] \quad (6)$$

$$\Pr\{IC\} = t[R_C(\varphi); R_{IC}(\varphi); f_x; f_C; f_{IC}; INNO] \quad (7)$$

where Pr{C} and Pr{IC} are the probability to adopt cooperation strategy C or IC respectively, whereas INNO denotes the innovation status of the enterprise (INNO = 1 for firms engaged in innovative activities, and 0 otherwise).[7]

[7] It is important to emphasize that, according to this formalization, innovation and productivity are both exogenous variables of the model. This is due to the short-run nature of this theoretical framework, which for simplicity does not take into account the possibility that innovation and productivity may both evolve in the longer run by means of the firm's R&D investments or learning effects in foreign markets. See the recent model by Costantini and Melitz (2007) in which firms may increase their future productivity by investing in innovative activities.

After having presented our proposed refinement of Melitz (2003) model, we follow again his formalization in order to outline the equilibrium condition and the main outcomes of this theoretical framework. Taking together the three groups of firms, each firm's combined profits may be written as:

$$\pi_i = \pi_D + \max \{0; \pi_C\} + \max \{0; \pi_{IC}\} \quad (8)$$

where i = D for domestic firms, C for exporters engaged in international cooperation, and IC for exporters engaged in international innovation cooperation. Firm's i value function is given by:[8]

$$\upsilon_i(\varphi) = \max \{0; \pi_i\} \quad (9)$$

The cutoff productivity levels are denoted by:

$$\varphi^* = \inf \{\varphi: \upsilon_i(\varphi) > 0\} \quad (10)$$

$$\varphi_X^* = \inf \{\varphi: \varphi \geq \varphi^* \text{ and } \pi_X(\varphi)\} \quad (11)$$

where φ^* is the cutoff productivity level for production in (at least) the domestic market, while φ_X^* is the productivity threshold for prospective exporters (i.e. our C and IC firms) . These cutoff levels must be such that the profits that may be earned by the firm

[8] Equation 9, differently from Melitz model, does for simplicity assume that the probability that a firm exit at any period due to an exogenous shock is 0 (see Melitz, 2003, p. 1709).

with productivity φ^* (or φ_X^*) must equal zero (the so-called *zero cutoff profit condition* of Melitz model):

$$\pi_D(\varphi^*) = 0 \tag{12}$$

$$\pi_X(\varphi_X^*) = 0 \tag{13}$$

Given these productivity thresholds, it is then possible to outline the distribution of productivity for incumbents (conditional upon successful entry):

$$\mu(\varphi) = g(\varphi) / [1 - G(\varphi^*)] \tag{14}$$

where the term $[1 - G(\varphi^*)]$ represents the ex-ante probability of successful entry in the domestic market. Therefore, the ex-ante probability of successful entry in the foreign market is given by:

$$\Pr\{X\} = [1 - G(\varphi_X^*)] / [1 - G(\varphi^*)] \tag{15}$$

As shown above, the productivity thresholds that appear in this expression (φ_X^* and φ^*) are determined as a function of the firms' profits π_i. The latter, in turn, have previously been specified as a function of the following main factors (see equations 3, 4 and 5): (1) the firm's productivity φ; (2) the fixed production costs f, and the sunk (export and cooperation) costs f_C and f_{IC}; (3) the cooperation strategy adopted by the firm, C or IC. Therefore, the export probability $\Pr\{X\}$ may be described as a function of these factors:

$$\Pr\{X\} = z[\varphi; f; f_x; f_C; f_{IC}; C; IC] \quad (16)$$

Specifically, our model expects that the probability that a firm becomes an exporter Pr{X} is related to these factors in the following manner: (1) positively related to the enterprise's productivity level; (2) negatively related to the fixed production and sunk (export and cooperation) costs; (3) to be greater for the cooperation strategy IC than for the strategy C (since the former leads to higher average expected profits than the latter).

In summary, the model leads to two main equations that will be investigated in the empirical analysis: one is the equation for the determinants of the firm's international cooperation (equations 6-7 above); the other is the equation for the firm's probability to become an exporter (equation 16). The empirical analysis presented in the reminder of the paper will first illustrate the empirical validity of some of the main model's assumptions and properties, and then provide an econometric test of the two equations for the cooperation and export propensity.

3. Data and indicators

The *Service Internationalization Survey* (SIS) was carried out by the Norwegian Institute of International Affairs in the period 2008-2009. The motivation for undertaking the survey was to provide new empirical evidence on the main channels, strategies and patterns of internationalization followed by firms in the service industries. The data collection work was based on a questionnaire that was distributed to a large sample of Norwegian firms. The questionnaire is composed of 25 questions, which ask

Norwegian service enterprises a number of information regarding their international activities in the period 2004-2006.

