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Abstract

This paper introduces service innovation in the proximity-concentration trade-off model of trade and FDI (Helpman, Melitz and Yeaple, 2004). The idea is that innovation will have two main effects on service firms' choice between exports and FDI. First, innovative firms will on average have higher productivity levels than non-innovative enterprises. Secondly, innovators will have to pay a higher relational distance cost for undertaking export activities, and they will therefore prefer to avoid (or reduce) these costs by choosing a FDI strategy instead. We test the empirical relevance of this idea on a new survey dataset for a representative sample of firms in all business service sectors in Norway. The results show that firms are more likely to choose FDI rather than export the greater their productivity level and the higher the relational distance costs they face.

JEL codes: F10; F15; L24; O33

Keywords: Service sectors; innovation; export; FDI; firm heterogeneity; survey data

1. Introduction

The proximity-concentration trade-off model initially developed by Brainard (1993; 1997) argues that trade and horizontal FDI are substitute strategies of internationalization at the firm level. On the one hand, the FDI choice makes it possible to avoid the transportation costs that are involved in international trade (the *proximity advantage*). On the other hand, however, FDI activities entail fixed plant costs that may be avoided if the firm decides to export (the *concentration advantage*).[1]

Helpman, Melitz and Yeaple (2004) have extended the proximity-concentration trade-off model within a firm heterogeneity framework. The main idea of this model, in a nutshell, is that enterprises within each industry have different productivity levels: the most productive firms will undertake FDI, those in the intermediate range of the productivity distribution will export, whereas less efficient enterprises will not be able to pay sunk costs and will only produce for the domestic market.[2]

The theoretical predictions of the Helpman, Melitz and Yeaple's model on the trade *versus* FDI choice faced by international firms have recently inspired a number of empirical works, which have brought robust empirical support on the model's outcomes and in particular on the role of productivity as a key firm-level explanatory factor (e.g. Girma, Kneller and Pisu, 2003; Kiyota and Urata, 2007; Tomiura, 2007; Arnold and Hussinger, 2010).

[1] Although the original and simplest version of this model regards horizontal FDI and trade as *substitute* strategies, subsequent models have additionally introduced vertical FDI and investigated the possible complementarities between trade and FDI. See in particular Baldwin and Ottaviano (2001), Head and Ries (2001), Yeaple (2003), Ekholm, Forslid and Markusen (2003), Grossman, Helpman and Szeidl (2006), as well as the useful review by Head and Ries (2004).

[2] The work of Helpman, Melitz and Yeaple (2004) is part of the recent class of models of firm heterogeneity and international trade initially developed by Bernard et al. (2003) and Melitz (2003). Overviews of this large theoretical and empirical literature can be found in Bernard et al. (2007), Greenaway and Kneller (2007), Mayer and Ottaviano (2007), Wagner (2007) and Castellacci (2011a).

Rooted in this recent literature, the present paper intends to take it one step further by focusing on *service innovation* – i.e. the production and commercialization of a new or significantly improved service – and by investigating its effects in the proximity-concentration trade-off model of trade and FDI. This extension is important for two reasons. First, R&D and innovation investments are widely recognised as crucial factors sustaining firms' productivity, profitability and international competitiveness. A few recent papers have introduced innovation within a firm heterogeneity framework to analyse the enterprises' export performance (e.g. Aw, Roberts and Winston, 2007; Costantini and Melitz, 2007; Castellacci, 2010). However, to the best of our knowledge, the firm heterogeneity literature has not yet investigated the effects of innovation on the firms' choice between trade and FDI. Secondly, focusing more specifically on the service sectors, only few empirical studies are available on the important theme of service firms' export (Blum and Goldfarb, 2005; Vogel and Wagner, 2010; Breinlich and Criscuolo, 2011), and no previous study exists on the more specific topic of service innovation within the proximity-concentration trade-off model of trade and FDI.

Motivated by these research gaps, the paper presents a model that introduces service innovation in the Helpman, Melitz and Yeaple (2004)'s model of trade and FDI. The model argues that innovation has two distinct (indirect) effects on service enterprises' choice between export and FDI. First, innovation tends to enhance service firms' productivity, thus making it easier for innovative enterprises to pay the sunk costs that are entailed by the internationalization process. Secondly, innovation makes export activities more risky and costly, due to the existence of *relational distance costs* that exporting firms must sustain in order to commercialize their *new* services overseas. This is a particularly important aspect for enterprises in the service sectors due to the great relevance of user-producer interactions and the related importance of physical (and

cultural) proximity that characterize service provision and commercialization. For both of these reasons, service innovation shifts the trade-off between trade and FDI towards the latter, i.e. the FDI choice becomes relatively more convenient for innovative firms *vis-à-vis* the export strategy.