A web-based survey was sent to all Norwegian firms with more than 10 employees in 14 different service industries. In total, the questionnaire was sent to a total number of 4230 enterprises and, after a series of reminders during the whole data collection process, 814 enterprises filled in the questionnaire, corresponding to a satisfactory response rate of 19%.

The 14 selected industries represent a wide coverage of the service branch of the economy, and contain both sectors characterized by a high international propensity as well as more domestically oriented industries (software; research and development; other business services; post and telecommunication; financial intermediation; insurance; auxiliary financial services; hotels and restaurants; sale, maintenance and repair; wholesale trade; retail trade; land transport; water transport; auxiliary transport services). Across the sectors, the response rate ranges from a minimum of 11% to a maximum of 35%.

The SIS questionnaire comprises a number of questions regarding the different delivery modes of service firms in international markets, the type of clients and cooperation partners that these have had, the internationalisation motives and objectives, their innovative activities, and the main barriers to internationalisation experienced by the enterprises. Our empirical analysis focuses on the following indicators available from the SIS survey, whose main descriptive statistics are reported in table 1.

- **Export participation**: dummy variable indicating whether a firm has had export activity in the period 2004-2006. On average, 19% of enterprises in our sample is an exporter.[9]

- **International cooperation**: dummy variable reporting whether the firm has cooperated with an international partner in the period. This measures the strategy C in the theoretical model presented in the previous section. 35% of firms have had this type of cooperation strategy.

- **International innovation cooperation**: dummy variable indicating whether the firm, in addition to having cooperation agreements on existing services, have also cooperated with an international partner for the commercialization of a new service. This measures the strategy IC of our theoretical model. On average, 14% of enterprises in our sample have adopted this cooperation strategy.

- **Part of a group**: dummy variable reporting whether the firm is part of a group rather than an independent enterprise.

- **Affiliate of a foreign MNE**: dummy variable indicating whether the firm is an affiliate of a foreign multinational enterprise.

- **Size (employment)**: number of employees.

[9] Notice that this variable only refers to export activities and excludes other channels of service internationalisation such as, for instance, FDI, foreign clients mobility and temporary presence abroad. In other words, among the four service internationalisation modes identified by GATS, the dummy variable used here only refers to *mode 1*.

- **Labour productivity**: Firm's turnover divided by the number of employees. This provides a measure of the productivity variable φ of the theoretical model.

- **Innovation (new services)**: dummy variable reporting whether the firm has developed a new service in the period. This indicator measures the variable INNO of the theoretical model.

- **Barriers to internationalization**: this is a set of five variables indicating the extent to which firms consider the following factors as important barriers to their internationalization activities: (1) Regulation of foreign business activities; (2) Lack of qualified workers; (3) Protection of intellectual property rights; (4) Infrastructure (communication, transport, distribution); (5) Costs of building up a network abroad. The indicators are categorical, ranging on a scale from 1 ("not important") to 4 ("very important"). These five variables provide a proxy measure of the sunk costs of export and international cooperation activity (i.e. the variables f_x, f_C, and f_{IC} of our theoretical model).

< Table 1 here >

4. Empirical analysis of the model's assumptions and set up

This section presents some descriptive evidence and statistical tests to illustrate the empirical validity of the main assumptions and properties of the theoretical model presented in section 2. The main novelty of our theoretical framework as compared to the standard trade and heterogeneity model is the idea that all prospective exporting

firms must engage in international cooperation in order to enable their commercialization activities overaseas, and that they may do that by following two alternative strategies: cooperation to favour the commercialization of existing products (C) or also to facilitate the export of innovative services (IC). Figures 1 and 2 show that these two cooperation strategies are indeed important for the service firms in our sample, and closely related to their export propensity and innovative status.

First, figure 1 reports the share of firms adopting different cooperation strategies and the extent to which these are related to the enterprises' export activities. The figure shows that nearly all exporters in our sample have also had some type of international cooperation agreement. This suggests that it is indeed reasonable to extend this class of models by focusing on firms' cooperation strategies, as the latter appear to be an inherent and important part of firms' activities overseas. In fact, the probability that a firm is an exporter is substantially higher for enterprises adopting strategy IC or C *vis-a-vis* non-cooperating firms.

Secondly, figure 2 shows the close relationship between the innovative status of the firms (INNO) and the international cooperation strategy they adopt (see equations 6 and 7 of the theoretical model). The diagram clearly indicates that: (1) if a firm is an innovator, it is much more likely that it is engaged in some type of international cooperation (C or IC); (2) innovators are more likely to adopt strategy IC than C.