The second part of the paper carries out an empirical analysis to assess the empirical relevance of this extension of the HMY model. We present a new survey dataset for a representative sample of firms in all business service sectors in Norway, and carry out an empirical analysis that corroborates both the model's key assumptions on the role of innovation as well as its main predictions on the main determinants of the FDI *versus* export choice. In short, the results show that international firms are more likely to choose a FDI rather than an export strategy the greater their productivity level and the higher the relational distance costs that they face if they undertake export activities, and that innovative firms have a significantly greater probability to choose a FDI internationalization mode than the corresponding group of non-innovative enterprises.

On the whole, the contribution proposed by the paper is twofold. First, the theoretical framework points out the relevance of innovation for the firms' internationalization strategy choice. Secondly, the empirical analysis 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 available data. In particular, by focusing on Norwegian firms, our survey dataset presents new evidence on the interesting case of Norway (Moxnes, 2010), a small open economy in which the service sectors account for a very large share of national GDP, employment and innovation dynamics. The paper is organized as follows. Section 2 presents the theoretical model. Section 3 presents the data and indicators. Section 4 discusses the results of the

empirical analysis. Section 5 concludes and briefly points out the main implications of the analysis.

2. The model

Our theoretical framework is based on the trade-off model of trade and FDI initially developed by Brainard (1993) and later extended within a firm heterogeneity framework by Helpman, Melitz and Yeaple (2004). Our model follows the same basic structure as the latter (HMY, from now on), and it extends it by studying the effects of service innovation on the firms' choice between exports and FDI. Focusing on firms in the service sectors, we define *service innovation* as "the market introduction of a new or significantly improved service". The concept is therefore analogous to that of *product innovation* for firms in manufacturing industries, and we may think of a new service (or a new variety of an existing service) as for instance a new software, a new financial, telecommunication or postal service.

There are H+1 sectors, H of which produce differentiated services and one a homogeneous product (which acts as the numeraire in the model). Differently from the HMY model, we assume the existence of two distinct groups of firms in each industry: innovators (I) and non-innovators (NI).[3] The productivity of each firm is denoted by δa, a labour-per-unit output coefficient drawn from the distribution $G(\delta a)$, where:

$$\begin{cases} \delta > 1 & \text{for innovative firms} \\ \delta = 1 & \text{for non-innovative firms} \end{cases}$$

[3] Since our main interest is to study the effects of innovation in the HMY framework, this is a static model, so we take innovation as an exogenous variable and do not investigate the factors, such as R&D investments and other firm-specific conditions, that may explain why some firms are innovative and others are not.

The parameter δ represents the *innovation-productivity bonus*, i.e. it indicates that innovative enterprises have on average a greater productivity level than non-innovative firms. This is the first main assumption of the model (which will be empirically tested in section 4).

The (industry-specific) cost structure is outlined as follows. All firms pay the fixed production costs f_K. International firms must in addition pay sunk costs f_X if they want to export, and f_F if they want to undertake FDI activities. The latter are assumed to be higher than the former, and the difference $f_F - f_X$ denotes plant-level returns to scale.

Further, export activities are subject to costs due to the geographical distance between the provider and the consumer. Differently from the previous literature, we argue that these distance-related costs D_X consist of two parts:

$$D_X = T_X + \gamma R_X \qquad (1)$$

where T_X indicates standard *transport costs* as in the existing literature (increasing with the geographical distance), whereas R_X denotes *relational distance costs*. The latter are due to the relational or cultural distance that separates the provider and the consumer, and which may lead to failures or frictions in the exporting and commercialization activities overseas, such as uncertainty about the quality of the exported service and its delivery, and the related communication failures and contractual frictions (Rauch, 1999). We assume that:

$$\begin{cases} \gamma = 1 & \text{for innovative firms} \\ \gamma = 0 & \text{for non-innovative firms} \end{cases}$$

i.e., only innovators pay the relational costs for the commercialization of their new services, whereas non-innovative enterprises only incur standard transportation costs. This is the second main assumption of the model, which will also be empirically investigated in section 4.[4]

The idea motivating this assumption is that the production of a *new* service entails substantial uncertainty about the quality of the new variety and its commercialization in the foreign market, and this will be reflected in greater risks for the exporting firm and higher relational costs, which on the whole make exporting a more costly activity. Specifically, service innovation makes physical (and cultural) proximity between the producer and the user all the more important. For example, for software, financial and telecommunication-related services, the high innovative content and the relevance of user-producer interactions make it very important for the service provider to be present overseas and actively interact with its foreign partners and clients. The service innovation literature has in fact previously pointed out the importance of user-producer interactions for service provision and commercialization (so-called *customization*, see Castellacci, 2008; Ganotakis and Love, 2011). In short, this tends to make FDI a more viable and more attractive internationalization strategy than export.