< Figures 1 and 2 here >

Next, we present the results of statistical tests that compare the export propensity and productivity levels for the three different groups of firms identified by our model: non-cooperating enterprises (NC), exporters with international cooperation (C), and

exporters with international innovation cooperation (IC). Table 2 presents the results of a set of Mann-Whitney tests and Kolmogorov-Smirnov tests. The former is a non-parametric test comparing the mean across two groups of observations, whereas the latter is a test of stochatic dominance that does not only focus on the mean but compares the whole distribution for different groups of firms.[10] The comparison exercise is repeated for each pair of groups: C *versus* NC (panel *a* of table 2), IC against NC (panel *b*), and IC *versus* C (panel *c*).

First, looking at the results for the productivity variable, we observe that firms with international cooperations (C) and those with innovation cooperations (IC) have higher labour productivity than firms with no cooperation (see the table's panels *a* and *b* respectively). These results provide empirical support for the trade and heterogeneity framework and for our extension of it. They show that firms are characterized by different productivity levels, and that these differences are particularly marked when comparing exporting to non-exporting firms (in terms of our theoretical model, this property may be expressed as: $\varphi_C > \varphi_D$ and $\varphi_{IC} > \varphi_D$). This is in line with a great number of recent contributions in the applied literature on firm heterogeneity and trade (Wagner, 2007; Mayer and Ottaviano, 2007; Bernard et al., 2007; Greenaway and Kneller, 2007).

However, the comparison of the groups IC and C (panel *c* of the table) is not statistically significant. The reason for this, according to our model, may be that the different strategies and performance of the groups C and IC are not only related to their productivity levels (which is for both groups above the necessary cutoff level), but they may also be affected by their innovation status (see equations 6 and 7).

[10] In the recent applied literature on firm heterogeneity and exports, analogous tests have been used by, among others, Cassiman and Golovko (2007) and Damijan et al. (2008). See in particular the related firm-level evidence on Norwegian manufacturing firms recently presented by Moxnes (2010).

Secondly, shifting the focus to the export participation variable, the test results clearly indicate that firms with international cooperations (C) and those with innovation cooperations (IC) have higher export propensity than firms with no cooperation (panels *a* and *b*). Furthermore, firms with innovation cooperations have higher export propensity than firms that only have international cooperations (panel *c*). These results are in line with our model's prediction (see equation 16) that the probability to become an exporter is not only related to the factors previously pointed out in the literature, productivity and sunk costs, but it is also affected by the firm's cooperation strategy.

In summary, the results presented in this section illustrate the empirical validity of our model's main assumptions and set up. Our sample is well described by distinguishing three groups of firms: domestic enterprises (D), exporters with international cooperation (C) and exporters with innovation cooperation (IC). Firms in the first group are not able to enter the export market because their productivity level is below the minimum cutoff level (as in Melitz model). On the other hand, the last two groups are both above the threshold productivity level, but must engage in a cooperation agreement with a foreign partner in order to enter the export market. These two groups differ however in terms of the cooperation strategy they adopt. Firms in the IC group are more likely to be innovators than enterprises in the C group, and have therefore on average a higher export propensity.

< Table 2 here >

5. Empirical analysis of the model's outcomes

As outlined at the end of section 2, our theoretical model leads to two main equations, which are empirically investigated in the regression analysis presented in this section. One is the equation for the determinants of the firm's international cooperation strategy (see equations 6-7 in section 2); the other is the equation for the firm's probability to become an exporter (see equation 16). The empirical version of these two equations that will be considered here is the following:

$$\begin{cases} \Pr\{CS_i\} = \alpha + \beta\,\varphi_i + \gamma\,SC_i + \delta\,INNO_i + \kappa\,FS_i + \varepsilon^1{}_i & (17) \\ \Pr\{X_i\} = \eta + \theta\,\varphi_i + \lambda\,SC_i + \omega\,CS_i + \xi\,FS_i\,\varepsilon^2{}_i & (18) \end{cases}$$

where the variables are defined as follows:

- $\Pr\{CS_i\}$ is the probability that firm *i* adopts a given cooperation strategy. CS_i equals C if the firm has international cooperation only, and IC if the firm has also innovation cooperation;
- $\Pr\{X_i\}$ is the probability that firm *i* is an exporter;
- φ_i is the enterprise's labour productivity;
- SC_i denotes the sunk (export and cooperation) costs (i.e. the variables f_x, f_C, f_{IC} of the theoretical model). These are measured through the set of barriers to internationalization variables that have been defined in section 3;
- $INNO_i$ represents the innovation status of the firm (it equals 1 for innovators, and 0 otherwise);

- FS_i is a set of firm-specific control variables (firm size; whether it is part of a group; and whether it is the affiliate of a foreign MNE).

Taken together, equations 17 and 18 constitute a *recursive* system of equations, since the dependent variable in the first equation $\Pr\{CS_i\}$ appears on the righ-hand-side of the second equation. We use two different econometric approaches to estimate these equations. The first is to estimate the two equations independently from each other by means of an ordinary *probit* model. This approach neglects the endogeneity of the CS_i variable in equation 18 and it is therefore likely to provide biased estimates. It is however useful to present these probit results as a benchmark. The second econometric approach makes use of a *recursive bivariate probit* model, in which both equations are simultaneously estimated and the endogeneity of the CS_i variable is properly handled by the way the model is estimated.[11]

Before presenting the econometric results, it is important to point out two simplifying assumptions, and possible limitations, of our empirical model. First, in line with Melitz (2003) model and our refinement of it, the productivity variable φ_i is assumed to be an exogenous factor, which firms take as given when they decide upon their cooperation and export strategies. Given the static nature of our theoretical model and the cross-sectional nature of the survey data we are using, our empirical analysis is not able to take into account the possible endogeneity of the productivity variable in a longer time frame. Nevertheless, a large number of microeconometric studies have previously investigated the possible feedback effect linking firms' international activities to their

[11] The recursive bivariate probit is a seemingly unrelated regression model with correlated disturbances, in which the dependent variable of the first equation appears on the righ-hand-side of the second equation. The model is estimated by MLE. Greene (2003, section 21.6.6, pp. 715-716) points out that in such a model the endogeneity of one of the RHS variables of the second equation can be neglected because this term does not affect the maximization of the log-likelihood (differently from what it would be the case in a *linear* recursive model not estimated by MLE).

productivity dynamics, and often failed to find robust support for the learning-by-exporting hypothesis (Wagner, 2007; Andersson and Loof, 2009). We therefore consider it reasonable to neglect this feedback effect in the context of our cross-sectional investigation.

Secondly, our model also assumes that the innovation status of the firm ($INNO_i$, the dummy variable indicating whether or not a firm is an innovator) is an exogenous factor in equation 17. Similarly to the productivity variable, this is justified in the context of our static theoretical model and cross-sectional nature of the data at hand. The underlying idea is that, in any given period, an enterprise's cooperation strategy will not affect its innovation status, because the latter is the result of choices and investments that the firm did in the past (e.g. to set up an R&D lab) and that cannot be affected and modified in the short run. However, this argument would certainly be less appropriate if we had the possibility to analyse a dynamic model by means of panel data, since in this case it would be reasonable to also investigate a possible feedback mechanism linking firms' international cooperation strategies to their innovation activities. Finally, it is also important to notice the exclusion restriction that we introduce in order to identify the recursive bivariate probit model: the (exogenous) INNO variable enters equation 17 but is not included in equation 18. In other words, in line with our theoretical model, the econometric specification assumes that the innovation status of the firm affects the probability that this decides to collaborate with a foreign partner, but does not have any *direct* effect on the probability that the enterprise is an exporter. Therefore, the firm's innovation status is assumed to have an *indirect* effect on its export propensity through the impacts it has on the cooperation strategy choice.

The econometric results are presented in tables 3 and 4. Table 3 reports the results for equation 17, and table 4 for equation 18. The first two columns of each table focus on

the cooperation strategy C (international cooperation), whereas the other two focus on the strategy IC (international innovation cooperation). The numbers of the various columns indicate the econometric approach used in each case, namely ordinary probit (1.1 and 1.3; 2.1 and 2.3) and recursive bivariate probit (1.2 and 1.4; 2.2 and 2.4).[12]

Let us first look at the results for equation 17 reported in table 3. The labour productivity variable is positively and significantly related to both dependent variables, international cooperation (C) and innovation cooperation (IC), and its coefficient is stable across the regressions. The innovation dummy variable is also positive and significant. Its estimated coefficient illustrates the strong impact that innovation has on the choice of firms to engage in international cooperation activities (strategy C or IC). Besides, as pointed out in our theoretical framework, the firm's innovation status has a stronger effect on the probability that an enterprise adopts strategy IC rather than C (compare columns 1.1 to 1.3, and 1.2 to 1.4).

Among the barriers to internationalization variables, three of them turn out to have significant estimates: the protection of IPRs, which is a particularly relevant issue for service provision in international markets; the lack of infrastructures in the foreign market; and the costs of building up a network abroad (this variable is only significant for the dependent variable IC, though; see right-hand-side of table 3). Notice that these barriers variables are all positively related to the dependent variable. Our interpretation of these results, in line with analogous survey data exercises, is that firms which are more actively engaged in international markets are more likely to attach higher importance to these hampering factors, because they are more aware and have a better knowledge of the sunk costs that it is necessary to pay in order to enter the export market.