Given this cost structure, the industry description follows a monopolistic competition set-up (as in the HMY model). Preferences are described by a CES function with elasticity of substitution: $\varepsilon = 1 / (1 - \alpha)$, with $\varepsilon > 1$. The demand function is given by $A\rho^{-\varepsilon}$, the price is $\rho = w\delta a/\alpha$, and the mark up factor is denoted by $1/\alpha$. Assuming for

[4] Regarding this second assumption, to be more specific, the empirical analysis in section 4 will test the proposition that the distance (relational) costs are *higher* for innovators than for non-innovators, and not that these costs are zero for the latter group. This is in fact a convenient simplification that we use in the theoretical model in order to make the non-innovators case as comparable as possible to the basic version of the HMY model, and that we can easily relax in our empirical analysis in order to make the findings more robust and general.

simplicity that w = 1, then the firm's output is given by $A(\delta a/\alpha)^{-\varepsilon}$, the costs by $\alpha(\delta a/\alpha)^{1-\varepsilon}$ and its revenues by $A(\delta a/\alpha)^{1-\varepsilon}$.

Next we derive profit functions and the export-FDI trade-off. Let us first focus on the case of *non-innovative firms*, which is the same as in the standard version of the original HMY model. Firms that only produce for the domestic market (D) are characterized by the following profit function:

$$\pi_D = (\delta a)^{1-\varepsilon} B - f_K \tag{2}$$

where $B = [(1 - \alpha)(A/\alpha^{1-\varepsilon})]$ indicates the demand level in the sector. Exporting firms may realize the additional profits:

$$\pi_X = [(T_X + \gamma R_X)\delta a]^{1-\varepsilon}] B - f_X \tag{3}$$

whereas the additional profits for FDI firms are:

$$\pi_F = (\delta a)^{1-\varepsilon} B - f_F \tag{4}$$

The profit functions outlined above make it possible to obtain the cut-off levels for the three groups of non-innovative firms (NI):

$$\begin{cases} \text{Domestic: } C_D^{NI}: \quad \pi_D = 0 \quad => \quad a^{1-\varepsilon} = f_K/B \\ \text{Exporters: } C_X^{NI}: \quad \pi_X = 0 \quad => \quad a^{1-\varepsilon} = f_X/[B(T_X^{1-\varepsilon})] \\ \text{FDI firms: } C_F^{NI}: \quad \pi_F = \pi_X \quad => \quad a^{1-\varepsilon} = (f_F - f_X)/[B(1 - T_X^{1-\varepsilon})] \end{cases} \tag{5}$$

Figure 1 depicts these profit functions and the corresponding cut-off levels. The upper panel focuses on non-innovative enterprises (the baseline HMY case), whereas the lower panel considers the case of innovative firms. It is useful to focus first on the upper panel (non-innovative enterprises), in order to recall the basic predictions of the heterogeneity trade-off model of trade and FDI. The HMY model leads to the following five comparative statics outcomes:

- Greater fixed production costs (f_K) shift the cut-off point C_D^{NI} towards the right, i.e. fewer firms are able to enter the market.
- Higher export sunk costs (f_X) shift the threshold level C_X^{NI} towards the right, so that fewer firms are able to export.
- Greater plant-level returns to scale in a given sector ($f_F - f_X$) tend to shift the cut-off point C_F^{NI} towards the right, i.e. less firms choose FDI and more choose export.
- A higher demand level in a given sector (B) increases the slopes of the profit function for all three groups of firms (π_D, π_X, π_F), so that the three cut-off points all shift towards the left. In other words, with good demand conditions, it is easier for firms to enter both the home and foreign markets and pay the necessary fixed production and internationalization costs.
- Greater transport costs (T_X) induce two effects: (1) they decrease the slope of the profit function for exporting firms (π_X), hence moving C_X^{NI} towards the right (fewer firms are able to export and more decide to stay domestic); (2) these costs also shift C_F^{NI} to the left, i.e. more firms decide to undertake FDI activities instead of exports.

< Figure 1 here >

Let us now shift the focus to the group of *innovative firms* (I), whose behaviour is illustrated in the lower panel of figure 1. The corresponding cut-off levels for innovators are:

$$\begin{cases} \text{Domestic: } C_D^I: \quad \pi_D = 0 \quad => \quad a^{1-\varepsilon} = f_K/B(\delta^{1-\varepsilon}) \\ \text{Exporting: } C_X^I: \quad \pi_X = 0 \quad => \quad a^{1-\varepsilon} = f_X/[B(D_X\delta)^{1-\varepsilon}] \\ \text{FDI firms: } C_F^I: \quad \pi_F = \pi_X \quad => \quad a^{1-\varepsilon} = (f_F - f_X)/[B(D_X\delta)^{1-\varepsilon}] \end{cases} \tag{6}$$

As outlined above, our model assumes that innovators have on average greater productivity levels and face higher distance costs than non-innovative firms (due to the existence of relational costs for innovators). Therefore, as shown in figure 1, given these innovation-related effects, all three profit functions for innovative firms have a higher slope than those for non innovative firms.[5] Consequently, comparing the threshold levels for the groups of innovative *versus* non-innovative enterprises, it is easy to see that:

$$\begin{cases} C_D^I < C_D^{NI} \\ C_X^I < C_X^{NI} \\ C_F^I < C_F^{NI} \end{cases} \tag{7}$$

[5] To be more specific, innovation has two contrasting effects on the profit function of *exporting firms*: (1) the greater distance (relational) costs induced by the commercialization of new products tend to decrease the slope of the profit function; (2) by contrast, the greater productivity level that characterizes innovative firms will increase it. We reasonably assume that the latter effect is stronger than the former, so that the profit function for exporting innovative firms is steeper than the one for exporting non-innovative enterprises (see figure 1).