[12] The LR tests reported at the bottom of tables 3 and 4 indicate that the hypothesis that the disturbances of the two equations are uncorrelated can be rejected. This supports the choice of estimating a bivariate version of the model instead of two separate probit models for the two equations.

Last, looking at the firm-specific control variables, the size of the enterprise and the foreign affiliate dummy indicator are both positively and significantly related to the enterprise's decision to engage in an international cooperation agreement. By contrast, the part of a group dummy variable is not significant at conventional levels. It is important to control for this factor in equation 17, since this suggests that the choice of a firm to cooperate with an international partner is not mainly driven by the fact that the enterprise is part of a group (and hence connected to other firms within an already established conglomerate).[13]

Table 4 shifts the focus to the results for equation 18, where the dependent variable is the export participation dummy indicator. The most important explanatory variable in this equation turns out to be the international cooperation strategy, namely C in columns 2.1 and 2.2, and IC in columns 2.3 and 2.4. The international cooperation variable is highly significant in all the regressions, and its estimated impact on the export propensity increases substantially when the endogeneity of this variable is taken into account by means of the recursive bivariate probit model.[14]

The labour productivity variable and the firm size (employment) control variable are also positively related to the export participation dummy, as previously found in the literature (Wagner, 2007; Mayer and Ottaviano, 2007; Bernard et al., 2007; Greenaway

[13] In additional regressions not reported in table 3, we have also estimated equation 17 by adding the export propensity (dummy) variable to the set of regressors, in order to control for the possibility of a feedback effect from firm's export participation to their international cooperation strategy (i.e. firms may be more likely to enter new cooperation agreements if they are already present in, and have knowledge of, the foreign market). This feedback effect is not present in our theoretical (static) model, but it would be a plausible extension in the context of a dynamic model. This export-cooperation feedback effect turns out to be positive and significant in these additional regressions, and its inclusion does not alter any of the results for the other variables in equation 17.

[14] In another set of regressions not reported here, instead of using separately the two regressors C and IC, we have made use of the variable "Cooperation_strategy", which combines C and IC together. This is a categorical variable taking three values: 0 for non-cooperating firms, 1 for firms adopting strategy C and 2 for IC enterprises. The results of these regressions are basically the same as those reported in table 4 here, but provide an additional relevant indication: the positive and significant estimate for the variable "Cooperation_strategy" confirms our theoretical model's prediction that the probability to become an exporter is higher for firms adopting strategy IC than C (see equation 16 in section 2).

and Kneller, 2007; Altomonte and Colantone, 2008; Castellani and Giovannetti, 2010). However, the statistical precision of these results is somewhat lower than in previous papers in the firm heterogeneity applied literature. This is likely due to the fact that in our approach, besides the *direct* effect of productivity and firm size on export propensity, we also consider an *indirect* effect, since these two firm-specific variables are assumed to affect the firm's cooperation strategy first (equation 17), and the latter does then have an impact on the enterprise's export propensity (equation 18). Our econometric results suggest it may be difficult to obtain a precise estimate of these two distinct effects of productivity and firm size on export participation.

Some of the barriers to internationalization variables turn out to be important for the export decision of enterprises: the regulation of business activities in foreign markets, the lack of qualified workers and the protection of IPRs. By contrast, the two variables measuring the lack of infrastructures in the foreign market and the costs of building up a network abroad do not turn out to have significant estimates, differently from it was the case in the results for equation 17. It is therefore interesting to observe that, among our set of barriers to internationalization variables, those measuring *natural barriers* (related to infrastructures and network building factors) are important for the firm's choice of what cooperation strategy to adopt, whereas those measuring *policy-imposed costs* (e.g. regulatory factors) are more relevant for its export decision.

< Tables 3 and 4 here >

6. Conclusions

The paper has investigated the role of international cooperations for firms' export decisions. The theoretical framework (section 2) has put forward an extension of the class of models of firm heterogeneity and international trade. The main idea we have introduced within the standard heterogeneity model is that an enterprise, once it realizes that its productivity is above a minimum cutoff level that is required to enter the export market, must not only pay the sunk export costs as previously pointed out in the literature, but it must also engage in a cooperation agreement with a foreign partner in order to favour its market access and distribution activities overseas. Specifically, our model argues that a prospective exporter can adopt two alternative international cooperation strategies: cooperation for the commercialization of existing products only, or also for the further development and commercialization of innovative (new) products. Such a cooperation strategy is one key factor affecting the export propensity of firms (in addition to the other factors previously pointed out in the literature such as productivity, firm size and sunk export costs).

The paper has then investigated the empirical relevance of this theoretical framework by means of a new survey dataset providing information on the internationalization activities of 814 Norwegian firms in the service sectors for the period 2004-2006. After a brief description of the data and indicators (section 3), the empirical analysis has shown that the model's set up and main properties closely resemble the characteristics of our firm-level sample (section 4). Our sample is well described by distinguishing three groups of firms: domestic enterprises (D), exporters with international cooperation (C) and exporters with innovation cooperation (IC). Firms in the first group are not able to enter the export market because their productivity level is below the minimum cutoff level (as in Melitz model). On the other hand, the last two groups are much more

productive than domestic firms and have of course a greater export propensity. However, in order to enter the export market, they must engage in a cooperation agreement with a foreign partner. Nearly all of the exporters in our sample, in fact, are also engaged in international cooperation agreements with foreign enterprises.

We have then shown the empirical relevance of these model's properties in a multivariate setting by estimating two equations, one for the firm's cooperation decision and the other for its export propensity (section 5). The regression results point out three interesting results. First, international cooperation, both on existing and on innovative products, is indeed an important strategy to foster the firms' decision to enter the export market. Secondly, differently from the previous literature on innovation and export, in our model innovation does not have a *direct* effect on the export decision but only an *indirect* impact, i.e. by affecting the firm's choice of whether to engage in an international cooperation and of which cooperation strategy to adopt. Finally, the results for the barriers to internationalization variables, which represent our set of proxy measures for sunk costs, point out that those variables measuring *natural barriers* (related to infrastructures and network building factors) are important for the firm's choice of what cooperation strategy to adopt, whereas those measuring *policy-imposed costs* (e.g. regulatory factors) are more relevant for its export decision. The only barrier variable that turns out to be important for both the cooperation and export decision is the protection of IPRs, which is indeed a particularly relevant obstacle for the provision of services in international markets.

These results on the role of international cooperation as a complementary strategy to foster firms' export participation open up new opportunities for future research in this field. One important limitation of this paper, in particular, needs to be addressed by future research. Due to the short-run nature of our theoretical model and the cross-

sectional data we have used in the empirical analysis, we have assumed throughout the work that innovation and productivity are both exogenous variables in the model. While this is a reasonable asumption in the context of a short-run model and cross-sectional investigation, it is clear that these variables are endogenous factors in a longer time frame. The challenge ahead is therefore to refine the main idea presented in this paper by means of a dynamic model framework in which both innovation and productivity may in turn be affected by the firm's cooperation and export activities, and to test the empirical relevance of the various feedback mechanisms by means of a panel dataset.

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Table 1: Descriptive statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Export participation	809	.193	.394	0	1
International cooperation	814	.350	.477	0	1
International innovation cooperation	814	.144	.351	0	1
Part of a group	801	.518	.499	0	1
Affiliate of a foreign MNE	764	.171	.377	0	1
Size (employment)	805	68.9	223.2	10	4861
Labour productivity	804	.142	.165	0	1.1
Innovation (new services)	814	.321	.467	0	1
Barrier: Regulation of foreign business activities	782	1.65	.954	1	4
Barrier: Lack of qualified workers	783	1.74	.977	1	4
Barrier: Protection of intellectual property rights	782	1.44	.768	1	4
Barrier: Infrastructure (commun., transp., distrib.)	782	1.83	1.08	1	4
Barrier: Costs of building up a network abroad	784	2.00	1.15	1	4

Figure 1: Relationship between international cooperation and export participation