Hence, as it is clear by comparing the upper and lower panels of figure 1, the main prediction of our model is that innovative firms are more likely to choose FDI to export *vis-à-vis* the group of non-innovative enterprises.

In summary, our extension of the HMY model leads to a few testable predictions that will be empirically analysed in section 4. First, our empirical analysis will investigate the relevance and plausibility of the two main assumptions on which the model extension is built:

$$1.\ \delta a^{I} > \delta a^{NI}: \tag{8}$$

The productivity level of innovators is on average greater than that of non-innovators.

$$2.\ (T_X + \gamma R_X)^{I} > (T_X + \gamma R_X)^{NI}: \tag{9}$$

The distance costs for innovators are higher than for non-innovators, because the former also incur a relational cost in addition to transport costs.

Secondly, our empirical analysis will test the main outcomes and predictions of the model. From the cut-off expressions and the intuition provided above, it is easy to derive the following function that outlines the main determinants of the firm's choice between FDI and exports:

$$\Pr\{F\} = g\,[f_K;\ f_X;\ f_F;\ B;\ T_X;\ R_X;\ \delta] \tag{10}$$

The probability that an enterprise decides to undertake FDI (rather than export) depends on the fixed costs it has to pay to enter production and prepare for commercialization activities overseas (f_K; f_X; f_F), the industry-specific demand conditions that it faces (B),

the distance costs that it must pay if it decides to export (transport costs T_X plus the relational distance costs R_X), and the productivity bonus it has if it is an innovative enterprise (δ).

In short, in our model innovation does not have a *direct* effect on the choice between trade and FDI but rather an *indirect* effect which goes through a twofold channel. First, innovation enhances firms' productivity thus making it easier for them to pay the sunk costs of internationalization. Secondly, due to the existence of relational costs for the commercialization of new services overseas, innovation makes exporting activities more costly and therefore less attractive to firms in comparison to the FDI strategy.

3. Data

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 the whole population of service firms in Norway. The questionnaire is composed of 25 questions, which ask Norwegian service enterprises various questions regarding their international activities in the period 2004-2006. First, we carried out a pilot study by phone in order to check the validity of the questionnaire and make sure that the formulation of the various questions was clear and fully understandable by the firms. Then, we proceeded with the main phase of data collection, which was based on a web-based survey.

The target for the survey data collection was the whole population of service firms in Norway as reported by the enterprise register of the Norwegian Statistical Institute

(*Bedrift- og foretaksregister*, SSB). This register contains the name, size, postal and e-mail address of all Norwegian firms in all 15 business service sectors (defined at the NACE 2-digit level). We disregarded firms with less than 10 employees, and focused our data collection work on the whole population of firms with more than 10 employees. In total, the questionnaire was sent to a 4230 enterprises. After a series of reminders during the whole data collection process, 814 enterprises filled in the questionnaire, corresponding to a response rate of 19%.[6]

The 15 service industries represent the full coverage of the (private) service branch of the economy, and contain both sectors characterized by a high international propensity as well as more domestically oriented industries. Table 1 reports the distribution of invited firms (our target population) and the corresponding number of respondents for each of the 15 sectors. The table indicates that our survey results are clearly representative, since the share of respondent firms in each industry closely corresponds to the percentage of enterprises in the target population (see the percentages reported between parentheses in the table). In fact, a t-test comparing the two sectoral distributions of firms' shares fails to find any significant difference among them.

< Table 1 here >

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 internationalization motives and objectives, their innovative activities, and the main barriers to internationalization experienced by the

[6] This response rate is indeed satisfactory as compared to other survey data collection exercises in this field. For instance, Ganotakis and Love's (2011) report a response rate around 10% for their recent survey of innovation and exports among technology-based firms in the UK.

enterprises. Our empirical analysis focuses on the following indicators available from the SIS survey, whose main descriptive statistics are reported in table 2.

- **FDI propensity**: dummy variable indicating whether a firm has had FDI activities in the period 2004-2006. On average, nearly 14% of enterprises in our sample have undertaken FDI.

- **Export propensity**: dummy variable indicating whether a firm has had export activity in the period 2004-2006. Around 19% of enterprises are exporters.

- **Productivity**: Firm's turnover divided by the number of employees. This provides a measure of the labour productivity variable δa of our theoretical model.

- **Size (employment)**: number of employees. The average size in our sample is around 70 employees per firm.

- **Innovation (new services)**: dummy variable reporting whether the firm has developed a new service in the period. The questionnaire defines *service innovation* as "the market introduction of a service that is new or significantly improved with respect to its capabilities, such as quality, user friendliness, software or subsystems". 32% of enterprises in our sample are *innovators* (I), whereas the remaining 68% are classified as *non-innovators* (NI).

- **Relational costs: Proximity to clients**: categorical variable indicating the extent to which firms consider the proximity to clients an important factor to support and

enable their international activities. The indicator ranges on a scale from 1 ("not important") to 4 ("very important"). It provides a proxy measure of the relational distance costs R_X of our model.

- **Relational costs: Language and culture**: categorical variable indicating the extent to which the enterprises consider language and culture an important barrier to their internationalization activities. The indicator ranges on a scale from 1 ("not important") to 4 ("very important"). The variable provides another proxy measure of the relational distance costs R_X of the model.

- **Geographical distance**: categorical variable indicating the extent to which firms consider geographical distance an important barrier to their internationalization activities. The indicator ranges on a scale from 1 ("not important") to 4 ("very important"). The variable provides a proxy measure of the transportation costs T_X of our model.

< Table 2 here >

4. Empirical results

Our empirical analysis carries out two tasks: the first is to illustrate and test the empirical relevance and plausibility of the two main assumptions on which the theoretical model is based; the second is to analyse the major outcomes and predictions of our extension of the HMY trade-off model of trade and FDI.

Regarding the two key model's assumptions pointed out in section 2, the first one argues that the productivity level of innovators is on average greater than that of non-innovators ($\delta a^{I} > \delta a^{NI}$; see equation 8); and the second points out that the distance costs for innovators are higher than for non-innovators, due to the existence of higher relational costs for the former group of firms ($(T_X + \gamma R_X)^{I} > (T_X + \gamma R_X)^{NI}$; see equation 9).

Table 3 presents the results of non-parametric tests of these two propositions, namely the Mann-Whitney rank-sum test and the Kolmogorov-Smirnov test. These exercises compare the distributions of innovative and non-innovative firms in terms of three variables. The first is the productivity indicator, for which our test results clearly show that service innovators have on average a higher productivity level than non-innovative enterprises. This result corroborates empirically our first model's assumption. The finding is in line with a few recent micro econometric studies that have studied the innovation-productivity relationship within the service sectors (e.g. Castellacci, 2011b).

The other two variables considered in table 3 are measures of the relational distance costs that exporting firms have to face when they seek to commercialize their new products and services overseas. As pointed out by the second main assumption of our model, the test results indicate that these relational costs are significantly higher for innovative firms than for the group of non-innovative enterprises. This fact provides support for the idea that innovative firms, when they want to commercialize their new

products and services overseas, face greater risks, uncertainties and costs than non-innovative enterprises, and may for this reason find it convenient to avoid (or reduce) these costs by choosing FDI rather than export as their main internationalization strategy.

< Table 3 here >

Given the empirical relevance and plausibility of the two main assumptions of the theoretical model, we then analyse the major outcomes and predictions of our extension of the HMY trade-off model of trade and FDI. Table 4 presents the results of non-parametric tests comparing the FDI propensity and the FDI *versus* export choice between innovative and non-innovative enterprises.[7] Both the Mann-Whitney rank-sum test and the Kolmogorov-Smirnov test results show that innovators have on average a greater FDI propensity than non-innovative firms, and also that they are more likely to choose FDI rather than export as their main internationalization strategy. This empirical result corroborates the main outcome and prediction of the model presented in section 2.

< Table 4 here >

According to our theoretical model, the reason explaining this pattern is the following. Innovation is expected to have an *indirect* effect on the FDI *versus* export choice which goes through a twofold channel. First, innovation enhances firms' productivity thus making it easier for them to pay the sunk costs of internationalization. Secondly, due to the existence of relational costs for the commercialization of new services overseas,

[7] The FDI propensity is the dummy variable that has been defined in section 3, and it takes a value of 1 for FDI firms and 0 for all other enterprises in the sample. The other dummy variable used here, the FDI *versus* export choice, assumes a value of 1 for FDI firms and 0 for exporting firms.

innovation makes exporting activities more costly and therefore less attractive to firms in comparison to the FDI strategy. It is thus interesting to analyse the main prediction of our model extension within a multivariate setting, and carry out a more detailed investigation of the (indirect) effects of innovation on internationalization that is postulated by our theoretical model.