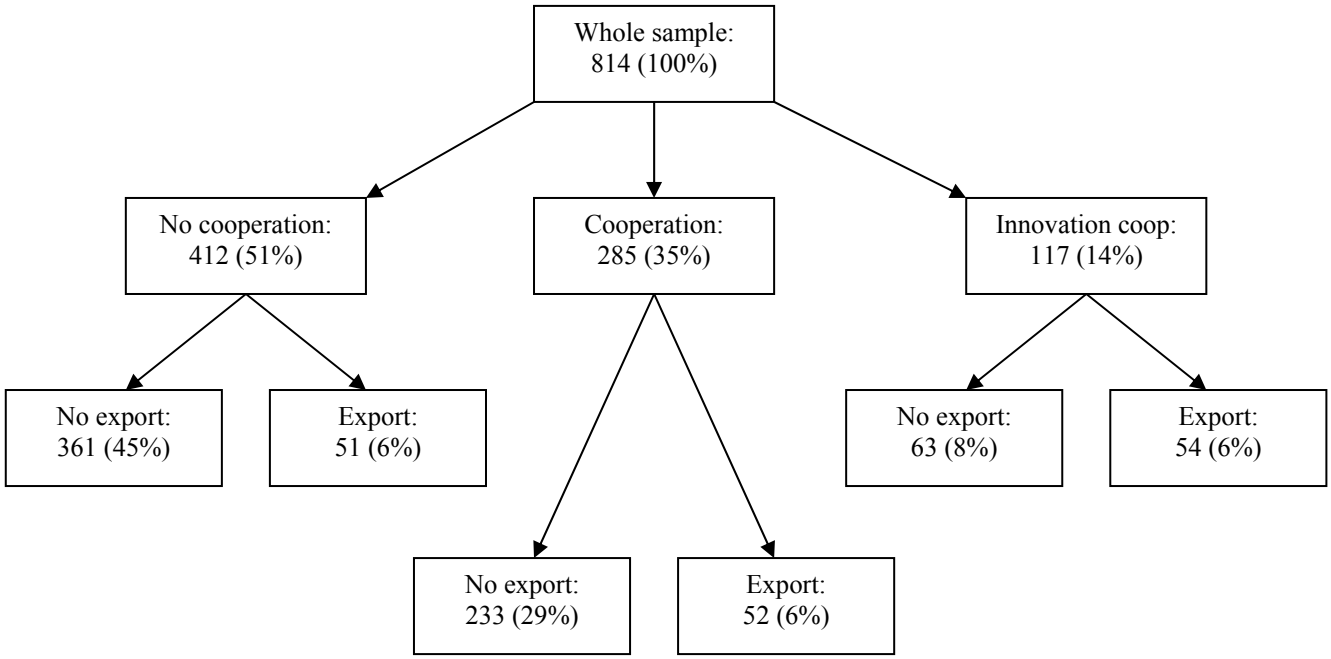

Figure 2: Relationship between international cooperation and innovation

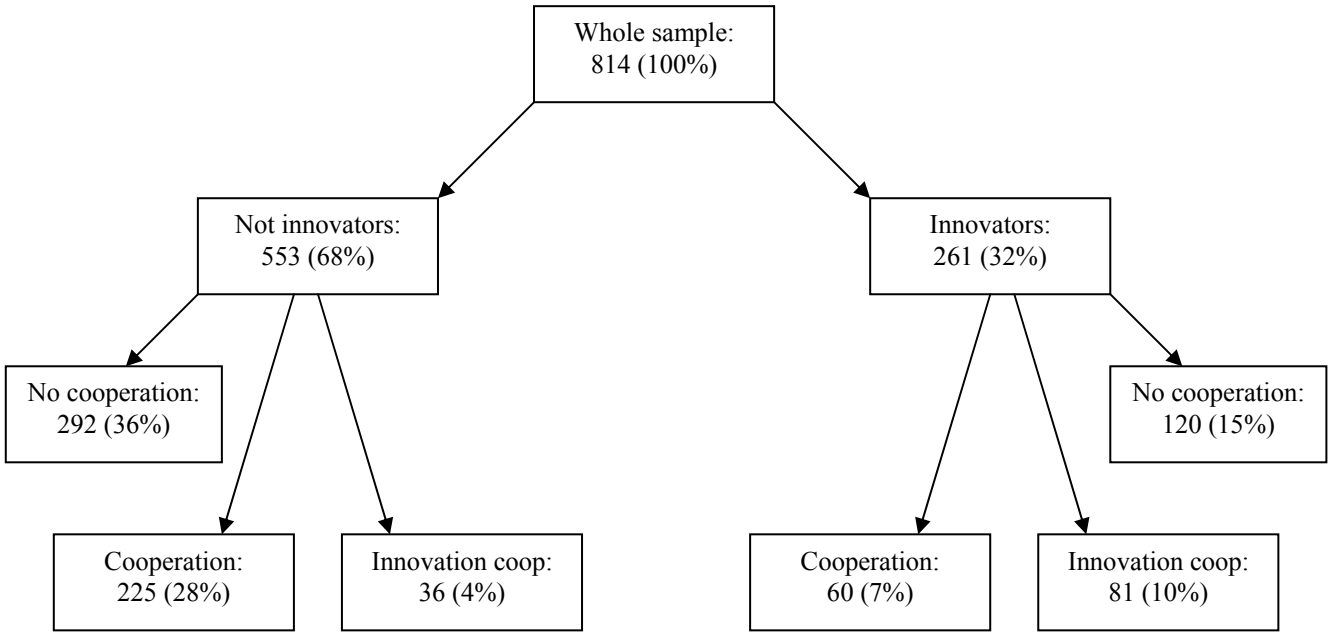

Table 2: Differences in export propensity and labour productivity according to firms' cooperation strategies

a. International cooperation (C) *versus* no cooperation (NC)