The regression analysis estimates the firm-level determinants of the FDI choice, which have previously been pointed out in equation 10 (section 2). The empirical counterpart of equation 10 is the following:

$$\Pr\{F^{ij}\} = LP^{ij} + N^{ij} + \delta^{ij} + R_X{}^{ij} + T_X{}^{ij} + S^j + \xi^{ij} \qquad (11)$$

where *i* indicates the firm and *j* the sector. This empirical model points out that the probability that a service enterprise decides to undertake FDI ($\Pr\{F^{ij}\}$) positively depends on the following factors: (1) its productivity level LP^{ij}, which measures the extent to which the firm is able to pay the necessary production and internationalization fixed and sunk costs (f_K; f_X; f_F); (2) its size N^{ij}, that is a commonly used measure for the enterprise's overall capability and other firm-specific factors unaccounted for in the model; (3) its innovative status δ^{ij} (i.e. the dummy variable indicating whether the firm is innovative); (4) the relational costs $R_X{}^{ij}$, measured by the two indicators of proximity to clients and language and cultural barriers; (5) the transportation costs $T_X{}^{ij}$, proxied by the variable measuring the extent to which the firm perceives the geographical distance as a main hampering factor; (6) a set of industry dummies S^j that account for sector-specific conditions (e.g. the demand level B^j of the theoretical model).

We estimate this model by making use of three related methods: a probit (comparing FDI firms to all other enterprises in the sample), a bivariate probit (which accounts for

the simultaneous relationship between FDI and export choice)[8], and a multinomial logit model (which makes it possible to compare FDI firms to both domestic firms and exporters). The regression results are reported in table 5.

The productivity indicator and the size (employment) variable are both positively and significantly related to the FDI dependent variable in all four regressions reported in table 5. The fourth column, in particular, shows that productivity and firm size are important factors to explain why firms decide to undertake FDI rather than export activities. In line with the HMY heterogeneity model (and our extension of it), the interpretation is that more productive firms are better able to pay the sunk costs related to internationalization activities, and are therefore more likely to reap the benefits of overseas commercialization through the FDI strategy.

Next, the innovation variable does also turn out to be positively related to the FDI propensity, although the relationship is not significant in the MNL model comparing FDI to exporting firms. The reason for this, as argued above, may be that our model expects innovation not to have a *direct* effect on the internationalization strategy choice, but rather an *indirect* effect through its relationships to productivity, on the one hand, and distance costs, on the other.

In fact, the next two variables confirm the finding that was already pointed out in table 3: relational (distance) costs are positive and significant determinants of service firms' FDI choice. Our model interpretation of this finding is that enterprises that face greater risks, uncertainty and costs due to a high relational distance between the provider and the consumer, find it relatively more convenient to avoid or reduce these costs by choosing a FDI rather than an export internationalization strategy. As shown above, innovative firms face substantially higher relational costs and risks than non-innovative

[8] The bivariate probit model estimates one equation for the FDI propensity dependent variable, and one where the export propensity is the dependent variable. Table 5 only reports the results for the first equation. The results for the second are not reported to save space and are available upon request.

enterprises, and this is what explains this indirect effect of innovation on the FDI-export choice.

In contrast, the geographical distance variable (our proxy measure for transportation costs) is positive but does not turn out to be significant in any of the regressions, differently from the standard prediction of the trade-off model of trade and FDI according to which higher transportation costs would induce more firms to prefer FDI to export. A reasonable explanation of the lack of precision of this estimated coefficient is that our empirical analysis focuses on the service sectors. It is a well-known fact previously documented in the literature that the export of services, differently from manufactured goods, entails substantially lower (or even zero) transport cost, due to the fact that ICTs and the digital transfer of data and information do now enable and greatly facilitate export activities in many branches of the service sector (e.g. software, telecommunications; see discussions of this in Freund and Weinhold, 2002; Blum and Goldfarb, 2006; Hoeckman, 2006). Therefore, in our sample of service firms, transport costs and geographical distance do not appear as relevant factors for explaining the FDI *versus* export choice, whereas relational distance costs emerge as a key factor in a world of increasing innovative and service-oriented production.

< Table 5 here >

5. Conclusions

The paper has put forward an extension of Helpman, Melitz and Yeaple's (2004) trade-off model of trade and FDI based on the innovative behaviour of heterogenous firms in the service sectors. The main idea, in a nutshell, is that service innovation has two distinct (indirect) effects on the enterprises' choice between export and FDI. First, innovation tends to enhance firms' productivity, thus making it easier for innovative enterprises to pay the sunk costs that are entailed by the internationalization process. Secondly, innovation makes export activities more risky and costly, due to existence of relational distance costs that exporting firms must sustain in order to commercialize their *new* services overseas. For both of these reasons, innovation shifts the trade-off between trade and FDI towards the latter, i.e. the FDI choice becomes relatively more convenient for innovative firms *vis-à-vis* the export strategy.

We have then carried out an empirical analysis in order to analyse the plausibility and empirical validity of the main assumptions that we have used to build up this HMY model extension and to test its main predictions. Using a new set of survey data for a representative sample of firms in the service sectors in Norway, our empirical analysis corroborates both the model's key assumptions on the role of service innovation as well as its main predictions on the main determinants of the FDI *versus* export choice.

Specifically, the regression results show that firms are more likely to choose a FDI rather than an export strategy the greater their productivity level and the higher the relational distance costs they face if they undertake export activities. In fact, the clear and robust pattern emerging in our sample of service firms is that innovative firms – that are on average more productive and face higher relational distance costs – have a significantly greater probability to choose a FDI internationalization mode than the corresponding group of non-innovative enterprises.

These results have some potentially important policy implications. As previously pointed out by firm heterogeneity models (e.g. Melitz, 2003; Bernard et al., 2003), trade liberalization and related policy changes tend to affect firms differently, in such a way that only more productive enterprises will be able to reap the opportunities opened up by economic globalization, whereas many other firms within the same industry will not be able to survive the increased level of competition and will eventually be driven out of the market. Our results suggest that innovation will tend to magnify and accelerate this process of selection, reallocation and industry growth related to the trade liberalization process. Innovative firms are in fact in a better position to take advantage of the process of trade liberalization and will be better able both to export and to undertake FDI, and will tend to prefer the latter strategy due to the higher payoff that this leads to. Therefore, R&D and innovation policy support schemes will not only have direct effects on the industry dynamics by enhancing the firms' productivity and profitability, but may also turn out to have indirect effects by fostering the enterprises' internationalization process. This implication is particularly relevant in the context of the service sectors, due to their increasing share in the economy, their rapid innovation pace, and the great importance of service trade liberalization for the political agenda.

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Figure 1: Profit functions: a comparison of innovative (I) and non-innovative (NI) firms

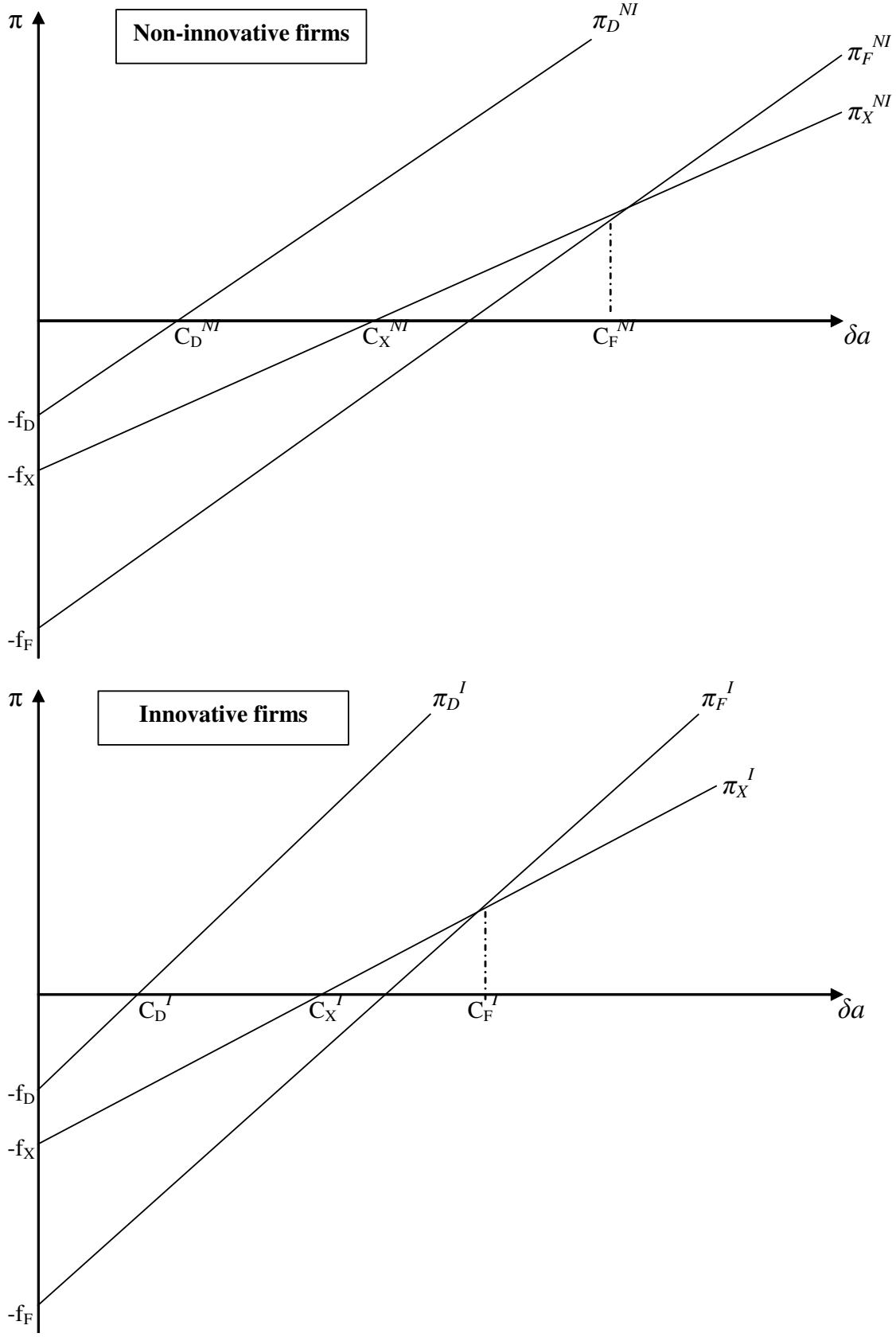

Table 1: Distribution of invited firms (population) and survey respondents by sector*