	Mann-Whitney test		**Kolmogorov-Smirnov test**	
	z-score	Probability{C>NC}	D-stat	P-value
Export participation	9.46***	0.362	0.27	0.000
Labour productivity	4.41***	0.398	0.20	0.000

b. International innovation cooperation (IC) *versus* no cooperation (NC)

	Mann-Whitney test		**Kolmogorov-Smirnov test**	
	z-score	Probability{IC>NC}	D-stat	P-value
Export participation	8.11***	0.339	0.32	0.000
Labour productivity	3.54***	0.395	0.21	0.000

c. International innovation cooperation (IC) *versus* international cooperation (C)

	Mann-Whitney test		**Kolmogorov-Smirnov test**	
	z-score	Probability{IC>C}	D-stat	P-value
Export participation	2.87**	0.416	0.16	0.031
Labour productivity	1.25	0.455	0.11	0.325

Significance levels: *** 1%; ** 5%.

Table 3: Regression results for the first equation. Dependent variables: International cooperation (C) and international innovation cooperation (IC)

	1.1	**1.2**	**1.3**	**1.4**
	Probit	**Recursive bivariate probit**	**Probit**	**Recursive bivariate probit**
Dependent variable	**C**	**C**	**IC**	**IC**
Labour productivity (log)	0.402 (5.09)***	0.394 (4.99)***	0.401 (3.84)***	0.353 (3.39)***
Innovation (new services)	0.611 (4.75)***	0.688 (5.50)***	0.816 (5.49)***	0.924 (6.25)***
Barrier: Business regulation	0.071 (0.91)	0.073 (0.93)	-0.106 (1.15)	-0.085 (0.92)
Barrier: Lack of qualified workers	-0.052 (0.65)	-0.048 (0.59)	0.047 (0.51)	0.039 (0.42)
Barrier: IPR protection	0.187 (1.96)**	0.203 (2.10)**	0.183 (1.84)*	0.181 (1.78)*
Barrier: Lack of infrastructure	0.198 (2.76)***	0.184 (2.53)**	0.186 (2.29)**	0.158 (1.93)*
Barrier: Costs of building up a network abroad	0.090 (1.24)	0.083 (1.14)	0.184 (2.16)**	0.187 (2.20)**
Employment (log)	0.286 (3.22)***	0.280 (3.16)***	0.303 (2.67)***	0.215 (1.85)*
Part of a group	0.180 (1.34)	0.143 (1.10)	-0.073 (0.44)	-0.088 (0.53)
Affiliate of a foreign MNE	0.488 (2.91)***	0.462 (2.78)***	0.331 (1.67)*	0.366 (1.88)*
(Pseudo) R-squared	0.219	-	0.273	-
LR test of exogeneity	-	5.79**	-	5.12**
Observations	607	604	595	604

All regressions include a constant and industry dummies. Significance levels: *** 1%; ** 5%; * 10%.

Table 4: Regression results for the second equation. Dependent variable: Export participation

	2.1	**2.2**	**2.3**	**2.4**
	Probit	**Recursive bivariate probit**	**Probit**	**Recursive bivariate probit**
International cooperation	0.795 (5.61)***	1.543 (5.75)***		
International innovation cooperation			0.718 (4.55)***	1.446 (4.81)***
Labour productivity (log)	0.243 (2.58)**	0.077 (0.75)	0.286 (3.09)***	0.170 (1.75)*
Barrier: Business regulation	0.110 (1.39)	0.092 (1.15)	0.139 (1.74)*	0.155 (1.92)*
Barrier: Lack of qualified workers	0.135 (1.64)	0.184 (2.23)**	0.095 (1.17)	0.139 (1.69)*
Barrier: IPR protection	0.197 (2.13)**	0.167 (1.74)*	0.212 (2.32)**	0.202 (2.13)**
Barrier: Lack of infrastructure	0.047 (0.64)	-0.061 (0.79)	0.058 (0.81)	-0.024 (0.32)
Barrier: Costs of building up a network abroad	0.097 (1.24)	0.047 (0.60)	0.104 (1.35)	0.048 (0.60)
Employment (log)	0.192 (1.93)*	0.038 (0.36)	0.249 (2.59)**	0.145 (1.42)
(Pseudo) R-squared	0.243	-	0.225	-
LR test of exogeneity	-	5.79**	-	5.12**
Observations	652	604	652	604

All regressions include a constant and industry dummies. Significance levels: *** 1%; ** 5%; * 10%.