Service sectors (NACE 2)	Invited firms	Respondents	Response rate
Computer and related activities	328 (7,75%)	62 (7,62%)	0,19
Research and development	18 (0,43%)	9 (1,11%)	0,50
Other business activities	963 (22,77%)	221 (27,15%)	0,23
Post and telecommunications	108 (2,55%)	33 (4,05%)	0,31
Financial intermediation	92 (2,17%)	32 (3,93%)	0,35
Insurance and pension funding	17 (0,40%)	5 (0,61%)	0,29
Activities auxiliary to financial intermediation	31 (0,73%)	9 (1,11%)	0,29
Wholesale and commission trade	856 (20,24%)	165 (20,27%)	0,19
Land transport	252 (5,96%)	48 (5,90%)	0,19
Water transport	116 (2,74%)	24 (2,95%)	0,21
Air transport	6 (0,14%)	1 (0,12%)	0,17
Auxiliary transport activities	227 (5,37%)	41 (5,04%)	0,18
Sale, maintenance and repair	255 (6,03%)	33 (4,05%)	0,13
Retail trade	594 (14,04%)	90 (11,06%)	0,15
Hotels and restaurants	367 (8,68%)	41 (5,04%)	0,11
Total	4230 (100%)	814 (100%)	0,19

* *Note*: A t-test comparing the industry distribution of invited firms (population) and survey respondents provides a non-significant result.

Table 2: Descriptive statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
FDI propensity	807	0.139	0.346	0	1
Export propensity	809	0.193	0.394	0	1
Productivity	804	0.142	0.165	0	1.1
Size (employment)	805	68.9	223.2	10	4861
Innovation (δ)	814	0.321	0.467	0	1
Relational costs (R_x): Proximity to clients	814	1.579	1.080	1	4
Relational costs (R_x): Language and culture	781	1.813	1.017	1	4
Geographical distance (T_x)	782	1.742	0.982	1	4

Table 3: Tests of the two main assumptions of the model: Comparing productivity and distance costs among innovative firms (I) and non-innovative firms (NI)

	Mann-Whitney test		**Kolmogorov-Smirnov test**	
	z-score	Probability{NI>I}	D-stat	P-value
Productivity	-2.270***	0.451	0.123	0.009***
Relational costs (R_x): Proximity to clients	-9.047***	0.352	0.289	0.000***
Relational costs (R_x): Language and culture	-5.542***	0.388	0.217	0.000***

Significance level: *** 1%

Table 4: Tests of the model's main outcomes: Comparing FDI propensity and FDI *versus* export choice among innovative firms (I) and non-innovative firms (NI)

	Mann-Whitney test		**Kolmogorov-Smirnov test**	
	z-score	Probability{NI>I}	D-stat	P-value
FDI propensity	-6.296***	0.418	0.164	0.000***
FDI *versus* export choice	-7.275***	0.379	0.232	0.000***

Significance level: *** 1%

Table 5: Regression results: The determinants of FDI propensity in the proximity-concentration trade-off model

	(1)	**(2)**	**(3)**	**(4)**
Estimation method	Probit	Bivariate probit	Multinomial logit	Multinomial logit
Group comparison	FDI *versus* all other firms	FDI *versus* all other firms	FDI *versus* domestic firms	FDI *versus* exporting firms
Productivity	0.648 (4.99)***	0.657 (5.07)***	1.415 (5.26)***	0.888 (3.08)***
Size (employment)	0.610 (3.10)***	0.617 (3.14)***	0.990 (2.62)***	1.182 (2.87)***
Innovation (δ)	0.280 (1.61)	0.277 (1.60)	0.821 (2.46)**	0.101 (0.27)
Relational cost (R_x): Proximity to clients	0.487 (7.29)***	0.490 (7.32)***	1.099 (8.14)***	0.391 (2.66)***
Relational cost (R_x): Language and culture	0.328 (3.62)***	0.327 (3.57)***	0.715 (4.08)***	0.343 (1.75)*
Geographical distance (T_x)	0.084 (0.90)	0.076 (0.80)	0.187 (1.04)	0.102 (0.51)
(Pseudo) R-squared	0.410	-	0.327	0.327
Observations	646	658	658	658

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